

Initial Environmental Examination

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India: Climate Resilient Brahmaputra Integrated Flood and Riverbank Erosion Risk Management Project in Assam

Additional High Priority Works in Sonitpur, Biswanath, Lakhimpur and Dhakuakhana

Prepared by the Flood and Erosion Management Agency of Assam for the Asia Development Bank (ADB).

CURRENCY EQUIVALENTS

(As of 12 December 2024)

Currency Unit Rupee (INR)
1.00 = \$0.012
\$1.00 = 82.20

ABBREVIATIONS

AADB	-	Assam Agroforestry Development Board
ADB	-	Asian Development Bank
AIFRERMIP	-	Assam Integrated Flood and Riverbank Erosion Risks Management Investment Program
DMO	-	Disaster Management Organization
EARF	-	Environmental Assessment and Review Framework
EIA	-	Environmental Impact Assessment
EIRR	-	Economic Internal Rate of Return
EMoP	-	Environmental Monitoring Plan
EMP	-	Environmental Management Plan
FREMAA	-	Flood and River Erosion Management Agency of Assam
FRERM	-	Flood and Riverbank Erosion Risk Management
IEE	-	Initial Environmental Examination
IUCN	-	International Union for Conservation of Nature
IWAI	-	Inland Water Transport Authority
MFF	-	Multi tranche financing facility
MOEF&CC	-	Ministry of Environment Forest and Climate Change
NGO	-	Non-Government Organization
PMU	-	Project Management Unit
PPTA	-	Project Preparatory Technical Assistance
PCBA	-	Pollution Control Board, Assam
WRD	-	Water Resources Department

WEIGHTS AND MEASURES

dB	-	decibel
ha	-	hectare
km ²	-	square kilometer
km	-	kilometer
m	-	meter
mm	-	millimeter
m ³ /s	-	cubic meter per second
l	-	liter

GLOSSARY

Porcupine	Tetrahedron-shaped concrete frames commonly made of six concrete members, each 3 meters long connected with bolts, which are placed in an arrayed manner in the riverbed to retard river water flow and induce sedimentation.
Revetment	A riverbank protection structure constructed on the bottom or banks of a river by placing a layer of material, such as rock, stones, concrete blocks, or mattresses including sand-filled geo-textile containers.
Spur	A river training structure built from the bank of a river in a direction transverse to the current, by placing a large quantity of rocks, stones, or concrete blocks (or earth armored with these heavy materials).

NOTES

- (i) The fiscal year (FY) of the Government of India ends on 31 March. FY before a calendar year denotes the year in which the fiscal year ends, e.g., FY2023 ends on 31 March 2023.
- (ii) In this report, "\$" refers to US dollars.

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EXECUTIVE SUMMARY

1. The Climate Resilient Brahmaputra Integrated Flood and Riverbank Erosion Risk Management Project (CRBIFRERMP) in Assam will build on the Assam Integrated Flood and Riverbank Erosion Risk Management Investment Program (AIFRERMIP) to increase the reliability and effectiveness of flood and riverbank erosion risk management (FRERM) systems in flood-prone areas.¹ It will focus on the climate-resilient, holistic, integrated, systematic, and reach-wise approach to managing riverbank erosion and the attendant flood risk of the Brahmaputra River in the selected districts in Assam.

2. Climate impacts are projected to worsen the floods and riverbank erosion while Assam already suffers from recurrent flooding and continual riverbank erosion from the Brahmaputra River.² These are critical development inhibitors of the state as natural hazards and remoteness have led to long-term slower development than the national average, while population growth and density are similar. Therefore, Assam continues to face high poverty, and its socio-economic development has stalled.

3. To continue the outcome of AIFRERMIP, the project will focus on (i) applying and demonstrating a comprehensive integrated risk-informed approach to build climate and disaster resilience; (ii) transferring knowledge and advanced technologies and practices for holistic natural resources management, asset management, and co-benefits optimization; and (iii) enhancing women's climate and disaster resilience and empowerment. Also, the project will leverage benefits from and collaborate with a World Bank investment aiming at improving integrated water resources management along selected tributaries of the Brahmaputra River system in Assam.³

4. The project is aligned with the following benefits: (i) make Assam a disaster resilient state (encompassing substantial and inclusive disaster risk reduction; (ii) reduction in loss of lives and livelihoods; (iii) increased protection of property and assets; and (iv) enhanced capacity to cope with disasters).⁴ The project will have the following outcome: climate resilient flood and riverbank erosion mitigation systems in the Brahmaputra River enhanced.

5. The ongoing subproject combines the structural and non-structural measures in four high-priority flood- and erosion prone areas to contribute to the broader stabilization of the river. The four high-priority subprojects characterized by a high risk of riverbank erosion, and valuable assets under threat, are: Dibrugarh (Dibrugarh and Tinsukia districts), Morigaon, Palasbari-Gumi/ Guwahati West (Kamrup rural district) or PGP, and Goalpara. The project CRBIFRERMP aims at delivering on following outputs:

- (i) Output 1: Climate resilient flood and riverbank erosion risk mitigation measures implemented and maintained in subproject areas.

¹ ADB. 2010. Report and Recommendation of the President to the Board of Directors: Multitranches Financing Facility - India: Assam Integrated Flood and Riverbank Erosion Risk Management Investment Program. Manila.

² Since the Great Assam Earthquake in 1950, the river has widened from about 6 kilometers (km) to 9 km along its 650 km course in Assam eroding about 5.5% of Assam cultivable area destroying roads, homesteads, crops, and flood defenses. Since 1954, around 427,000 hectares (ha) of land (equivalent to about 7% of Assam area) have been eroded at an average annual erosion rate of 8,000 ha. Between 2000 and 2018, 93 locations eroded along the main stem of the Brahmaputra River in Assam causing damages to a total length of more than 400 km. Also, 40% of Assam area is prone to flooding by the Brahmaputra River and its tributaries, which is 9.4% of the national flood prone area.

³ The World Bank-financed Assam Integrated River Basin Management Program (AIRBMP) (\$108 million loan) approval is anticipated in early 2023. It is the first phase of a \$500 million multiphase programmatic approach.

⁴ Assam State Disaster Management Authority. 2022. Assam State Disaster Management Plan 2022 Vol. I. (p. 14).

- (ii) Output 2: Knowledge-based FRERM planning strengthened
- (iii) Output 3: Vulnerable people's livelihoods and resilience improved.

6. The proposed additional high-priority works focus on identified reaches along the Brahmaputra River and are covered under the Initial Environmental Examination (IEE). These works aim to continue flood protection efforts in the following locations: (i) Bamuni Chapari to Tekeliphuta (under Dhakuakhana WRD Division), (ii) Bonpuroi-Jamuguri and adjoining areas (under North Lakhimpur WRD Division), (iii) Rangchali Dalani and Paken (under Biswanath WRD Division), and (iv) Jarani and Zahaz Ghat in Tezpur and Biswanath District (under Sonitpur WRD Division). The subproject consists of three main components: (i) construction of riverbank revetment and apron works using geo-bags at nine locations, covering a total length of 15.170 km (Dhakuakhana – 8 km, Lakhimpur – 1.28 km, Biswanath – 2.94 km, and Sonitpur – 1.8 km); (ii) widening of embankments at Paken for 225 m and earthwork for 10 check bunds in Dhakuakhana; and (iii) adaptation works in Lakhimpur for 1.15 km. Additionally, 14 porcupine screen installations are planned at Dhakuakhana (2), Lakhimpur (5), Biswanath (6), and Sonitpur (1), each consisting of three layers of pre-stressed concrete.

7. As per the Government of India (GOI) environmental impact assessment (EIA) Notification, 2006, these subprojects do not require prior environmental clearance (EC) from Ministry of Forest, Environment and Climate Change (MoEF&CC) or State Environmental Impact Assessment Authority (SEIAA). However, if new quarries for sand and aggregates will be opened, the subproject should obtain prior EC and various government permissions including requirement from Pollution Control Board Assam (PCBA). In view of Safeguards Policy Statement (SPS) 2009, the categorization of the project was determined using ADB rapid environmental assessment (REA) checklist. Through this checklist, the environmental categorization of additional high priority works under CRBIFRERMP was determined by its most environmentally sensitive component that includes direct, indirect, cumulative, and induced impacts in the area of influence. The potential negative impacts were identified in relation to pre-construction, construction and operation phases through due diligence and compliance with environmental requirements of SPS 2009. Proposed high priority project was assessed according to its components, location, scale, and sensitivity and the magnitude of its potential environmental impacts and documented in this IEE.

8. The environmental assessment for the additional high-priority work areas has been conducted based on the Detailed Project Report (DPR) provided by the Flood and River Erosion Management Agency of Assam (FREMAA) and the Water Resources Department (WRD). The assessment also incorporates data collected by M2M Consulting Consortium Pvt. Ltd., which was engaged by FREMAA under the Project Implementation Support Consultant (PISC) contract. The scope of data collection covered several key aspects. Environmental quality monitoring was conducted to assess baseline conditions for air, water, noise, and soil quality. Wildlife and habitat surveys were carried out to evaluate ecological features, particularly the presence of protected and endangered species. Additionally, physical and socio-economic data, including geographical information system (GIS) mapping, were compiled to analyze land use and socio-economic conditions in the project area. Further, environmental risk identification and analysis focused on evaluating potential threats associated with flood control measures, erosion management, and construction activities. To ensure community participation, public consultations were conducted with local stakeholders to address concerns and integrate mitigation strategies effectively. Based on a risk rating approach, the environmental assessment concludes that the potential environmental impacts of the proposed subprojects are not severe, site-specific, and largely reversible. Most impacts can be effectively managed through mitigation measures commonly implemented in construction projects, which are well understood by civil works contractors. The assessment ensures that environmental safeguards are integrated into project planning and execution, aligning with the ADB SPS 2009 and national environmental regulations.

9. The proposed interventions under Additional High Priority works are classified as Environmental Category B as per the SPS 2009 as no significant impacts are envisaged. Accordingly, this IEE assesses the environmental impacts and provides mitigation and monitoring measures to ensure that there are no significant impacts as a result of the project.

10. All proposed sites under the additional high-priority works are located outside forest or protected areas. However, the Paken and Rangachali Dalani sites in Biswanath district are situated approximately 40 meters from the notified boundary of Kaziranga National Park on the north bank of the Brahmaputra River, while the core zone of the park is on the south bank. A No Objection Certificate (NOC) has been obtained from the Field Director of Kaziranga National Park and the Divisional Forest Officer of Biswanath. No significant negative impacts on the park are anticipated, as the proposed works are limited to the northern bank of the Brahmaputra. Gangetic River Dolphins and other endangered species present in the Brahmaputra River and nearby areas are not exclusive to the project site. According to the biodiversity report, Ganges River Dolphins have been observed by consultees at distances ranging from 100 meters to 1 kilometer from the riverbanks, particularly in the main channels of the Brahmaputra River. Additionally, the study confirmed that there are no active breeding sites for Gangetic River Dolphins along the bank line where the proposed anti-erosion works will be implemented.

11. The critical habitat assessment was conducted for all four additional high-priority work locations. While potential critical habitat has been deemed possible for the Assam Roofed Turtle, Hog Deer, and Wild Water Buffalo, the occurrence of these species at the project sites are insufficient to definitively trigger critical habitat designation. To address biodiversity-related risks, a Biodiversity Action Plan (BAP) has been developed, outlining necessary measures for conservation and impact mitigation. A detailed biodiversity and ecological survey will be conducted by the contractor for the entire high-priority project areas, including Dhakuakhana, Lakhimpur, Biswanath, and Sonitpur, during the project implementation phase. The PISC and Project Management Unit (PMU) will incorporate the survey findings and any necessary updates to the BAP into the IEE and submit the revised document to ADB for review and necessary actions.

12. There are no other environmental sensitive resources found in the project areas which are likely to be affected by works. Efforts shall also be made by the contractors to ensure that construction waste does not end up in the water and channels are not obstructed. The geo-bags and other material used by the WRD as emergency flood protection measures shall be disposed properly to ensure low impact on aquatic ecology. All works along the river areas are moderate and involve mostly earth works by local workers. Construction camps will be located outside of the villages and destruction of the existing vegetation will be minimum. Furthermore, care will be taken for construction not to obstruct the breeding period (April - August) in the aquatic breeding sites.

13. During the construction phase, tree cutting may be required in selected reaches of high-priority project areas. To mitigate this impact, compensatory afforestation at a 1:10 ratio (i.e., planting ten seedlings for every tree cut) will be implemented. If properly executed and monitored for survival rates, this initiative will contribute to a positive environmental outcome. The cost of compensatory afforestation is included as part of the environmental management plan (EMP) to ensure its effective implementation. Other environmental impacts may arise during construction; however, these are expected to be temporary in nature. The implementation of mitigation measures outlined in Chapter 6 (Anticipated Environmental Impacts and Mitigation Measures), along with the environmental management and monitoring plan, will help minimize these temporary impacts. Additionally, socio-economic impacts will remain minimal based on site-specific assessments. FREMAA remains fully committed to its socio-environmental responsibilities, drawing from its successful experience in implementing Tranche 1 and Tranche 2 under the AIFRERMIP and the ongoing works under CRBIFRERMIP. This commitment ensures that best practices in environmental and social safeguards continue to be upheld throughout project implementation.

14. The land acquisition and resettlement impact are likely triggered in few locations for the anti-erosion (AE) works, involving both legal title holders and squatters. The resettlement plan (RP) is being prepared parallelly for these Additional High Priority project areas and it cover the details of the households likely to be affected and compensation shall be paid to the affected persons as applicable per ADB SPS, national and state laws.

15. Stakeholder consultations were conducted through on-site discussions and public meetings at the village level. The feedback and concerns raised during these consultations were incorporated into the IEE and considered in the planning and development of the project. The IEE will be made publicly accessible at designated locations and disclosed to a wider audience through the websites of ADB, FREMAA, and WRD. The consultation process will continue and expand throughout project implementation to ensure meaningful stakeholder engagement, allowing communities to actively participate in the project's development and execution. Additionally, a Grievance Redress Mechanism (GRM) has been established within the IEE to provide a structured and efficient process for addressing public concerns and resolving grievances promptly.

16. The institutional framework for project implementation has been established. The PMU holds overall responsibility for implementing the EMP and addressing any environmental issues related to the project. The PMU includes an in-house environmental specialist to ensure compliance with environmental safeguards. The PMU is supported by the Environmental Assessment and Planning (EAP) Wing of Water Resources Divisions (WRD) project implementation units (PIUs). WRD's PIU is further assisted by environment officers responsible for ensuring adherence to environmental safeguard requirements. Additionally, the Flood and River Erosion Management Agency of Assam (FREMAA) will deploy Field Supervisors at all WRD to oversee environmental and social safeguard measures throughout the project implementation phase. A structured monitoring system has been established, with coordination among the PMU, PIUs, and PISC. The contractor is required to appoint an Environment, Health, and Safety (EHS) officer or focal person and submit monthly reports on EMP implementation. Additionally, the PIU will conduct routine field monitoring and inspections. The PMU is further supported by the PISC safeguard team, which includes an environmental specialist. An Environmental Monitoring Report (EMR) will be prepared based on EMP implementation and environmental quality monitoring, and it will be submitted to ADB following the format prescribed in the IEE.

17. The proposed subproject will have net benefits in controlling soil erosion and preventing progression of land loss. It is estimated that 16,017 Ha. (Dhakuakhana – 10117 Ha, Lakhimpur – 200 Ha, Biswath – 5500 Ha and Sonitpur – 200 Ha) as well as approx. 5,33,000 numbers of population (Dhakuakhana – 500000, Biswanath – 25000 and Sonitpur - 8000) will be benefited from the proposed interventions. The project is likely to bring positive impact by preventing existing embankment at Dhakuakhana, Lakhimpur and Paken area and agricultural productivity due to protection from flood and reduced sedimentation. The introduction of NbS (pilot) shall be beneficial in strengthening the flood protection works and embankment at Dhakuakhana.

18. The project activities shall have an incremental impact on the local socioeconomics by: (a) reducing impact of annual floods, (b) increase source of livelihood in agriculture, fisheries, etc. thus aiding poverty reduction, (c) creating employment opportunities in this project and else, (d) women involvement and empowerment and (e) reducing the negative impacts of climate change. The project shall have overall positive impact on the life of the inhabitants in the subproject area.

19. Overall, there are no significant negative environmental and socio-economic impacts associated with the proposed project that cannot be mitigated to negligible or acceptable levels. There is full local community acceptance of the project. All required mitigation measures and monitoring are documented in the EMP. The observations and conclusions from the IEE, the project appears to be acceptable for implementation, as designed according to Gol and ADB environmental and technical standards and policy requirements.

I. INTRODUCTION

A. Project Background

20. The livelihoods of people in the state of Assam are affected by water-related disasters including floods and riverbank erosion especially due to the vast flat floodplain of the Brahmaputra River - one of the world's largest rivers. Climate change impacts exacerbate these disasters and are projected to worsen the floods and riverbank erosion while Assam already suffers from recurrent flooding and continual riverbank erosion from the Brahmaputra River. These are critical development inhibitors of the state as natural hazards and remoteness have led to long-term slower development than the national average, while population growth and density are similar. Therefore, Assam continues to face high poverty, and its socioeconomic development has been hindered.

21. Riverbank erosion is one of the most prominent causes of disasters in Assam due to highly dynamic morphology of the Brahmaputra River and its tributaries. Since the Great Assam Earthquake in 1950, the river has widened from about 6 kilometers (km) to 9 km along its 650 km course in Assam eroding about 5.5% of Assam cultivable area destroying roads, homesteads, crops, and flood embankments. Since 1954, around 427,000 Hectares (Ha.) of land (equivalent to about 7% of Assam area) have been eroded at an average annual erosion rate of 8,000 Ha. Between 2000 and 2018, 93 locations eroded along the main stem of the Brahmaputra River in Assam causing damages to a total length of more than 400 km. Riverbank erosion disproportionately affects the poor, who face significant social hardships, such as loss of homesteads, lands, and crops, and are often displaced to fringe lands or urban slums. Disaster risks increase as the population grows, and the high population density of the state hinders people moving away from disaster-prone areas.

22. Erosion damage also extends to public infrastructure, including roads and flood embankments, and the high occurrence of riverbank erosion hinders construction and rehabilitation of flood embankments. About 40% of the state (i.e., about 9.4% of the national flood prone area) is inundated on average annually during the monsoon by the Brahmaputra River and its tributaries, resulting in damages and loss of assets and crops. The threat of recurrent floods and riverbank erosion also discourages investment and leads to lower economic growth in the riparian areas. Effective flood and riverbank erosion risk management is therefore essential for economic growth, livelihood improvement, and poverty reduction in these locations. With a growing population as well as the expansion of settlements within the floodplain, future development will need to be carefully managed to protect the population from water-induced disasters. In addition, most of the length of the existing embankments system cannot be relied upon for protection from floods; during severe flood events, embankments are often overtopped or even breach which often leads to disaster. Furthermore, the growing population demands more reliable protection from riverbank erosion and flooding to safeguard their increasing assets and to sustain economic development.

23. Securing the livelihoods of the population living on floodplain needs to be addressed through public sector interventions aiming at: (i) mitigating the economic losses and social displacement caused by riverbank erosion, (ii) reducing the economic losses resulting from flooding, and (iii) providing a secure environment to facilitate an increase in agricultural and industrial production and to enhance related economic activities.

24. The multi tranche financing facility (MFF) between the Government of India and the Asian Development Bank (ADB) for the Assam Integrated Flood and Riverbank Erosion Risk Management Investment Program (AIFRERMIP) was approved by ADB in 2010. The facility increased the reliability and effectiveness of flood and riverbank erosion risk management systems in priority reaches along three subprojects of the Brahmaputra River through structural and nonstructural interventions, policy strengthening, and institutional and knowledge bases. The second and final tranche of the MFF was physically completed on 18 October 2020. Over the past 20 years, ADB has supported development and innovation of a cost-effective systematic river stabilization approach introduced in Assam in 2010

via AIFRERMIP, providing a first opportunity to increase the state's disaster resilience and paving the way for replicability.

25. Following the request of the State Government of Assam for a follow-on project, in early 2022, the Department of Economic Affairs (DEA), Government of India (GoI) posted to ADB a follow-on investment for external assistance of \$400 million under which urban, suburban, and productive rural and other strategic sites have been prioritized for protection by improving key flood and riverbank erosion risk management (FRERM) infrastructure, such as flood embankments, riverbank protection, and flood management structures, and by enhancing or introducing a range of nonstructural protective measures to development capacity at state and local communities level. The title of this new investment is Climate Resilient Brahmaputra Integrated Flood and Riverbank Erosion Risk Management Project (or CRBIFRERMIP) in Assam.

26. The CRBIFRERMIP is financed by ADB to focus on the main stem of the Brahmaputra River in Assam and follow a climate resilient, holistic, integrated, systematic, and reach-wise approach to managing riverbank erosion and the attendant flood risk, while the World Bank-financed Assam Integrated River Basin Management Program (AIRBMP) focuses on river basins of selected tributaries of the Brahmaputra River in Assam.

27. The ongoing project combines structural and nonstructural measures in four high-priority flood- and erosion prone areas to contribute to the broader stabilization of the river. The four high-priority subprojects characterized by a high risk of riverbank erosion, and valuable assets under threat, are: Dibrugarh, Palashbari-Gumi/Guwahati West, Morigaon, and Goalpara.

- (i) **Output 1: Climate resilient flood and riverbank erosion risk mitigation measures implemented and maintained in subproject areas.** The project will combine structural and nonstructural measures in four subproject areas to stabilize their river reaches by applying an integrated river stabilization approach that was developed and refined under the earlier ADB-financed Jamuna–Meghna River Erosion Mitigation Project (JMREMP), AIFRERMIP, and the ongoing Flood and Riverbank Erosion Risk Management Investment Program (FRERMIP) in Bangladesh.⁵ Specifically, this output will include: (i) constructing about 60 km of riverbank erosion protection and 14 km of adaptation/emergency works to stabilize the river and improve the river's navigability; (ii) placing about 32 km (194 screens) of pro-siltation measures such as porcupines to induce sediment deposition thereby reclaiming riverine land; and (iii) constructing/rehabilitating/widening about 4.4 km of climate resilient flood embankments including regulators, fish passes and drainage structures in critical areas to maintain river-floodplain interconnectivity to enhance biodiversity⁶ (See Appendix 1 and 2 for details of the scope of works). As learned from prior investments, construction contracts will include provisions for five years of monitoring, adaptive maintenance, and emergency works from construction completion, to improve sustainability. Nature-based solutions, such as reed plantations that promote sediment deposition and reduce rain cuts on slopes, will be pilot tested.
- (ii) **Output 2: Knowledge-based FRERM planning strengthened.** This output will further develop key agencies' knowledge bases by improving various decision support tools initiated under AIFRERMIP and will strengthen the state's institutional capacity to deliver FRERM, thereby promoting disaster resilience of the state and affected communities. Specifically, Output 2 will: (i) strengthen flood forecasting and early warning systems in close

⁵ ADB. 2014. Report and Recommendation of the President to the Board of Directors: Multitranchise Financing Facility to Bangladesh: Flood and Riverbank Erosion Risk Management Investment Program. Manila. Innovative features developed under JMREMP, AIFRERMIP, and FRERMIP, include sustainable low-cost sand-filled geotextile bag revetments placed underwater in combination with nature-based solutions will be expanded under the project.

⁶ The new or rehabilitated embankments will be designed to accommodate: (i) multipurpose use, (ii) a 100-year flood return period water level, including sufficient base width and freeboard for climate impacts related increases in water levels.

collaboration with others; (ii) undertake flood mapping to identify people and infrastructure at risk of flooding and facilitate better land use planning and management on risk-sensitive land; (iii) improve erosion prediction and embankment breach models to prioritize maintenance; (iv) enhance asset management systems and conduct life-cycle reliability analyses to improve budget and maintenance decisions; (v) gather data through topographic and bathymetric surveys, flow and sediment measurements, and asset condition surveys; and (vii) strengthen existing guidelines for flood and riverbank protection design to address climate impacts and resilience, update river stabilization principles, and document the effectiveness of nature-based solutions. These outputs will also contribute to an update of the 2020 Flood and Erosion Management Plan.

- (iii) **Output 3: Vulnerable people's livelihoods and resilience improved.** This output will directly improve the livelihoods and disaster resilience of poor and destitute people living on the flood embankments and *charlands* within the project areas and who are routinely severely affected by floods and riverbank erosion. It will specifically target women. Interventions will: (i) establish modern weaving centers, provide sewing machines, and train female headed households and female self-help groups to spin, weave, and market silk; (ii) increase vegetable production by providing climate resilient seeds, promoting improved agricultural practices, and extending marketing support; (iii) provide vocational training for unemployed youth; (iv) raise awareness on flood and riverbank erosion; and (v) strengthen disaster preparedness and emergency response (through also provision of equipment at district/regional level). Support for subsistence and small farmers will include: (i) assistance creating agriculture and fisheries businesses; (ii) identifying alternative income opportunities associated with the nature-based solutions in Output 1;⁷ and (iii) improving rural markets. Further, the graduation approach will be piloted to complement the various state-led initiatives that strengthen beneficiaries' wellbeing by providing livelihood assistance through agriculture, livestock, fisheries, industries, and vocational training activities.⁸ Beneficiaries will be producer collectives registered as Farmer Producer Companies (FPC) in the vicinity of the Brahmaputra River.

B. Additional High Priority work sites

28. Under CRBIFRERMP four high-priority Water Resources (WR) Divisions are characterized by high risk of riverbank erosion, and valuable assets under threat are proposed. The locations of the work sites are under (i) Dhakuakhana, (ii) Lakhimpur (iii) Biswanath, and (iv) Tezpur Water Resource Division within the administrative district of Sonitpur, Biswanath and Lakhimpur are shown in Figure 1-1. This report covers the IEE of high priority work sites of these three districts. High priority works Locations and Components

29. Under CRBIFRERMP four high-priority subprojects characterized by a high risk of riverbank erosion, and valuable assets under threat have been selected. The locations of the subprojects are (i) Dhakuakhana, (ii) North Lakhimpur (iii) Biswanath, and (iv) Sonitpur are shown in Figure 1-1. This report covers the IEE of high priority work areas of these districts.

⁷ New livelihood opportunities will arise from nature-based solutions along embankment slopes and reed plantations on charlands as well as from the revival of *beels* resulting in new fishing opportunities.

⁸ The graduation approach combines cash transfers with an asset transfer, financial inclusion, tailored skills training, livelihood development, social inclusion, and life-skills coaching and psychosocial support. Cash transfers will be made to FPCs, not individuals.

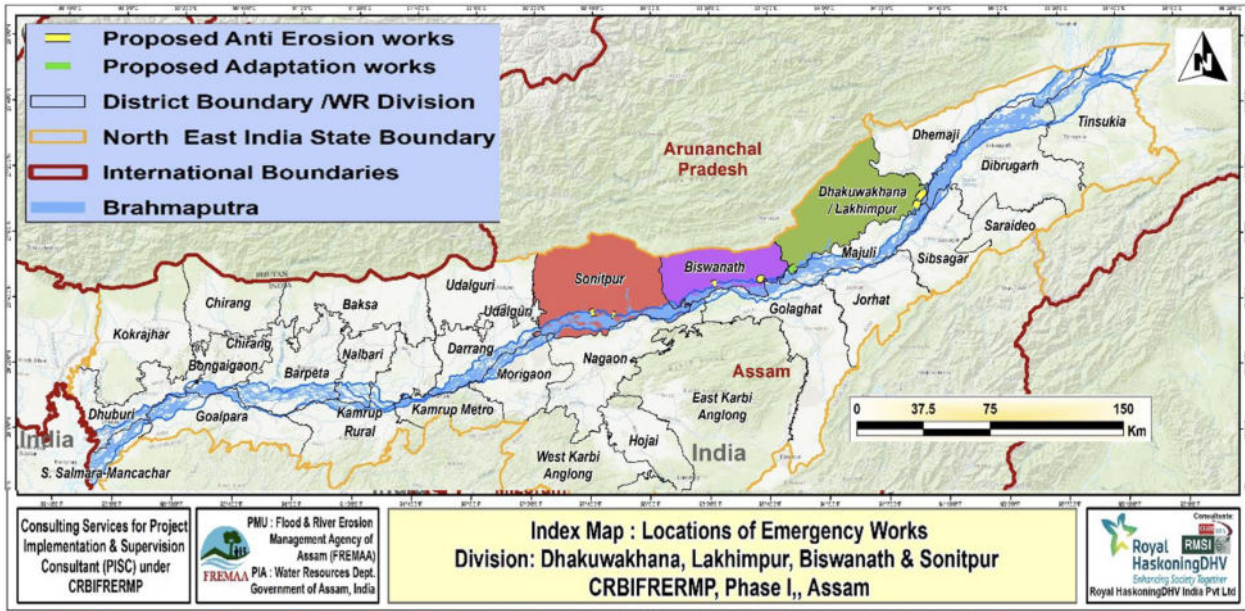


Figure 1-1. Index Map of CRBIFRERP of proposed high priority work districts.

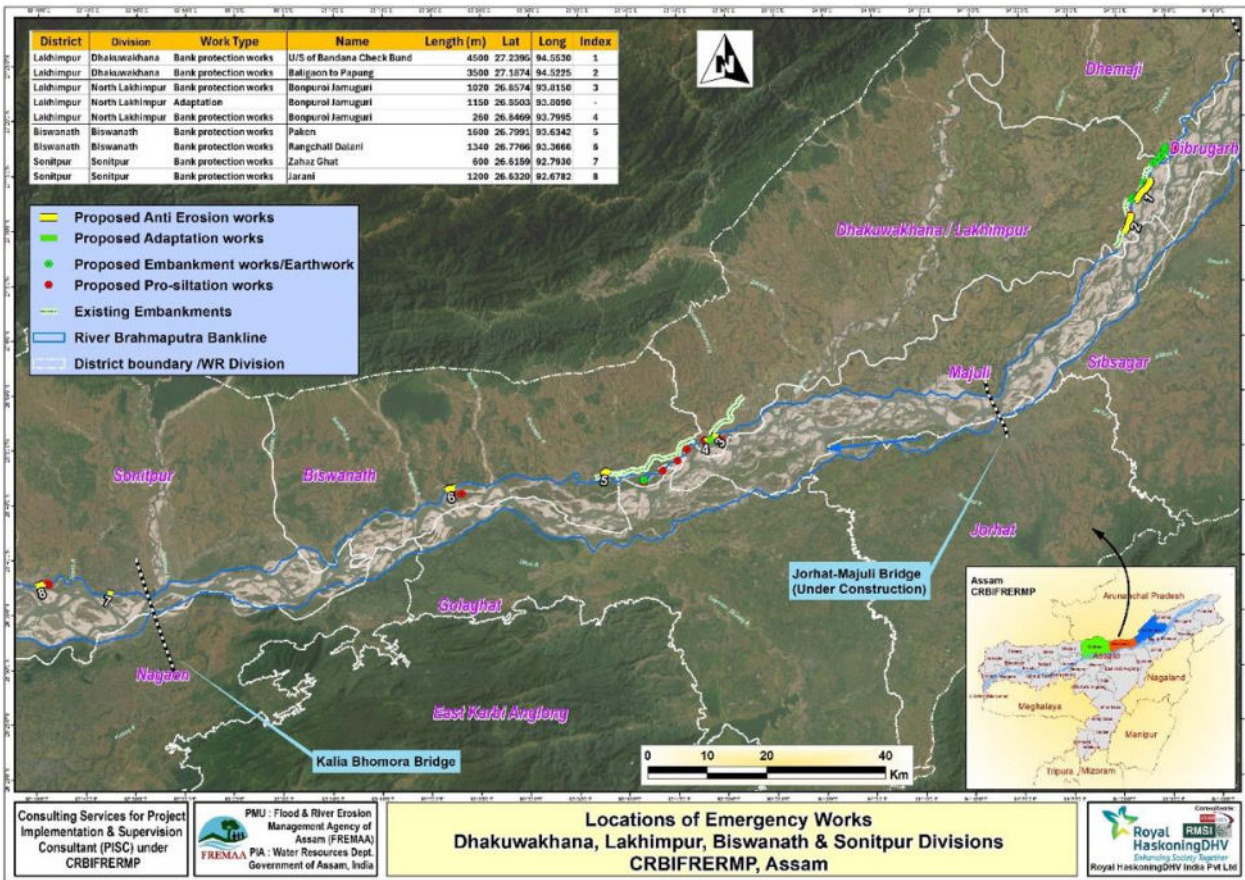


Figure 1-2. Location map of High Priority work sites.

30. The Project will involve construction of bank revetment and apron works with geo-bags for a total length of 15.170 km, upgrading the existing embankment at Paken for a small distance of 225

m and placing of 3 layers of Prestressed Concrete (PSC) porcupine at 14 Locations for all four high priority project areas. The high priority project location and alignment are shown in Figure 1-2.

31. The location wise details of project interventions under high priority project areas are given in Chapter – II , Table 2-1 to

32. Table 2-4.

33. As an outcome of this IEE, EMP has been developed to provide mitigation measures to avoid, minimize, and manage adverse environmental impacts. The EMP outlines strategies for controlling sediment runoff, preserving biodiversity, and ensuring sustainable material sourcing for construction activities. Specific measures include compensatory afforestation (1:10 ratio) for tree cutting, seasonal work scheduling to avoid interference with aquatic breeding cycles, and erosion control measures to stabilize riverbanks and embankments. Additionally, the EMP integrates monitoring protocols to assess air, water, and noise quality, ensuring compliance with SPS 2009 and national environmental regulations.

C. Executing and Implementing Agencies

34. The project CRBIFRERMP shall be executed by the State of Assam acting through FREMAA as executing agency and acting as PMU. FREMAA will oversee, monitor progress, lead the land acquisition process, ensure full compliance with environmental and social safeguards, and report the progress. WRD - PIU will be the key implementing agency of the project and will be responsible for the works (i.e. preparation of bidding documents, procurement, implementation, and supervision). Assam Agroforestry Development Board (AADB) will be an implementing agency of the project and will be responsible for the nature-based solutions (NbS) with the support of FREMAA for the procurement. PISC shall support and provide assistance to PMU/PIU in execution and implementation of the project. The organizational structure of FREMAA is indicated in the figure below.

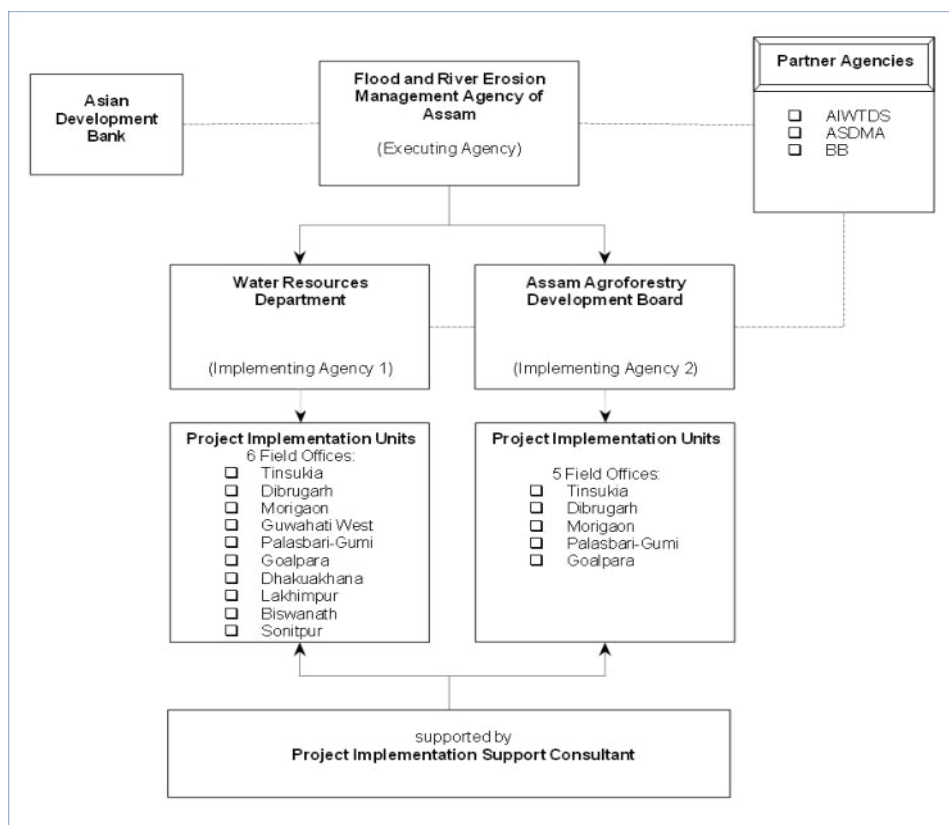


Figure 1-3. Organizational Structure for CRBIFRERMP.

D. Purpose of this IEE Report

35. ADB requires the integration of environmental considerations into all aspects of its operations. The environmental assessment requirements are outlined in the ADB SPS 2009, which serves as the guiding framework for evaluating potential environmental impacts. In line with these requirements, this IEE has been conducted to assess the environmental implications of the proposed high-priority flood and erosion mitigation works and to establish mitigation and monitoring measures ensuring that any identified impacts are effectively managed.

36. The environmental categorization of the subproject was determined using ADB's Rapid Environmental Assessment (REA) Checklist (Appendix 3). The due diligence and assessment process utilized multiple sources of information, including environmental quality monitoring (air, water, noise, and soil), wildlife and habitat surveys, GIS mapping for land use, and public consultations. Potential negative impacts were analyzed across the pre-construction, construction, and operational phases of the project (Chapter VI). The results of the assessment indicate that the subproject does not pose significant adverse environmental impacts. Consequently, in compliance with ADB SPS 2009, the project has been categorized as Category B for environmental assessment.

37. This IEE focuses on the selected high-priority project areas in Lakhimpur, Biswanath, and Sonitpur districts, where a combination of structural and non-structural measures will be implemented to mitigate flood and riverbank erosion risks and contribute to long-term river stabilization. The assessment draws from DPR prepared by FREMAA and WRD, incorporating field reconnaissance surveys, environmental monitoring, and secondary data analysis. A key component of the IEE is stakeholder engagement, ensuring that community perspectives and concerns are integrated into project planning.

38. The implementation of the subprojects will adhere to the Gol and State of Assam's environmental laws, regulations, and standards, alongside compliance with ADB SPS 2009. Throughout the design, construction, and operational phases, pollution prevention and control measures will be implemented, aligning with international best practices and recognized environmental standards.

39. In the event of design modifications, component changes, or alterations to project interventions, FREMAA, either directly or through its consultants, will update the IEE to reflect these changes accurately. This ensures that the project remains environmentally compliant and continues to meet the safeguard requirements established under the ADB SPS.

E. Report Structure

40. The report has been structured in compliance with ADB SPS, 2009 and contains the following ten (10) sections including the executive summary at the beginning of the report:

Executive Summary

- I. Introduction
- II. Description of the Project
- III. Analysis of Alternative
- IV. Policy, Legal, and Administrative Framework
- V. Description of the Environment
- VI. Anticipated Environmental Impacts and Mitigation Measures
- VII. Public Consultation and Information Disclosure
- VIII. Grievance Redress Mechanism
- IX. Environmental Management Plan

X. Conclusion and Recommendations

II. DESCRIPTION OF THE HIGH PRIORITY PROJECT

A. Project Area

41. Additional high priority works to be undertaken in selected districts in view of riverbank erosion that increased during this year monsoon, and which could lead to further flood risk in town areas during next monsoons. The areas are proposed under this additional high priority works are as follows: (i) Bamuni Chapari to Tekeliphuta area (under Dhakuakhana WRD division), (ii) Bonpuroi-Jamuguri and its adjoining areas (under North Lakhimpur WRD division), (iii) Rangchali Dalani area and iv) Paken area (under Biswanath WRD division), and (v) Jarani and (vi) Zahaz Ghat in Sonitpur district (under Tezpur WRD division).

42. The proposed types of works are the same as in the existing subproject areas (i.e.: underwater works, pro-siltation, earthwork, and other preliminary protection works along the riverbank). The PMU informed about the urgency of undertaking these works, as the recent erosion could.

Dhakuakhana

43. The mighty river Brahmaputra flows for a length of about 25 km under Dhakuakhana Civil Sub-Division of Lakhimpur District. The Brahmaputra dyke from Sissikalghar to Tekeliphuta is the main Dyke under Dhakuakhana W.R. Division, Dhakuakhana. The dyke protects not only the whole Dhakuakhana Civil Sub-Division of Lakhimpur District but also it protects a large area of Majuli District. In other way, the dyke can be signified as the Lifeline of the entire areas as because the whole area is located under flood prone area. Though various flood protection and damage control measures are taken from time to time by the department as per intensity of the flood damage, but still flood devastation is a major problem for the entire area.

44. The area covered with 25 km of its length by river Brahmaputra from Lotachur to Tekeliphuta under Dhakuakhana Water Resources Division is almost completely in a vulnerable zone. As such, the flood causes tremendous threat and panic to the entire Dhakuakhana Civil Sub Divisional area and a part of Majuli District every year. Of late, the entire Brahmaputra dyke from Lotachur to Tekeliphuta for a length of 20.175 Km is well strengthened by raising and strengthening work along with laying of Geo-Mattress in the river side slope of it. It is to be worth mentioning here that in the year 2008, the Brahmaputra dyke was breached for a reach length of around 5 (five) Km at Matmara due to erosion and accordingly breached gap was plugged in the subsequent year with 5.00 km by constructing well known Geo-dyke retirement by using technology of geo-textile mega tube, mattress etc. The importance of the dyke become more at present as because the entire dyke under this division is converted to road cum embankment by APWD. The location of the project areas is given in Table 2-1.

Lakhimpur

45. The project site is located in the Lakhimpur district of Bihpuria Legislative Assembly Constituency. The proposed project area is Bonpuroi-Jamuguri, and its adjoining areas are situated on the right bank of the mighty river Brahmaputra under Narayanpur Revenue Circle. The coordinates of the project site are Lat- 26°51'16.54"N, Long- 93°48'48.SI"E and Lat- 26°50'48.89"N, Long- 93°47'57.60"E. The project area is comprised of very thickly populated villages of Bothakhana, Horidah, Jamuguri, Bonpuroi, Latabari, Teteliguri, Tamulibheti, Puronibheti, Pichala, Arimora etc.

Biswanath – Rangchali Dalani

46. The Rangchali Doloni is a far remote area of Behali LAC within the Biswanath District of Assam falling under Longitude 93.364069° and Latitude 26.776459° on the right bank of river Brahmaputra at about 39.00 km towards east of Biswanath District Head-Quarter.

Biswanath – Paken

47. Paken falls under the jurisdiction of the Gohpur Civil sub-division, as well as the Gohpur sub-division of the Water Resources Department. Since last few years it has been seen those changes in morphology at Aliguri (Amguri Pichala) area has induced an oblique channel hitting perpendicularly to the bank at Aliguri area. Similarly spill channels are also seen at Kharoiati, Gospuria, Paken etc. These channels further join together at Gospuria area and reaches Paken hitting the 'B-Dyke from Jamuguri to Kharoi outfall' perpendicularly with heavy thrust. The slope of the B-Dyke at Paken has already been eroded away during the flood of 2024. If the dyke is breached, a vast area upto NH-15 (D/S of Gohpur town) under Helem Revenue Circle will be inundated. The economic backbones of the local people will be broken, and various socio-economic problems will arise if this location under high priority works delayed to execute.

Sonitpur

48. The river Brahmaputra has been posing serious threat in Zahazghat and Jarani area on the south-west part of Tezpur town under Sonitpur District. The location of Zahazghat area is at a distance of about 1 Km from Tezpur town and Jarani area is at a distance of about 20 Km from Tezpur town. The project covers very thickly populated area of Tezpur Town including Zahazghat, Lalmati, Cotton Road and Jarani, Tinkharia, Bihaguri etc.

B. Existing Situation

Dhakuakhana

49. After great earthquake of 1950, silt load of Brahmaputra River is rapidly increased and deposited silt on its beds in the plains where velocity is reduced. The maximum silt load of Brahmaputra is 700 million tons/day during peak discharge. Thus, the river underwent geomorphological changes since 1950's great earthquake and gradually developed braiding nature dividing into many small channels on deposition of huge sediment on its bed in the plain region. Thus, creating bank erosion on one side and formation of chars become a continuous phenomenon. Due to braided nature, oblique channel gets developed between the sand chars which changes their magnitude and orientation after each flood. These oblique channels are found to be primarily responsible for bank erosion.

50. Due to abrupt change of river configuration, the flow of Brahmaputra River loses its dynamic equilibrium and ultimately unloads its silt and sediment forming numerous sand chars. Due to formation of these sand chars, the flow pattern of the river becomes oblique specially during draw down stage of river and attach to its bank causing erosion. The Brahmaputra River has shifted over time towards the south bank, in the past decade it had formed a more established channel. Most part of the banks here are clayey with slow erosion rates, however, in places the existing embankment has been repeatedly undercut, resulting in a long history of embankment failure and consequent retirement.

51. At present, the Brahmaputra dyke is covering for a length of 20.175km from Lotachur to Tekeliphuta under Dhakuakhana W.R division. The name of dyke popularly known as "B/dyke from Sissikalghar to Tekeliphuta" which acts as flood barrier for entire Dhakuakhana Civil Sub-Division and a part of Majuli District. Though, the dyke system of river Brahmaputra under Dhakuakhana WRD is well enough to protect the area from direct hit of flood water as mentioned above, but still bank erosion is an imminent and chronic problem to the area which has to be considered seriously for future safeguarding of the area as well as people of Dhakuakhana and Majuli district. Presently, bank of river Brahmaputra from Bamuni Chapori to Tekeliphuta area has become most vulnerable and severe erosion prone location,

Lakhimpur

52. The Brahmaputra embankment from Bodoti to Kharoi outfall via Jamuguri was constructed in the year 1955 -56 for a length of 47.40 km to protect an area of about 18,000 Hector of land on the R/B of Subansiri and Brahmaputra under undivided Lakhimpur District out of which 27.10 Km is under North Lakhimpur W.R Division (Bihpuria W.R. Sub-Division) after bifurcation of divisions. The balance length of 20.30 km is under Biswanath W.R. Division (Gohpur W.R. Sub-Division) in Biswanath District. Although the major portion of the embankment stands on the right bank of river Subansiri, it is called Brahmaputra Embankment as it was constructed mainly to prevent the back water of river Brahmaputra in the high flood spate as well as floods of river Subansiri. The river Subansiri confluences with a major off shoot channel of river Brahmaputra at Bothakhana area from where they flow together and finally merge with river Brahmaputra again at U/S of Bonpuroi ferry-ghat. The embankment was initially constructed for a length of 27.10 km. but after subsequent breaches and retirements the final length at present consists of 26.10 km. Out of this 26.10 Km, 5.40 km stands on the right bank of river Brahmaputra. There were 6 (six) numbers of Check-Bundhs to protect the Brahmaputra embankment from Jamuguri to Kharoi outfall which were constructed during the year 1977-78. The check bundhs were playing vital role and acted as the main deflector by deflecting major flood flow and thus saving the entire Jamuguri, Pichala, Bonpuroi, Latabari, Bonpuroi, Arimora, Puranibheti, Teteliguri, Haridah, Nalanihulla, Momoi guri, Kachuwa, Majgaon, Da-gaon, Dakua, Barkhathani, Bhitordoloni, Hawajan under Narayanpur Revenue Circle and Ghuriagaon, Sutagaon, Kalahari, Kamdewall, Gohpur etc. under Gohpur Revenue Circle. Out of the above 6 (six) numbers of check bunds, check bund No. 3 and 4 have already been washed out during the year 2020-21 due to severe erosion.

Biswanath – Paken

53. Since last few years it has been seen those changes in morphology at Aliguri (Arnguri Pichala) area has induced an oblique channel hitting perpendicularly to the bank at Aliguri area. Similarly spill channels are also seen at Kharoiati, Gospuria, Paken etc. These channels further join together at Gospuria area and reaches Paken hitting the B-Dyke from Jamuguri to Kharoi outfall' perpendicularly with heavy thrust. The slope of the B-Dyke at Paken has already been eroded away during the flood of 2024. If the dyke is breached, a vast area upto NH-15 (D/S of Gohpur town) under Helem Revenue Circle will be inundated. The economic backbones of the local people will be broken, and various socio-economic problems will arise.

54. Moreover, after each dawn these channels are widening, increasing its discharge conveyance and creating havoc among the riverine people of Aliguri, Amguri, Kharoiati, Bhalukaguri, Kaliapani, Gojpuria, Choraibari, Sowaguri, Rownamukh, Paken etc. Already a vast cultivable area along with some dwelling houses have been washed away due to the erosion of river Brahmaputra. So, it has become very urgent to arrest the acute bank erosion permanently so as to avert possible breach of the 'B-Dyke from Jamuguri to Kharoi outfall' as well as a vast area of Southern Gohpur area with many governments, semi government establishments, educational institutions, fertile paddy fields etc.

55. The nearby people facing many problems are pressing hard to take necessary steps to arrest further erosion and to save the Brahmaputra Dyke from flood devastation. The Hon'ble Minister, Water Resources along with Hon'ble MLA, Gohpur LAC; Chief Engineer, Water Resources Department and other departmental officials visited these flood and erosion affected areas on 15/06/2024 and instructed to prepare a proposal with the provisions of pro-siltation measures which can choke out the spill channels and reclaimed land and finally develop the area along with getting rid of the chronic problem at Paken.

Biswanath – Rangchali Dalani

56. Though erosion at Rangchali Doloni (Arimora Chapori) area has begun from the year 2015 at very slow rate but in course of time due to formation of a big sand char near the outfall point of the

river Buroi in the river Brahmaputra a spill channel namely Botiamari channel formed during 2020-21 and caused heavy erosion there at Botiamari. The Botiamari channel after travelling a distance of about 2.00km again outfalls at a spill channel of the river Brahmaputra formed at "Gai Tapu" downstream of the Botiamari spill channel mouth. The combined discharge of the two spill channels one from Botiamari mukh and other from Gai Tapu caused erosion at Rangchali Doloni since 2021. But due to oblique thrust of Botiamari channel previously the rate of erosion at Rangchali Doloni area was not so prominent. In the year 2021-22 a scheme under nomenclature "Anti-Erosion measures to protect Botiamari and its adjoining area from the erosion of river Brahmaputra" amounting to Rs. 13,32,00,000.00 was taken up to control erosion at Botiamari area under CM Dashboard and erosion was permanently controlled and the flow through the Botiamari spill channel became stagnant. But in course of time the mouth of the spill channel at down-stream of Botiamari channel at "Gai Tapu" area got enlarged and subsequently discharge through the channel got increased and in absence of the previous oblique thrust of the Botiamari channel the Rangchali Doloni area experienced heavy thrust of the river discharge resulting in severe active bank erosion at these area since 2023 beginning from the outfall point of Bottiamari channel upto the outfall point of the Behali river. The rate of erosion has become very active from the last year 1.e., 2023 and many hectares area fell and many hectares of cultivable fertile land. Comprising of paddy field and tea plantation fell under the grip of this erosion. If the said Northern Bank is not protected with flood control structures there is possibility of loss of valuable cultivable as well as homestead Land under numbers of G.P.s of Behali LAC namely Ni - Behali G.P., Telangonia G.P., Botiamari G.P. and Ganga mouthan G.P. comprising of many villages namely Rangchali Doloni, Rangchali, Telangonia, Botiamari, Mazgaon etc.

Sonitpur

57. Right bank of river Brahmaputra from Tezpur town consists of a series of hillocks separated by easily erodible plain reaches of thickly homestead land. The Zahazghat area is situated on the southern part of Tezpur town. Tezpur Circuit house, Divisional Forest Office, Divisional Office of Soil Conservation, Inland Water Transport Office, Railway office etc. and many public and private institutions are situated in this area. Heavy bank erosion is observed in this area since last few years. The main course of river Brahmaputra has been shifted towards right bank near Tezpur town forming a series of sand chars in the middle of the river. Already a vast costly area of Zahazghat has been eroded by the river Brahmaputra. Still, massive bank erosion is going on in this area. The bank in this area comprises of easily erodible soil and cannot resist erosion. At present the Zahazghat area is under serious threat of bank erosion.

C. Proposed Project and its Rational

58. The proposed high priority works in Dhakukahna, Lakhimpur, Biswanath and Sonitpur shall be executed under ADB financed CRBIFRERMP in Assam. At present, measures for sediment management in the entire river have not yet been viable. Except some reaches of the river where both banks are of hard soil mass, most reaches have been widened by erosion to 10-15 km wide in place of its original width of 3 to 4 km. Such rapid changes in configuration are multiplying the erosion every year.

Dhakuakhana

59. During each flood, the river water of Brahmaputra flows through borrows pit channel along the embankment from Sissikalghar to Tekeliphuta. This flood water exerts tremendous flood pressure on Sissi-Tekeliphuta Dyke specially in Bahir Bandana, Up stream of Matmara Check Bund, Juria and Takarchuk area. As such, immediate bank protection work is utmost necessary to protect the Brahmaputra dyke from Sissikalghar to Tekeliphuta

Lakhimpur

60. Due to braided characteristics, the main stem river consists of number of different size channels and sand bars (char) which change their locations and sizes each year. The most significant bank line modifications take place during the falling stages when excess sediment is deposited as sand bars (char) within channel, causing a change in local flow direction and migration of thalweg. During floods, because of change of river hydraulics, the channel starts shifting at some vulnerable reaches. There is a major off shoot channel of the river Brahmaputra that directly hits the right bank at U/S of Check Bundh No.1 at Bonpuroi ferry-ghat. Moreover, the river Subansiri merges with the mighty Brahmaputra at this location. Combined volume of both the rivers results in intense erosion every year during peak flood season. The tendency of flood water and the off-shoot channels to shift towards the right bank has become more prominent recently, resulting in deposition of sediments at opposite bank thus forming a sand bar (Char). As the size of sand bar (Char) is increasing resulting in severe erosion at the opposite bank. Unabated bank erosion has engulfed a large portion of land mass which is about 200 Hectares and depth of maximum erosion is 1,740 m from 2014 till date at the proposed site. The severe erosion prone reach. from Bonpuroi ferry-ghat (CH: 23,933m) to Latabari at Check Bundh No.6 (CH:25,000m) has been protected by launching Geo Bags (Type-B) in apron under already executed schemes but the erosion at D/S of Check Bundh No.6 and U/S to the existing anti-erosion works is still active and it is a major threat to the very safety of the existing embankment system.

Biswanath – Paken

61. Considering the gravity of the situation and to arrest the erosion and choke out the spill channels thereby avert possible breach of B-Dyke, the area shall be developed based on the measures suggested by PISC to take up emergency works in the form of anti- erosion work with geo-bags, pro-siltation measures (PSC porcupines) and channel closure (geo- tubes and/or porcupines). It may be also noted that on bank trimming, the embankment at Paken will have to be shifted towards countryside since the river side slope has been eroded during last flood, as such provisions for widening is incorporated in the proposal.

Biswanath – Rangchali Dalani

62. With a view to solve this chronic age-old problem of riverbank erosion this scheme has been prepared with provision of bank revetment work covering the present entire erosion affected reach of Rangchali Doloni area with geo-synthetic eco-friendly materials to safeguard these area against river bank erosion. Along with bank revetment works, some river training works in the form of launching of PSC porcupine screens at the mouth of the channel at Gai Tapu and at the outfall of the river Behali are also incorporated in the DPR.

Sonitpur

63. Considering the gravity of the situation and to save Zahajghat and Jarani area from further bank erosion, protective measures are highly essential. Based on the close study of the area as outlined above the following provisions are incorporated in the estimate and the provisions are as follows:

- Bank Trimming
- Bank revetment with Geo materials
- Apron with Geo bag type-C
- PSC porcupine Screen/Bar

D. Proposed project Components

Structural Measures and Civil works

64. To protect the communities in these high priority project districts from land erosion, Riverbank revetment is necessary, the general specification of proposed Anti Erosion works are as below⁹:

- Width of apron= 40m, launching of C-Type Geo Bags (0.2 m thick) in 4 layers for a thickness of 0.8 m
- Bank Revetment, Launching of A-Type Geo Bags (0.15 m thick) in 3 layers for a thickness of 0.45 m
- Toe-Key, is formed of wire-netting cages (dimension of one cage is 1.5m x 1.5m x 0.45m) filled with Type A Geo-Bags and is placed at the LWL at hard river bed in 2 layers

65. The location wise proposed interventions details are given in Table 2-1.

Table 2-1. List of proposed interventions for additional high Priority works at Dhakuakhna.

Sl.	Name	District	W.R Div.	Length	Geo-coordinates
Apron Protection and Riverbank Revetment Works					
1	U/S of Bandana Check Bund to Matmara	Lakhimpur	Dhakuakhana	4500 m	27°14'22.03"N, 94°33'10.83"E to 27°12'23.68"N, 94°31'51.32"E
2	Baligaon to Papung	Lakhimpur	Dhakuakhana	3500 m	27°11'14.65"N, 94°31'21.08"E to 27°09' 27.97"N, 94°30'37.15"E
Pro-siltation works					
3	Bamuni Chapori	Lakhimpur	Dhakuakhana	-	27°17'17.79"N, 94°36'5.39"E
4	In between Matmara and Baligaon	Lakhimpur	Dhakuakhana	-	27°11'21.93"N, 94°31'17.55"E
Embankment works/Earthwork					
5	U/S of Lutasur 1 st Check Bund	Lakhimpur	Dhakuakhana	-	27°17'10.70"N, 94°34'56.10"E
6	D/S of Lutasur 1 st Check Bund	Lakhimpur	Dhakuakhana	-	27°16'56.99"N, 94°34'52.05"E
7	D/S of Lutasur near 2 nd Check Bund	Lakhimpur	Dhakuakhana	-	27°16'47.40"N, 94°34'57.18"E
8	D/S of Lutasur near 2 nd Check Bund	Lakhimpur	Dhakuakhana	-	27°16'25.24"N, 94°34'32.43"E
9	U/S of Jugisuti Check Bund	Lakhimpur	Dhakuakhana	-	27°16'2.34"N, 94°34'10.86"E
10	D/S of Jugisuti Check Bund	Lakhimpur	Dhakuakhana	-	27°15'44.84"N, 94°33'41.32"E
11	U/S of Bandana Check Bund	Lakhimpur	Dhakuakhana	-	27°30'57.91"N, 94°32'40.15"E
12	D/S of Matmara Check Bund	Lakhimpur	Dhakuakhana	-	27°12'42.73"N, 94°31'51.38"E
13	D/S of Matmara Check Bund	Lakhimpur	Dhakuakhana	-	27°12'34.62"N, 94°31'39.15"E
14	D/S of Matmara Check Bund	Lakhimpur	Dhakuakhana	-	27°12'30.59"N, 94°31'28.36"E

⁹ PPT presented during ADB mission

Table 2-2. List of proposed interventions for additional high priority works at Lakhimpur

Sl.	Name	District	W.R Div.	Length	Geo-coordinates
Apron Protection and Riverbank Revetment Works					
1	Bonpuroi Jamuguri	Lakhimpur	North Lakhimpur	1020 m	26.857429°N, 93.815014°E to 26.850334°N, 93.808962° E
2	Bonpuroi Jamuguri	Lakhimpur	North Lakhimpur	1150 m	26.850334°N, 93.808962° E to 26.846926° N, 93.799465° E
3	Bonpuroi Jamuguri	Lakhimpur	North Lakhimpur	260 m	26.846926° N, 93.799465° E to 26.846504° N, 93.797156° E
Pro-siltation works					
4	Bonpuroi Jamuguri	Lakhimpur	North Lakhimpur	-	26.848580°N, 93.824112°E
5	Bonpuroi Jamuguri	Lakhimpur	North Lakhimpur	-	26.849088°N, 93.819027°E
6	Bonpuroi Jamuguri	Lakhimpur	North Lakhimpur	-	26.847355°N, 93.796382°E
7	Bonpuroi Jamuguri	Lakhimpur	North Lakhimpur	-	26.847535°N, 93.795818°E
8	Bonpuroi Jamuguri	Lakhimpur	North Lakhimpur	-	26.847797°N, 93.795153°E

Table 2-3. List of proposed interventions for additional high priority works at Biswanath

Sl.	Name	District	W.R Div.	Length	Geo-coordinates
Apron Protection and Riverbank Revetment Works					
1	Paken	Biswanath	Biswanath	1600 m	26°47'56.66"N, 93°38'3.28"E to 26°47'42.43"N, 93°37'33.18"E
2	Rangchali Dalani	Biswanath	Biswanath	1340 m	26°46'35.78"N, 93°21'59.68"E to 26°46'23.76"N, 93°21'25.69"E
Embankment Works/Earthwork					
3	Paken	Biswanath	Biswanath	225 m	26°47'14.61"N, 93°41'34.82"E
Pro-siltation Works					
4	Amguri Pichala, Aliguri	Biswanath	Biswanath	-	26°50'14.00"N, 93°45'58.32"E
5	Kharoiati	Biswanath	Biswanath	-	26°49'11.09"N, 93°45'0.67"E
6	Bhalukaguri	Biswanath	Biswanath	-	26°48'5.58"N, 93°43'29.52"E
7	Gospuria	Biswanath	Biswanath	-	26°47'14.61"N, 93°41'34.82"E
8	Rangchali Dalani	Biswanath	Biswanath	-	26°46'36.05"N, 93°22'9.64"E
9	Gai Tapu	Biswanath	Biswanath	-	26°46'14.77"N, 93°23'3.81"E

Table 2-4. List of proposed interventions for additional high priority works at Sonitpur

Sl.	Name	District	W.R Div.	Length	Geo-coordinates
Apron Protection and Riverbank Revetment Works					
1	Zahaz Ghat	Sonitpur	Sonitpur	600 m	26°36'57.29"N, 92°47'34.65"E to 26°37'2.55"N, 92°47'13.82"E
2	Jarani	Sonitpur	Sonitpur	1200 m	26°37'55.27"N, 92°40'41.46"E to 26°37'39.78"N, 92°40'2.34"E
Pro-siltation works					
3	Borchalla	Sonitpur	Sonitpur	-	26°37'47.57"N, 92°41'11.59"E to 26°37'54.66"N, 92°40'59.70"E

Source: WRD

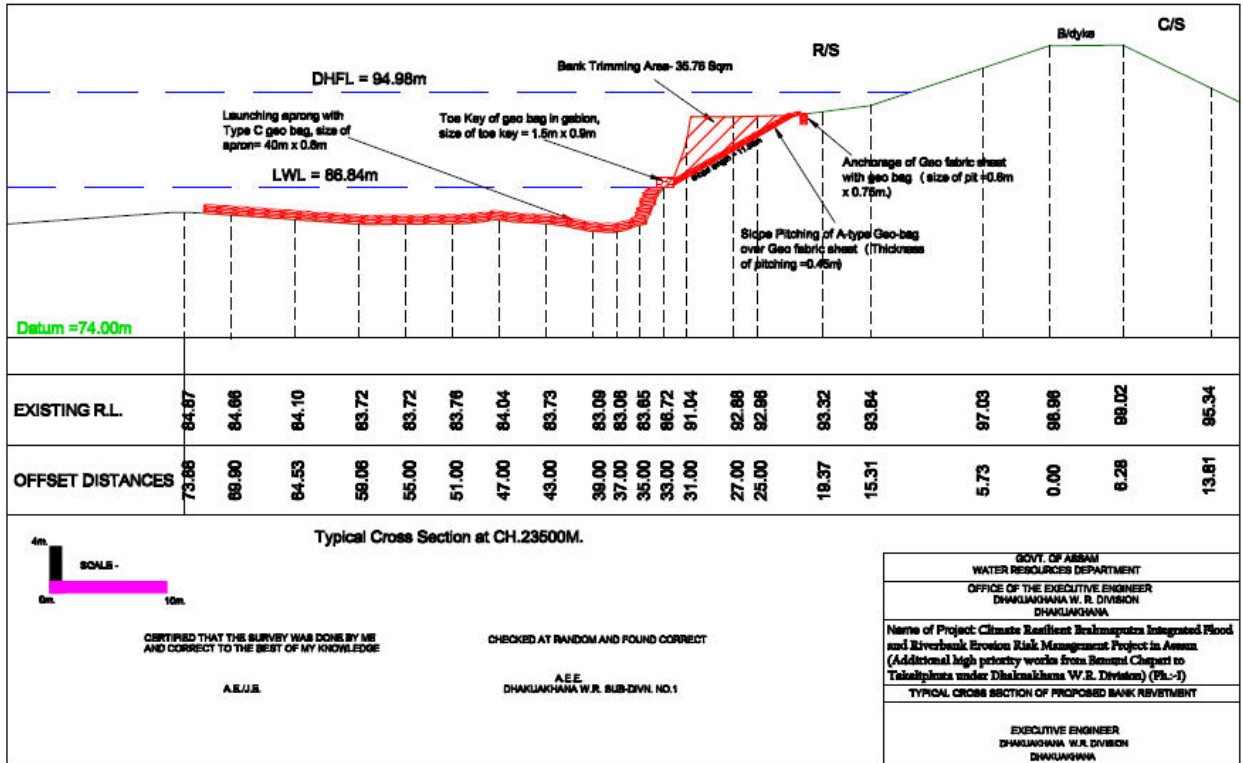


Figure 2-1. Typical Cross Section (TCS) of anti-erosion (AE) works of Dhakuakhna high priority area.





Proposed location at Dhakuakhana



Proposed location at Lakhimpur



Proposed location at Lakhimpur



Proposed location for widening of Embankment and Anti Erosion at Paken, Biswanath



Proposed location at Rangchali Dalani, Biswanath



Proposed location at Jarani, Sonitpur



Proposed location of Jahajghat, Sonitpur

Figure 2-2. Photographs of Dhakuakhana, Lakhimpur, Biswanath and Sonitpur Project Areas.

Non-Structural Measures

66. Nature-based solutions (NbS) e.g., bioengineering techniques such as the planting of reeds will be pilot tested to be applied to embankment slopes to reduce maintenance requirements from the risk of rain cuts and to provide local stakeholders with income generating activities opportunities. Assam Agroforestry Development Board or AADB, has been created in June 2022 by the government of Assam as an unlisted public company classified as state government company under the Forest Department. It is mandated to increase the people's livelihood options through various agroforestry models and to support nature conservation. AADB is responsible for implementing the nature-based solutions. AADB with support of WRD will develop, implement, improve, guide, and supervise pilot nature-based solutions including relevant research and dissemination of research results. The pilots will provide employment opportunities for riverine rural poor and as the pilots can be upscaled to broader implementation, more employment opportunities will be created in the next phases. The exact locations of these pilot areas shall be identified based on surveys and studies, later on. FREMAA shall assist AADB for procurement of all goods and services.

E. Construction Material for Bank Protection

67. Flood management and river training works in form of embankment, bank revetment, spurs, reinforced cement concrete (RCC) porcupines, etc. are provided to manage/control the floods, improve drainage system and to check the bank erosion. Construction of these works makes use of different kind of materials depending on the nature of problem and the structure provided. Different construction materials have their own uniqueness and are used according to the site conditions, availability, transportability, cost effectiveness, low maintenance cost etc.

68. Materials like boulders, timber are in use since ages, but due to their increased usage in other sectors leading to reduced supply and environment un- friendliness, their use now-a-days is decreasing. High wear and tear of timber structures in underwater and near water situation make it less suitable for its use in AE measures.

69. Now–a-day’s use of new innovative materials like geo- textile in the form of geo-textile bags, geo-textile tubes, sand filled geo-mattress, neo-web, submerged wanes, and RCC porcupines is being increased in construction of revetments, spurs, groynes, embankments etc. These materials are used due to their unique characteristics like durability, resistance to chemical waste, environment friendly nature, easiness in installation etc. Different construction materials being used for structural measures of flood management under this project are described below:

70. **Geo-bags:** Use of inert or natural material is proposed. Geo-textile bags filled with sand shall be the preferred option. The sand should be coarse sand and free from organic material. Loamy and clayey type soil should be avoided. It is very stable material and used worldwide. The engineered bags life is much beyond 30 years, the economic life of the Project. Use of geotextile is considered beneficial even from aquatic fauna aspect.

71. Geo-textile bags are made of woven or nonwoven geo- textile fabrics which are specially designed for good soil tightness and high seam efficiency. Geo-textile bags range in volume from 0.05 m³ to around 5 m³, and are pillow shaped, box shaped, or mattress shaped depending on the required application. Geo-textile bags have also been used as revetment, breakwaters, etc. to build structural erosion protection measures. It is proposed to use the Geo-bag size 1.03m x 0.70m (Geo-bag type A) with toe key size 3 m x 0.9m. Sample photographs of a geo-textile bag used for anti-erosion (AE) works are shown in the figures below.





Source: IEE – Goalpara, CRBIFRERMP

Figure 2-3. Use of Geo textile bags for Existing AE works.

72. **Reinforced cement concrete porcupine:** RCC is mainly used for construction of the PSC porcupine screens due to ease of construction, cast in-situ nature, longer durability and low cost. The use of RCC is replacing the timber in construction of porcupine screens.

73. River training is an art to protect the bank from erosion, changing the course, flood, and sediment control and navigation etc. Protection to the riverbanks is normally achieved by construction of stone revetments, impermeable spurs etc. The cost of these traditional methods is very high, due to which the bank protection is generally restricted to the important areas such as urban areas, important roads, railway lines, agricultural lands, etc. Construction of permeable structure is cheap and simple alternative method which can help not only to protect the bank, but also to induce siltation along the bank and help to divert the river channel away.

74. Only a dampening action on the velocity of flow is achieved by a permeable structure, distinguished from the deflecting or repelling action of an impermeable structure. It is a well-known fact that the sediment transport capacity of a flow is highly sensitive to the flow velocity. Therefore, the dampening of velocity could result in deposition of coarser particles in the downstream of the structure. So, the permeable structures can be called as sedimenting structure.

75. It is a structure made up of small units placed in suitable arrangements. These units are called as elements. Permeable structures are usually cheaper than the impermeable ones. The basic principle behind the permeable structure is to reduce the velocity by providing partial obstruction to the flow and thereby induce deposition of the sediment. The elements used in the PSC porcupine screens/spurs are as under:

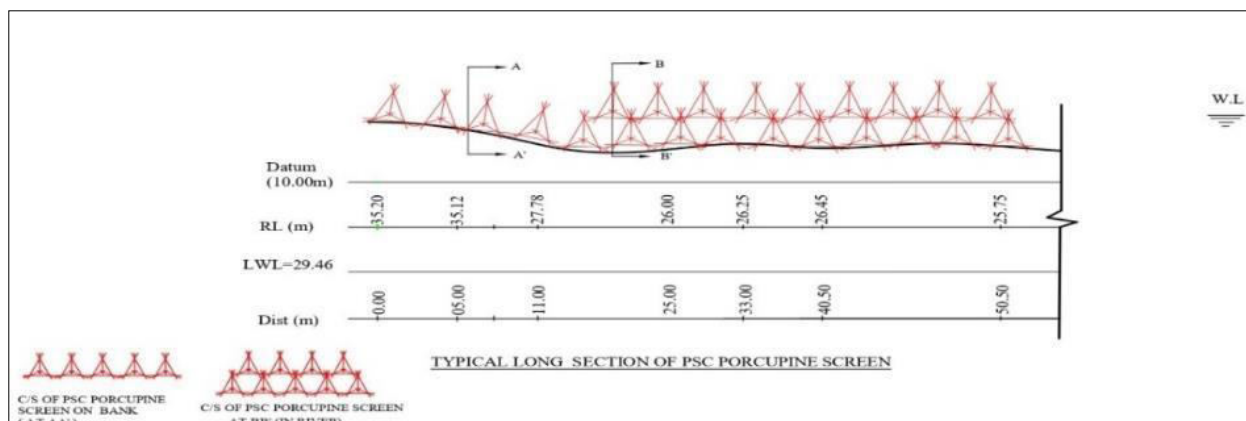
- a. **Members:** The porcupines are made of RCC members/elements. These members are casted in-situ at the site or location near the site. Generally, six members are used to construct one porcupine. The size of one member is kept as 3mx0.1mx0.1m or 2mx0.1mx0.1m. These members are joined with the help of Nails.
- b. **Nails:** Standard commercially available nails of length 100 mm to 150 mm are used to join the porcupine members. Double nailing at critical joints may be provided.
- c. **Galvanized iron (GI) Wire:** 4 to 5 strands of 4 mm GI wire should be used for inter-connecting the porcupines and may be anchored with the ground. Alternatively, 12 mm 3-4 strands wire ropes should be used for the interconnecting the porcupines.

76. It is proposed that 6 screens of PSC porcupines in 3 layers covering 4.500 km will be launched for providing the riverbank protection. Sample photographs of Porcupine screens used in the project area is shown in the figure below.



Source: IEE, Goalpara, CRBIFRERMP (<https://www.adb.org/projects/documents/ind-56283-001-iee-3>)

Figure 2-4. Presence of old porcupine screens in Project Area.



Source: WRD

Figure 2-5. Typical Long section and Cross section of Porcupine Screens.

77. **Other construction requirements:** The proposed project work aims at protecting the community from land erosion of Brahmaputra River by way of executing anti-erosion and flood protection works. The sites for bank revetment work align along with the riverbank and the selected reaches are actively erosion prone. It is necessarily to execute the apron work in the dry season.

78. The proposed construction activity under this project is simple involving anti-erosion works and flood protection works by way of construction of bank revetment and apron using geo-bags of different sizes. The geo-bags are required to be filled by sand which will be quarried by the contractor. Quarrying permits must be acquired by the contractors prior to start mining sands to fill the geo bags. For both anti-erosion works, and flood protection works soil compaction and slope stabilization will involve earth work. Substantial quantity of the earth will be required for construction of 1:2 to 1:3 which is designed for 100-year flood return period. It is proposed that the demand for earth will be fulfilled by excavating borrow pits in the vicinity of the river embankment.

79. Since all the work sites are located along the Brahmaputra River the construction material and equipment will be transported both through the road and river. The Contractor will employ barges for placing geo-bags under the water. The contractor is expected to transport the material by road up to a certain point from where the material will be transported by river.

F. Project Benefits

80. After implementation of the project, large area will be protected and will give benefit to the people for cultivation etc. Many school buildings, government institutions, rural hospitals, public utility buildings, industrial setups will be safe from the grip of erosion of Brahmaputra River. Hence, it will be great help for maintaining socio-economic development of the people for a vast area. Furthermore, the most important communication to the local people will also be in future after implementation of the project.

Dhakuakhana

81. After implementation of the scheme around 10,117 Ha of land and 500,000 population of Dhakuakhana and a part of Majuli district will be benefitted.

Lakhimpur

82. The execution of the scheme will benefit vast areas of thickly populated homestead and fertile cultivable land in the Lakhimpur district of Assam.

Biswanath - Rangchali Daloni

83. Successful implementation of the project will provide adequate protection against loss of fertile soil mass and will uplift socio-economic development of the poor agro based villagers in terms

of safeguarding their paddy fields, small tea gardens, horticulture fields etc.

Biswanath – Paken

84. After implementation of the project approx. 25,000 numbers of people and 5,500 hectares of area is likely to be benefited comprising of vast thickly populated homestead land, fertile cultivated land, numbers of Govt and Private buildings, educational institutions, small industries etc.

Sonitpur

85. After successful completion of the scheme, the erosion and flood problem will be mitigated in Zahazghat and Jarani area and about 200 hectare of land with 8,000 population will be benefited.

G. Implementation Schedule and Project Cost

86. The project is planned to be implemented over 540 days where land acquisition is required, and 435 days where land acquisition is not required. After the completion of construction work, there will be a one-year Defect Notification Period (DNP). The total duration for porcupine work is 14 months. The estimated cost for the proposed additional high-priority structural works is \$33.5 million.

III. ANALYSIS OF ALTERNATIVES

A. Introduction to Analysis

87. The analysis of alternative is an effective tool to examine the number of options (locational and technological) and establishing most environmentally favorable alternative which cause minimum environmental loss to the natural and social environment. However, since the proposed high priority project is site specific, i.e., aims to sustain the functions of the existing flood embankment systems protecting a large number of people and landmass from frequent devastating flooding and riverbank erosion of the Brahmaputra River, the scope for assessing alternatives to the project is limited. Under high priority project there are four project components: The areas are as follows: (i) Bamuni Chapari to Tekeliphuta area (under Dhakuakhana WRD division), (ii) Bonpuroi-Jamuguri and its adjoining areas (under North Lakhimpur WRD division), (iii) Rangchali Dalani area and Paken area (under Biswanath WRD division), and (iv) Jarani and Zahaz Ghat in Tezpur and Biswanath District (under Sonitpur WRD division). The proposed types of works are the same as in the existing subproject areas (i.e.: underwater works, pro-siltation, earthwork and other preliminary protection works along the riverbank).

B. Without Project Option

88. **Physical Environment.** In the 'without project' scenario, loss of precious land will continue due to riverbank erosion. Average erosion 17 m/year. Siltation of land due to flood will result to reduced productivity or loss of single crop. No effect on ambient air and noise quality is anticipated. The sedimentation level in wetlands and riverbank may continue to increase due to erosion or flood.

89. **Biological Environment.** In the 'without project' scenario, the present species composition of the vegetation, fisheries and wildlife is expected to remain unchanged. In normal conditions (no flood scenario), no change is anticipated in fish productivity of wetlands, pond fisheries, or productivity of agricultural land. However, loss of vegetation or loss of agricultural productivity, loss of pond fisheries productivity would be high during floods.

90. **Socio-economic Environment.** Without the project, large number of populations will remain vulnerable to flood effect. Even the current rate of erosion to the tune of about 90.1 ha every year is a big loss of agricultural land and settlement areas. Flood also causes many linked socio-economic and health problems.

C. With Project Option

91. **Physical Environment.** In the 'with project' scenario, no change is expected in air, soil and water conditions. The air pollution and noise levels are likely to increase during the construction phase but will be confined within the close vicinity of construction sites and will be temporary in nature. The bank protection measures will prevent erosion loss of the productive land and prevent an increase of sedimentation load to river.

92. **Biological Environment.** In the 'with project' scenario, there is likelihood of improved fish productivity from wetland and pond fisheries. No significant impact is expected in terms of the increase in sedimentation level or fish productivity during construction stage. With the implementation of mitigation measures the overall impact of the project is likely to be nil or positive on the biological environment except in terms of loss of trees which will be minimized and regenerated over a period of time due to proposed tree plantation program as compensatory plantation. The project entails cutting of trees in the project area due to construction of new embankment and some anti erosion works and other project activities. The number of trees to be felled is yet to be determined as of the time of preparation of the IEE. The number will be finalized at the pre-construction stage and disclose

the actual number of trees in monitoring reports.

93. Needless to say, trees play an important role in the environment as oxygen purification, checking soil erosion, habitat of numerous different faunas etc. The bamboo and Simul trees are found in maximum quantity in all the project areas. The maturity period of bamboo is about 3 years, and Simul is about 10 years, which means most of the trees are fast growing. The economic benefit has been worked out based on direct sale value of a matured tree. The average value of a Simul tree is INR 2,500/tree and that of bamboo is INR 4,000/bunch.t

94. **Mitigation Cost:** With regards to mitigation measures, it is planned to plant ten times the tree cut. Since the number of trees to be impacted is yet to be finalized, the total trees to be planted shall be updated at the pre-construction period and shall be disclosed in monitoring reports. Trees shall be maintained for 5 years, and the cost of maintenance shall be part of the mitigation cost.

95. **Socio-economic Environment.** The 'with project' scenario is also likely to bring stability to the economy of the area. About 75% of Assam's farm families live in the Brahmaputra valley, where 90% of the net cropped area is at risk of flooding. Flooding causes agriculture losses and deposits sand on fertile fields. Reduced productivity disproportionately affects small farmers, especially female headed farms. Outmigration of men causes women additional burdens in household responsibilities, farm production, and financial obligations. Women have limited access to flood warnings, and little representation on decision-making bodies that would better help with flood response. With the implementation of the project, conservation of large area from erosion shall be done, which means increased agricultural produce. AADB shall also be running pilot nature-based solutions to reduce erosion of the slopes of embankments, to plan and promote wetland revival and biodiversity, and to promote siltation on possibly reclaimed land. It is expected that these pilots will provide employment opportunities for riverine rural poor and as the pilots can be upscaled to broader implementation, more employment opportunities will be created in the next phases.

96. Farmers will be able to plant three crops, instead of two crops in a year. Wetlands and pond fisheries productivity will improve due to reduce siltation load and improved fishery practices. The project will also provide better commuting opportunities to fishermen and people of the area through the paved road on the embankment, which means reduced commuting time to reach the markets. The flood protected environment may also promote agro-based industries in the area. The post-project scenario will enhance the overall economy of the area. A major output of the project is to improve the livelihood of vulnerable people and resilience. Various interventions including training and supports are proposed which shall improve the socio-economic environment of the project area. As per socioeconomic study, based on land use record of State Government of Assam, majority of the land in the project benefit area is agriculture which is about 62%.¹⁰ The major crops grown are rice, maize, vegetables, mustard, tea and other Rabi and Kharif crops, with rice crop accounting for 66%. The crop farmers will considerably benefit post project implementation, and these benefits can further improve with improved cropping patterns and use of climate resilient and high yielding variety (HYV) seeds. With availability of land, even non-polluting industries as agro-based and cottage industries by female self-help groups shall also be promoted in the area.

D. 'Repeated Embankment Retirement' Option

97. **Physical Environment.** This option involves the retirement of flood embankments in response to the riverbank erosion process, with the acquisition of land and compensation to the

¹⁰ ADB. India: Assam Integrated Flood and Riverbank Erosion Risk Management Investment Program Project 2, Initial Environmental Examination Report (Palasbari Subproject - Palasbari and Gumi Reach, Kamrup District). May 2018. <https://www.adb.org/projects/documents/ind-38412-033-iee-0>

affected people. In this scenario, loss of land will continue due to riverbank erosion. There is also a possibility of frequent flood inundation in the project area, unless the retired embankment can be constructed before the existing embankment is breached due to the riverbank erosion.

98. **Biological Environment.** In this option, the eroded land will turn into a river channel turning into an aquatic environment. The environment of floodplain and wetlands during the monsoon season will depend on the timing of constructing the retired embankment against the breach of existing embankment due to erosion. For other seasons, no change is anticipated in fish productivity of wetlands, or productivity of agricultural land in the flood plain.

99. **Socio-economic Environment.** Since this option involves continuous river erosion, there will also be displacement of people associated with eroded land lost due to river erosion, of which agriculture productivity will be lost. Similar economic benefits may be delivered in case of timely construction of retired embankment prior to the breach of existing embankment due to river erosion. However, there is a risk of failure given the lengthy procedures for land acquisition and opposition from the concerned population in the project areas (when compared with the 'with-project' option), in which case there will be repeated flood damage, affecting the confidence of local population on the reliability and effectiveness of FRERM systems leading to much less positive socio-economic impacts as compared with the 'with-project' option.

100. **Conclusion.** "Without" high priority projects would yield the project area to be continuously under the threat of floods and effects of soil erosion that puts the socio-economic conditions and life of the general public at an increasing risk and could potentially worsen the living environment. This 'no project' scenario would impede further social and economic development of the project area and the defer commitments to improve the proportion of the population with better life.

101. The Repeated Embankment Retirement option involves loss of land due to erosion and needs substantial provisions for land acquisition. In this scenario, the threat of floods also continues to remain there. As such this "Repeated Embankment Retirement option" is also not feasible.

102. Given the large-scale benefits to the population and environment, 'With Project' alternative is thus considered appropriate.

IV. POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

A. ADB's Environmental Safeguard Policy and Requirement

103. ADB SPS requires that during the design, construction and operation of the project necessary compliance to all applicable laws and international conventions/treaties along with pollution prevention and control technologies and practices consistent with international good practice, are ensured.

104. Screening and Categorization with that of ADB SPS 2009. ADB uses a classification system to reflect the significance of a project's potential environmental impacts. A project's category is determined by the category of its most environmentally sensitive component, including direct, indirect, cumulative, and induced impacts in the project's area of influence. Each proposed project is scrutinized as to its type, location, scale, and sensitivity and the magnitude of its potential environmental impacts. Projects are assigned to one of the following four categories:

(i) **Category A.** A proposed project is classified as category A if it is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment (EIA) is required.

(ii) **Category B.** A proposed project is classified as category B if its potential adverse environmental impacts are less adverse than those of category A projects. These impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for Category A projects. An initial environmental examination (IEE) is required.

(iii) **Category C.** A proposed project is classified as category C if it is likely to have minimal or no adverse environmental impacts. No environmental assessment is required although environmental implications need to be reviewed.

(iv) **Category FI.** A proposed project is classified as category FI if it involves investment of ADB funds to or through a FI.

105. The environmental impacts of the proposed additional high priority project areas have been identified and assessed as part of the planning and design process. An environmental assessment using ADB's rapid environmental assessment checklists (Appendix 3) were conducted, and results of the assessments shows that the proposed project is unlikely to cause significant adverse impacts. Thus, this IEE has been prepared in accordance with ADB SPS's requirements for environment Category B projects.

106. **Environmental Management Plan (EMP).** An EMP which addresses the potential impacts and risks identified by the environmental assessment shall be prepared. The level of detail and complexity of the EMP and the priority of the identified measures and actions will be commensurate with the Project's impact and risks. The EMP shall include the proposed mitigation measures, environmental monitoring and reporting requirements, emergency response procedures, related institutional or organizational arrangements, capacity development and training measures, implementation schedule, cost estimates, and performance indicators.

107. **Public Disclosure.** The IEE will be put in an accessible place (e.g., local government offices, libraries, community centers, etc.), and a summary translated into local language for the project affected people and other stakeholders. The following safeguard documents will be put up in ADB's website so that the affected people, other stakeholders, and the public can provide meaningful inputs into the project design and implementation:

(i) Final or updated IEE upon receipt; and

- (ii) Environmental monitoring reports submitted by the Project Management Unit (PMU) during project implementation upon receipt.
- (iii) Consultation and Participation. ADB SPS requires FREMAA, WRD and AADB to conduct meaningful consultation¹¹ with affected people and other concerned stakeholders, including civil society, and facilitate their informed participation. The consultation process and its results are to be documented and reflected in the environmental assessment report.

108. **Grievance Redress Mechanism.** ADB SPS requires FREMAA to establish a mechanism to receive and facilitate resolution of affected people's concerns, complaints, and grievances about the project's performance. The grievance mechanism shall be scaled to the risks and adverse impacts of the proposed project.

109. **Monitoring and Reporting.** FREMAA shall monitor measure and document the implementation progress of the EMP. If necessary, the borrower shall identify the necessary corrective actions and reflect them in a corrective action plan. Borrower shall prepare and submit to ADB annual environmental monitoring reports that describe progress with implementation of the EMP and compliance issues and corrective actions, if any. For projects likely to have significant adverse environmental impacts during operation, reporting will continue at the minimum on an annual basis until ADB issues a project completion report.

110. **Unanticipated Environmental Impacts.** Where unanticipated environmental impacts become apparent during project implementation, ADB SPS requires the FREMAA to update the environmental assessment and EMP or prepare a new environmental assessment and EMP to assess the potential impacts, evaluate the alternatives, and outline mitigation measures and resources to address those impacts.

111. **Occupational Health and Safety.** ADB SPS requires the FREMAA, WRD and AADB to ensure that workers¹² are provided with a safe and healthy working environment, taking into account risks inherent to the sector and specific classes of hazards in the high priority project work areas, including physical, chemical, biological, and radiological hazards. All constructions shall take steps to prevent accidents, injury, and disease arising from, associated with, or occurring during the course of work, including: (i) identifying and minimizing, so far as reasonably practicable, the causes of potential hazards to workers; (ii) providing preventive and protective measures, including modification, substitution, or elimination of hazardous conditions or substances; (iii) providing appropriate equipment to minimize risks and requiring and enforcing its use; (iv) training workers and providing them with appropriate incentives to use and comply with health and safety procedures and protective equipment; (v) documenting and reporting occupational accidents, diseases, and incidents; and (vi) having emergency prevention, preparedness, and response arrangements in place.

112. **Community Health and Safety.** ADB SPS requires identification and assessment of risks to, and potential impacts on, the safety of affected communities during the design, construction, operation, and decommissioning of the project, and shall establish preventive measures and plans to address them in a manner commensurate with the identified risks and impacts. The PMU and

¹¹ Per ADB SPS, 2009, meaningful consultation means a process that (i) begins early in the project preparation stage and is carried out on an ongoing basis throughout the project cycle; (ii) provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people; (iii) is undertaken in an atmosphere free of intimidation or coercion; (iv) is gender inclusive and responsive, and tailored to the needs of disadvantaged and vulnerable groups; and (v) enables the incorporation of all relevant views of affected people and other stakeholders into decision making, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues

¹² Including non-employee workers engaged by the borrower/client through contractors or other intermediaries to work on project sites or perform work directly related to the project's core functions.

project implementation units (PIUs) shall ensure to apply preventive and protective measures for both occupational and community health and safety consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health and Safety Guidelines. PMU shall also adhere to necessary protocols in response to infectious diseases such as the corona virus disease (COVID-19) consistent with the guidelines of relevant government healthcare agencies and the World Health Organization.

113. PMU shall ensure to apply preventive and protective measures consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health and Safety Guidelines.

114. **Physical Cultural Resources.** PMU and PIUs are responsible for siting and designing the project to avoid significant damage to physical cultural resources. ADB SPS requires that such resources likely to be affected by the project are identified, and qualified and experienced experts assess the project's potential impacts on these resources using field-based surveys as an integral part of the environmental assessment process. When the proposed location of a project component is in areas where physical cultural resources are expected to be found as determined during the environmental assessment process, chance finds procedures shall be included in the EMP.

115. **Pollution Prevention and Control Technologies.** During the design, construction, and operation of the project, PMU, shall apply pollution prevention and control technologies and practices consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health and Safety Guidelines.¹³ These standards contain performance levels and measures that are normally acceptable and applicable to the project infrastructures. When the government's regulations differ from these levels and measures, the project shall achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, PMU, will provide full and detailed justification for any proposed alternatives that are consistent with the requirements presented in ADB SPS.

116. **Bidding and Contract Documents.** This IEE report, which contains the EMP, shall be included in bidding and contract documents and verified by PMU. The PMU shall also ensure that bidding and contract documents include specific provisions requiring contractors to (i) comply with all other conditions required by ADB, and including (i) proposed sites/locations for construction work camps, storage areas, hauling roads, lay down areas, disposal areas for solid and hazardous wastes; (ii) specific mitigation measures following the approved EMP; (iii) monitoring program as per EMP; and (iv) budget for EMP implementation, among others as may be required. A copy of the EMP will be kept on site during the construction period at all times. Non-compliance with, or any deviation from, the conditions set out in the EMP constitutes a failure in compliance and shall require corrective actions.

117. **Conditions for Award of Contract and Commencement of Work.** PMU shall not award any works contract under the project until (i) relevant provisions from the EMP are incorporated into the works contract; (ii) PMU has obtained ADB's clearance of final IEE report; and (iii) other necessary permits from relevant government agencies have been obtained.

B. Regulatory Requirements of the Government of India and Assam State

118. The implementation of the projects will be governed by Government of India and State Government of Assam and other applicable environmental acts, rules, regulations, and standards. These regulations impose restrictions on the activities to minimize or mitigate likely impacts on the environment. It is the responsibility of the project executing and implementing agencies to ensure

¹³ World Bank Group. 2007. Environmental, Health, and Safety General Guidelines. Washington, D.C.; <https://www.ifc.org-ehs-guidelines>

projects are consistent with the legal framework, whether applicable international, national, state or municipal or local. Key standards include those related to drinking water quality, air quality, effluent discharge, and protected areas. Compliance is required in all stages of the projects including design, construction, and operation and maintenance.

119. **Environmental assessment.** The Government of India EIA Notification of 2006 (replacing the EIA Notification of 1994) sets out the requirement for Environmental Assessment in India. This states that environmental clearance (EC) is required for specified activities/projects, and this must be obtained before any construction work or land preparation (except land acquisition) may commence. Projects are categorized as A or B depending on the scale of the project and the nature of its impacts.

120. None of the components of this project falls under the ambit of the EIA Notification 2006, and therefore EIA Study or EC is not required for the project. However, mining of sand/river silt for use in filling geo-bags and aggregates for use in cement concrete structures are under the ambit of EIA notification and shall require prior EC from State Environmental Impact Assessment Authorities (SEIAA)

121. The Government of India has framed various laws and regulation for protection and conservation of natural environment. These legislations with applicability to this project are summarized below in Table 4-1.

122. The national and international environmental standards and guidelines for all relevant parameters are provided in Appendix 4.

123. As the project does not require forest land diversion and the project is not falling within any protected areas (National Parks, Tiger Reserve and Wildlife Sanctuaries) or defined eco-sensitive zone area, thus no clearance is required from Forest Department of Assam and from National Wildlife Board, MoEF&CC, Government of India.

Table 4-1. Key National Environmental Legislations

Name	Key Requirement	Applicability	Type of permit and stage of applicability	Administrative Authority	Responsibility
Environmental Protection Legislations					
National Environment Policy (NEP), 2006	NEP is a comprehensive guiding document in India for all environmental conservation programs and legislations by Central, State and Local Government. The dominant theme of this policy is to promote betterment of livelihoods without compromising or degrading the environmental resources. The policy also advocates collaboration method of different stakeholders to harness potential resources and strengthen environmental management.	Applicable for all the projects which have environmental impacts associated with its development and operation	No permit required. Permits are required as per various laws and rules framed under the act.	MoEF&CC	-
The Environmental (Protection) Act, 1986 and The Environmental (Protection) Rules, 1987 and its amendments	All construction activities must comply with the legislation issued under this act and rules, the EIA process and implementation of the EMP will enable this. Construction activities must also comply with the environmental quality standards	Umbrella act under which environmental rules, notifications, schedules and standards applicable to the proposed project are issued Ecological Sensitive Zones are notified under the act	No specific permits but all environmental clearances, NOCs and permits are referred to the act.	MoEF&CC, Assam Forest Dept, CPCB and Pollution control Board, Assam (PCBA)	-
EIA Notification 14 th September 2006 and amendment till date	Requires prior environmental clearance (EC) for new, modernization and expansion projects listed in schedule 1 of EIA Notification, 2006	Considered. Not Applicable (EIA Notification 2006 does not classify for embankment construction and anti erosion activities)	No prior EC required for embankment construction and anti erosion activities	MoEF&CC/ SEIAA	Contractor (obtaining for mining of sand/river silt) and FREMAA (monitoring)

Name	Key Requirement	Applicability	Type of permit and stage of applicability	Administrative Authority	Responsibility
		Applicable for mining of sand/river silt for use in filling geo-bags and aggregates for use in cement concrete structures	Prior EC required for mining of sand/river silt for use in filling geo-bags and aggregates for use in cement concrete structures		
Air (Prevention and Control of Pollution) Act, 1981, 1987 The Air (Prevention and Control of Pollution) Rules, 1982	Act to prevent and control Air pollution	Applicable. The applicability is due to emission from operation of construction equipment like diesel generator (DG) sets, heavy machineries etc.	Consent to Establish (CTE) and Consent to Operate (CTO) to be obtained and maintained for setting up each facility, DG set as prior to its establishment and operation from PCBA. Conditions to be complied	PCBA	Contractor (obtaining CTE and CTO) and FREMAA (monitoring)
Water Prevention and Control of Pollution) Act, 1974,1988 The Water (Prevention and Control of Pollution) Rules, 1975 The Water (Prevention and Control of Pollution) Cess Act, 1977 and amendment in 2003	Acts to prevent and control water pollution.	Applicable. It is applicable for the project's having potential to generate effluent during any stage of the project. Effluents are expected to be generated during construction stage from construction camps.	CTE and CTO for disposal of sewage and construction of septic tank/soak pit prior to start of establishment and operation from PCBA. Conditions to be complied	PCBA	Contractor (obtaining CTE and CTO) and FREMAA (monitoring)
Noise Pollution (Regulation and Control Act) 2000 and 2010 as amended	Ambient Noise standards for different areas and zones	Applicable due to generation of noise during construction	No separate permits issued under this act. Permissions are covered for diesel generator (DG) sets under CTE/CTO	PCBA	Contractor (obtaining CTE and CTO) and FREMAA (monitoring)
Hazardous and Other Wastes (Management and Transboundary)	Protection to public against improper handling storage and disposal of hazardous	Applicable. Project may generate hazardous wastes (like waste oil) during construction	Authorization for storage and handling of hazardous waste	PCBA	Contractor (obtaining permits from PCBA) and

Name	Key Requirement	Applicability	Type of permit and stage of applicability	Administrative Authority	Responsibility
Movement) Rules, 2016	waste. The rules prescribe the management requirement of hazardous wastes from its generation to final disposal.				FREMAA (monitoring)
Manufacture, Storage, and Import of Hazardous Chemicals (MSIHC) Rules, 1989	Usage and storage of hazardous material	Applicable only for storage of highly inflammable liquids and gases like high-speed diesel (HSD) or liquified petroleum gas (LPG). Compliance to the rules should be ensured	No specific permit is required, however precautions defined under the material safety datasheets should be followed for use of hazardous substances listed under the schedules attached to this notification if any proposed to be used. Safety requirements should have to be complied if storage quantity exceeds the regulated threshold limit	Chief Controller of Explosives	Contractor (compiling with precautions and safety requirements) and FREMAA (monitoring)
Construction and Demolition Waste Management Rules, 2016	To manage the construction and demolition waste	Applicable. Applies to all those wastes resulting from construction repair and demolition of any civil structure of individual or organization who generates construction and demolition waste such as building material, rubble, debris. Segregation, management and disposal of wastes to be as per rules.	Approval required from local authorities, if waste generation is >20 tons in a day or 300 tons per project in month	Local Authorities	Contractor (obtaining approvals) and FREMAA (monitoring)
Plastic waste Management Rules, 2016	To manage the plastic waste generated	Applicable. Plastic waste is unlikely to be generated in small quantities. Wastes will be generated from packaging materials during construction. Wastes to be	No authorization to be obtained. Waste management and minimization to be done.	Local bodies	Contractor (obtaining) and FREMAA (monitoring)

Name	Key Requirement	Applicability	Type of permit and stage of applicability	Administrative Authority	Responsibility
		segregated and disposed as per Solid Waste Management Rules, 2016.	Fee to be paid to local bodies, if applicable		
The Batteries (Management and Handling) Rules, 2001	To regulate the disposal and recycling of lead acid batteries	Applicable for disposal of used lead acid battery if likely to be used in any equipment during construction stage.	No specific registration required. Compulsion to buy and sale through registered vendor only.	PCBA	Contractor (obtaining) and FREMAA (monitoring)
Forest Conservation and Wildlife Protection Legislation					
Indian Forest Act, 1927 The Forest (Conservation) Act, 1980 and amendments The Forest (conservation) Rules, 1981 and amendments	To protect forest by restricting conversion of forested areas into non-forested areas and deforestation	Not fully applicable. No forest land is being diverted. However large no. of tree cutting is envisaged for which NOC from forest department should be obtained prior to tree cutting as per applicable rules of the state. Compensatory plantation should be carried out as per state forest policy.	Forest Clearance/Permission for tree cutting.	Assam Forest Department and MoEF&CC	Contractor (obtaining) and FREMAA (monitoring)
Wildlife Protection Act, 1972, 1993 Biological Diversity Act, 2002	To protect wildlife through notifying National Parks (NP) and Wildlife Sanctuaries (WLS) and notified ESZ or in its absence 10 km buffer areas around the Protected Areas (PAs)	No diversion of NP and WLS area. Wildlife clearance is thus not applicable No presence of non-notified NP and WLS within 10 km radius of the project area and hence not applicable	NOC obtained for work at Paken and Rangchali dalani sites of Biswanath district, no other NoC/permission is required further for high priority project activities None of the site of additional high priority works located within boundary of Kaziranga National Park or any other protected areas	Chief Wildlife Warden, State Board of Wildlife and National Board of Wildlife	FREMAA
Safety and Other Related Legislations					
Chemical Accidents (Emergency Planning, Preparedness and	Requirement of preparation of on-site and off-site Disaster	Not Applicable. The project does not involve handling of any hazardous chemical during both construction and operation, phase	No permits issued under this act Additional	Central, State and District Crisis Group (headed by the Deputy Commissioner)	Not Applicable

Name	Key Requirement	Applicability	Type of permit and stage of applicability	Administrative Authority	Responsibility
Response) Rules, 1996	Management Plans for accident-prone areas.	which may lead to continuous, intermittent or repeated exposure to death, or injury.			
Public Liability and Insurance Act 1991	Protection from liability arising due to Accidents from Handling of hazardous chemicals.	Not Applicable. The project does not involve storage of any chemicals (i.e., HSD) beyond the threshold limit during construction and	No permits issued under this act. Owner of project should take out insurance policies providing for contracts of insurance so as he is insured against liability to give relief, before handling any such hazardous material	Labor Commissioner and Deputy Commissioner (DC)	Not applicable
Explosive Act 1884 and Explosive Rules, 2008	Safe transportation, storage and use of explosive material	Not Applicable. No explosive (as described in act and rules) is proposed to be used in the construction and operation stage of the project.	Permission for storage and usage of explosive	Chief Controller of Explosives	Not applicable
The Petroleum Act, 1934 The Petroleum Rules 2002	Use and storage of Petroleum products	Applicable as storage of HSD/LPG or any other petroleum product may be required for the project purpose	License to store petroleum beyond prescribed quantity.	Chief Controller of Explosives/DC	Contractor (obtaining license) and FREMAA (monitoring)
Central Motor Vehicle Act 1988 and amendments Central Motor Vehicle Rules, 1989 and amendments	To minimize the road accidents, penalizing the guilty, provision of compensation to victim and family and check vehicular air and noise pollution.	Applicable, for all the contractor's vehicles at site during construction and operation phase	Driving licenses and pollution under control certificates are issued under this Act	Motor Vehicle Department (Licensing authority, registration authority and State Transport Authorities)	Contractor (obtaining licenses and certificates) and FREMAA (monitoring)
The Gas Cylinder Rules 2004	To regulate the storage of gas / possession of gas cylinder more than the exempted quantity	Applicable if contractor store more than the exempted quantity of gas cylinder.	License to store gas cylinder more than the regulated quantity	Chief Controller of explosives	Contractor (obtaining license) and FREMAA (monitoring)
Ancient Monuments Preservation Act 1904	Areas within 100 meters (m) of the "protected monument/area" are	Applicable only if any intervention is planned within 100 m of	No objection certificate	Archaeological Survey of India, Indian Heritage Society and Indian	Not applicable

Name	Key Requirement	Applicability	Type of permit and stage of applicability	Administrative Authority	Responsibility
<p>Ancient Monuments and Archaeological Sites and Remains Act, 1958 and Ancient Monuments and Archaeological Sites and Remains (Amendment and Validation) Act, 2010. Heritage Conservation and Preservation Act, 2010</p> <p>Ancient Monuments and Archaeological Sites and Remains (Framing of Heritage Bye laws and Other Functions of Competent Authority) Rules, 2011</p> <p>National Monument Authority Rules, 2011</p>	<p>designated as “prohibited area” and beyond that up to 200 m as “regulated area” respectively.</p> <p>No “construction” is permitted in the “prohibited area” and any construction activity in the “regulated area” requires prior permission of the Archaeological Survey of India (ASI).</p>	<p>archaeological protected sites falling along the ROW.</p> <p>No archaeological sites are within the 100m of the project components</p>		<p>National Trust for Art and Culture Heritage (INTACH), Directorate of Archaeology, Assam</p>	
<p>Guidelines for evaluation of proposals/requests for ground water abstraction for drinking and domestic purposes in Notified areas and Industry/Infrastructure project proposals in non-notified areas, 2012</p>	<p>To regulate extraction of ground water for drinking and domestic purpose</p>	<p>Applicable if new borewell installed by contractors at project sites</p>	<p>No objection certificate</p>	<p>Central ground Water Authority/Board</p>	<p>Contractor (obtaining no objection certificate) and FREMAA (monitoring)</p>
<p>Other Regulations</p>					
<ul style="list-style-type: none"> • Workmen's Compensation Act 1923 • Contract Labour (Regulation and Abolition) Act, 1970 					

Name	Key Requirement	Applicability	Type of permit and stage of applicability	Administrative Authority	Responsibility
<ul style="list-style-type: none"> • Minimum Wages Act, 1948 • Payment of Wages Act, 1936 • Equal Remuneration Act, 1979 • Child Labour (Prohibition and Regulation) Act, 1986 • Inter-State Migrant Workmen's (regulation of Employment and Conditions of Services) Act, 1979 • The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 and the Cess Act of 1996 • The Factories Act, 1948 • Hazardous Wastes (Management and Handling) Rules, 1989 Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996 					

Table 4-2. International Conventions and Treaties

Law	Description	Requirement	Relevance to the project
Ramsar Convention, 1971	The Ramsar Convention is an intergovernmental treaty that provides the framework for national action and international co-operation for the conservation and wise use of wetlands and their resources. India is one of the signatories to the treaty. The Ramsar convention made it mandatory for the signatory countries to include wetland conservation in their national land use plans.	No Ramsar sites in project district. There is one Ramsar site (Deepor Beel) in Assam which is approx. 250 km from the nearest project district i.e. Sonitpur Not applicable.	No
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973	India is a signatory of this convention which aims to control international commercial trade in endangered species	Reported presence of International Union for Conservation of Nature (IUCN) Red listed species like River Dolphins and other species in the project area. Contractor to create awareness amongst workers to desist from illegal wildlife activities including poaching, hunting and fishing by workers	Yes
Montreal Protocol 1992	India is a signatory of this convention which aims to reduction in the consumption and production of ozone-depleting substances (ODS), while recognizing differences in a nation's responsibilities. Ozone depleting substances are divided in two groups Chlorofluorocarbons (CFCs) and Hydro chlorofluorocarbon carbons (HCFCs)	Not applicable in this project as no ODS are involved in construction works.	No
Basel Convention on Trans-boundary Movement of	India is a signatory of this convention which aims to reduce trans-boundary movement and creation of hazardous wastes	Contractor to follow the provisions of Hazardous Waste Rules 2016 for storage, handling, transport and	Yes

Law	Description	Requirement	Relevance to the project
Hazardous Wastes, 1989		disposal of any hazardous waste emerged during construction works	
Convention on Migratory Species of Wild Animals (CMS), 1979 (Bonn convention)	CMS, also known as Bonn convention, was adopted in 1979 and entered into force on 1 November 1983, which recognizes that states must be the protectors of migratory species that live within or pass through their national jurisdictions, and aims to conserve terrestrial, marine and avian migratory species throughout their ranges. Migratory species threatened with extinction are listed on Annexure 8 of the Convention. CMS Parties strive towards strictly protecting these species, conserving or restoring the places where they live, mitigating obstacles to migration and controlling other factors that might endanger them.	Reported presence of IUCN Red listed species like River Dolphins that migrate all along the Brahmaputra River and migratory avian species in the Central Asian Flyway in the project area. Contractor to create awareness amongst workers to desist from illegal wildlife activities including poaching, hunting and fishing by workers	Yes
Convention on Biological Diversity (Rio De Janeiro, 1992)	The UN Convention on Biological Diversity which India ratified in 2019 deals with biodiversity conservation and sustainable usage, habitat preservation, and protection of indigenous people's rights, and intellectual property.	No direct relevance to the project though seeks to avoid or minimize the loss of any flora and fauna.	Yes

Source: IEE, Goalpara, CRBIFRERMP: <https://www.adb.org/projects/documents/ind-56283-001-iee-3>

V. DESCRIPTION OF THE ENVIRONMENT

A. Introduction

124. This section presents a brief description of the existing environment around the project area, including its physical resources, ecological resources, socioeconomic development and social and cultural resources. Broad aspects of various environmental parameters such as physical, biological, and socio-cultural and economic development parameters that are likely to be affected by the proposed project have also been discussed. For completing the baseline description, emphasis was given to data collection on the physical environment, biological environment, and socio-economic environment of the study area. These data are considered to be of prime importance considering the nature and location of the proposed additional high priority project in Dhakuakhana, Lakhimpur, Biswanath and Sonitpur areas of Assam.

B. Geographical location

Dhakuakhana

125. Dhakuakhana is a sub-division of Lakhimpur district in the north-eastern state Assam, This place is bounded on the east by Brahmaputra and Dhemaji, to the west, by Subansiri river and North Lakhimpur sub-division . To the north Dhemaji and to the south, Majuli river island and Brahmaputra river. Geographical position of Dhakuakhana is between 27.60 degree to 27.35 degree north latitude and 94.24 degree to 94.42 degree east longitude

Lakhimpur

126. Lakhimpur District is situated on the North East corner of Assam and at the north bank of the River Brahmaputra. The district lies between 26.48' and 27.53' Northern latitude and 93.42' and 94.20' East longitude. The river Brahmaputra along with Majuli District stands on the southern side and Gahpur subdivision of Biswanath District is on the West. The district is divided into two subdivisions viz. North Lakhimpur and Dhakuakhana.

Biswanath

127. Biswanath a district of Assam which is created in the year 2015. The district is bounded by a state at the top (North), Lakhimpur District at the East, Sonitpur District at the West and River Brahmaputra at the south portion. The district lies between 92°16' to 93°43' East Longitude and 26°30' to 27°01' North Latitude¹⁴

Sonitpur

128. Sonitpur district is spread over an area of 2,076.70 sq. km on north bank of Brahmaputra river. In its North is a state, in South is the Morigaon, Nagaon, Jorhat and Golaghat districts, in East is the Biswanath District and in West is the Darrang District. Sonitpur District lies between 26°30'N and 27°01'N latitude and between 92°16'E and 93°43'E longitude. Located between mighty Brahmaputra River and Himalayan foothills of a state, the district is largely plain with some hills. The Brahmaputra River forms the south boundary of the district. Pachnoi, Belsiri, Gabharu, Bharali are some of the sub- tributaries of the mighty Brahmaputra.¹⁵

¹⁵ Draft district survey report, Sonitpur district

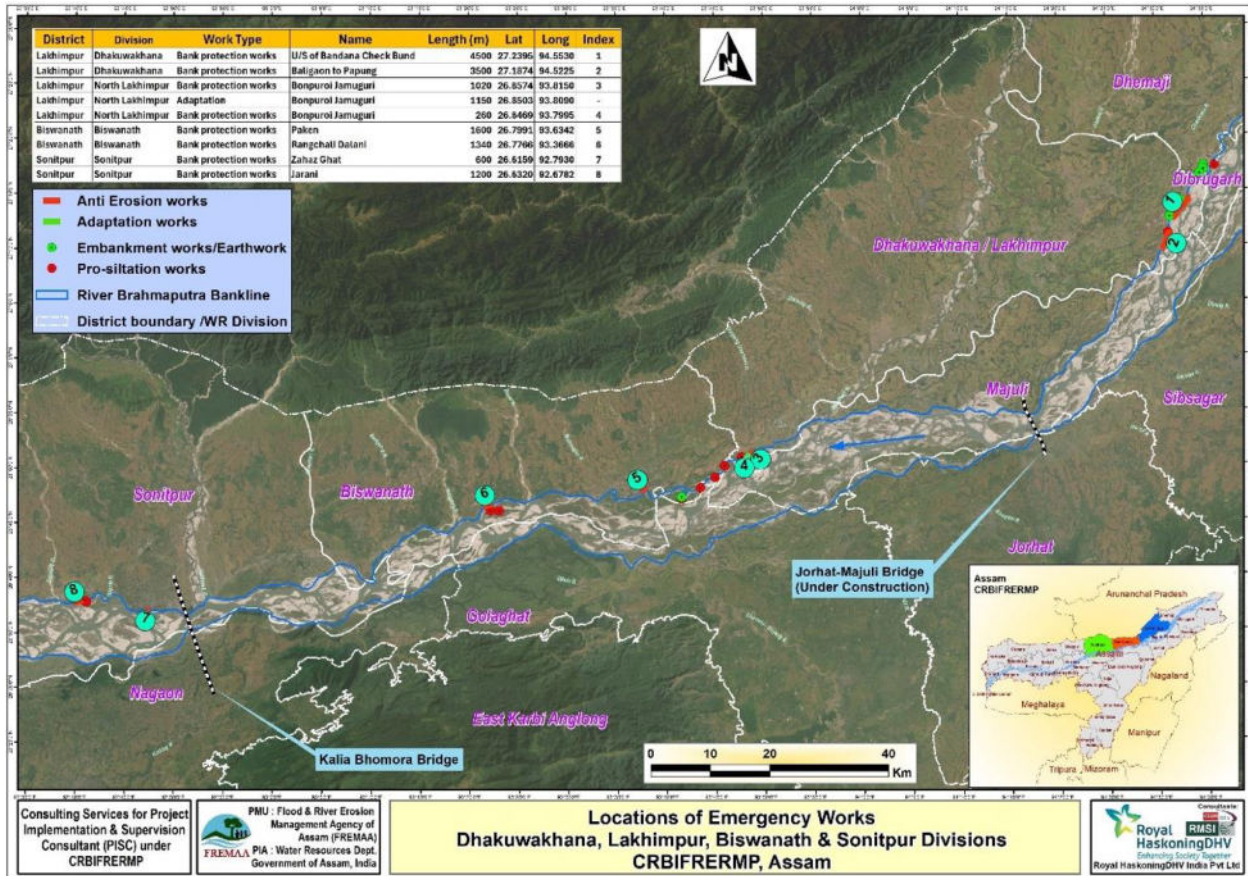


Figure 5-1. Proposed work sites under additional high priority work sites in Dhakuakhana, Lakhimpur, Biswanath and Sonitpur.

C. Project Area of Influence

129. For baseline establishment a project influence area (PAI, or study area) has been determined for the site; the subsequent sections provide an understanding of the PAI in relation to each environmental parameter and reasons for its selection.

- **Project Footprint/Direct Impact Area:** The project footprint is the area that may reasonably expected to be directly physically disturbed by activities or infrastructure during construction. This includes areas where project interventions are proposed.
- **Project Area of Influence or PAI:** The effects of physical activities or infrastructure during different phases on a particular environmental resource or sensitive receptor will have spatial and temporal dimensions. Some activities will impact resources or receptors in a larger radius than others, whilst some resources or receptors will be more sensitive to impacts. This has been considered in defining the PAI in relation to each environmental parameter. The PAI has been divided into core and buffer zones:
 - **Core Zone:** the core zone is defined as the radius extending from the project footprint area (direct impact area), which will be subject to the most impacts or the greatest magnitude of change during construction and operation period; and
 - **Buffer Zone:** the buffer zone is the remaining part of the PAI which may be subject to impacts but fewer in number or of lesser magnitude than the core zone.

Table 5-1. Project Area of Influence

Environment Parameter	Core	Buffer	Remarks
Biological	1 km	5 km (50km)	PAI of 5 km radius was considered for undertaking the biological data collection. Surveys provide an understanding of the project site, its immediate surroundings (core zone) and wider setting (buffer zone). For primary biological survey, both floral and faunal surveys were conducted through transects in the project footprint and within 1 km radius. For running an Integrated Biodiversity Tool (IBAT) report a 50km buffer was used to pick up on any wide-ranging species and nearest protected/key biodiversity areas. The IBAT report is appended in Appendix 6.
Physical	500m	5 km	PAI of 5 km radius was considered for undertaking physical environment data collection. For most parameters, 500m radius was considered as core zone for mapping of sensitive receptors during the field surveys and for undertaking baseline monitoring. The spatial extents are representative of the extents of likely adverse impacts associated with the noise assessment, as dictated by initial model runs.
Socio-economic	500m	5 km	PAI of 5 km radius is considered for socio-economic context, with a core zone of 500m radius for mapping of individual sensitive receptors and consultations during field surveys.

IBAT = Integrated Biodiversity Assessment Tool, PAI = project area of influence

Source: IEE – Dibrugarh, CRBIFRERMP

D. Physical Environmental Setting

Land Use and Agricultural Practices

Dhakuakhana and Lakhimpur

130. The land use in Lakhimpur includes agricultural land, forest land, sand bars, settlements, sparse vegetation and waterbodies (have been elaborated in following pages). Forest area is about 32,816.112 hectares. These categories reflect both natural and human-induced changes in the landscape. This diverse geomorphology makes Lakhimpur a region of significant ecological and agricultural importance.

Table 5-2. Land use pattern in Lakhimpur district

Sl. no.	Land put to different uses	Area in hectares
1	Total Geographical area	2,35,024
2	Forest area	29,379
3	Land not available for cultivation	94,361
a	Land put to non-agricultural uses	57,373
b	Barren and un-cultural land	36,988
4	Other non-cultivated land excluding fallow land	7,335
a	Permanent pastures and other grazing land	4,331
b	Land under misc., trees, groves etc. not included in net area	974
c	Cultivable waste land	2,030
5	Fallow land	3,780
a	Fallow other than current fallow	1,465
b	Current fallow	2,315
6	Net sown	1,00,169
7	Total cropped area	2,06,501
8	Area sown more than one	1,06,332

Source: Statistical Handbook, Assam - 2022

Sonitpur

131. In the district, the area of the government wasteland was very large, till the later part of the 19th century but with waves of influx of immigrants, a large chunk of the virgin soil has been upturned. At the same time, large tracts of wasteland have also been taken up for tea cultivation. However, an analysis of the land use pattern shows that the area of land not available for cultivation is still quite considerable. The following table shows the salient features of land put to different uses and cultivation in the district.

Table 5-3. Land use pattern in Sonitpur district.

Sl. No.	Land put to different uses	Area in hectares
1	Total Geographical area	5,32,298
2	Forest area	1,47,843
3	Land not available for cultivation	1,94,498
a	Land put to non-agricultural uses	1,73,145
b	Barren and un-cultural land	21,353
4	Other non-cultivated land excluding fallow land	18,983
a	Permanent pastures and other grazing land	11,902
b	Land under misc., trees, groves etc. not included in net area	6,854
c	Cultivable waste land	227
5	Fallow land	5,833
a	Fallow other than current fallow	1,907
b	Current fallow	3,926
6	Net area sown	1,65,141
7	Total cropped area	2,65,397
8	Area sown more than once	1,00,256

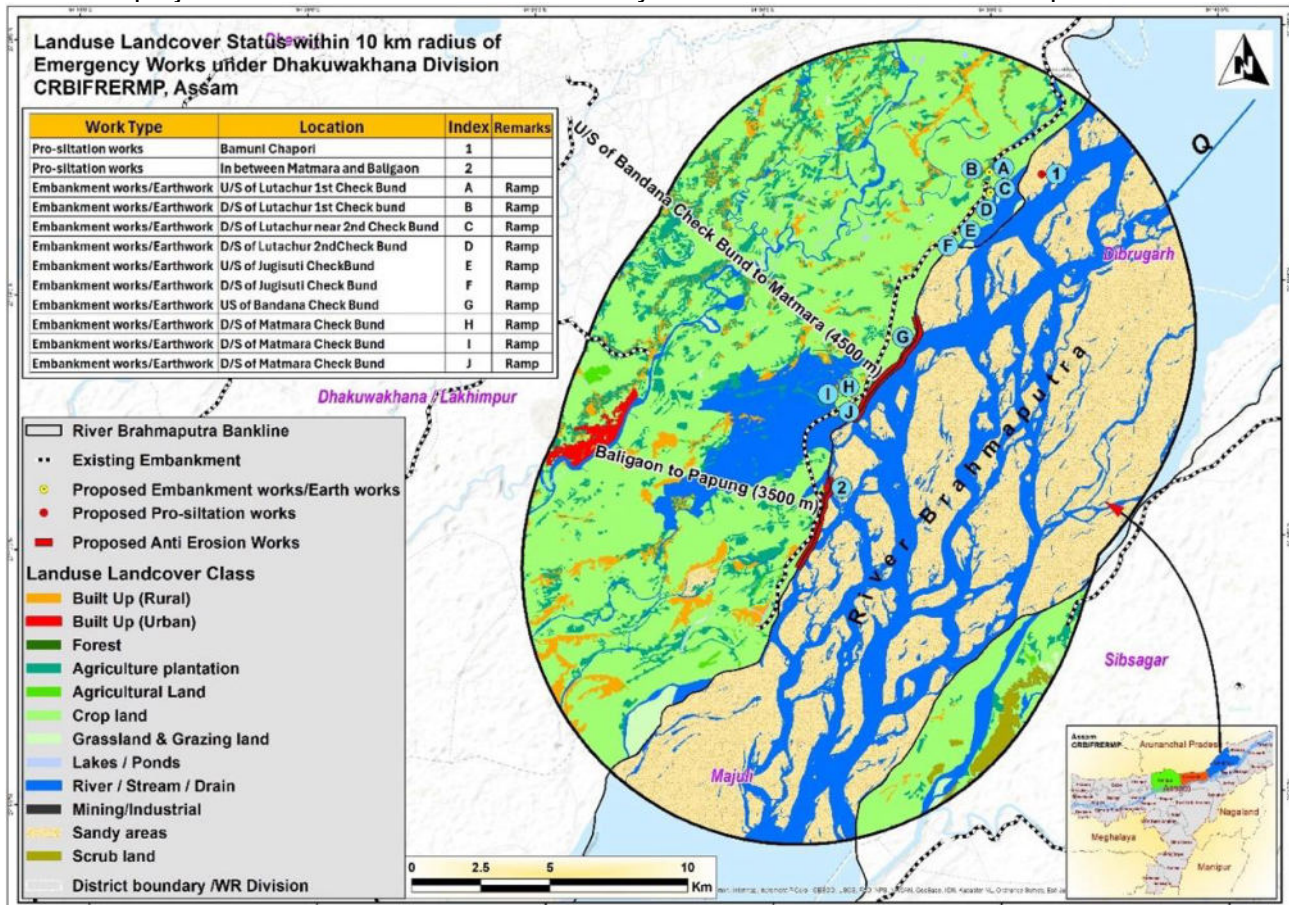
Source: District survey report, Sonitpur

Table5-4. Land use pattern in Biswanath district.

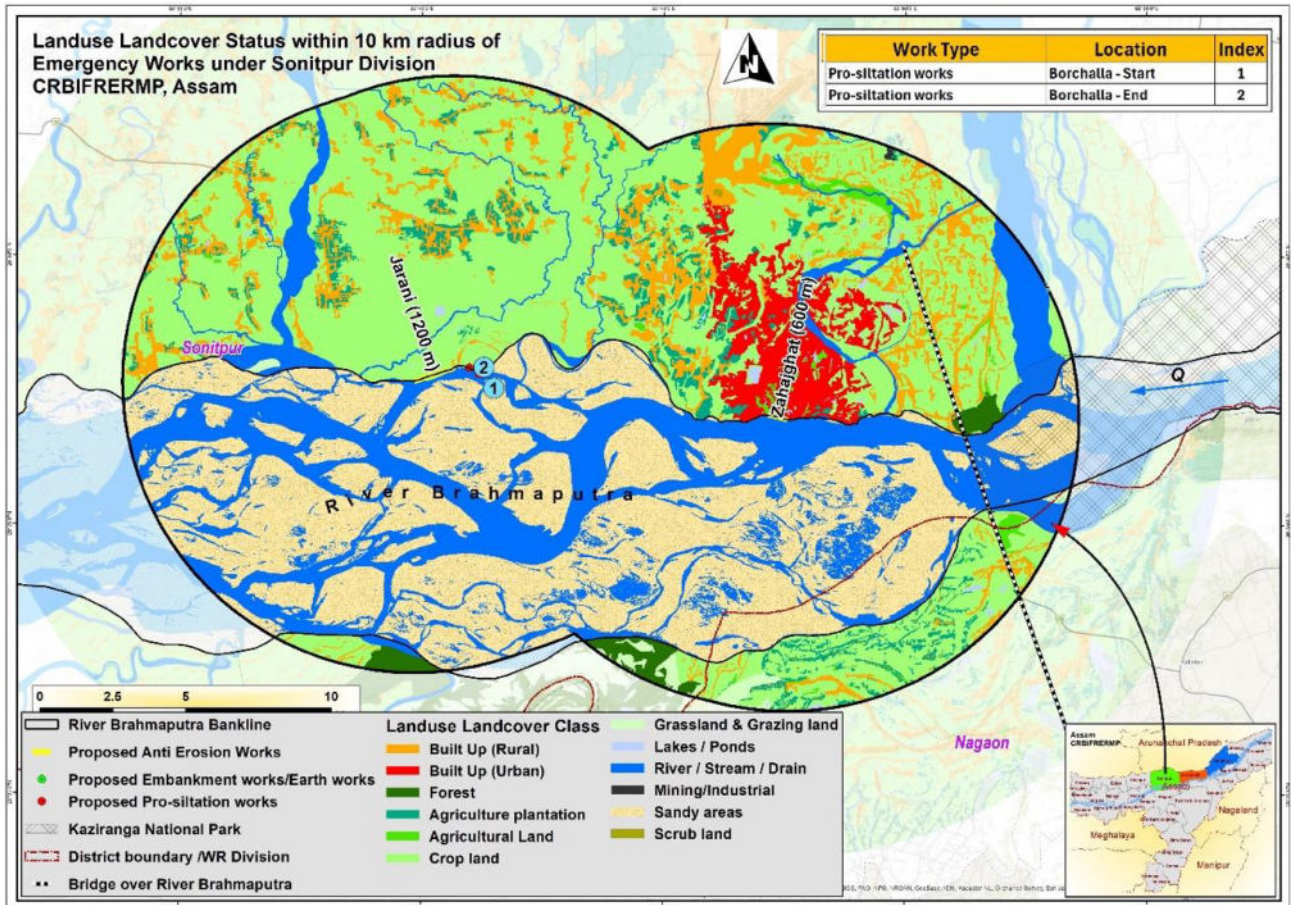
District	Geographical area	Reporting Area for land utilization statistics	Forest	Not available for cultivation		
				Area under non-agricultural uses	Barren and unculturable land	Total col (5+6)
Biswanath						
	179,500	179,500	47,428	56,088	8,104	64,192

132. M2M Consulting Consortium Pvt. Ltd. (M2M) has been appointed by FREEMA through PISC contract (under provisional sum) for data collection for environmental assessment and their scope included (a) environmental quality monitoring for air, water, noise, soil, (b) wildlife and habitat survey, (c) physical and socio-economic data including GIS mapping for land use, (d) environmental risks identification and analysis and (e) public consultations. They have done the LULC study in December 2024 by utilizing recent satellite images, the project area's present land use pattern is examined within 10 km buffer zone from project locations (Dhakuakhana, Lakhimpur, Biswanath and Sonitpur) taking the nature and potential impact of the project aspects into consideration. The Maps prepared

for project locations by M2M. are presented in



133. Figure 5-2 to



134.

Source: M2M December 2024

135. **Figure 5-5** and the area covered by different land use within 10 km buffer from project locations is presented in Table 5-5 and

136. Table 5-8.

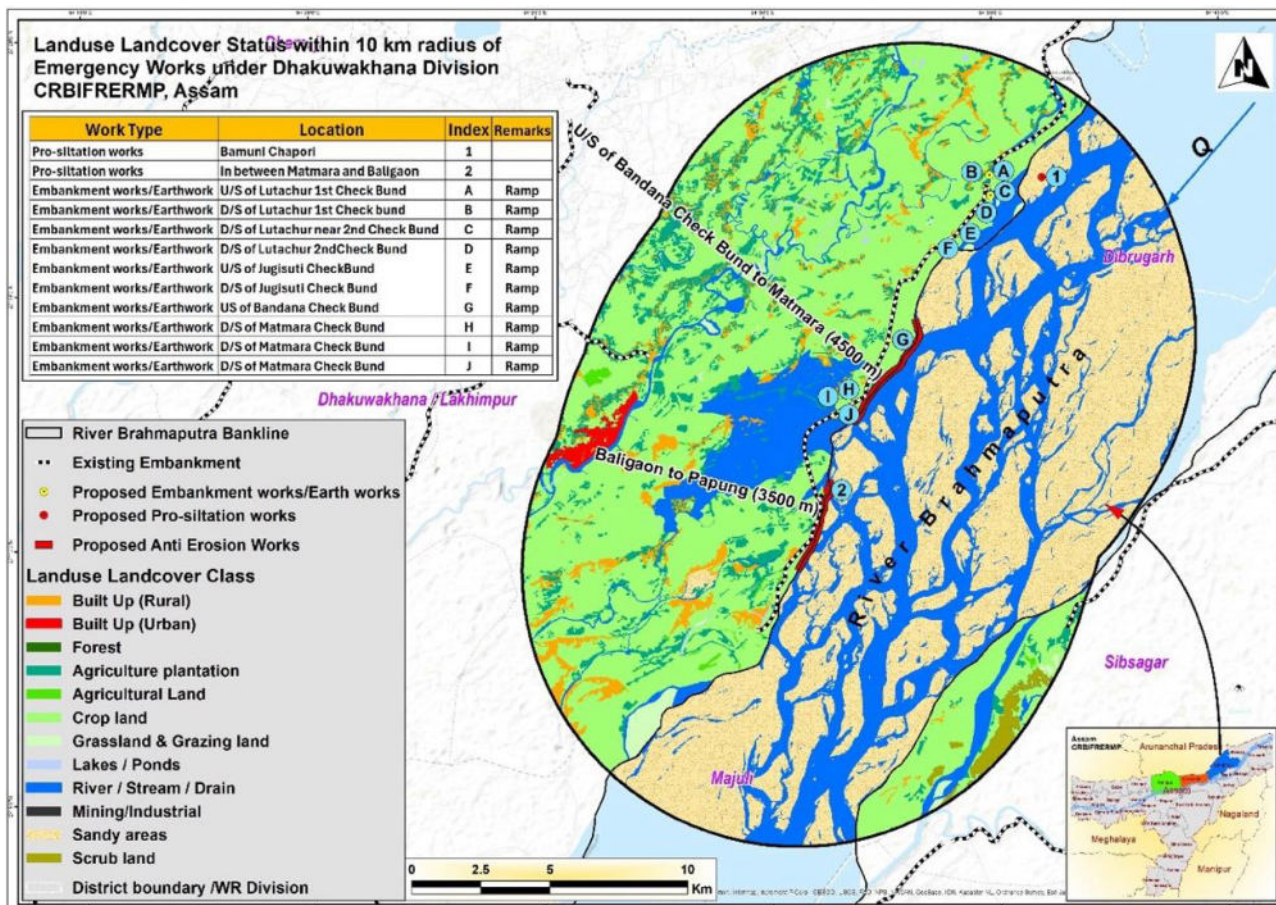


Figure 5-2. Land use map of 10 km radius of project locations in Dhakuakhana.

Table 5-5. Land use area within 10 km radius of project locations in Dhakuakhana

SI No.	Dhakuakhana	Area (ha.)	Area (%)
1	Agricultural Land	105	0.20
2	Agriculture plantation	3,322	6.38
3	Built Up (Rural)	1,789	3.44
4	Built Up (Urban)	194	0.37
5	Crop land	19,236	36.96
6	Grassland and Grazing land	407	0.78
7	Lakes/Ponds	90	0.17
8	River/Stream/Drain	10,972	21.08
9	Sandy areas	15,633	30.04
10	Scrub land	297	0.57
	Total	52,044	100

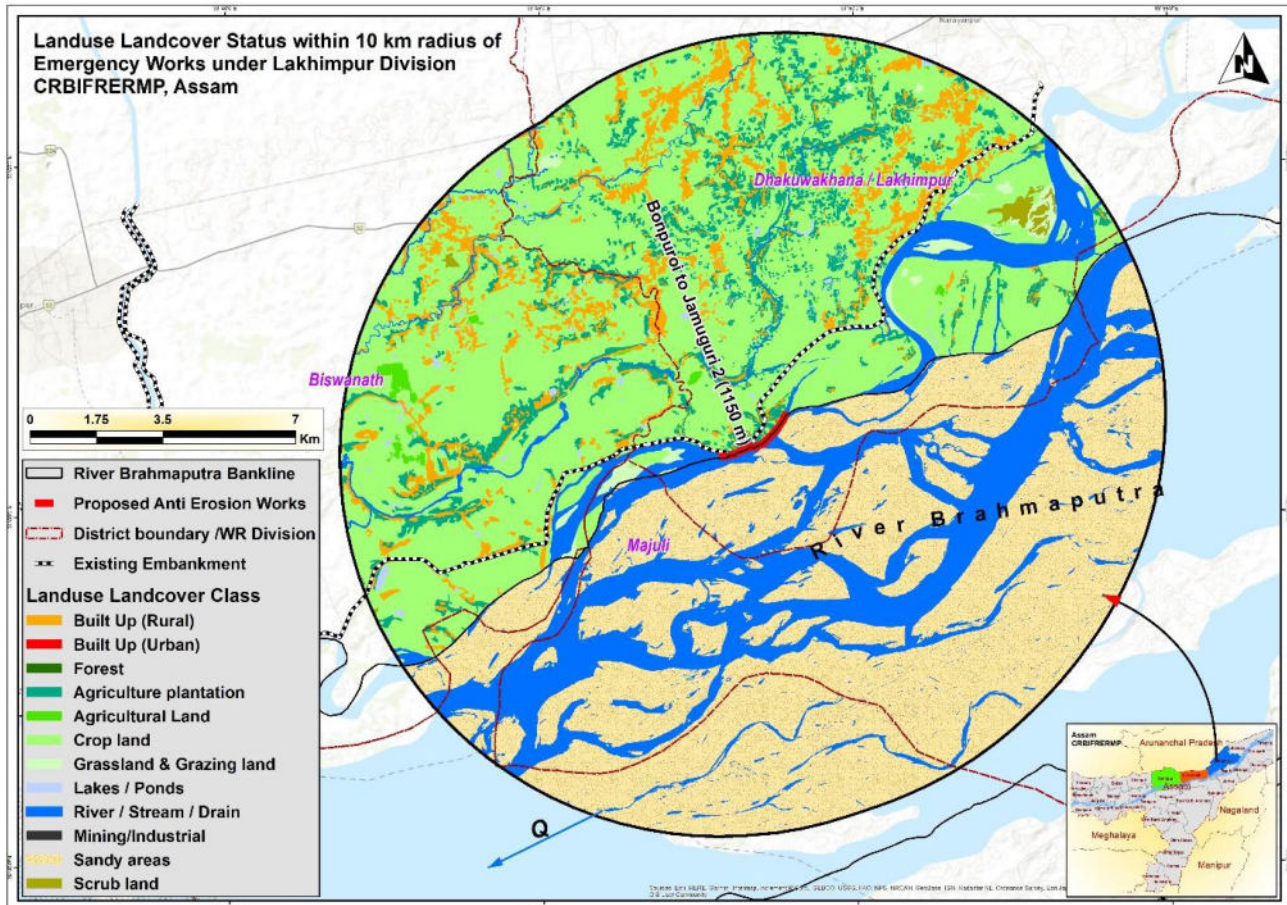


Figure 5-3. Land use map of 10 km radius of project locations in Lakhimpur.

Table 5-6. Land use area within 10 km radius of project locations in Lakhimpur

SI No.	Lakhimpur	Area (ha.)	Area (%)
1	Agricultural Land	103	0.29
2	Agriculture plantation	2,068	5.77
3	Built Up (Rural)	2,290	6.39
4	Crop land	12,829	35.79
5	Grassland and Grazing land	339	0.95
6	Lakes/Ponds	166	0.46
7	River/Stream/Drain	5,934	16.55
8	Sandy areas	12,023	33.54
9	Scrub land	92	0.26
	Total	35,845	100

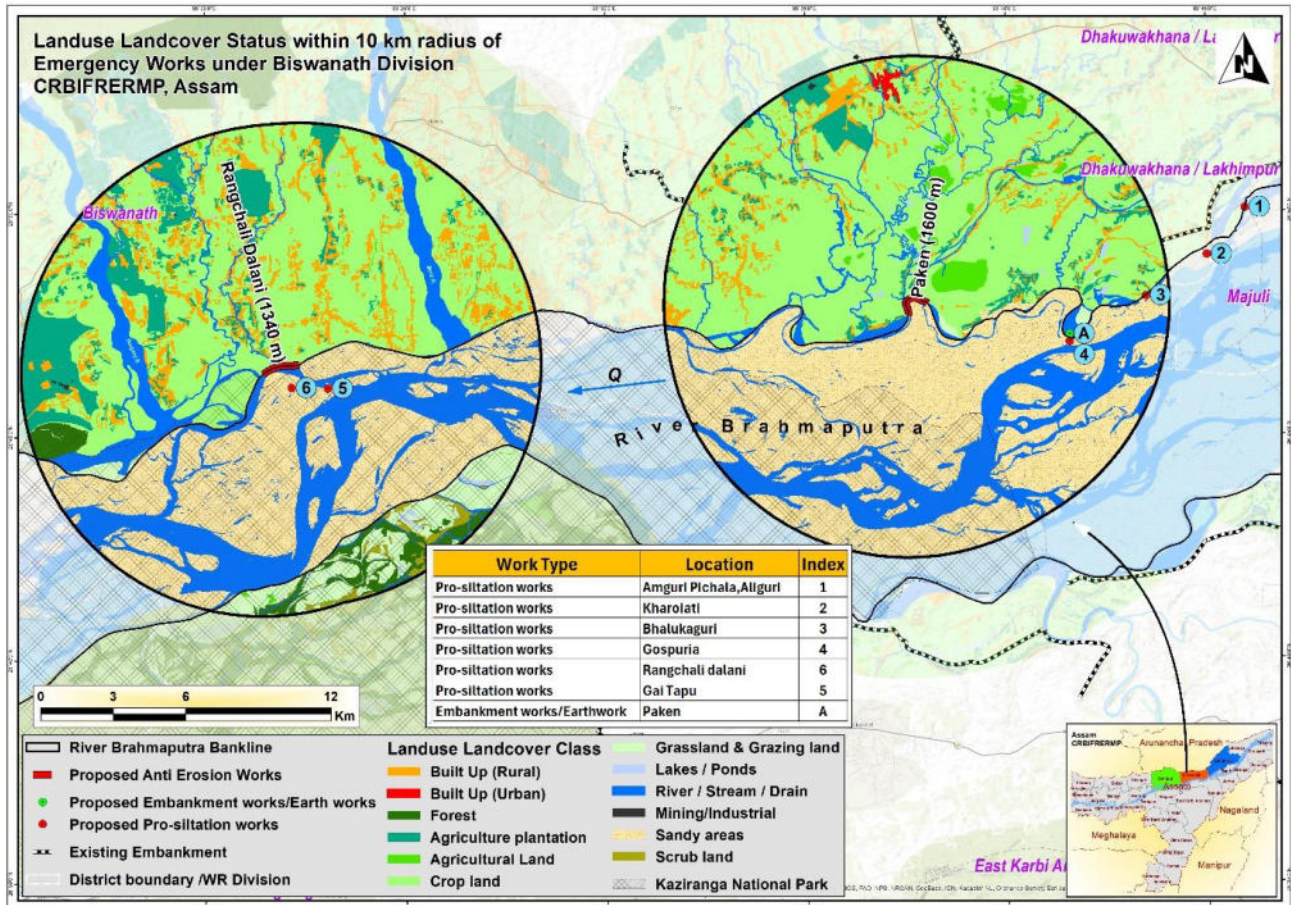
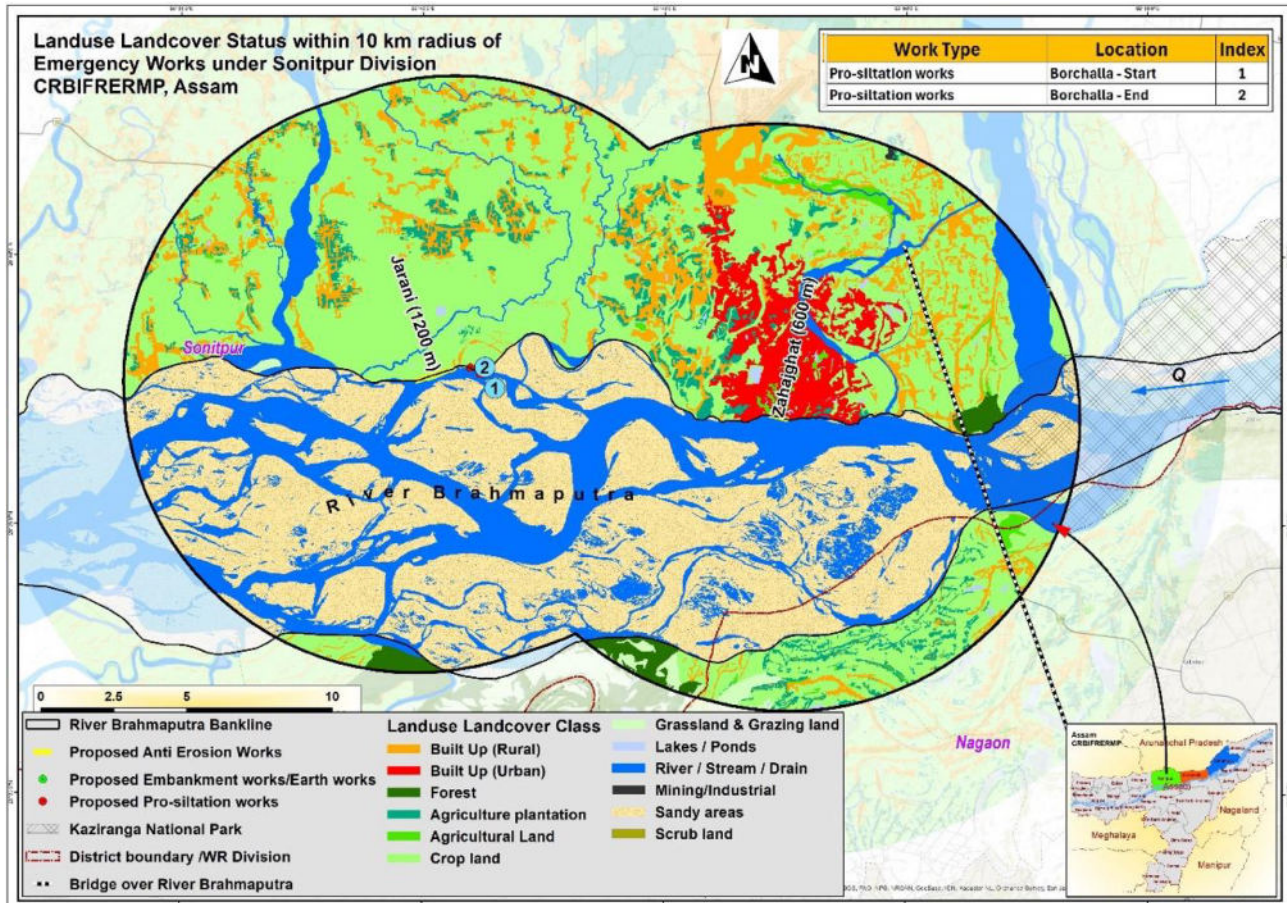


Figure 5-4. Land use map of 10 km radius of project locations in Biswanath.

Table 5-7. Land use area within 10 km radius of project locations in Biswanath.

Sl no.	Biswanath	Area (ha.)	Area (%)
1	Agricultural Land	678	0.99
2	Agriculture plantation	3,903	5.69
3	Built Up (Rural)	4,786	6.98
4	Built Up (Urban)	66	0.10
5	Crop land	25,085	36.59
6	Forest	972	1.42
7	Grassland and Grazing land	1,783	2.60
8	Lakes/Ponds	312	0.46
9	Mining/Industrial	16	0.02
10	River/Stream/Drain	10,656	15.54
11	Sandy areas	19,952	29.11
12	Scrub land	339	0.49
	Total	68,547	100



Source: M2M December 2024

Figure 5-5. Land use map of 10 km radius of project locations in Sonitpur District.

Table 5-8. Land use area within 10 km radius of project locations in Sonitpur District.

Sl no.	Sonitpur	Area (ha.)	Area (%)
1	Agricultural Land	368	0.65
2	Agriculture plantation	1,758	3.12
3	Built Up (Rural)	4,703	8.35
4	Built Up (Urban)	1,856	3.29
5	Crop land	19,354	34.35
6	Forest	540	0.96
7	Grassland and Grazing land	309	0.55
8	Lakes/Ponds	233	0.41
9	Mining/Industrial	11	0.02
10	River/Stream/Drain	11,047	19.61
11	Sandy areas	16,156	28.67
13	Scrub land	11	0.02
	Total	56,344	100

Source: M2M, December 2024

137. Dhakuakhana: Based on the analysis of LULC within 10 km buffer zone of project areas, crop land has dominance in these project areas of Dhakuakhana, Lakhimpur, Biswanath and Sonitpur. The total study area of Dhakuakhana is 52044 ha, out of which crop land cover 19236 ha (39.96 %), River sand 15633 ha (30.04%), river stream 10972 ha (21.08%), Agriculture plantation 3322 ha (6.38%) and Buildup area (rural) 1789 ha (3.44 %).

138. Lakhimpur: While as river sand dominates within 10 km of the study area in Lakhimpur, project areas. The total study area cover is 35845 ha, out of which 12829 ha (35.79%) is under crop land. This is followed by 12023 ha (33.54%) river sand, 5934 ha (16.55) Water body, 2290 (6.39%) Buildup area (rural) and 2068 ha (5.77%) agriculture land.

139. Biswanath: The analysis of LULC within the 10 km buffer zone of the project areas in Biswanath indicates that cropland is the dominant land cover. Out of the total study area of 68,547 ha, cropland accounts for 25,085 ha (36.59%), followed by river sand covering 19,952 ha (29.11%) and river streams occupying 10,656 ha (15.54%). Built-up areas in rural regions make up 4,786 ha (6.98%), and agricultural plantations cover 3,903 ha (5.68%).

140. Sonitpur: The analysis of Land Use and Land Cover (LULC) within the 10 km buffer zone of the project areas in Sonitpur reveals that cropland is the dominant land cover. Out of the total study area of 56,344 ha, cropland covers 19,354 ha (34.35%), followed by river sand at 16,156 ha (28.67%) and river streams at 11,047 ha (19.61%). Built-up areas in rural regions account for 4,703 ha (8.35%), while urban built-up areas and agricultural plantations cover 1,856 ha (3.12%) and 1,758 ha (3.12%).

Physiography, Topography, Drainage, and Soil Characteristics

Lakhimpur and Dhakuakhana

Physiography

141. The district is at the foothill of the Eastern Himalayas. The district is rich in the production of bamboos and reeds. The dense forests are found in a long stripe along the northern boundary. The Subansiri is the main river of the district with shallow beds and meandering courses. The river originates high on the mountains and enjoys the continuous flow of water. Besides 'Ranga Nadi' flows through the district rising from the Dafla Hills. Dikrong, Ganga, Charikoria, etc. are the other important rivers of the district.

142. The district consists of alluvial soil. The rivers have played a domineering role in respect of soil composition. The soil in most places is the mixture of sand and clay on a variegated proposition. The riverbeds are full of rocks and pebbles. The soils of the district, as classified by NBSS and ICAR are Udalfs Orchapts Acquepts, Fluvent Aquepts, Aquepts Aqualfs Fluvent¹⁶.

Drainage

143. The Brahmaputra River controls the main drainage system in the district. The Subansiri – Ranga Nadi –Dikrong –Boginadi System (including Bhabar and Kimin) that debouches in Brahmaputra forms an intricate drainage network in the district. The Subansiri, the largest tributary of river Brahmaputra is a Trans- Himalayan River originating from the Western part of Mount Pororu (5059 m) in the Himalaya. The tributaries are in general meandering as well as braided in nature. Peak discharge observed during monsoon and generally perennial in nature. However, near the foothills small streams generally dry up during the month of March/April. The riverbed and the bank materials are boulders, cobbles, pebbles and sands of various grades with very low clay materials concentration.

144. All the major drainage viz. Kakoi, Baginadi merges to river Subansiri in the southwestern part. Before emerging to Subansiri, these streams create waterlogged and marshy condition in the southwest part of the district. The Kawaimari Beel and the Bhimpara Beel are created by these two tributaries of Subansiri in the downstream. The drainage pattern of this area is dendritic.

¹⁶Source: District Census Handbook, Lakhimpur District

Hydrogeology

145. Lakhimpur can be divided into two hydrogeological units i.e. semi-consolidated and unconsolidated formations. The semi-consolidated formation is composed of Neogene-Siwalik Group rocks, which border the northern boundary of the district.

Biswanath

146. Physiographically the area can broadly be divided into three parts, i.e., the hilly tract, the foothill region and the extensive flood plain created by the river Brahmaputra and its tributaries. The hilly tracts comprise Siwalik sediments of lesser Himalayas. The southern limit of the sub-Himalaya is marked by Himalayan Frontal Fold (HFF). The foothill region is characterized by older terrace deposit. These terrace deposits are characterized by undulating surface comprising boulders, pebbles of quartzitic and gneissic rocks with fine sand, silt and clay act as matrix. The alluvial flood plain consists of younger and older alluvial deposits. It represents various sub-features, viz., paleochannel, swampy/marshy land, river terraces, flood plains, point bars, channel bar and river channel. The general slope of the entire district is from north to south¹⁷.

Topography

147. Biswanath district is located between Himalayan foothill and Brahmaputra River. This district is mostly plain in nature. This is a part of north bank of Brahmaputra River. The total area of the district is 1,415.185 sq. km, and the elevation of the area is 48-849m from the mean sea level.

Hydrogeology

148. The Brahmaputra River controls the main drainage system in the district. The Jai Bharali-Gabharu-Ghiladhari-Bargang-Belsiri–System that debouches in Brahmaputra forms an intricate drainage network in the district. Jai Bharali is the largest tributary of river Brahmaputra originating from the Himalaya. The tributaries are in general meandering as well as braided in nature. Peak discharge observed during monsoon and generally perennial in nature. However, near the foothills small streams generally dry up during the month of March/April. The riverbed and the bank materials are boulders, cobbles, pebbles and sands of various grades with very low clay materials concentration.

Sonitpur

149. Physiographically, Sonitpur district can broadly be divided into three parts, i.e., the hilly tract, the foothill region and the extensive flood plain created by the river Brahmaputra and its tributaries. The steep areas are made mostly of Siwalik sediments from the lower Himalayas. Himalayan Frontal Fold (HFF) marks the southern border of the sub-Himalaya. The foothills are distinguished by older terrace deposits. These terrace deposits have an undulating surface made up of boulders and pebbles of quartzitic and gneissic rocks with fine sand, silt, and clay acting as a matrix. The alluvial flood plain is made up of both young and old alluvial deposits. It represents palaeochannels, swampy/marshy soil, river terraces, flood plains, point bars, channel bars, and river channels. The general slope of the entire district is from north to south.

150. The Brahmaputra River controls the main drainage system in the district. The Jia Bharali-Gabharu-Ghiladhari-Bargang-Belsiri–System that debouches in Brahmaputra forms an intricate drainage network in the district.

Hydrogeology

151. Based on geology and hydrogeological character, the district can be classified into two separate hydrogeological units, namely semi-consolidated and unconsolidated formations. The

¹⁷ District survey report, Biswanath District

semi-consolidated formation of rocks from the Neogene Siwalik Group forms the district's northern boundary. The Siwalik rocks are not suitable for ground water development. Consolidated Archean rocks cover a very small area in the extreme southern part of the district.

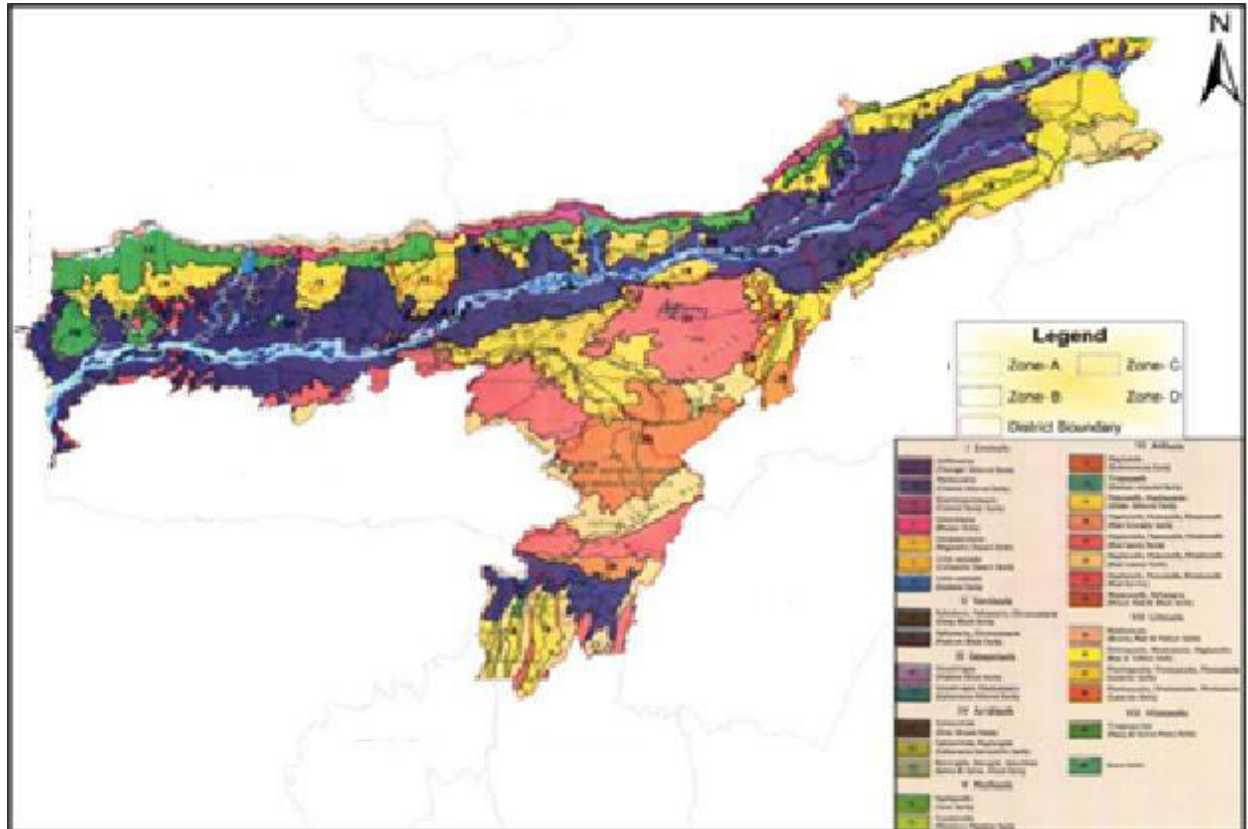
152. The major water-bearing formations are alluvial deposits in the foothills and flood plains, which comprise the unconsolidated formation. The piedmont zone stretches over 8-10 km from the foothill and is laterally followed by a younger flood plain area that continues up to the northern bank of the Brahmaputra River in the south. Sand, pebble, cobble, and boulders make up the alluvial formations in the foothills. These materials are highly permeable. However, in the flood plain, little gravel mingles with various grades of sand.

153. In Sonitpur district, the CGWB has monitored 31 ground water wells (GWW). Pre- monsoon depth to water level ranged from 2.16 to 9.21 mbgl in 2012, and post monsoon depth to water level ranged from 0.76 to 4.57 mbgl. During the pre-monsoon period, approximately 67% of GWM stations had water levels between 2 and 5 mbgl, while the remainder had water levels between 5 and 10 mbgl. During the post-monsoon period, around 43% of GWM stations had water levels above 3mbgl, while the remainder had water levels between 2-5 mbgl.

154. **Soil Type:** Different types of soil have formed in the state as a result of the state's diverse geological conditions, topographical features, climatic conditions, and vegetation types. The four major groups of soils in Assam are alluvial soils, piedmont soils, hill soils, and lateritic soils.

155. The fertile alluvial soils have a wide distribution across the Brahmaputra plain. The alluvial soils can further be divided into two main sub types-young alluvial and old alluvial soils. Modern alluvium deposits define the young alluvial soil. These soils are typically grey to molted grey in color. On the other hand, some areas of the districts of Kokrajhar, Barpeta, Nalbari, Kamrup, Darrang, Sonitpur, Lakhimpur, and Dhemaji have historic alluvial soils. The old alluvial soils often have very deep, fine- to coarse-textured loams.

156. The northern, constrained region along the piedmont zone of the Himalayan foothills is where the piedmont soils are found. The soils are very deep and fine to coarse loamy in texture. The southern hill portions of the state are often where generally the hill soils are found. These soils have a fine to coarse loamy texture and a deep, dark greyish-brown color. In the NC Hills (Dima Hasao) district and in some areas of the southern Karbi Plateau, lateritic soils are widely distributed. These soils have heavy loams and a fine, dark texture.



Source: National Atlas of India

Figure 5-6. Soil Region Map of Assam.

157. A study of the lithological of the quaternary sediments of the Brahmaputra valley extending down to more than 100 m reveals repeated sequence of clay, pebbles, and boulders.¹⁸ In the hill areas, especially to the south of the Brahmaputra River, laterites and red loams are found. The soil of the district is very suitable for production of all seasonal paddy and other Rabi and Horticultural crops. The soil of the district has been classified on the basis of chemical composition as follows: a) Strongly acidic to alkaline b) Low to medium content of total soluble salts c) Medium to high phosphate d) Low to medium inorganic carbon percentage and e) Medium to high in Potash content.

158. The soil of Lakhimpur district is alluvial soil. The rivers have played a domineering role in respect of soil composition. The soil in most places is the mixture of sand and clay on a variegated proposition. The riverbeds are full of rocks and pebbles. The soils of the district, as classified by NBSS and ICAR are Udalfs Orchapts Acquepts, Fluvent Aquepts, Aquepts Aqualfs Fluvent.

159. The Soil of Biswanath and Sonipur districts can broadly be classified into the following groups:

i. Red Loamy soils: These are found in the northern border of the district. This soil type develops in the hill slopes under high rainfall condition. This soil is characterized by low nitrogen, low phosphate and medium to high potash. PH is acidic.

ii. Lateritic Soil: The lateritic soils are the product of high leaching and found in hilly region. Soil PH is acidic due to intensive leaching of bases and formation of clay minerals and ferric hydroxides. The lateritic soils are characterized by brick red to brownish red colour and poor plant nutrient.

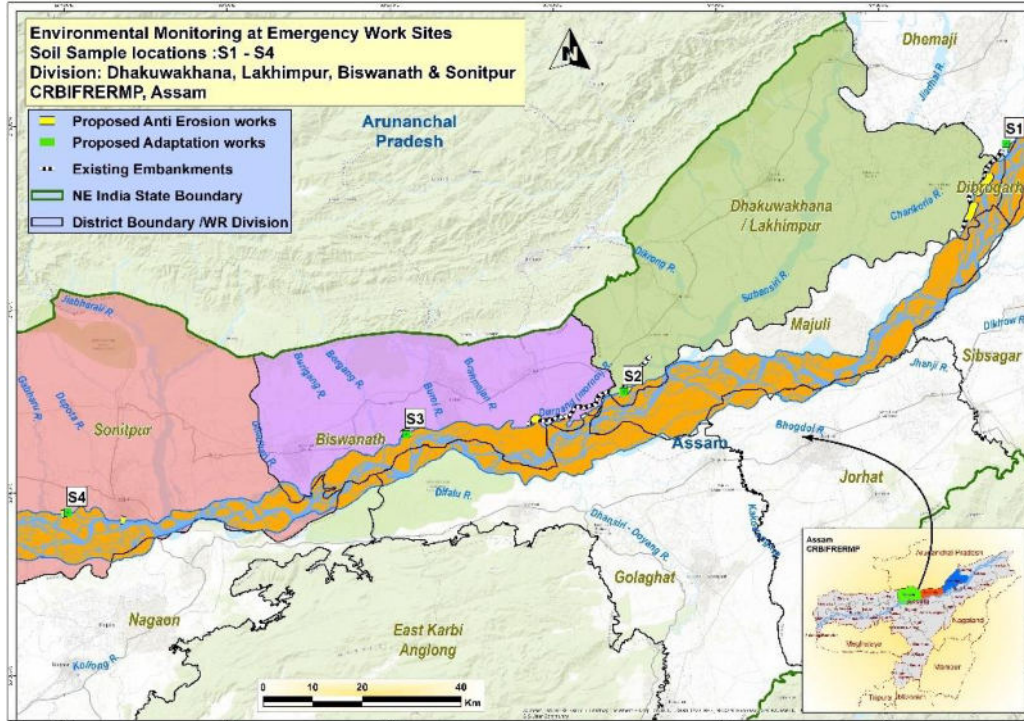
iii. New Alluvial Soils: The new alluvial soils are found in the flood plain area and are subjected to occasional floods and consequently receive considerable silt deposit after the

¹⁸ GSI. 1977. Contributions of geomorphology and geohydrology of the Brahmaputra Valley. Miscellaneous Pub. 32.

flood recedes. These are yellow to yellowish grey in colour and are admixtures of sand, silt and clay in varying proportions. Mineral weathering and geo-chemical changes are nominal. But incipient changes in the top layer have been noticed due to biological activity. Soil PH is feebly alkaline and moderately rich in plant nutrient.

iv. Older Alluvial Soil: It develops at higher levels and practically unaltered alluvium representing a broad spectrum of sand, silt and humus rich clay depending on landform. The soils are comparatively more acidic than the newer alluvial soil and hence more crop sensitive.

160. The soil quality of the project area was sampled and analyzed at one location for each high priority project areas of Dhakuakhana, Lakhimpur, Biswanath and Lakhimpur. The sampling location



is shown in

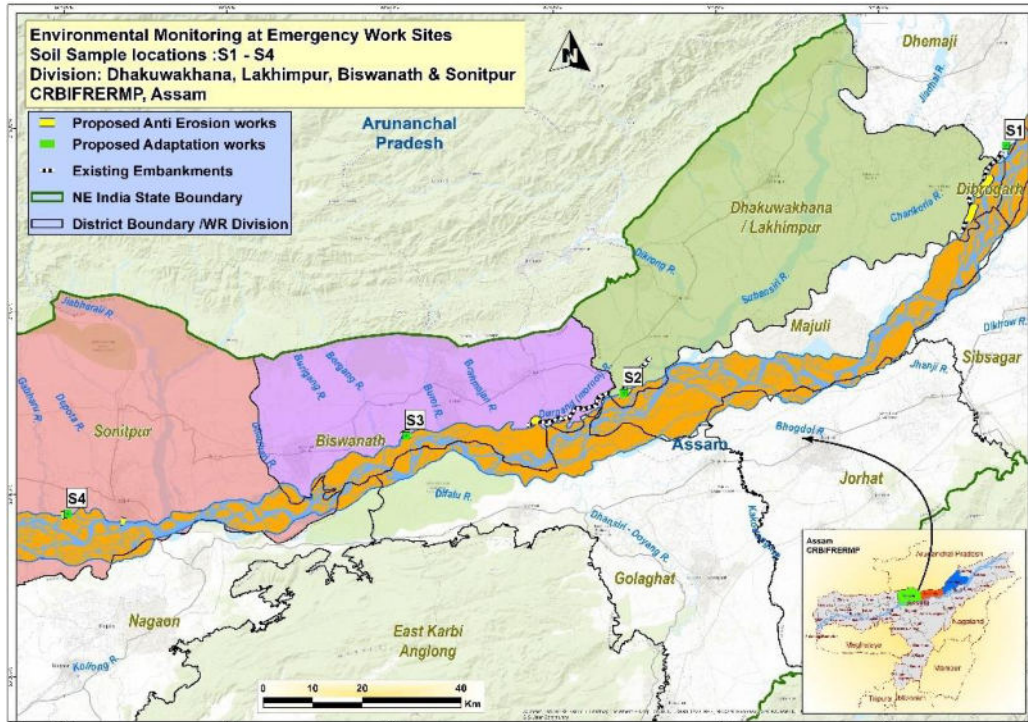
161. Source: M2M Primary Survey Report, 2024

162. Figure 5-7 and the soil quality results at selected location is given in Table 5-10.

Table 5-9. Soil Sampling Location within high priority project areas.

Name of the project areas	Date of Sampling	Location of Sampling	Coordinates	Sensitive Receptors
Sonitpur	28/11/2024	Zahaz Ghat	26 37' 50.988" N 92 40' 38.280" E	Settlement Area
Biswanath	27/11/2024	Rangchali Dalani	26 46' 24.024" N 93 21' 51.768" E	Settlement Area
Lakhimpur	26/11/2024	Bonpuroi to Jamuguri	26 50' 57.048" N 93 48' 25.992" E	Settlement Area
Dhakuakhana	25/11/2024	U/S of Bandana Check Bund to Matmara	27 17' 38.544" N 94 35' 22.200" E	Settlement Area

Source: M2M Primary Survey Report, 2024



Source: M2M Primary Survey Report, 2024

Figure 5-7. Soil Sampling Locations within high priority project areas.

Table 5-10. Soil Test Report within project areas.

SI No.	Soil Parameters	Unit	Reference Method	Indian Standards	Test results			
					Sonitpur	Biswanath	Lakhimpur	Dhakuakhana
1	pH	---	Potentiometric		7.7	7.5	8.2	7.9
2	Soil type	---	Hydrometer		Sandy Clay Loam	Sandy Clay Loam	Sandy Clay Loam	Sandy Clay Loam
	Sand	%	Hydrometer		68	70	73	70
	Clay	%	Hydrometer		19.1	18.4	16.7	18.7
	Silt	%	Hydrometer		7.5	6.9	8.2	7.4
3	Nitrogen	kg/ha	Alkaline KMnO ₄		0.08	0.05	0.09	0.07
4	Phosphorus	mg/kg	Olsen method		19.6	19	17.7	19.8
5	Potassium	mg/kg	NH ₄ -acetate extraction		8.858/24	9.5458/24	8.4658/24	8.158/24
6	Electrical conductivity	mS/cm	Conductivity meter		0.296	0.375	0.438	0.568
7	Water holding capacity	%	Standard method		48	47.8	49.5	44.5
8	Organic matter	%	Titrimetric		1	1.8	1.1	1.6
9	Salinity	mS/cm	Conductometric		2.06	2.87	2.31	1.92
10	Iron	g/100g	Flame AAS (mg/kg)		1.1	1.26	1.96	2.36
11	Copper	mg/kg	Flame AAS	135-270	7.12	7.7	6.7	5.1
12	Nickel	mg/kg	Flame AAS	75- 150	8.17	8.9	8.2	7.8
13	Manganese	g/kg	Flame AAS (mg/kg)		53.1	50.4	48.3	50.8
14	Zinc	mg/kg	Flame AAS		28.9	30.3	31.2	33.4
15	Chloride	mg/kg	Argentometric		77	75.5	78.6	80.4

Source: M2M Primary Survey Report, 2024

163. The sample have been collected from the agricultural field adjacent to the riverbank. Based on result and comparison with Indian Standards, it can be concluded that soil is deficient in micronutrient (heavy metals) and can be concluded that the soil test reports shall not have any implications on the project components. The monitoring reports and the sampling pictures are placed at Appendix 8.

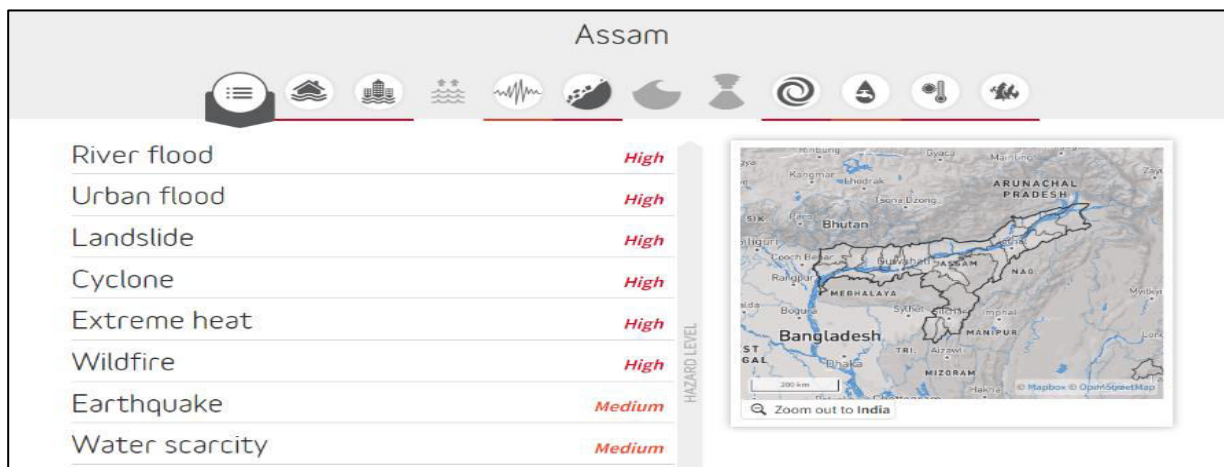
164. **Soil Erosion:** Riverbank erosion in the valley during times of major flooding is a regular annual feature. Due to the variable depth of coarse sand that has been deposited on the surface as a result of over bank flooding caused by embankment breaches, the fertile cultivable land is no longer suitable for crop production. Records from the Assam Government Revenue Dept. show that in 1994, soil erosion in the Upper Brahmaputra Valley and North Bank Plain zone affected 6,116 hectares of land.

165. Assam's highly productive and fertile soils are currently facing with the major issue of soil erosion. The most frequent sort of soil erosion in the entire state occurs when there is heavy precipitation and a humid climate. During the flood season, topsoil erosion is a serious issue in the plain. Nearly 3.2 million hectares of land in the state's plain districts are thought to be susceptible to topsoil erosion of varying intensity. Another form of soil degradation, known as terrain deformation by mass movement, is mostly confined to the Karbi Anglong and N.C. hill areas.

166. A total of around 1.53 million hectares are covered with hills. The state's rivers' bank erosion is a significant sort of soil erosion that has recently taken on alarming proportions. It has been observed that in some locations, rivers are eroding a few km of bank alongside villages, productive agricultural regions, and roadways. The world's largest river island, Majuli, is presently severely eroding and practically in danger of being lost. Depending on how severe the state's floods are, the

amount of damage caused by bank erosion fluctuates from year to year.

167. **Hazard Profile:** As per data generated from Think hazard ¹⁹ the likelihood of different natural hazards in the state of Assam is depicted in the figure below. The likelihood of natural hazards in the state of Assam is high for floods, cyclones, extreme heat and landslides.



Source: *Think Hazard!* <https://thinkhazard.org/en/>

Figure 5-8. Likelihood of Different Natural Hazards in Assam.

168. In recent past there has been an increase in the number of natural disasters. The growing incidents of natural disasters are highly correlated to the increasing vulnerability of households and communities in developing countries. Floods and earthquakes are the two major hazards which pose a serious threat to the state of Assam and project area districts of Lakhimpur, Biswanath and Sonitpur.

169. **Floods and Flooding Behavior:** Assam possesses a high risk of flooding due to a number of factors, including its location in an area with heavy rainfall and its proximity to the Himalayas, which makes it vulnerable to flash floods, landslides, and other floods in addition to river overflows. Deforestation in river catchments and subsequent soil erosion may also cause sedimentation in rivers, reducing the ability of the land to absorb rainwater and causing additional runoff and flooding. The risk of flooding in Assam is increasing due to climate change, which is one of the factors causing more extreme weather events, including as flooding and periods of excessive rainfall.

170. Assam is prone to floods due to rise in river water levels in Brahmaputra River and its tributaries. It appears that, the Assam state is vulnerable to flood during the monsoon season more than twice every year. The monsoon season, which normally lasts from June to September, is when rain falls most frequently. During this time, the state frequently experiences floods. The list of recent flood events from 1998 and the duration of floods which were mapped by National Remote Sensing Centre (NRSC), Indian Space Research Organization (ISRO), Department of Space, and Government of India using satellite data is listed in Table 5-11.

Table 5-11. Major flood events in Assam state (1998- 2022).

Sl. No	Year	Description of the flood event	Districts Affected
1	1998	Floods occurred in Assam during June	6
2	2003	Floods have affected in two spells during 16 th and 23 rd June	21

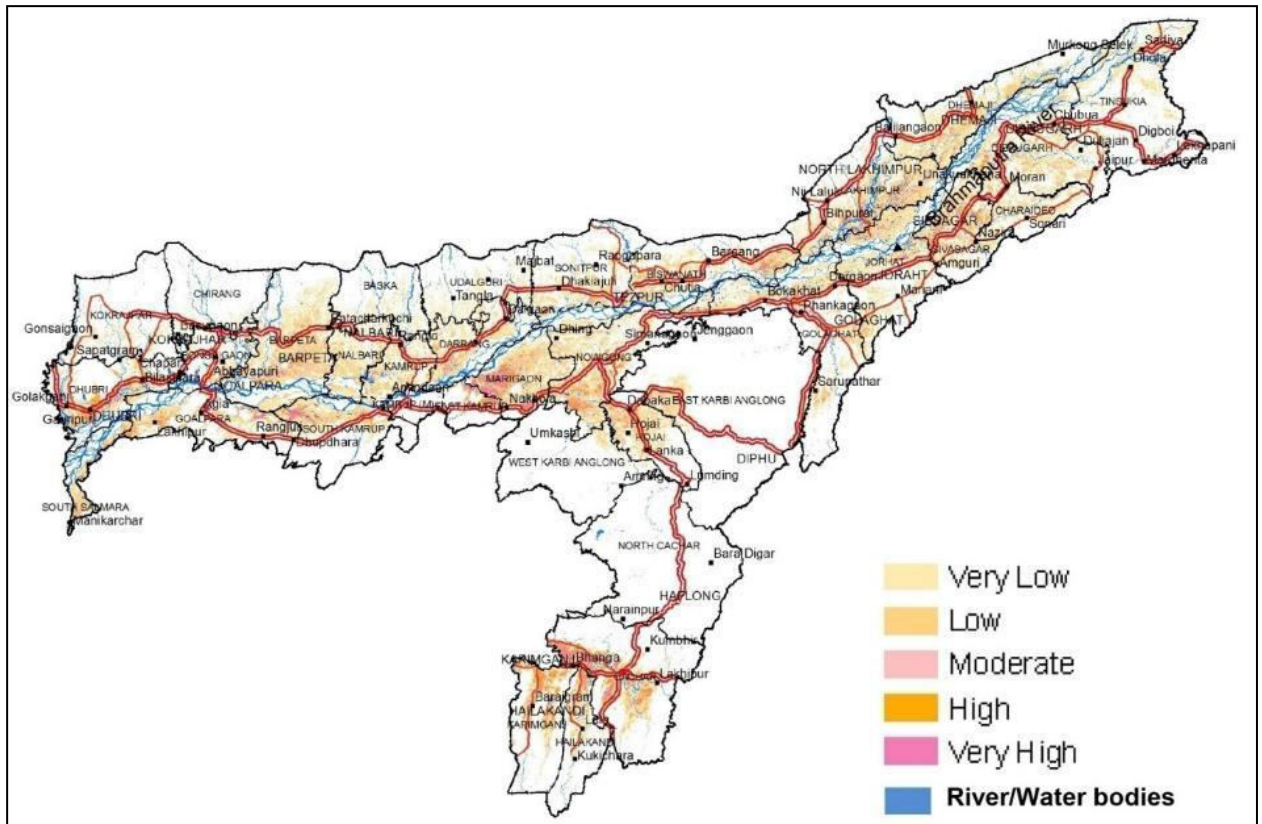
¹⁹ Think Hazard. 2020. <https://thinkhazard.org/en/report/1487-india-assam/EQ>

Sl. No	Year	Description of the flood event	Districts Affected
3	2004	Floods occurred in 4 spells during 20-21 st April 28 th Jun-6 th Jul 10 th Jul-5 th Aug, 10-13 th Oct	9
4	2005	Floods occurred in during 20-21 st April 28 th Jun- 6 th Jul 10 th Jul-5 th August, 10-13 th Oct	20
5	2006	Floods occurred in 3 spells during 2 nd -16 th Jun 26 th June 26 th - 28 th July	24
6	2007	Floods occurred in 2 spells during 21-26 th Jun 14 th Jul- 4 th Oct	21
7	2008	Floods occurred in 2 spells during 9-23 rd Jul 2 nd Aug -14 th Sep	21
8	2009	Floods occurred during 1 st Jul - 28 th Aug. In addition, Matmora embankment breach in Lakhimpur district	21
9	2010	Floods occurred during on 19 th Jun - 31 st Jul 17 th Aug - 23 rd Sep	24
10	2011	Floods occurred during on 29 th Jun - 18 th August	16
11	2012	Floods occurred during on 6 th Jun - 7 th Oct	28
12	2013	Floods occurred during 1-10 th Jul 9-14 th Aug 9-12 th Sep	27
13	2014	Floods occurred during 16 th - 29 th Aug 22 nd - 29 th Sep	27
14	2016	Floods occurred during 24-26 th April 5-29 th July	20
15	2017	Floods occurred during 3 rd Jun - 22 nd Jul	36
16	2018	Floods occurred during 8 th Jun - 13 th Sep	37
17	2019	Floods occurred during 10 th Jul - 2 nd Aug	34
18	2021	Floods occurred during 7 th Jun - 6 th Sep 2021	33
19	2022	Floods occurred during 18 th May - 26 th May and 16 th June - 17 th July 2022	35

Source: Flood Affected Area Atlas of India (1998-2022) - Satellite based Study, NRSC and ISRO in association with NDMA, GoI, March 2023 ²⁰

171. The cumulative flood impacted region map of Assam State has been generated using multi-date satellite derived spatial flood inundation maps between 1998 and 2002 by National Remote Sensing Centre (NRSC), Indian Space Research Organization (ISRO), Department of Space, Government of India, in Association with National Disaster Management Authority Ministry of Home Affairs, Government of India. Cumulative flood affected area is estimated as 24.64 lakh ha affecting 35 districts of the State.

²⁰ <https://ndem.nrsc.gov.in/documents/downloads/Flood%20Affected%20Area%20Atlas%20of%20India%20-Satellite%20based%20study.pdf>



172.

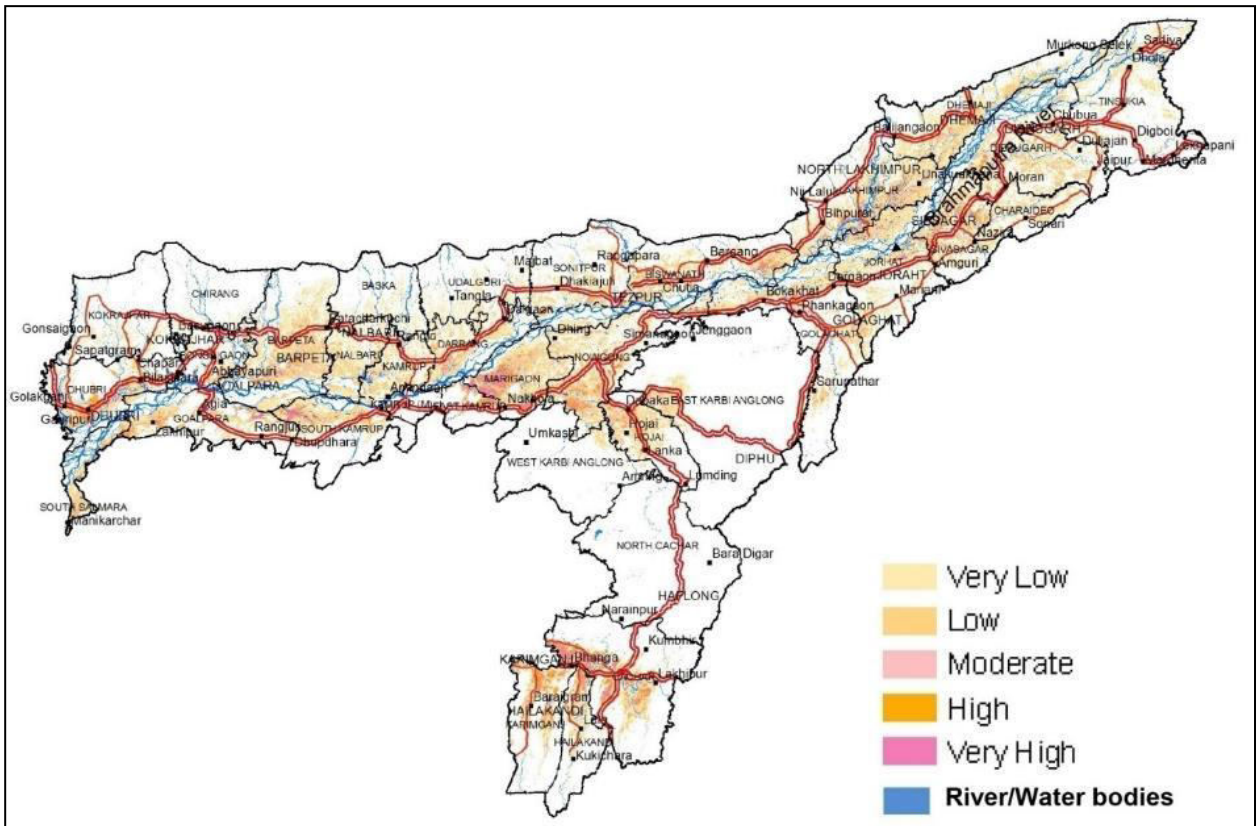
Source: Flood Hazard Zonation Atlas for Assam State (1998-2015) – A Geospatial Approach, September 2016.

173. Figure 5-9 depict a map of the flood hazard and the Table 5-12 provides the details of the flood affected areas in the 3 proposed high priority project districts.

Table 5-12. Flood Affected Areas in the proposed additional high priority works Districts.

Sl. No.	District	Flood Affected Area (Ha)
1	Lakhimpur	164,329
2	Sonitpur	97,195
3	Biswanath	88,810
Total in Project districts		350,334
Total		2,464,958

Source: Flood Hazard Zonation Atlas for Assam State (1998-2015) – A Geospatial Approach, September 2016.



Source: Flood Hazard Zonation Atlas for Assam State (1998-2015) – A Geospatial Approach, September 2016.

Figure 5-9. Flood Affected Area in Assam State.

174. **Flood hazards zones during 1998-2015:** A geospatial approach to study the flood hazard of the state of Assam was conducted by National Remote Sensing Centre, Indian Space Research Organization and Dept of Space, Govt. of India in association with Assam State Disaster Management Authority of Assam to categorize the frequently flood affected areas in the state. In this approach, 18 years (1998-2015) of satellite data from Indian and foreign satellites was used in identifying the flood hazard zones and the flood hazard is categorized into 5 classes, i.e., very high, high, moderate, low and very low based on the frequency of inundation. Further, a flood hazard ranking index, which represents the worst flood affected districts in Assam, is calculated based on the hazard severity, percentage of flood inundation area and intra-annual flood wave index. The atlas is ground verified by the Government of Assam. It is observed that out of 34 districts in Assam, 17 districts are worst flood affected and about 2.2 million hectares in Assam is affected by floods at least once during last 18 years. The flood hazard statistics of High priority project area districts, Lakhimpur, Biswanath and Sonitpur are presented in the

175. Table 5-13 to

176. Table 5-15.

Table 5-13. Flood Hazards Statistics – Lakhimpur District.

Hazard Code	Severity	Flood Hazard	Area (hectares)
1	Very Low	Very Low	77,229
2	Low	Low	37,429
3	Moderate	Moderate	20,985
4	High	High	7,269
5	Very High	Very High	1,868

Source: Flood Hazard Zonation Atlas for Assam State (1998-2015) – A Geospatial Approach, September 2016.

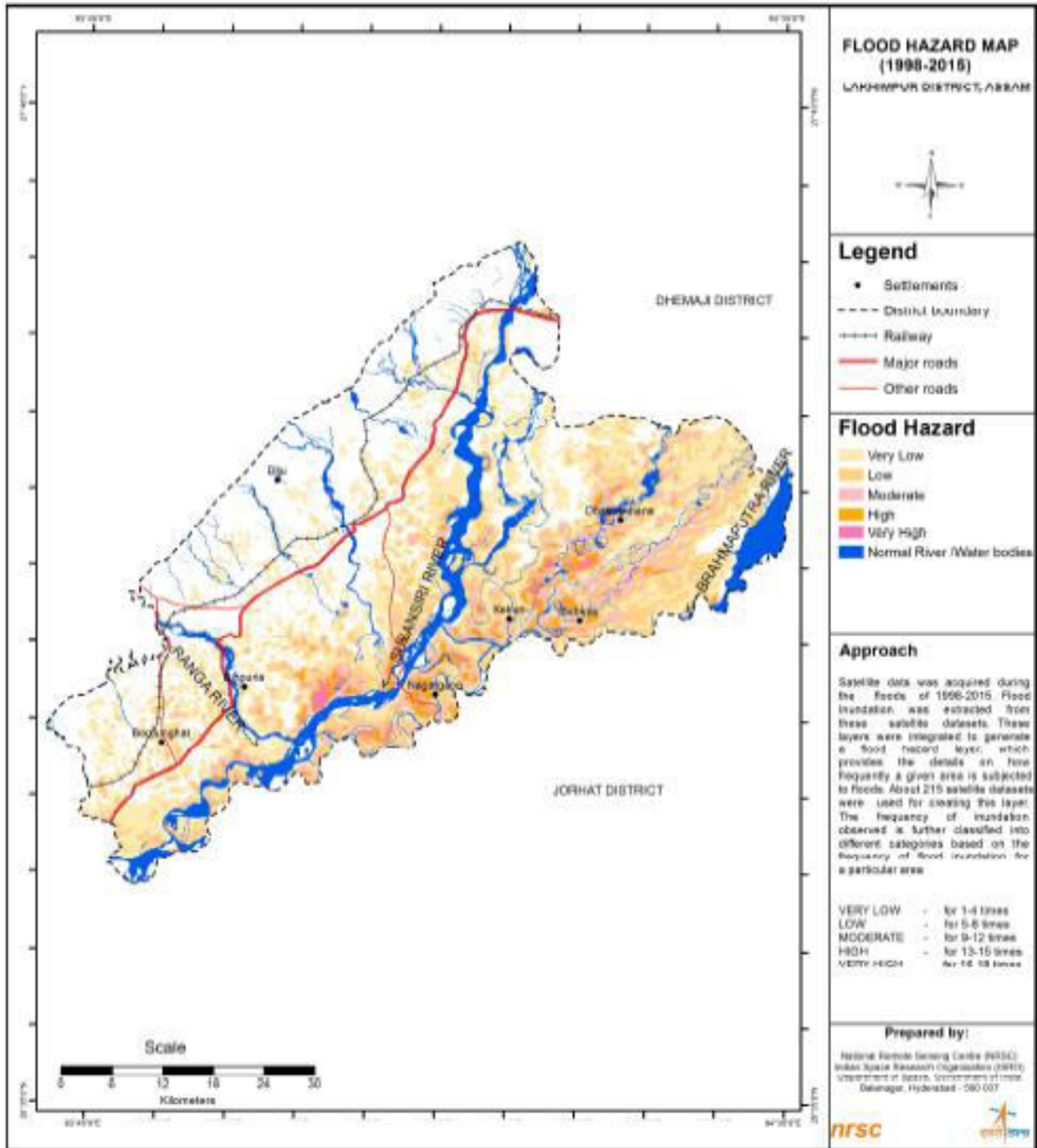


Figure 5-10. Flood Hazard Map (1998-2015) in Lakhimpur District.

Table 5-14. Flood Hazards Statistics – Sonitpur District.

Hazard Code	Severity	Flood Hazard	Area (hectares)
1		Very Low	54,897
2		Low	12,442
3		Moderate	3,046
4		High	845
5		Very High	139

Source: Flood Hazard Zonation Atlas for Assam State (1998-2015) – A Geospatial Approach, September 2016.

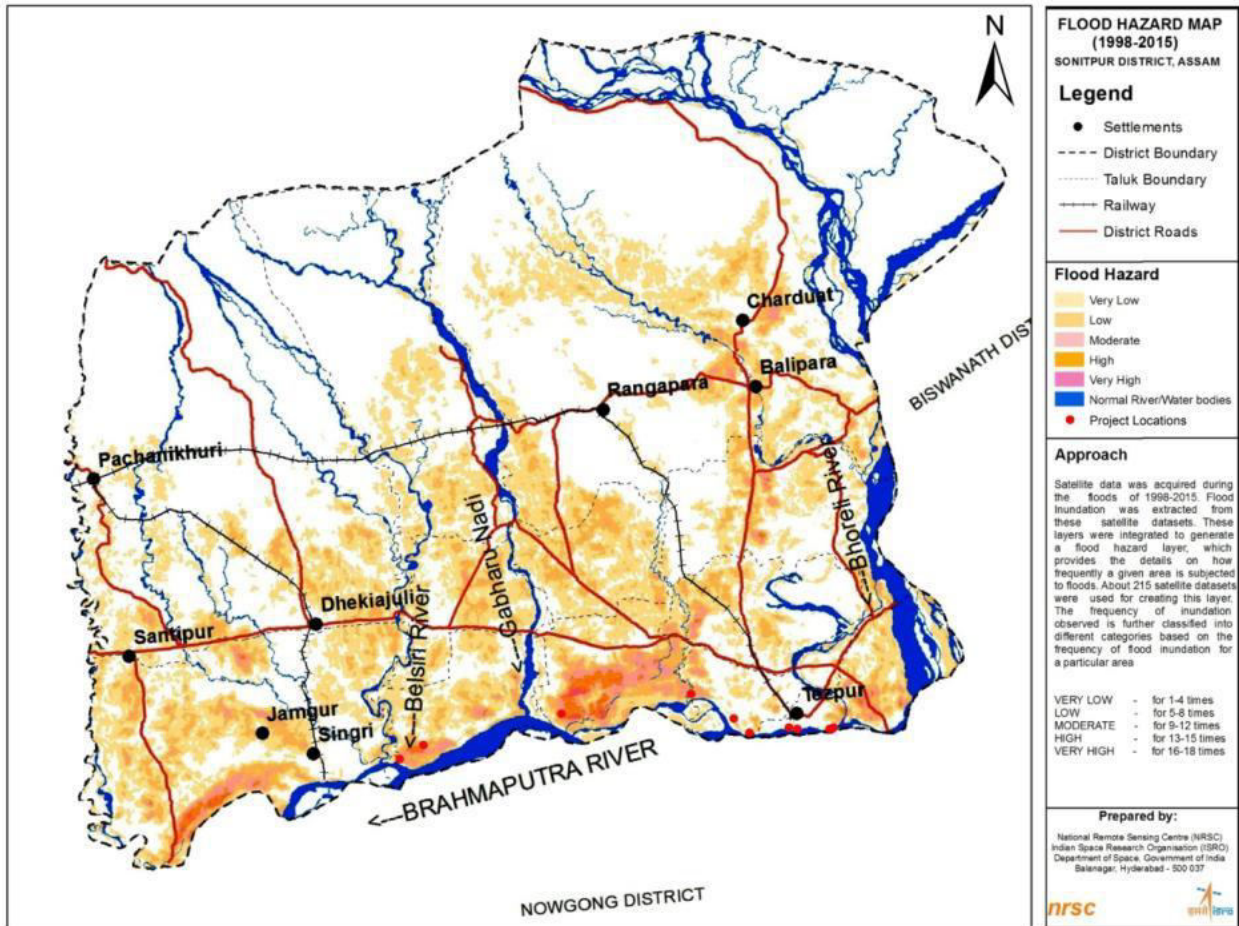


Figure 5-11. Flood Hazard Map (1998-2015) in Sonitpur District

Table 5-15. Flood Hazards Statistics – Biswanath District.

Hazard Code	Severity	Flood Hazard	Area (hectares)
1		Very Low	71,420
2		Low	29,195
3		Moderate	11,688
4		High	2,867
5		Very High	1,177

Source: Flood Hazard Zonation Atlas for Assam State (1998-2015) – A Geospatial Approach, September 2016.

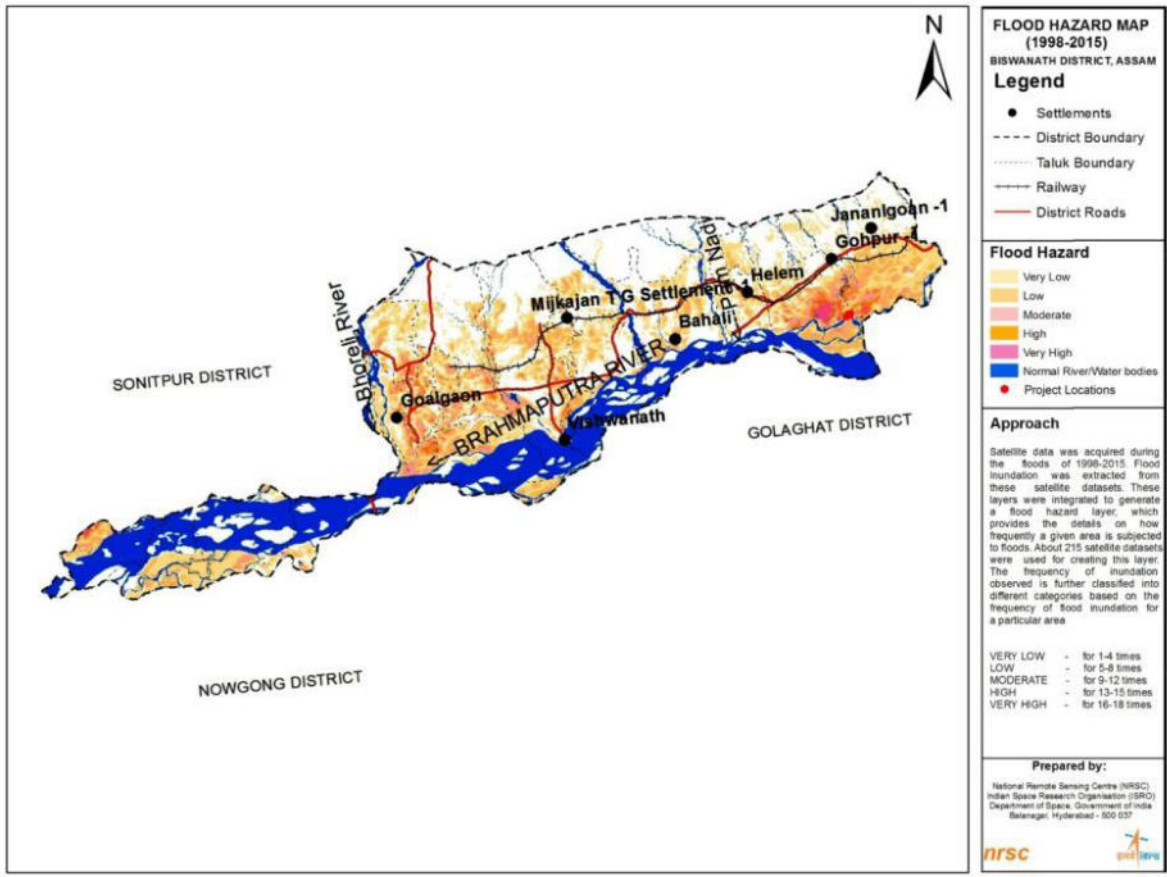
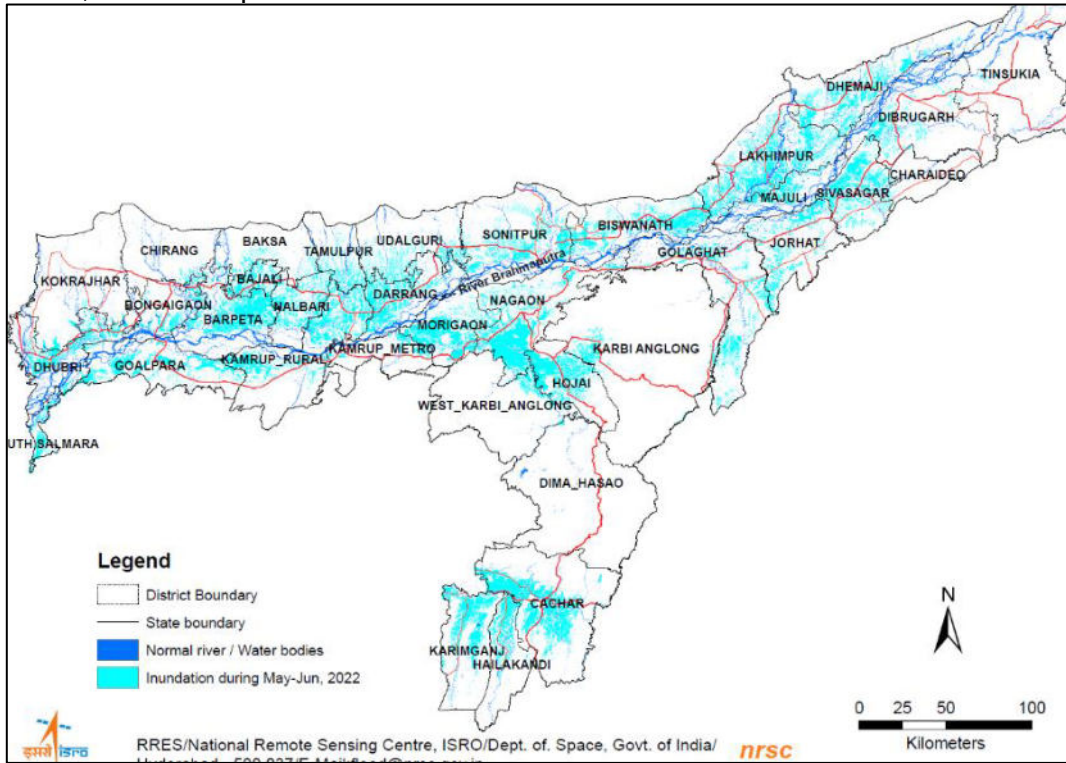


Figure 5-12. Flood Hazard Map (1998-2015) in Biswanath District.

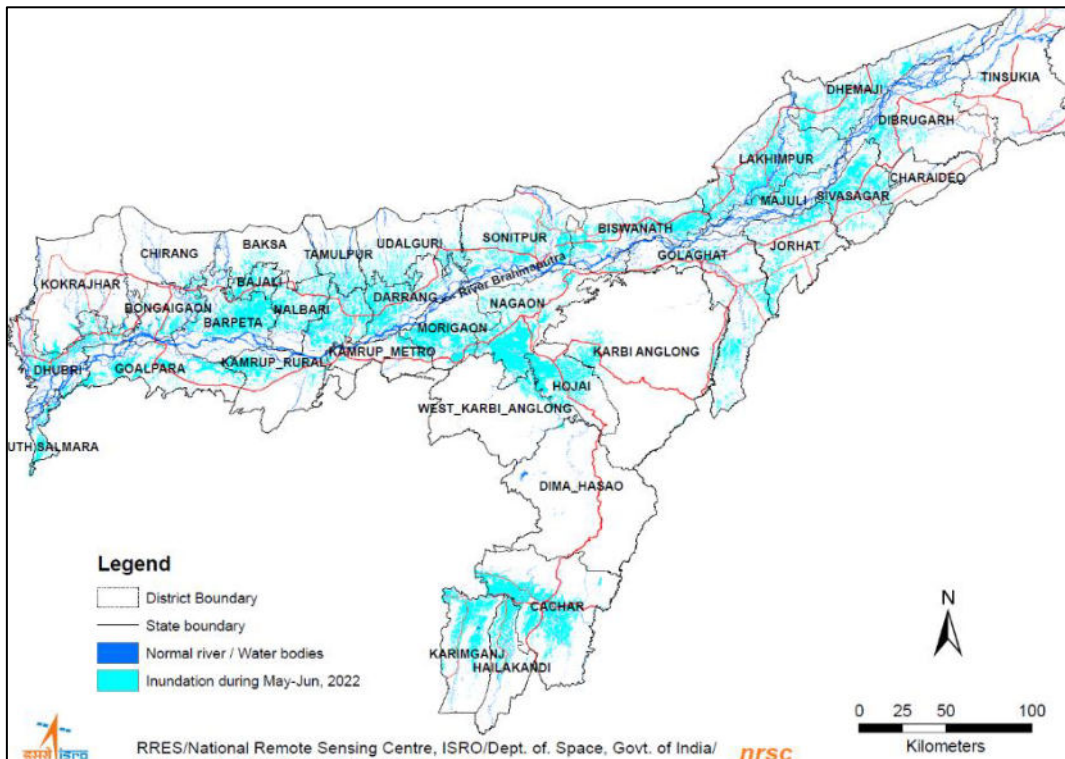
177. **Flood inundation areas of Assam 2022:** Satellite based analysis has been carried out continuously by National remote Sensing Centre (NRSC) during May-June 2022 and flood inundation occurring in larger areas were mapped and monitored across Assam state. It is observed that the total area under flood inundation is observed to be ~ 10.37 Lakh Ha. District wise area Inundated area during first wave of floods pre-monsoon in 3rd week of May 2022 and the second wave of floods started during 16-28th June 2022 which has affected 34 districts in Assam state presented in table

below, spread over 35 districts as shown



178. Source: Satellite based Analysis - Flood Mapping and Monitoring in Assam State, Disaster Management Support Group, NRSC, Indian Space Research Organization (ISRO), Dept. of Space, Govt. of India Balanagar, Hyderabad-37 Telangana State, India, August 2022

179. Figure 5-13.



Source: Satellite based Analysis - Flood Mapping and Monitoring in Assam State, Disaster Management Support Group, NRSC, Indian Space Research Organization (ISRO), Dept. of Space, Govt. of India Balanagar, Hyderabad-37 Telangana State, India, August 2022

Figure 5-13. Flood Inundated areas in Assam State during May-June 2022.

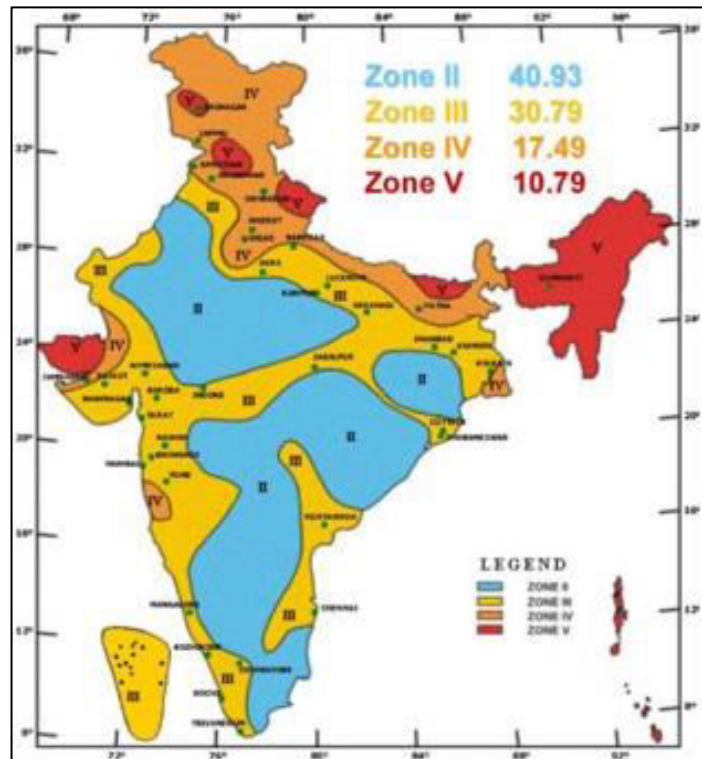
Table 5-16. Area of Project Districts Affected During the Flood Inundation in May-June 2022.

SI. No.	District	Area Inundated (ha)
1.	Lakhimpur	77,099
2.	Biswanath	46,478
3.	Sonitpur	40,386
Total in Assam		10,37,985

Source: Satellite based Analysis - Flood Mapping and Monitoring in Assam State, Disaster Management Support Group, National remote Sensing Centre (NRSC), Indian Space Research Organization (ISRO), Dept. of Space, Govt. of India Balanagar, Hyderabad-37 Telangana State, India, August 2022

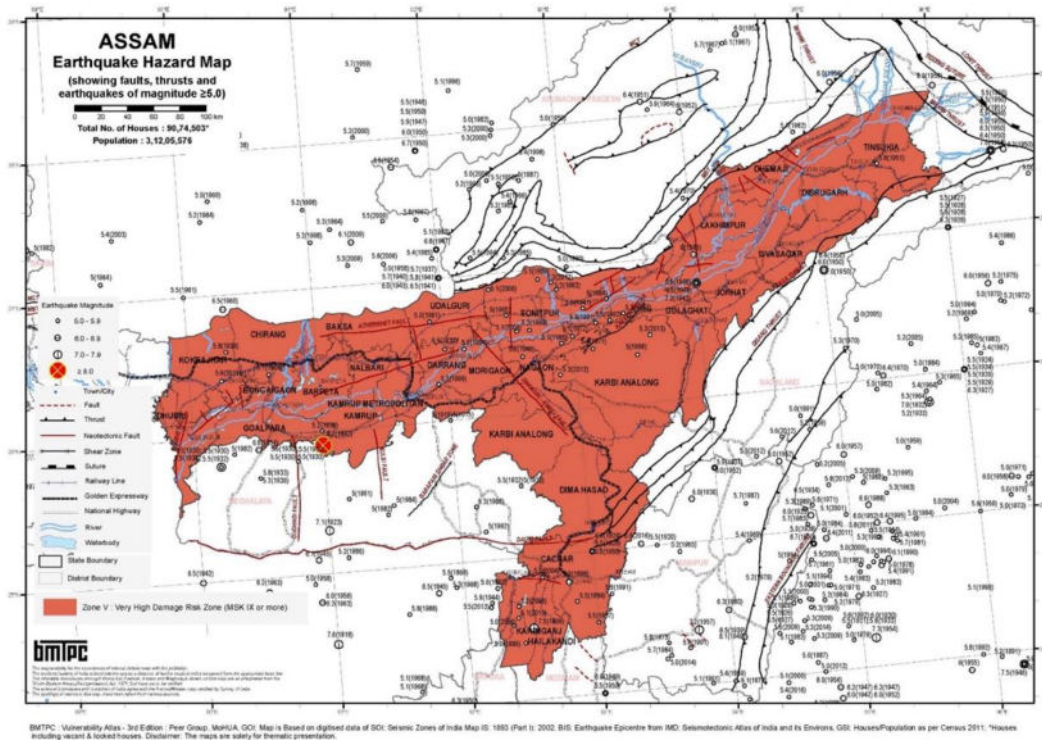
180. **Seismic Hazard:** High seismic activity is a feature of northeast India and the areas surrounding it. The eastern Himalayas, the Indo-Myanmar arc, the Mishmi Massif, the Shillong Plateau and surrounding areas, the Tripura folded belt, the Assam intermountain depression, and the northern part of the Bengal basin are all included in this region, which spans the northern portion of the Assam-Arakan geological province.

181. According to Figure 5-14 seismic hazard zonation map of India, the entire northeast of the country is located in zone V, the most vulnerable area in the nation. Recent research has shown that adjacent locations are affected differently by earthquake shaking. The conditions at the site are closely related to the shaking's intensity.



Source: National Institute of Disaster Management (NIDM). https://nidm.gov.in/safety_earthquake.asp

Figure 5-14. Seismic Zonation Map of India – 2002.



Source: <https://www.bmtpc.org/DataFiles/CMS/file/VAI2019/eq-assam.html>

Figure 5-15. Earthquake Hazard Map of Assam.

182. According to Global Seismic Hazard Assessment Program (GSHAP) data, the state of Assam falls in a region of moderate to high seismic hazard. As per the 2002 Bureau of Indian Standards (BIS) map, Assam also falls in Zones II, III and 5 (Zone I is low Risk and Zone V is high Risk). Historically, parts of this state have experienced seismic activity in the M6, which means strong as per US Geological Survey.

183. As per the data from Think hazard, the earthquake hazard in Assam and project areas districts, Lakhimpur, Biswanath and Sonitpur are classified as medium according to the information that is currently available. This means that there is a 10% chance of potentially damaging earthquake in Assam in the next 50 years.

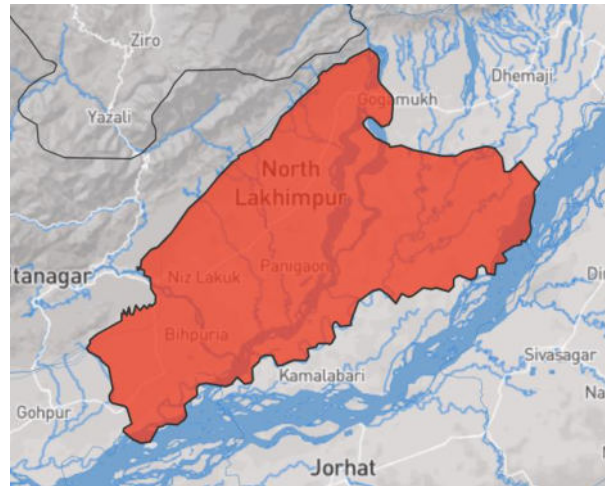
184. Even though the majority of northeast India is susceptible to earthquakes, their magnitudes typically range from 5 to 8 or higher. Low-magnitude earthquakes with a Richter scale value of less than 5 are widely distributed in the area. However, the majority of earthquakes with a magnitude of greater than 5 have been recorded in the lower Brahmaputra Valley. Earthquakes measuring between 5 and 6 on the Richter scale have primarily been felt in Assam's northern, western, southern, and eastern rims. The Brahmaputra Valley saw the majority of the earthquakes, which typically had Richter scale magnitudes between 6 and 7, on a regular basis. The areas with the highest densities of powerful earthquakes, with magnitudes ranging from 7 to 8, have been found to be central and lower Brahmaputra Valley.

Table 5-17. Major Earthquakes in Assam.

Place	Year	Magnitude
Cachar,	Assam January 10, 1869,	Mw > 7.0
Shillong plateau	June 12, 1897,	Mw 8.1 - 8.7
Sibsagar	August 31, 1906,	Ms 7.0

Place	Year	Magnitude
SW Assam	September 9, 1923,	Ms 7.1
Dhubri	July 2, 1930,	Ms 7.1
Assam	January 27, 1931,	Ms 7.6
N-E Assam	October 23, 1943,	Ms 7.2
Upper Assam	July 29, 1949,	Ms 7.6
Upper Assam	August 15, 1950,	Mw 8.6-8.7

Source: Seismic Microzonation Atlas of Guwahati Region, Department of Science and Technology Government of India, 2007 https://asdma.assam.gov.in/sites/default/files/Seismic_Microzonation.pdf



Source: *ThinkHazard!* <https://thinkhazard.org/en/>

Figure 5-16. Seismic Hazard in Lakhimpur.



Source: *ThinkHazard!* <https://thinkhazard.org/en/>

Figure 5-17. Seismic Hazard in Sonitpur and Biswanath.

Climate

185. The average air temperature across India has increased by 0.7oC between 1901—2018. The largest increase in normalized temperatures is found over the southern tip of India. Historic

temperature trends in Assam are aligned with the national trends. Between 1990 and 2019, the average maximum and minimum temperature in Assam was 28.56°C and 18.39°C, respectively. The maximum and minimum temperatures in Assam have risen by an average of 0.049°C and 0.013°C, respectively. Overall, the temperatures in Assam have been increasing over this time period. Climate Risk and Adaptation Assessment (CRA²¹) study conducted to assess the impact of climate change on proposed project and mitigation measures suggested for consideration into project design and planning for the proposed river bank protection works under CRBIFRERP.

186. The weather in Lakhimpur is characterized by a mild and moderate climate. Summers experience significantly more rainfall compared to winters, reflecting a clear seasonal variation. According to the Köppen-Geiger climate classification, Lakhimpur falls under the 'Cwa' category, indicating a subtropical monsoon climate with dry winters and hot summers. The average annual temperature is 22.7 °C | 72.8 in Lakhimpur. The precipitation level on a yearly basis amounts to 2965 mm | 116.7 inch as per the meteorological records. The given location is in the northern hemisphere. Summer begins here at the end of June and ends in September. The months of summer are June, July, August, September. The most popular time to visit is April, October.

Table 5-18. Summary of Long-Term Meteorological Data (1991 – 2021).

Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Avg. Temperature °C (°F)	15.9	18.1	20.8	22.7	25	26.8	27.2	27.4	26.7	24.2	20.3	17
	(60.7)	(64.5)	(69.4)	(72.9)	(77)	(80.2)	(80.9)	(81.3)	(80)	(75.6)	(68.5)	(62.6)
Min. Temperature (°F)	10.7	13	15.9	19.1	21.9	24.4	25	25	24	20.5	15.5	11.9
	(51.2)	(55.4)	(60.7)	(66.3)	(71.4)	(76)	(77.1)	(77)	(75.3)	(68.9)	(59.9)	(53.4)
Max. Temperature (°F)	21.6	23.2	25.5	26.5	28.4	29.7	29.9	30.3	29.8	28.4	25.6	22.8
	(70.9)	(73.8)	(78)	(79.7)	(83.2)	(85.5)	(85.8)	(86.6)	(85.7)	(83.1)	(78.1)	(73)
Precipitation/Rainfall mm (in)	59	110	194	319	404	500	481	403	311	123	32	29
	-2	-4	-7	-12	-15	-19	-18	-15	-12	-4	-1	-1
Humidity(%)	73%	70%	69%	79%	82%	85%	87%	86%	85%	81%	76%	75%
Rainy days (d)	7	11	15	16	18	20	21	21	18	11	5	4

Source: <https://en.climate-data.org/asia/india/assam/lakhimpur-24712/>

187. The climate in Sonitpur district is subtropical, with warm and humid summers followed by dry and cold winters. In June and July, temperature reaches up to 37.5 °C, while the minimum temperature drops to 7.6°C in December and January. The mean maximum and minimum temperature varies from 28°C to 35 °C and 19°C to 20°C respectively. The district experiences SW monsoon rainfall beginning in June and lasting until September/October. The district's highest rainfall areas are near the foothills of the Arunachal Himalayas, in the district's northern part. The average annual rainfall remains between 1,365 and 2,350 mm, with 122 to 134 rainy days per year. The yearly average relative humidity ranges from 69.8 to 94%. The South-West monsoon period receives almost 65-70% of annual rainfall, whereas the pre-monsoon period receives 20-25%.

188. The Biswanath district has sub-tropical tropical/ Equatorial climate as Assam lies in the regime of monsoon climate of the sub-tropical belt. Biswanath district is a subtropical with a monsoon season. Summers are hot and humid, with an average temperature of 29°C. The highest temperature is recorded just prior to the onset of Monsoon (around May-early June). The maximum temperature goes up to 37.5°C during June/July and minimum temperature falls to 7.6°C in December and January. The district receives high amounts of rainfall during the rainy season, which can lead to flash floods and erosion. The climate of the district is subtropical and humid characterized by high rainfall. The annual rainfall is 2,173 mm and relative humidity 65 to 85 percent. The district receives

²¹ <https://www.adb.org/sites/default/files/linked-documents/56283-001-craa.pdf>

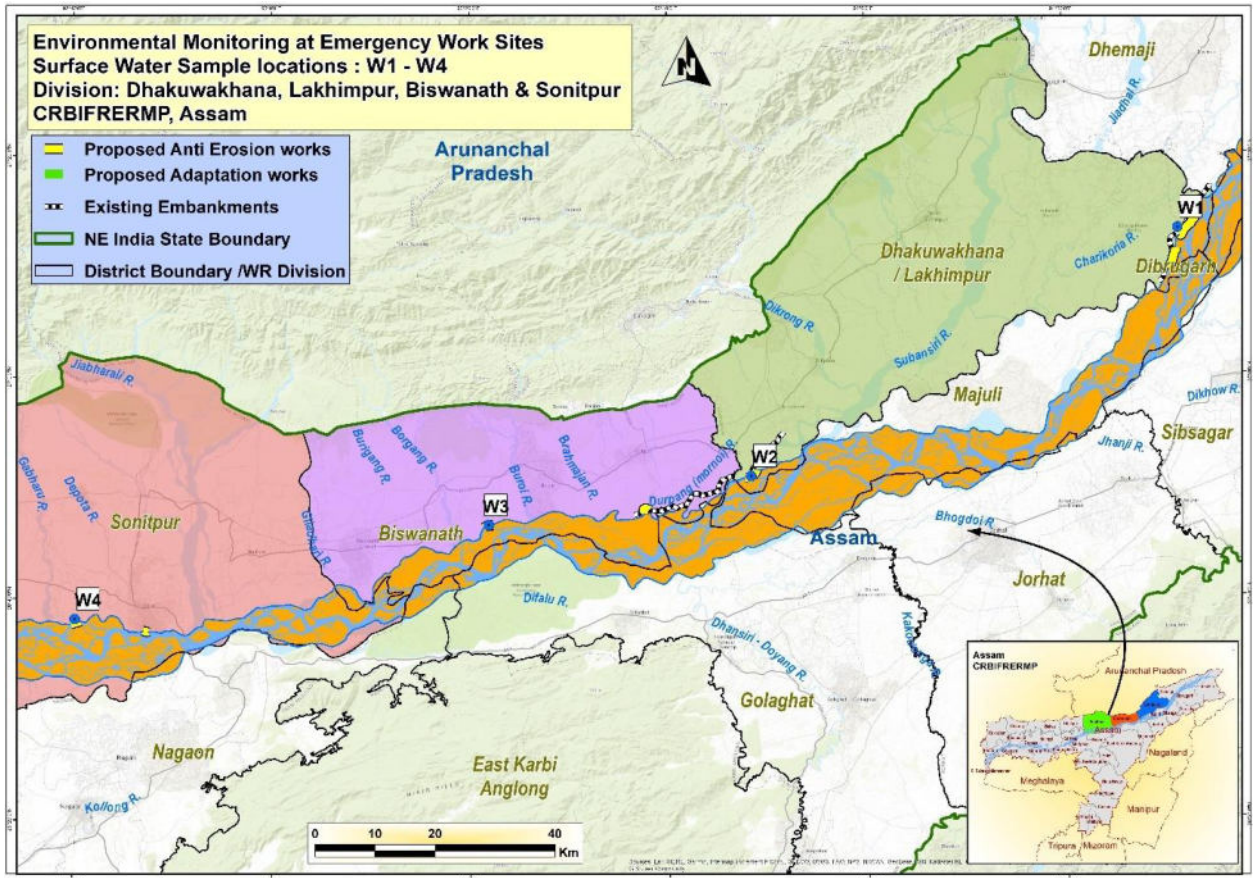
SW monsoon rainfall from the month of June and continues up to September/October. The highest rainfall areas of the district are located near the foothills of Arunachal Himalayas, northern part of the district.

Water Environment

189. **Surface Water.** The State of Assam in general and the Brahmaputra Valley in particular, is endowed with vast water resources potential. The Brahmaputra River and the 33 major tributaries joining it in Assam including the main trans-Himalayan tributaries of Subansiri, Jia Bharali, and Manas carry about 30% of the country's total water resources potential. Surface water bodies covering about 8,251 km² account for 10.5% of the total geographical area of the State. Of these, the river systems including waterlogged areas occupy 6,503 km². The annual surface water availability is over 53 million ha m. Besides, there are 3,513 wetlands in the Brahmaputra valley covering 1012.3 km areas in Assam. Groundwater is also plentifully available at shallow depth in the valley and the utilizable ground water resources estimated at over 2 million ha m.

190. Water quality monitoring and analysis in regard to physico-chemical as well as biological parameters was carried out on samples collected from one locations from each project area areas as per

191. Table 5-19. The locations of the sampling points are shown in
 192.



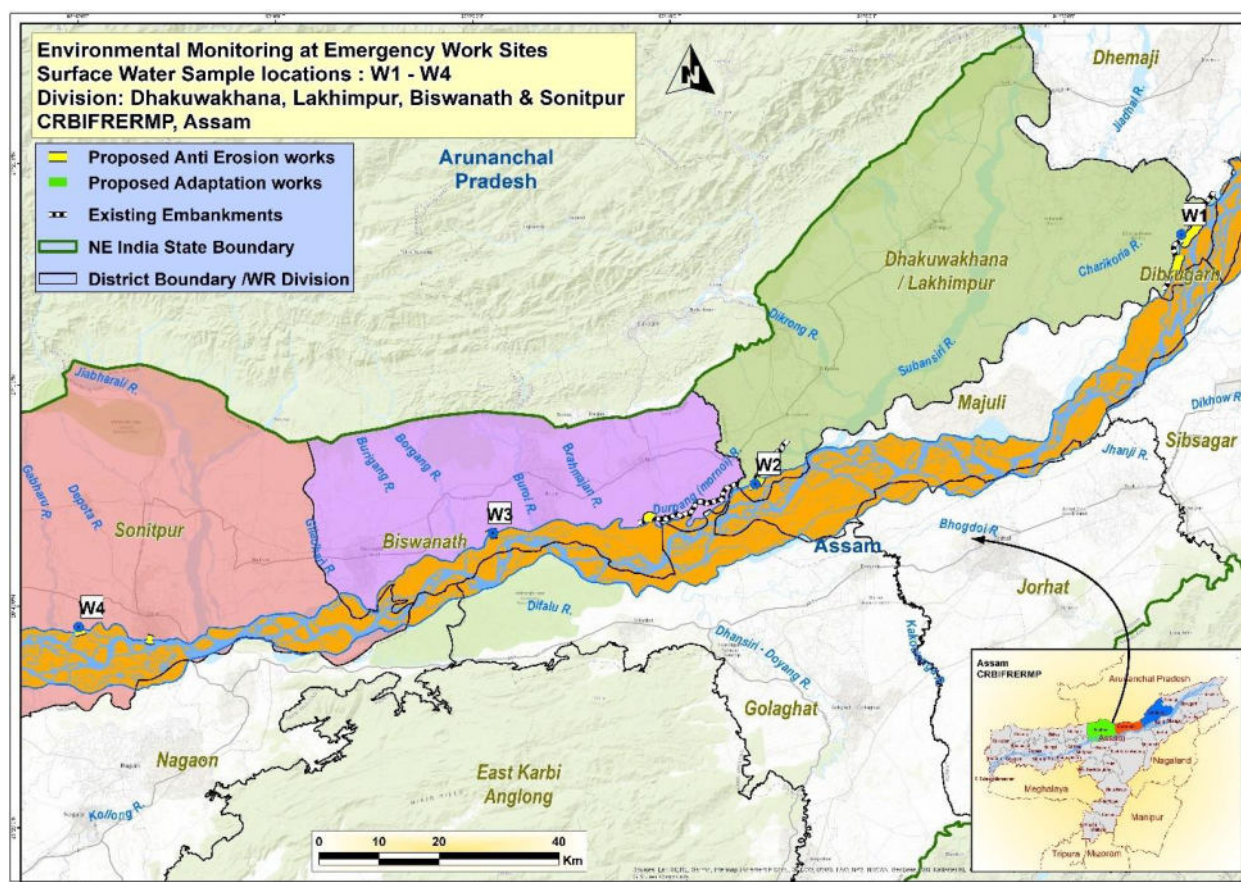
193. Source: M2M Primary Survey Report, 2024

194. Figure 5-18. The results of the analysis are presented in Table 5-20, and these are compared with the water quality criteria of designated best use given by Central Pollution Control Board (CPCB).

Table 5-19. Surface Water Sampling Locations.

Areas	Location of Sampling	Date of collection	Geographical Coordinate	Project Activities
Sonitpur	Zahaz Ghat (Sonitpur)	28/11/2024	26 38' 7.742" N 92 40' 13.209" E	River Bank Protection
Biswanath	Rangchali Dalani, Biswanath.	27/11/2024	26 46' 36.012" N 93 21' 55.116" E	River Bank Protection
Lakhimpur	Bonpuroi Jamuguri(North Lakhimpur)	26/11/2024	26 50' 56.544" N 93 48' 22.788" E	River Bank Protection
Dhakuakhana	U/S Of Bandana Check Bund to Matmara, Dhakuakhana.	25/11/2024	27 13' 7.034" N 94 31' 36.584" E	River Bank Protection

Source: M2M Primary Survey Report, 2024



Source: M2M Primary Survey Report, 2024

Figure 5-18. Surface Water Quality Monitoring Location within high priority project area.

Table 5-20. Surface Water Quality Results – Additional High Priority work areas.

SI No.	Parameters	Unit	Reference Method	Test Result			
				Sonitpur	Biswanath	Lakhimpur	Dhakuakhana
1	pH	---	IS:3025(Part II)-1983 (Reaffirmed 1996)	7.31	7.24	7.13	6.91
2	Turbidity	NTU	IS:3025(Part 10)	3.7	3.1	3.5	3.7

SI No.	Parameters	Unit	Reference Method	Test Result			
				Sonitpur	Biswanath	Lakhimpur	Dhakuakhana
3	TDS	mg/L	IS:3025(Part 16)	218.8	222.4	220.5	217.8
4	Total hardness	mg/L	IS:3025(Part 21)	186.2	190.4	191.6	189.6
5	Calcium	mg/L	IS:3025(Part 40)	40.4	42.8	43	42.1
6	Magnesium	mg/L	IS:3025(Part 46)	15.2	17.6	18.9	17.7
7	Total Alkalinity	mg/L	IS:3025(Part 23)	201.1	207.3	201.2	198.2
8	Chloride	mg/L	APHA 23 rd Edition,4500-CI B,Page:4-75	28.4	30.3	32.2	33.6
9	Sulphate	mg/L	APHA 23 rd Edition,4500-SO ₄ ²⁻ E,Page:4-199	21.2	23.4	22.7	20.4
10	Nitrate	mg/L	APHA 23 rd Edition,4500-NO ₃ ⁻ B,Page:4-127	2.4	2	2.5	3.1
11	Residual Chlorine	mg/L	APHA 23 rd Edition,4500-CI B,Page:4-63	BDL	BDL	BDL	BDL
12	Fluoride	mg/L	APHA 23 rd Edition,4500-F-D,Page:4-90	0.16	0.12	0.18	0.12
13	Copper	mg/L	APHA 23 rd Edition,3111 B,Page:3-20	0.17	0.14	0.1	0.19
14	Iron(as Fe)	mg/L	APHA 23 rd Edition,3111 B,Page:3-20	0.2	0.19	0.11	0.15
15	Cadmium	mg/L	APHA 23 rd Edition,3111 B,Page:3-20	0.22	0.31	0.29	0.22
16	Lead(as Pb)	mg/L	APHA 23 rd Edition,3111 B,Page:3-20	0.18	0.11	0.12	0.18
17	Zinc	mg/L	APHA 23 rd Edition,3111 B,Page:3-20	0.012	0.016	0.011	0.015
18	Chromium Total	mg/L	APHA 23 rd Edition,3111 B,Page:3-20	0.04	0.05	0.09	0.03
19	Manganese	mg/L	APHA 23 rd Edition,3111 B,Page:3-20	0.029	0.025	0.031	0.042
20	Selenium	mg/L	APHA 23 rd Edition,3114A,Page:3-36	<0.001	<0.001	<0.001	<0.001
21	BOD	mg/L	IS 3025(Part 44)	3.3	3.7	3.1	2.9
22	COD	mg/l	APHA 23 rd Edition 2017,5220-BPage:5-18	7.2	7.8	7	6.4

Source: M2M Primary Survey Report, 2024

195. Based on the test report it can be concluded that all the 22 parameters against which surface water is analyzed, all test result values are within CPCB limits of Water Quality Standards (as per IS: 2296), class -D. The monitoring reports and the sampling pictures are placed at Appendix 8.

196. **Ground Water.** The entire Brahmaputra Valley especially its floodplain zone underlain by unconsolidated alluvial materials is a vast reservoir of groundwater. The dynamic resource of groundwater in the Brahmaputra valley is estimated to be of the order of 2.79 million ha m. In the floodplain zone the depth of water is shallow, normally within 5 m below ground level. During the post monsoon period, in almost the entire flood plain area of the Brahmaputra Valley, the water table lies within 2 m below the ground surface, caused mainly by the impact of monsoon rains and recharge to the groundwater aquifers. This situation leads to water logging in large areas of the floodplain.

197. Study by Central Ground Water Board shows that the annual dynamic ground water resources as on 2013, is 767.85 MCM and the net annual ground water draft from all sources is 281.89 mcm. The stage of ground water development is 41%. The projected demand for domestic and industrial uses up to 2025 is estimated to be about 29.75 MCM. The district has 1 critical block, and sufficient resources are still available for future development.

198. Groundwater quality of sample was taken from one location for each high priority project areas as per

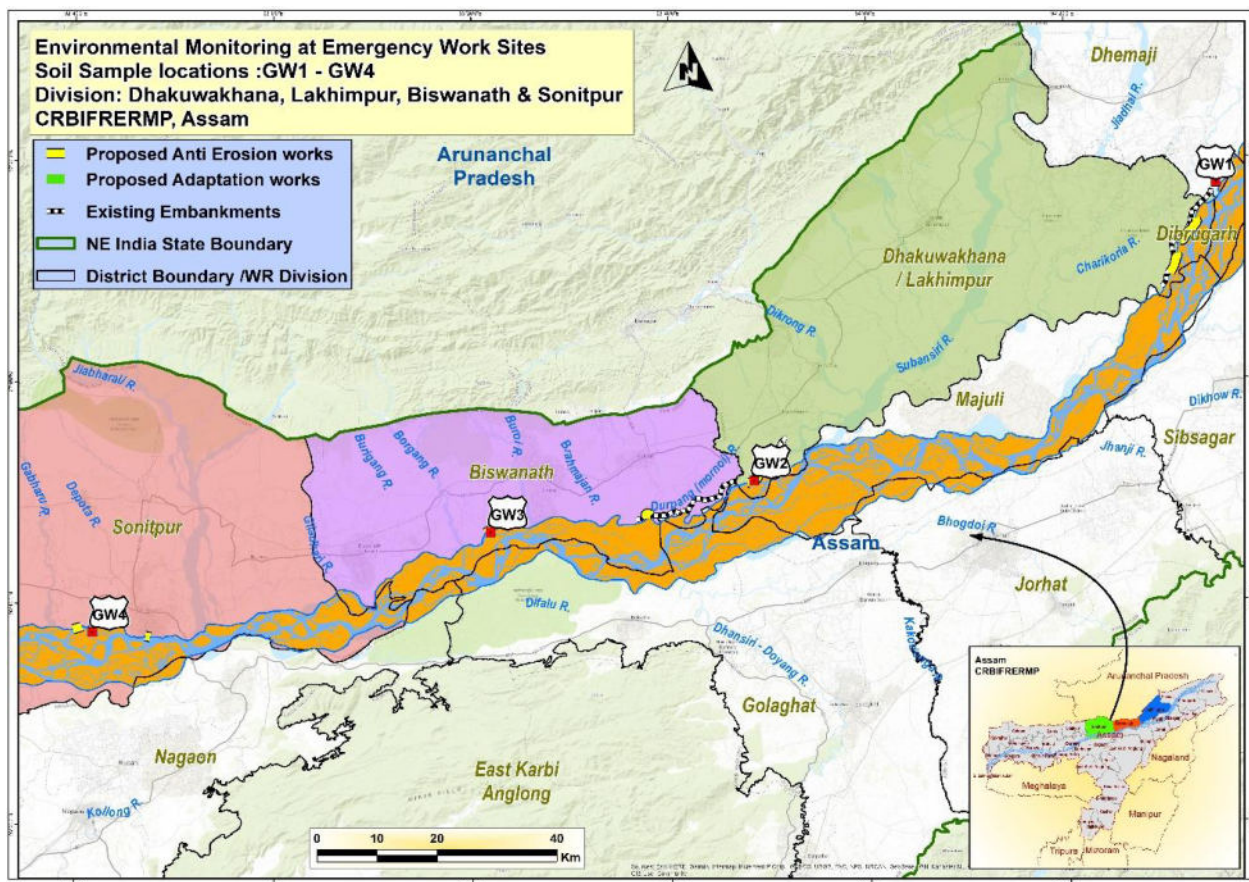
199. Table 5-21. The sample location is indicated in the Figure 5-19. Based on the ground water test report and its comparison with the WHO and IS:10500(2012) standards, it can be concluded all monitored parameters are within the permissible limits. The ground water is fit of drinking after regular minimal filtering process. The results of the groundwater quality are represented in

200. Table 5-22.

Table 5-21. Groundwater Sampling Locations.

Name of High Priority Project areas	Location of Sampling	Date of Sampling	Geographical Coordinate	Source of Water
Sonitpur	Zahaz Ghat, Sonitpur	28/11/2024	26 37' 24.024" N 92 41' 48.048" E	Hand pump
Biswanath	Rangchali Dalani, Biswanath	27/11/2024	26 46' 25.068" N 93 21' 53.172" E	Hand pump
Lakhimpur	Bonpuroi Jamuguri	26/11/2024	26 50' 57.372" N 93 48' 26.064" E	Hand pump
Dhakuakhana	Bandana Check Bund to Matmara	25/11/2024	27 17' 36.960" N 94 35' 20.544" E	Hand pump

Source: M2M Primary Survey Report, 2024



Source: M2M Primary Survey Report, 2024

Figure 5-19. Ground Water Quality Monitoring Location within project area.

Table 5-22. Ground Water Quality Results – Additional High Priority work areas.

SI No.	Parameters	Unit	Reference Method	IS 10500: 2012		Test Results			
				Acceptable limit	Permissible limit	Sonitpur	Biswanath	Lakhimpur	Dhakuakhana
1	pH	---	IS 3025 (Part 11) Electrometric Method	6.5-8.5	No relaxation	7.47	7.22	7.16	7.28
2	Turbidity	NTU	IS 3025 (Part 4) Nephelometric Method	1	5	1.1	1.7	1.5	1.3
3	TDS	mg/L	IS 3025 (Part 16)	500	2000	132.4	121.1	125.6	128
4	Total hardness	mg/L	IS 3025 (Part 21)	200	600	106.4	101.3	105.4	103.2
5	Calcium	mg/L	IS 3025 (Part 40) EDTA Titrimetric Method	75	200	24.3	22.1	29.4	28.9
6	Magnesium	mg/L	IS 3025 (Part 46)	30	100	8.2	7.6	10.1	9.3
7	Total Alkalinity	mg/L	IS 3025 (Part 23)	200	600	116.7	119.4	123.5	126.7
8	Dissolved Oxygen	mg/L	APHA 23 rd Edition 2017,4500-O C,Page:4-146	-	-	4.3	4.4	4.6	4.8
9	Chloride	mg/L	APHA 23 rd Edition 2017,4500-Cl- B,Page:4-75	250	1000	12.4	13.2	14.3	16.5
10	Sulphate	mg/L	APHA 23 rd Edition 2017,4500-SO ₄ ²⁻ E,Page:4-199	200	400	5.1	6.9	9.4	10.2
11	Nitrate	mg/L	APHA 23 rd Edition 2017,4500-NO ₃ -B,Page:4-127	45	No relaxation	1.18	1.11	1.24	1.1
12	Fluoride	mg/L	APHA 23 rd Edition 2017,4500-F ⁻ D,Page:4-90	1	1.5	0.26	0.29	0.33	0.31
13	Copper	mg/L	APHA 23 rd Edition 2017,3111 B,Page:3-20	0.05	1.5	0.019	0.017	0.014	0.01
14	Iron(as Fe)	mg/L	APHA 23 rd Edition 2017,3500-Fe B,Page:3-80	0.3	No relaxation	0.27	0.26	0.2	0.24
15	Cadmium	mg/L	APHA 23 rd Edition 2017, 3111 B,Page:3-20	0.003	No relaxation	BDL	BDL	BDL	BDL
16	Lead	mg/L	APHA 23 rd Edition 2017, 3111 B,Page:3-20	0.01	No relaxation	BDL	BDL	BDL	BDL

SI No.	Parameters	Unit	Reference Method	IS 10500: 2012		Test Results			
				Acceptable limit	Permissible limit	Sonitpur	Biswanath	Lakhimpur	Dhakuakhana
17	Zinc	mg/L	APHA 23 rd Edition 2017, 3111 B, Page:3-20	5	15	0.158	0.172	0.1	0.12
18	Total Chromium	mg/L	APHA 23 rd Edition 2017, 3111 B, Page:3-20	0.05	No relaxation	BDL	BDL	BDL	BDL
19	Manganese	mg/L	APHA 23 rd Edition 2017, 3111 B, Page:3-20	0.1	0.3	0.013	0.012	0.018	0.012
20	Selenium	mg/L	APHA 23 rd Edition 2017, 3114 B, Page:3-36	0.01	No relaxation	BDL	BDL	BDL	BDL
21	Arsenic	mg/L	APHA 23 rd Edition 2017, 3114 B, Page:3-36	0.01	0.05	BDL	BDL	BDL	BDL

Source: M2M Primary Survey Report, 2024

201. Based on the ground water test report and its comparison with the WHO and IS:10500(2012) standards, it can be concluded all monitored parameters are within the permissible limits. The groundwater is fit for drinking.

Air Quality

202. The proposed high priority work areas, except Zahazghat of Sonitpur (within the Tezpur town) are primarily rural in character and thus due to limited economic development and infrastructure, the ambient air environment is relatively undisturbed. However, in order to scientifically establish the baseline air quality status as required in this assessment and in view of its future relevance, ambient air quality was monitored in 2 locations at each high priority project areas in the field as indicated in Source: M2M Primary Survey Report, 2024

203. Figure 5-20. The results of ambient air quality monitoring in the reach are presented in Table 5-23.

204. The ambient air quality results have also been compared with the National Ambient Air Quality Standards (NAAQS) for industrial, residential, rural and other areas and WHO Ambient Air Guidelines. The average time for monitoring for PM₁₀, PM_{2.5}, NO₂, SO₂ is 24 hours.

Table 5-23. Ambient Air Quality Monitoring Locations and Results.

Name of project location	Date of Monitoring	Village Name	Geographical Coordinate	Sensitive Receptors	Ambient Air Quality Monitoring Parameters			
					PM ₁₀	PM _{2.5}	SO ₂	NO ₂
Sonitpur	28-11-2024	Zahaz Ghat	26 37' 34.069" N 92 47' 12.567" E	Settlement Area	58.3	31.6	13.7	11.7
	28-11-2024	(Near Gandhi Ashram School)	26 38' 17.694" N 92 39' 17.674" E	School	57.6	30.7	14.8	12.8
Biswanath	27-11-2024	Rangchali Dalani	26 46' 50.916" N 93 21' 45.828" E	Settlement Area	58.6	30.5	13.6	11.5
	27-11-2024	Near Tea Garden	26 47' 16.812" N 93 19' 27.062" E	Settlement Area	57.6	32.6	14.6	9.5
Lakhimpur	26-11-2024	Bonpuroi Jamuguri	26 50' 57.192" N 93 48' 18.108" E	Settlement Area	61.6	31.8	13.6	11.1
	26-11-2024	Near Pakilchuk LP School	26 50' 48.948" N 93 47' 58.056" E	School	59.2	30.6	14.1	10.8
Dhakuakhana	25-11-2024	Bandana Check Bund to Matmara	27 13' 19.657" N 94 30' 47.728" E	Settlement Area	57.3	37.1	14.4	10.1
	25-11-2024	Near Deorigaon	27 11' 29.403" N 94 30' 39.317" E	Settlement Area	55.8	32.9	13.8	9.5
National Ambient Air Quality Standard for Industrial, Residential, Rural and other Areas					100	60	80	80
WHO Ambient Air Quality Guidelines (24 hr)					45	15	40	25

Source: M2M Primary Survey Report, 2024

205. Based on monitored data reflected in the table above the monitoring result for all the parameters are within the National Ambient Air Quality Standard. The monitoring reports and the sampling pictures are placed at Appendix 8.



Source: M2M Primary Survey Report, 2024

Figure 5-21. Ambient Air Quality Monitoring Results.

Noise Environment

206. Ambient noise levels in high priority project areas (Dhakuakhana, Lakhimpur, Sonitpur and Biswanath) have been monitored in 2 locations at each project sites during day time as per the directives issued by CPCB - Protocol for Ambient Level Noise Monitoring. The noise monitoring conducted for day time only, as river bank protection works are now allowed in night time, hence only day time baseline ambient noise monitoring conducted. In the absence of any major source of noise pollution in the immediate vicinity of the impact corridor, the noise levels observed were well within the standards for silent and residential areas. The sampling location for noise level monitoring is indicated in the Source: M2M Primary Survey Report, 2024

207. Figure 5-20. The ambient noise levels during day and nighttime are presented in Table 5-24.

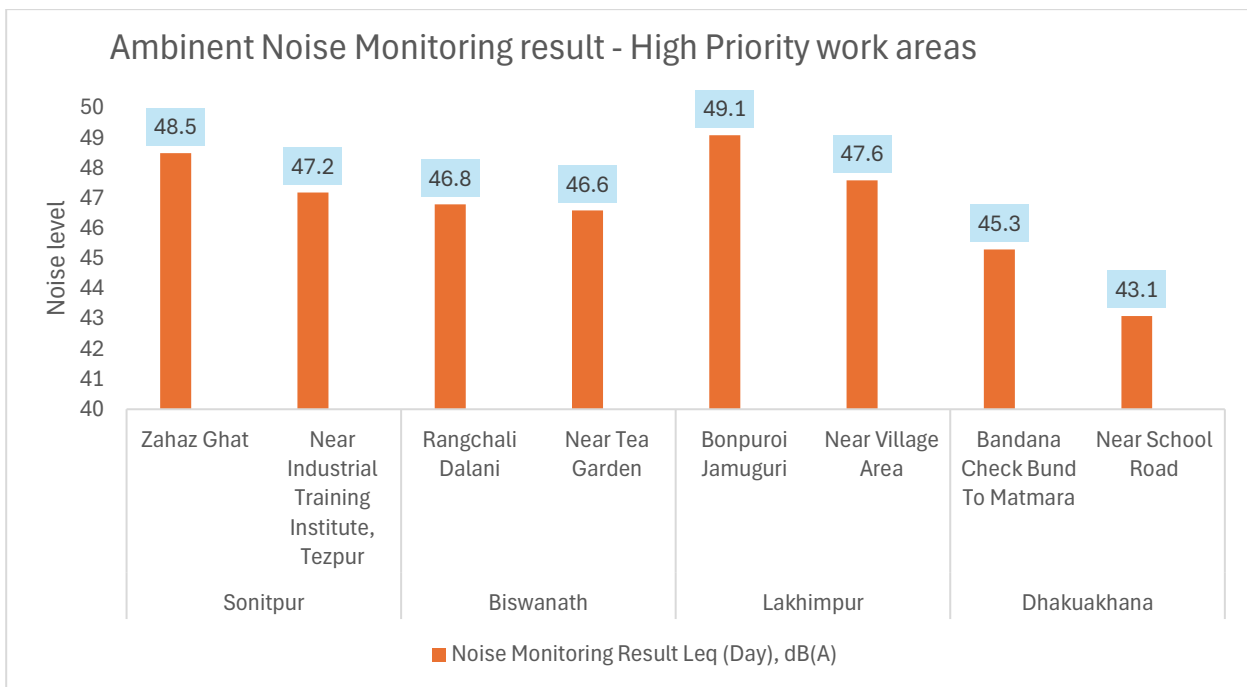
Table 5-24. Ambient Noise Monitoring Location and Results.

Name of the project area	Date of Monitoring	Location/Village Name	Geographical Coordinate	Sensitive Receptors	Noise Monitoring Result
					Leq (Day), dB(A)
Sonitpur	28-11-2024	Zahaz Ghat	26 37' 2.033" N 92 47' 16.178" E	Settlement Area	48.5
	28-11-2024	Near Industrial Training Institute, Tezpur	26 38' 35.827" N 92 40' 13.914" E	Institutional areas	47.2
Biswanath	26-11-2024	Rangchali Dalani	26 46' 35.616" N 93 21' 53.208" E	Settlement Area	46.8
	26-11-2024	Near Tea Garden	26 46' 39.528" N 93 20' 1.548" E	Sensitive area	46.6
Lakhimpur	26-11-2024	Bonpuroi Jamuguri	27 14' 1.226" N 94 31' 21.931" E	Settlement Area	49.1
	26-11-2024	Near Village Area	26 51' 1.188" N 93 48' 32.256" E	Settlement Area	47.6
Dhakuakhana	25-11-2024	Bandana Check Bund to Matmara	27 13' 43.719" N 94 31' 50.547" E	Settlement Area	45.3
	25-11-2024	Near School Road	27 10' 41.662" N 94 30' 23.765" E	Settlement Area	43.1
				Silent Area	50
				Residential Area	55
				Commercial area	65
				Industrial Area	75
				Residential, Institutional and Educational	55
				Industrial and Commercial	70

Source: M2M Primary Survey Report, 2024

²² Gazette of India, vide S.O. 123(E), dated 14.2.2000 and subsequently amended by the Noise Pollution (Regulation and Control) (Amendment) Rules, 2000 vide S.O. 1046(E), dated 22.11.2000 and by the Noise Pollution (Regulation and Control) (Amendment) Rules, 2002 vide S.O. 1088(E), dated 11.10.2002, under the Environment (Protection) Act, 1986

²³ Environmental, Health, and Safety General EHS Guidelines. World Bank Group. 2007.



Source: M2M Primary Survey Report, 2024

Figure 5-22. Ambient Noise Monitoring Results.

208. Based on the above table and figure, it is clear that the back ground ambient noise level falls within the permissible limit of residential and sensitive areas Category of CPCB. The noise level for the day in both the locations are within the permissible limit for sensitive area zone. The monitoring reports and the sampling pictures are placed at Appendix 8.

Key Physical Aspects

209. Summary of the key physical aspects in the PAI are given in Table 5-25.

Table 5-25. Summary of Key Physical Environmental setting in PAI.

Particulars	Key Features in PAI
Elevation and Topography	<ul style="list-style-type: none"> The general average elevation of Lakhimpur district is 96 m, Biswanath district is 99 m and Sonitpur district is 68m. The project area is characterized by undulating plain.
Land Use and Land Cover – Study Area	<ul style="list-style-type: none"> Physiography is characterized primarily by plains LU is predominantly agrarian
Microclimatic condition	<ul style="list-style-type: none"> The climate in Lakhimpur, Biswanath, and Sonitpur districts is characterized by moderate winters and hot summers Lakhimpur - Average temperature of 7°C to 34°C and the average rainfall is 2015 mm. Biswanath - Average temperature of 6°C to 34°C and the average rainfall is 2000 mm. Sonitpur Average temperature of 7.6°C to 37.5°C and the average rainfall is 2350 mm.
Geological and Climatic Risks	<ul style="list-style-type: none"> Seismic hazards: Zone-V. and very high Damage Risk Zone Surface Water Flooding – High Medium Risk Landslides – Low Risk area Storms and cyclones – High risk area

Particulars	Key Features in PAI
General environmental conditions – soils, air quality, noise, water	<ul style="list-style-type: none"> Parameters are within the CPCB standards in general

Source: M2M Primary survey report

E. Biological Setting

Protected Areas (PA)

210. 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.

211. The State of Assam has 7 National Parks (NP), 17 Wildlife Sanctuaries (WLS) and 1 Ramsar wetland site which is also a WLS. There are 21 Key Biodiversity Areas (KBA) and Important Bird Areas (IBA) in the state. The details are as follows:

Table 5-26. Summary of Protected Areas in Assam.

Sl. No.	Name	National Status ^{24, 25}	IUCN Protected Area Level/Ramsar Criteria	IBA Criteria ^{26, 27}	KBA	Critical Habitat as Protected Area
1	Dibru-Saikhowa NP	NP	Not categorized yet but considered as Category II as per IUCN criteria	A1, A2	Yes	Supports CR/EN species
2	Kaziranga NP	NP	Category II (NP) and X (World Heritage Site) as per IUCN criteria ²⁸	A1, A2, A4i, A4iii	Yes	Fulfils IUCN category II PA criterion
3	Manas NP	NP	Category IV (habitat or species management area) as per IUCN	A1, A2	Yes	Supports CR/EN species
4	Nameri NP	NP	Category IV as per IUCN	A1, A2	Yes	Supports CR/EN and endemic species
5	Orang NP	NP	Category IV as per IUCN	A1, A4ii	Yes	Supports CR/EN and migratory species
6	Dihing Patkai	NP	Category II (NP) As per IUCN	A1, A2	Yes	Supports CR/EN species

²⁴ WII ENVIS, Govt. of India. 2023. http://wiienvis.nic.in/Database/wls_8230.aspx

²⁵ Assam State Biodiversity Board, Govt. of Assam. <https://asbb.assam.gov.in/information-services/protected-area-network>

²⁶ BirdLife International (2022) Country profile: India (<http://datazone.birdlife.org/country/india>)

²⁷ Rahmani, A.R., Islam, M.Z. and Kasambe, R.M. (2016) Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated). Bombay Natural History Society, Indian Bird Conservation Network, Royal Society for the Protection of Birds and BirdLife International (U.K.). Pp. 1992 + xii

²⁸ IUCN. 1990. IUCN Directory of South Asian Protected Areas. IUCN, Gland, Switzerland and Cambridge, U.K. xxiv + 294 pp. https://wedocs.unep.org/bitstream/handle/20.500.11822/8084/IUCN_directory_South_Asian_Protected_Areas.pdf?sequence=3&isAllowed=y

Sl. No.	Name	National Status ^{24, 25}	IUCN Protected Area Level/Ramsar Criteria	IBA Criteria ^{26, 27}	KBA	Critical Habitat as Protected Area
7	Raimona	NP	Category II (NP) As per IUCN	A1, A3	Yes	Supports CR/EN species
8	Amchang WLS	WLS	Not categorized yet but considered as Category IV as per IUCN	A1	Yes	Supports CR/EN species
9	Barail WLS	WLS	Not categorized yet but considered as Category IV as per IUCN	A1, A2, A3	Yes, as part of Barail Range	Supports CR/EN and endemic species
10	Barnadi WLS	WLS	Category IV as per IUCN	A1	Yes	-
11	Bherjan-Borajan-Podumoni WLS	WLS	Not categorized yet but considered as Category IV as per IUCN	A1	Yes	-
12	Burachapori WLS	WLS	Not categorized yet but considered as Category IV as per IUCN	A1, A2	Yes	-
13	Chakrashila WLS	WLS	Not categorized yet but considered as Category IV as per IUCN	A1, A4i, A4iii	Yes	-
14	Deepor Beel	Ramsar Site	Ramsar Site per criterion 1, 2, 4, 7 and 8. Category IV as per IUCN	A1, A4iii	Yes	Ramsar site. it is a wetland that provides key ecosystem Services/fish breeding ground
15	East Karbi Anglong WLS	WLS	Not categorized yet but considered as Category IV as per IUCN	A1	Yes	-
16	Garampani WLS	WLS	Category IV as per IUCN	A1	Yes	-
17	Hollongapar-Gibbon WLS	WLS	Not categorized yet but considered as Category IV as per IUCN	A1	Yes	Supports CR/EN and endemic species
18	Laokhowa WLS	WLS	Category IV as per IUCN	A1, A2	Yes	Supports CR/EN and endemic species
19	Marat Longri WLS	WLS	Not categorized yet but considered as Category IV as per IUCN	A1	Yes	-
20	Nambor Doigrung WLS	WLS	Not categorized yet but considered as Category IV as per IUCN	A1	Yes	-

Sl. No.	Name	National Status ^{24, 25}	IUCN Protected Area Level/Ramsar Criteria	IBA Criteria ^{26, 27}	KBA	Critical Habitat as Protected Area
21	Nambor WLS	WLS	Not categorized yet but considered as Category IV as per IUCN	A1	Yes	-
22	Pobitora WLS	WLS	Category IV as per IUCN	A1, A2, A4iii	Yes	Supports CR/EN and migratory species
23	Pani-Dihing WLS	WLS	Not categorized yet but considered as Category IV as per IUCN	A1, A4iii	Yes	-
24	Sonai-Rupai WLS	WLS	Category IV as per IUCN	A1	Yes	Supports CR/EN species

CR = Critically Endangered, EN = Endangered, IBA = important bird area, KBA = Key Biodiversity Areas, IUCN = International Union for Conservation of Nature

Source: IEE, Morigaon, CRBIFRERMP (<https://www.adb.org/projects/documents/ind-56283-001-iee-0>)

Areas of Eco-sensitivity/Protected Area/Restricted Area

212. The proposed high priority works fall in the landscape of Assam, which is home to rich biodiversity and several ecologically significant areas. Within a 10 km radius of the project sites, there is one notified protected area—Kaziranga National Park—which holds UNESCO World Heritage Site status due to its importance in conserving the largest population of Indian Rhinoceros (*Rhinoceros unicornis*) and several other threatened species. A more comprehensive list of Protected Areas (PAs) and Key Biodiversity Areas (KBAs) within 10 km and 50 km of the project interventions is provided in Table 5-27.

213. One of the proposed project interventions, specifically at Paken and Rangchali Dalani, is situated near the boundary of Kaziranga National Park (40m away). Given its proximity to this ecologically sensitive area, the necessary No Objection Certificates (NOCs) were secured from the Field Director of Kaziranga National Park and the Divisional Forest Officer (DFO) of the Biswanath Wildlife Division to ensure legal compliance and adherence to conservation requirements (see Appendix 16 for details). This clearance ensures that the project will implement precautionary measures to prevent any potential ecological disturbances during the construction and operational phases.

214. The Assam Plains is designated as an Endemic Bird Area (EBA)²⁹ by BirdLife International. This recognition indicates that the region hosts bird species that are restricted to a particular geographical area, making it a significant zone for avian conservation. Assam is uniquely located between two global biodiversity hotspots—the Eastern Himalayas and Indo-Myanmar—which contributes to its high avian diversity and the presence of several endemic bird species. However, it is important to note that EBA is not a legally protected area under Indian environmental laws but rather a conservation priority area identified by BirdLife International for the protection of endemic and range-restricted birds. The EBA designation emphasizes the need for conservation efforts to preserve critical bird habitats and maintain biodiversity integrity.

215. Given these ecological sensitivities, the specific guidelines from the Kaziranga National Park Management Plan will be strictly followed during the implementation activities. To ensure all

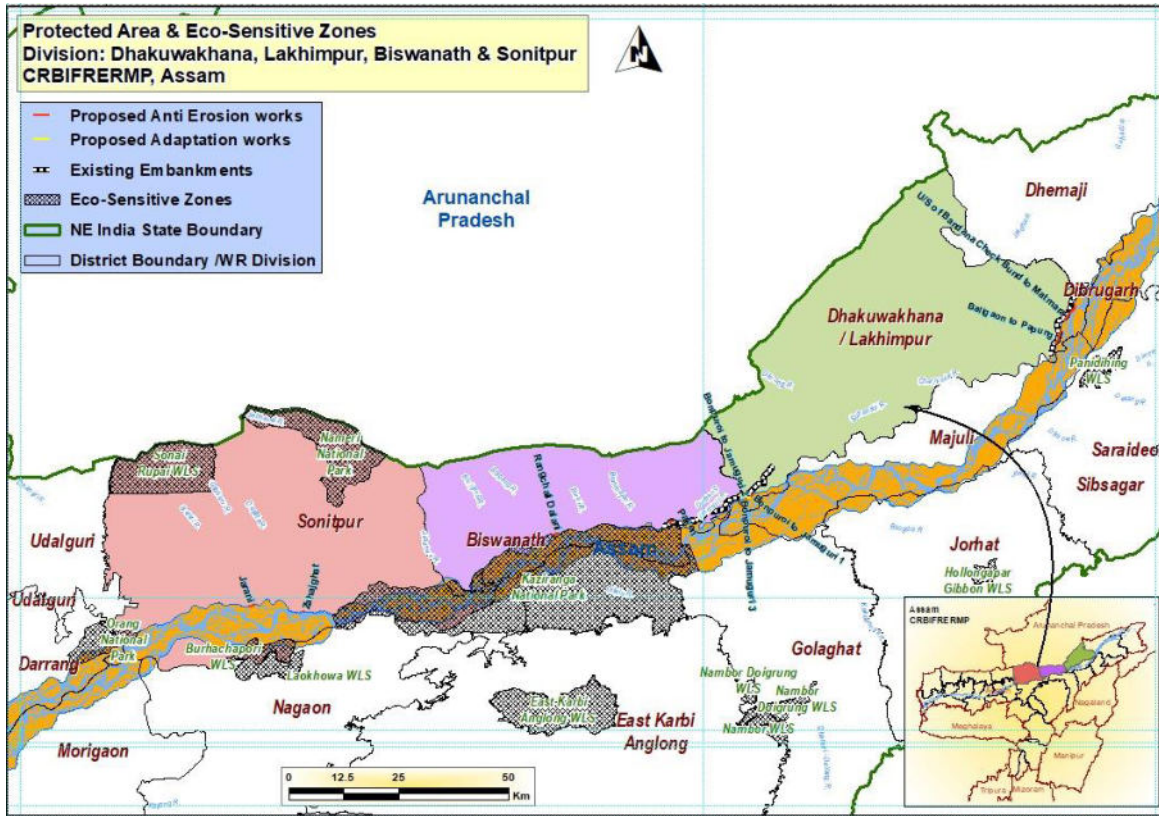
²⁹ BirdLife International (2023) Endemic Bird Areas factsheet: Assam plains. Downloaded from <http://datazone.birdlife.org/eba/search> on 24/05/2023. BirdLife Data Zone

interventions align with conservation priorities, minimize habitat disturbances, and incorporate necessary biodiversity safeguards in line with environmental best practices.

Table 5-27. Protected Areas and KBAs within 10km of the Project Area³⁰.

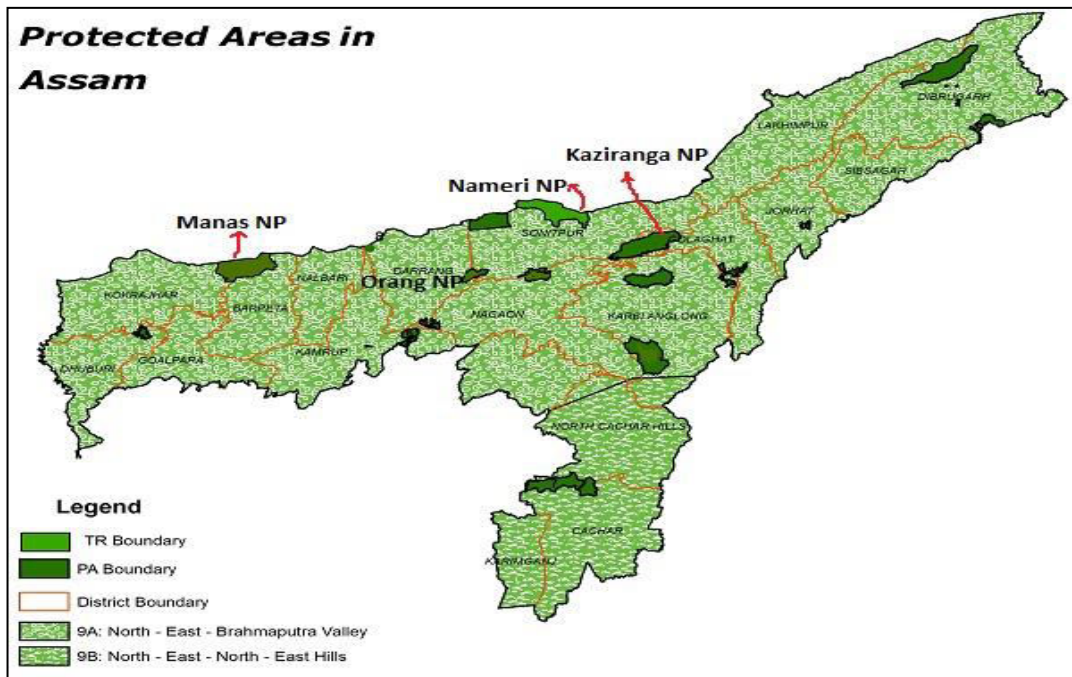
Name	PA (Name and Distance - within)			KBA (Name and Distance - within)		
	1-5 km	5-10 km	>10 km	1-5 km	5-10 km	>10 km
Dhakuakhana, Lakhimpur, Biswanath and Sonitpur		Kaziranga National Park is 6 km away from Biswanath district, as per IBAT.	-	Majuli – 1 km away from proposed river works of Dhakukahna as per IBAT	As per IBAT, KBA at distance of 10 km from proposed reached of Biswanath district, Jhanjimukh – Kokilamukh Kaziranga National Park 10 km distance from Sonitpur proposed sites - Laokhowa and Burhachapori Sanctuaries 10 km distance from Dhakuakhan Kuarbari Dalani and Pani-Dihing Bird Sanctuary	50 km distance <ul style="list-style-type: none"> • Behali Reserve Forest • Bordoibam-Bilmukh Bird Sanctuary • Bordoloni – Sampora • Deobali Jalah • Deobali Jalah, Sialmari, Haibargaon, • Khutikatia (Nagaon) • Dibru - Saikhowa Complex • East and North Karbi Anglong Wildlife Sanctuaries: • Garampani, Nambor and Doigrung • Gibbon (Hollongapar) Sanctuary • Itanagar Wildlife Sanctuary • Jamjing and Sengajan • Kane Wildlife Sanctuary • Nagaon Township • Nameri National Park • Orang National Park • Pabho Reserve Forest • Pakhui or Pakke Wildlife Sanctuary • Papum Reserve Forest • Sibsagar Tanks • Sonai-Rupai Wildlife Sanctuary • Subansiri

³⁰ IBAT on October 2024 (GMT)



Source: Chief Wildlife Warden Assam through WRD

Figure 5-23. Map Showing Protected Areas and ESZs in Proximity to Project Sites.



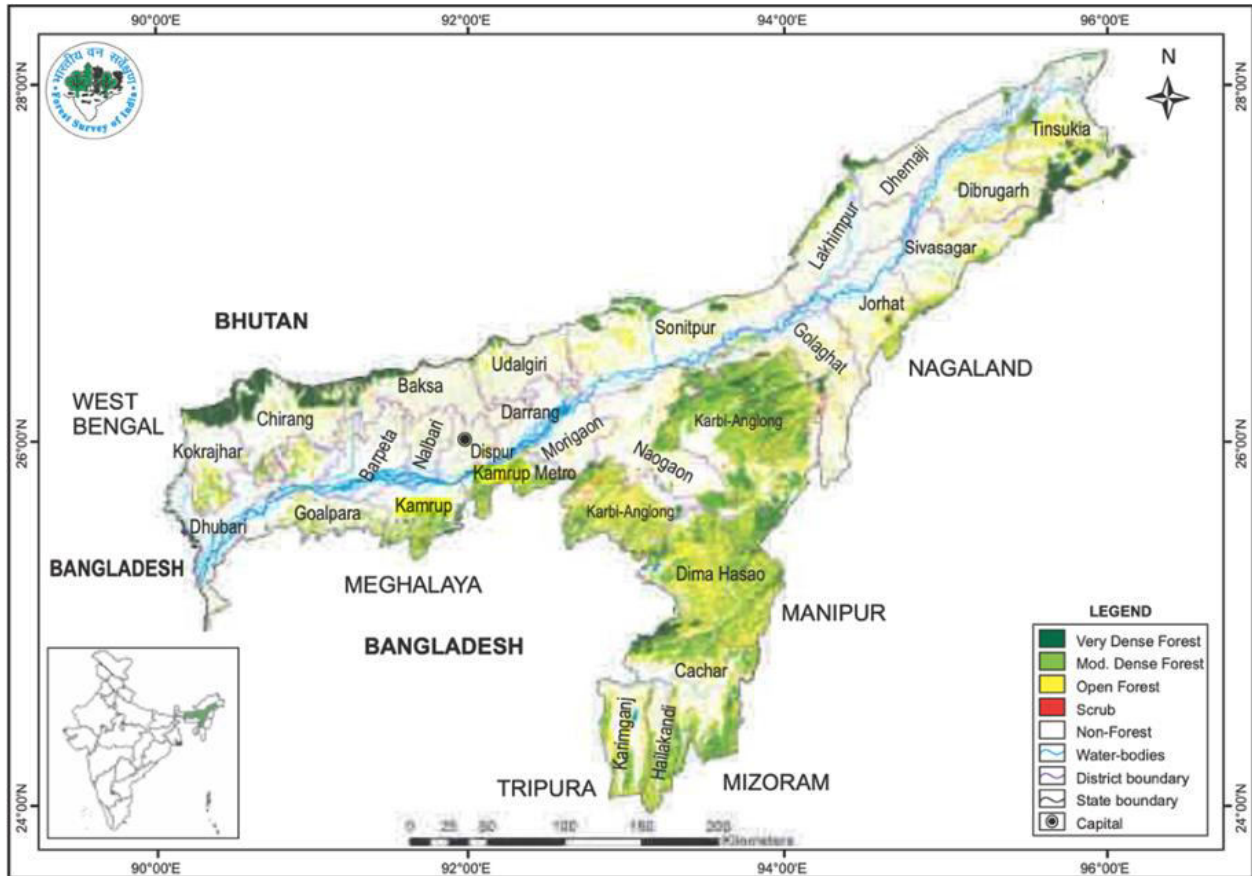
Source: Wildlife Institute of India.

http://wiienviis.nic.in/WriteReadData/UserFiles/image/PAs_Map_Database/images/assam_enviis1.jpg

Figure 5-24. Map Showing Protected Areas in Assam.

Forests

216. The total recorded forest area (RFA) in the State is 26,836 sq km., which is 34.21 % of the total geographical area of Assam. Out of the total RFA, 17,864 sq. km is reserve forest and 8,972 sq. km is unclassified forests. The forest cover of the State is 28,311.51 sq. km., which is 36.09 % of total geographical area excluding the 227.94 sq. km. of scrub forest area. The very dense forest area is 3016.67 sq. km., moderate dense forest is 9991.02 sq. km. and open forest is 15,303.82 sq. km.



Source: India State of Forest Report, 2021, Forest Survey of India

Figure 5-25. Forest Cover Map of Assam.

217. The forest in Assam can be described into following types/sub-types³¹:

- Tropical Wet Evergreen Forests
- Tropical Semi Evergreen Forests
- Tropical Moist Deciduous Forests
- Sub-tropical Broadleaf Hill Forests
- Sub-tropical Pine Forests
- Littoral and Swamp Forests
- Grassland and Savannahs

³¹ <https://environmentandforest.assam.gov.in/information-services/biodiversity-of-assam-0>

Table 5-28. Statement of Forest Land in Project districts.

District/State	Geographical Area km ²	Forest Area	
		Total km ²	% Total Forest Area in State
Lakhimpur	2277	310.55	13.64
Sonitpur ³²	5204	1071.36	20.59
Assam	78,438	38,311.51	36.09

Source: India State of Forest Report, 2021, Forest Survey of India

218. The Forest types of the Lakhimpur³³ district are mainly tropical rainforest. The important reserved forests of the district are Ranga Reserve, Kakoi Reserve, Dulung Reserve and Pava Reserve. The varieties of tree species grown in the forest area are Hollock (*Terminalia Myriocarpa*), Urium (*Bichotia Jauvanica*), Nahar (*Mesua Ferrea*), Ajhar (*Lagerstroemia speciosa*), Simolu (*Bombax ceiba/Salmalia Malabarica*), Sum (Machilus), Sualu, Gomari (*Gmelina orborea*), Sissoo (*Dalbergia Sissoo*), Jutuli (*Altingia excelsa*), Silikha (*Terminalia Chebula*), Neem (*Azadirachta Indica*), Sopa (Magnolia) etc.

219. The important forest types in Biswanath district are. moist semi-evergreen forests, Moist Mixed Deciduous forests, Rivera in Type Miscellaneous type with scattered pure or mixed patches of bamboos.

220. The forests of Sonitpur³⁴ district are semi-evergreen forests, moist deciduous forests and bamboo forests, with hydrophytes in the wetlands. Species include *Aegle marmelos*, *Albizia procera*, *Alstonia scholaris*, *Arundo donax*, *Bambusa balcooa*, *Cynodon dactylon*, *Dipterocarpus macrocarpus*, *Duabanga grandiflora*, *Eichhornia crassipes*, *Mesua assamica*, *Melocanna baccifera*, *Mesua ferrea*, *Shorea assamica (mekai)* and *Shorea robusta*.

Wetlands

221. In Assam, approximately 7% of total land surface is covered by wetlands, total wetland area in Lakhimpur District is 27307 ha that includes 458 small wetlands (<2.25 ha). River/stream occupies 89.34% of wetlands The other major wetland type is Ox-bow lakes (3.80%). There are 59 lake/pond (locally called as Beels) with 652 ha area. In the Sonitpur³⁵ District the percentage of wetland is remarkably high total wetland area in the district is 83427 ha that includes 980 small wetlands. River/stream occupies 94.52% of of wetlands. The other wetland types are waterlogged-natural (2.11%) and ox-bow lakes (1.04%).

Table 5-29. Area Estimates of Wetlands in Lakhimpur.

Wetland Category	No. of Wetlands	Total Wetland Area (Ha.)	Percentage of wetland area	Open Water (Ha.)	
				Post-monsoon Area	Pre- monsoon Area
Inland Wetlands - Natural					
Lakes/Ponds	53	652	2.39	388	458
Ox-bow lakes/Cut-off meanders	92	1038	3.80	807	706
High altitude wetlands	-	-	-	-	-
Riverine wetlands	7	134	0.49	53	66
Waterlogged	34	524	1.92	174	322

³² At the time of report published Biswanath district was part of Sonitpur

³³ <https://lakhimpur.nic.in/Lakhimpur/about.htm>

³⁴ Source: https://en.wikipedia.org/wiki/Sonitpur_district

³⁵ Including Biswanath district, earlier it was part of Sonitpur district

Wetland Category	No. of Wetlands	Total Wetland Area (Ha.)	Percentage of wetland area	Open Water (Ha.)	
				Post-monsoon Area	Pre-monsoon Area
River/Stream	30	24397	89.34	12258	12048
Inland Wetlands - Man-made					
Reservoirs/ Barrages	-	-	-	-	-
Tanks/Ponds	14	41	0.15	33	38
Waterlogged	4	63	0.23	26	26
Total - Inland	234	26849	98.32	13739	13664
Wetlands (<2.25 ha), mainly Tanks	458	458	1.68	-	-
Total	692	27307	100	13739	13664

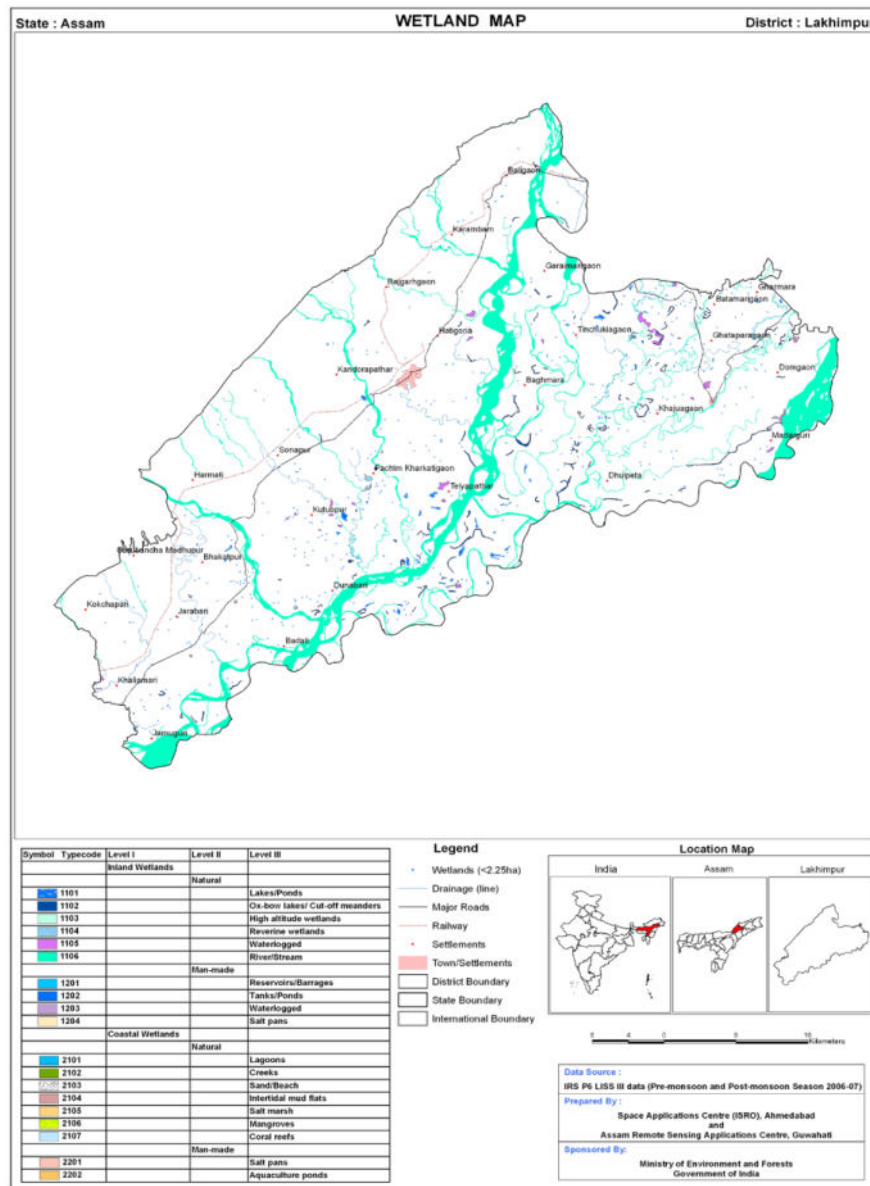


Figure 5-26. Wetland Map of Lakhimpur.

Table 5-30. Area Estimates of Wetlands in Sonitpur.

Wetland Category	No. of Wetlands	Total Wetland Area (Ha.)	Percentage of wetland area	Open Water (Ha.)	
				Post-monsoon Area	Pre- monsoon Area
Inland Wetlands - Natural					
Lakes/Ponds	69	740	0.89	391	335
Ox-bow lakes/Cut-off meanders	96	864	1.04	555	427
High altitude wetlands	-	-	-	-	-
Riverine wetlands	--	--	--	--	--
Waterlogged	32	1764	2.11	284	201
River/Stream	12	78852	94.52	32301	29072
Inland Wetlands - Man-made					
Reservoirs/ Barrages	-	-	-	-	-
Tanks/Ponds	23	84	0.10	75	73
Waterlogged	15	143	0.17	99	81
Total - Inland	249	82447	98.65	33705	30189
Wetlands (<2.25 ha), mainly Tanks	980	980	1.17	-	-
Total	1229	83427	99.83	33705	30189

Source: National Wetland Atlas: Assam, SAC/RESA/AFEG/NWIA/ATLAS/18/2010, Space Applications Centre (ISRO), Ahmedabad, India, 174p.

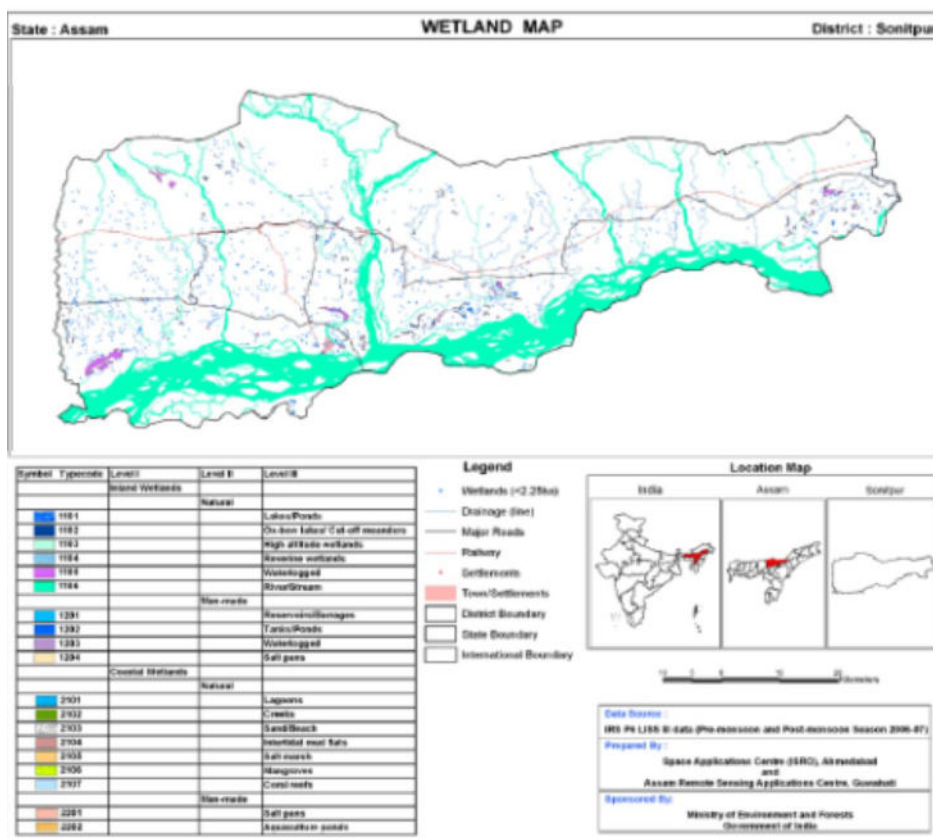


Figure 5-27. Wetland Map of Sonitpur.

222. There are very few perennial wetlands/beels available near the project area of Dhakuakhana, Rangchali Dalani and Paken area.

Ecology in Project Area

223. The Brahmaputra River plays a vital role in shaping the terrestrial and aquatic ecosystems of the floodplain regions. Communities residing in these floodplains rely heavily on the ecological benefits provided by the river and its monsoon flooding. Each year, the rising waters of the river submerge the low-lying floodplains, enriching the soil with natural nutrients and promoting biodiversity.

224. Assam's favourable geographical location, diverse topography, and ideal climatic conditions have endowed it with abundant biodiversity. The state's vegetation is primarily tropical and subtropical, encompassing evergreen, semi-evergreen, and deciduous forests, along with grasslands and riverside woodlands. Notable tree species in Assam include Hoolong (*Dipterocarpus macrocarpus*), Mekai (*Shorea assamica*), Nahar (*Mesua ferrea*), Gamari (*Gmelina arborea*), Sal (*Shorea robusta*), and Ajar (*Lagerstroemia speciosa*).

225. The river has contributed to the formation of numerous wetlands in the floodplain areas. These wetlands support a diverse range of aquatic biodiversity, including species that are both ecologically and commercially significant. They serve as habitats for insects, fish, amphibians, reptiles, mammals, birds, and a variety of economically valuable aquatic plants, ornamental species, and medicinal plants. These wetlands form essential life-support systems for the traditional communities living in the floodplains. The biodiversity resources derived from these river-created wetlands play a crucial role in sustaining the livelihoods of rural populations. Formed through the ongoing interaction of land and water, these ecosystems depend on consistent water sources for their existence; without them, wetland ecosystems in the floodplain zones would cease to exist.

226. The project districts are home to evergreen, semi-evergreen, and deciduous forests that feature a wide variety of tree species. Prominent among these are Nahar, Sianahar, Ajar, Bheleu, Jori, Aahot, Dimoru, and Xualu. Common shrubs in the region include Jermany Bon, Kathanda, Hengenapoka, and Dhapat Tita, while widely seen herbs include Gundhua Bon, Durun, and Gakhiroti Bon. Short grasses like Dubori, Bahpotia Bon, and Mutha Bon are prevalent, while grasslands are dominated by taller grasses such as Birina, Kohua, Kher, Nol, Ikora, and Khagori.

Methodology of Baseline Data Collection

227. The conduct biodiversity assessment and collect primary ecology data, surveys were carried out in the months of November and December 2024 in project areas of Sonitpur, Biswanath and Lakhimpur District. The biodiversity assessment report and the primary ecological data collected is appended in Appendix 7. The study area was 1 km radius of the project interventions, dividing the study into three zone; Core (project interventions works), Inner Buffer Zone (500 meters from the core) and Outer Buffer Zone (500 meters to 1 km area). Methods adopted for Survey and data collection included:

1. Transect belt method for flora and fauna
2. Walk Through method for flora and fauna
3. Spot Method for avifauna
4. Call detection method for avifauna
5. Pug mark of animals on sandy river beds for fauna
6. Fishing point for aquatic fauna

228. Secondary data like forest working plan for respective forest divisions, publications, similar reports etc. were also used to compile and conform the data.

Terrestrial and Aquatic Flora

229. The vegetation assessment of the study areas revealed a diverse array of plant species including trees, shrubs and herbs. Some bamboo and banana species were also documented. Predominantly native, these plants thrive in the Brahmaputra floodplains, supporting soil stability, local fauna habitats, and ecosystem resilience. The vegetation primarily supports the agricultural and ecological systems by stabilizing the soil. The project site is dominated by growth of herbs and shrubs followed by trees. Grasses and invasive shrubs dominate the ground cover of the core areas. The no. of trees increases in the buffer areas. All the species of trees, shrubs, herbs, climbers and grasses are recorded adopting line transect methods. After identification of the plants, we have checked for their correct scientific names and confirmed their presence with the help of online database "Plants of the World Online" of Royal Botanical Garden, Kew.

230. As a result of the documentation of the flora of the study areas, there are 110 plant species. 39 of them are trees, 26 numbers of plants are shrubs and 39 herbs which include aquatic, cultivated, ornamental plants and a few climbers. Though the study sites almost show similar kind of vegetation (all are Brahmaputra river banks). But the sites are located in far distances from each other. Only exception is the 3 sites of Bonpuroi Jamuguri, which are adjacent to each other. There are 16 trees, 8 shrubs and 14 herbs in Zahaz Ghat; 21 trees, 18 shrubs and 21 herbs in Jarani; 21 trees, 14 shrubs and 23 herbs in Rangchali Dalani; 12 trees, 7 shrubs and 17 herbs in Paken; 19 trees, 11 shrubs and 20 herbs in Bonpuroi Jamuguri; 17 trees, 13 shrubs and 21 herbs in Bandana Check Bund to Matmara; and 17 trees, 14 shrubs and 20 herbs in Baligaon to Papung.

231. As the core areas are basically sandbars, trees are mostly present in the buffer areas. Both planted and naturally growing trees are there in the study sites. Trees like Ximolu (*Bombax ceiba*), Bhelkol or Bheleu (*Mallotus nudiflorus*), Khakasa Dimoru (*Ficus hispida*) are naturally growing whereas trees like aam (*Mangifera indica*), Hilikha (*Terminalia chebula*), Arjun (*Terminalia arjuna*) are planted by people. Ximolu (*Bombax ceiba*) and Bheleu (*Mallotus nudiflorus*) being the elements of secondary succession playing role in creating forests in the river sides. The trees reported can be classified as fruit bearing, timber trees and shade trees. All the 39 trees reported in the study are *Aegle marmelos*, *Albizia chinensis*, *Alstonia scholaris*, *Areca catechu*, *Artocarpus heterophyllus*, *Averrhoa carambola*, *Bischofia javanica*, *Bombax ceiba*, *Carica papaya*, *Cocos nucifera*, *Corymbia maculate*, *Delonix regia*, *Ehretia acuminata*, *Erythrina variegata*, *Ficus hispida*, *Ficus racemose*, *Ficus rumphii*, *Heteropanax fragrans*, *Lagerstroemia speciosa*, *Litsea monopetala*, *Mallotus nudiflorus*, *Mallotus tetracoccus*, *Mangifera indica*, *Melia azedarach*, *Moringa oleifera*, *Neolamarckia cadamba*, *Oroxylum indicum*, *Peltophorum pterocarpum*, *Phyllanthus emblica*, *Pongamia pinnata*, *Psidium guajava*, *Spondias pinnata*, *Streblus asper*, *Syzygium cumini*, *Tamarindus indica*, *Terminalia arjuna*, *Terminalia chebula*, *Toona ciliate* and *Ziziphus mauritiana*.

232. A total of 26 shrubs are found in the study sites. They are *Calotropis gigantea*, *Camellia sinensis*, *Chromolaena odorata*, *Citrus maxima*, *Citrus × limon*, *Clerodendrum indicum*, *Clerodendrum infortunatum*, *Datura metel*, *Glycosmis pentaphylla*, *Hibiscus mutabilis*, *Hibiscus × rosa-sinensis*, *Ipomoea carnea*, *Jatropha curcas*, *Lippia javanica*, *Mallotus roxburghianus*, *Malvaviscus arboreus*, *Ocimum americanum*, *Pandanus odorifer*, *Passiflora foetida*, *Ricinus communis*, *Sarcochlamys pulcherrima*, *Senna alata*, *Senna tora*, *Tabernaemontana divaricata*, *Tamarix dioica*, *Urena lobata*, and *Xanthium strumarium*. Among them, *Lippia javanica* (Pohukota Bon), *Ipomoea carnea* (Panibhutura or Bor Kolmou), *Chromolaena odorata* (Germany Bon) are invasive plants and available in most of the sites. *Tamarix dioica* (Jhau Bon), *Xanthium strumarium* (Agara Gutti), and *Glycosmis pentaphylla* (Hengenapoka) were other common species across the study sites. Most of these grow naturally, except a few cultivated for fruits or ornamental purposes.

233. Among the herb species, both short and tall grasses, one ornamental species, three cultivated species, one fern, and four climbers were found, along with other herbs. *Nol* (*Arundo donax*), *Birina* (*Chrysopogon zizanioides*), *Horon Kher* (*Imperata cylindrica*), *Khagari* (*Phragmites karka*), and *Ikora*

(*Tripidium ravennae*) were the tall grasses documented. *Dubori Bon* (*Cynodon dactylon*), *Keya Bon* (*Cyperus brevifolius*), *Mutha Bon* (*Cyperus iria*), *Mutha Bon* (*Cyperus rotundus*), *Bobosa Bon* (*Eleusine indica*), *Bonguti* (*Eragrostis atrovirens*), and *Bahpotia Bon* (*Oplismenus compositus*) were the short grasses recorded in the study. Among these, *Cynodon dactylon*, *Cyperus brevifolius*, *Cyperus rotundus*, and *Oplismenus compositus* were present in all study areas.

234. *Thelypteris parasitica*, commonly known as *Bih dhekia*, was the only fern identified and was present in all study areas. Climbers included *Cuscuta reflexa*, *Ficus heterophylla*, *Ipomoea quamoclit*, *Piper thomsonii*, and *Mikania micrantha*. *Mikania micrantha*, commonly called *Amor lota*, an invasive climber, was present in all areas. Cultivated crop plants included *Rongalau* (*Cucurbita maxima*), *Halodhi* (*Curcuma longa*), and *Til* (*Sesamum indicum*). *Nargi Ful* (*Tagetes erecta*) was the only ornamental herb recorded. One aroid, *Kolakosu* (*Colocasia esculenta*), was present across all sites. Similarly, *Chromolaena corymbosa*, locally called *Gundhua Bon*, was an invasive herb present in all study areas. Other herbs recorded were *Achyranthes aspera*, *Amaranthus spinosus*, *Cleome viscosa*, *Euphorbia hirta*, *Leucas zeylanica*, *Lemna perpusilla*, *Nicotiana plumbaginifolia*, *Parthenium hysterophorus*, *Persicaria barbata*, *Persicaria hydropiper*, *Physalis angulata*, *Portulaca oleracea*, *Pontederia crassipes*, *Scoparia dulcis*, and *Solanum lasiocarpum*. Among these, *Leucas zeylanica* was present in all study areas.

235. Two bamboo species, *Bholuka Baah* (*Bambusa balcooa*) and *Jati Baah* (*Bambusa tulda*), and one cane species, *Jati Bet* (*Calamus tenuis*), were found in the study areas. These are planted by people for various purposes. Additionally, three banana species were recorded: *Jahaji Kol* (*Musa acuminata*), *Aathia Kol* (*Musa balbisiana*), and *Kas Kol* (*Musa × paradisiaca*).

236. The project may entails cutting of trees in project areas due to construction of new embankment and some anti-erosion works and other project activities. The number of trees to be felled is yet to be determined as of the time of preparation of the IEE. The number will be finalized at the preconstruction stage. Information on the number of trees to be cut will be indicated in the environmental monitoring report.

237. **Canopy Cover (Core Zone):** Because most of the core area is sand bars and direct river banks. Trees are almost absent in the core areas. So, canopy cover is not calculated

238. **Ground Cover (Core Zone):** The ground cover flora within the core area consists mainly of herbs, mostly grasses and shrubs. Shrubs reported within the impact zone include *Lippia javanica* (Pohukota Bon), *Ipomoea carnea* (Panibhutura or Bor Kolmou), *Chromolaena odorata* (Germany Bon), *Tamarix dioica* (Jhau Bon), and *Xanthium strumarium* (Agara Gutu).

239. Grasses reported from the core area include *Dubori Bon* (*Cynodon dactylon*), *Keya Bon* (*Cyperus brevifolius*), *Mutha Bon* (*Cyperus rotundus*), *Bobosa Bon* (*Eleusine indica*), *Bonguti* (*Eragrostis atrovirens*), and *Bahpotia Bon* (*Oplismenus compositus*), along with *Nol* (*Arundo donax*), *Birina* (*Chrysopogon zizanioides*), and *Horon Kher* (*Imperata cylindrica*).

240. Other herbs reported within the core zone include *Chromolaena corymbosa*, *Colocasia esculenta*, *Ficus heterophylla*, *Thelypteris parasitica*, *Achyranthes aspera*, *Amaranthus spinosus*, *Cleome viscosa*, *Leucas zeylanica*, *Parthenium hysterophorus*, and *Scoparia dulcis*.

241. **Invasive Plant Species:** The survey identified various invasive species across all study sites, primarily herbs, climbers, and shrubs. No invasive tree species were found. The invasive shrub species reported from the study area include *Panibhutura* (*Ipomoea carnea*), *Germany Bon* (*Chromolaena odorata*), and *Pohukata Bon* (*Lippia javanica*), all of which are widespread throughout the study sites. Similarly, two invasive herbs, *Gundhua Bon* (*Chromolaena corymbosa*) and *Parthenium* (*Parthenium hysterophorus*), are commonly found across most sites. In some locations, *Amar Lota* (*Mikania micrantha*), a highly invasive climber, was observed. Some grasses, such as

Xoron Kher (Imperata cylindrica), were also non-native. *Water Hyacinth* or *Meteka (Pontederia crassipes)*, a prevalent aquatic invasive plant in Assam, was noted at some sites.

242. **Aquatic Plants:** The Brahmaputra River's dynamic riparian habitat experiences constant change due to strong currents and monsoon flooding. However, no stable riparian habitat was observed in the study areas, largely due to severe bank erosion. The study identified only a few aquatic plant species, as the survey was conducted during the dry season when most temporary water bodies had dried up. Recorded species included *Meteka (Pontederia crassipes)*, *Horu-Puni (Lemna perpusilla)*, and two species of *Persicaria (Biholongoni)*: *Persicaria barbata* and *Portulaca oleracea*. Additionally, semi-aquatic plants like *Panibhutura (Ipomoea carnea)* were also noted.

243. **Sandbars and Sandy Riverbeds Vegetative Cover:** The core study areas were primarily sandbars. During the winter season, these areas are almost dry. Grasses such as *Dubori Bon (Cynodon dactylon)*, *Keya Bon (Cyperus brevifolius)*, *Mutha Bon (Cyperus rotundus)*, and *Bahpotia Bon (Oplismenus compositus)* were present on the sandbars. Two invasive plants, *Parthenium (Parthenium hysterophorus)* and *Pohukata Bon (Lippia javanica)*, were also recorded in some areas. *Jhau Bon (Tamarix dioica)*, a shrub commonly found in riverbeds, was also present in some locations.



Germany Bon (*Chromolaena odorata*)



Kathanda (*Tabernaemontana divaricate*)



Agara Gutti (*Xanthium strumarium*)



Bogori (*Ziziphus mauritiana*)



Kolakosu (*Colocasia esculenta*)



Jati Baah (*Bambusa tulda*) and Jati Bet (*Calamus tenuis*)

Figure 5-28. Photographs of Some Floral Species in the project areas.

Terrestrial and Aquatic Fauna

Butterflies

244. Assam has rich floral diversity. This result in large varieties of butterflies. Largenumber of butterflies were reported during primary survey within the core zone and from buffer zone. Spot methods, walk through and transect methods were adopted to record the butterflies in study. About 12 species off butterflies were reported. The most commonly reported butterfly are small grass yellow, common grass yellow and lemon pansy. Table below gives the list of butterflies reported in study area

Migratory Route of Fauna

Table 5-31. Butterfly diversity across the project locations.

Sr. No.	Family	Scientific Name	Common Name	IUCN Category	IWPA 1972	Study Area
1	Lycaenidae	<i>Chilades lajus</i>	Lime Blue	LC	Not listed	Core+Buffer
2	Lycaenidae	<i>Acrocnemis violacea</i>	Lesser Glass Blue	LC	Not listed	Core+Buffer
3	Nymphalidae	<i>Junonia lemonias</i>	Lemon Pansy	LC	Not listed	Core+Buffer
4	Nymphalidae	<i>Junonia atlites</i>	Grey Pansy	LC	Not listed	Core
5	Pieridae	<i>Eurema hecabe</i>	Common Grass Yellow	LC	Not listed	Core+Buffer
6	Nymphalidae	<i>Mycalesis perseus</i>	Common Brush Brown	LC	Schedule I	Core+Buffer
7	Nymphalidae	<i>Danaus chrysippus</i>	Plain Tiger	LC	Not listed	Core
8	Nymphalidae	<i>Athyma perius</i>	Common Sergeant	LC	Not listed	Core+Buffer
9	Papilionidae	<i>Papilio demoleus</i>	Lime Butterfly	DD	Not listed	Core+Buffer
10	Pieridae	<i>Pieris canidia</i>	Indian Cabbage White	LC	Schedule I	Core+Buffer
11	Pieridae	<i>Eurema brigitta</i>	Small Grass Yellow	LC	Not listed	Core+Buffer
12	Nymphalidae	<i>Cepora nadina</i>	Lesser Gull	LC	Not listed	Core+Buffer

Amphibians

245. Seven amphibian species were recorded from the buffer areas of the project locations. The species of amphibian reported from the study areas are *Duttaphrynus melanostictus*, *Polypedates teraiensis*, *Hoplobatrachus tigerinus*, *Euphlyctis cyanophlyctis*, *Hylarana leptoglossa*, and *Microhyla ornata*. None of the Amphibian species reported falls under any threatened category in the IUCN Red List.

Reptiles

246. No reptilian species were noticed during primary survey. Based on interaction with locals 13 reptilian species were reported from during survey. 12 out of all the reptiles reported in the study area are rated Least Concern by IUCN. Only one species, i.e. Bengal Monitor has been listed under Near Threatened category of IUCN Red List. The reported species are Indian Rat Snake, Chinese Rat Snake, Monocled Cobra, Checkered Keelback, Red-necked Keelback, Copper-headed Trinket, Common Wolf Snake, Buff-striped Keelback, Painted Bronzeback, Bengal Monitor Lizard, Common House Gecko, Garden Lizard, Many-lined Grass Skink.

Fishes

247. To record the distribution of fish species in a 1 km study area, all fishing points near settlements were surveyed. About 9 fishing points were visited. A total of 23 fish species were reported from the study area in the Brahmaputra River. Based on primary surveys, the species recorded included *Labeo gonius*, *Wallago attu*, *Cirrhinus cirrhosus*, *Cirrhinus reba*, *Labeo bata*, *Labeo calbasu*, *Labeo rohita*, *Mystus vittatus*, *Rita rita*, *Chitala chitala*, and others. Secondary sources confirmed additional species such as *Amblypharyngodon mola*, *Aspidoparia morar*, and *Clupisoma garua*, which are sold in local markets. Notably, *Wallago attu* is listed under the Vulnerable category of the IUCN Red Data Book, but it is a commonly and commercially available fish in the fish markets of Assam. Based on the desktop review, it is anticipated that species like *Tor putitora* (LC), *Anguilla bengalensis* (LC), and others may also be present in the study area.

Avifauna

248. Based on primary survey and secondary findings, 66 species of birds are reported in the core and buffer areas of the proposed project sites. One vulnerable (VU) species i.e Swamp francolin (*Francolinus gularis*) was reported in Jaroni area of Sonitpur. Remaining 65 species of birds are listed under Least Concern (LC) as per IUCN Red List of threatened species. One species i.e Swamp francolin is listed under Schedule-I and others are listed under Schedule II of Wildlife protection act 1972 (2022 amendments). Based on Habitat distribution about 11 species are found in agricultural areas, 17 are from forested areas, one from the grassland areas, 10 are from river banks, 9 are riverine, one from sand bar, 4 are from swampy areas, and 4 are cosmopolitan species.

249. To record the species distribution 12, transect survey method, 12 walk through survey methods and 12 point count methods were adopted. Line transect and walk through methods were adopted to carry out avifaunal study. The location of transect were same as those for Flora study proposed. The spot study locations for avifauna are same as proposed for floral Quadrant Locations. Based on random count methods, The total population avifauna reported are 2560 individuals within 1 km radius. These are not the actual population of avifauna in study area, but project population based on primary survey. Based on the log book, it has been reported that 54 species of birds are recorded by transect methods, 11 species were recorded during point count method, and one was recorded by call detection method The details of avifauna reported in the study area is given in the following Table 5-32.

Table 5-32. List of avian fauna reported from the project locations.

S. No	Common Name	Scientific Name	Reported	IUCN Red list	WPA-72
1	Whistling Duck	<i>Dendrocygna javanica</i>	Sighted	LC	Schedule II
2	Ruddy Shelduck	<i>Tadorna ferruginea</i>	Sighted	LC	Schedule II
3	Little Cormorant	<i>Microcarbo niger</i>	Sighted	LC	Schedule II
4	Common Myna	<i>Acridotheres tristis</i>	Sighted	LC	Schedule II
5	Jungle Myna	<i>Acridotheres fuscus</i>	Sighted	LC	Schedule II
6	Chestnut-tailed Myna	<i>Sturnia malabarica</i>	Sighted	LC	Schedule II
7	Asian Pied Starling	<i>Gracupica contra</i>	Sighted	LC	Schedule II
8	Barn Swallow	<i>Hirundo rustica</i>	Sighted	LC	Schedule II
9	Grey-throated Martin	<i>Riparia paludicola</i>	Sighted	LC	Schedule II
10	Cattle Egret	<i>Bubulcus ibis</i>	Sighted	LC	Schedule II
11	Intermediate Egret	<i>Ardea intermedia</i>	Sighted	LC	Schedule II
12	Little Egret	<i>Egretta garzetta</i>	Sighted	LC	Schedule II
13	Grey Heron	<i>Ardea cinerea</i>	Sighted	LC	Schedule II
14	Indian Pond Heron	<i>Ardeola grayii</i>	Sighted	LC	Schedule II
15	White-breasted Waterhen	<i>Amaurornis phoenicurus</i>	Sighted	LC	Schedule II
16	Little Ringed Plover	<i>Charadrius dubius</i>	Sighted	LC	Schedule II
17	Red-wattled Lapwing	<i>Vanellus indicus</i>	Sighted	LC	Schedule II
18	Green Sandpiper	<i>Tringa ochropus</i>	Sighted	LC	Schedule II
19	Wood Sandpiper	<i>Tringa glareola</i>	Sighted	LC	Schedule II
20	Common Sandpiper	<i>Actitis hypoleucos</i>	Sighted	LC	Schedule II
21	House Crow	<i>Corvus splendens</i>	Sighted	LC	Schedule II
22	Large-billed Crow	<i>Corvus macrorhynchos</i>	Sighted	LC	Schedule II
23	Cinereous Tit	<i>Parus cinereus</i>	Sighted	LC	Schedule II
24	House Sparrow	<i>Passer domesticus</i>	Sighted	LC	Schedule II

S. No	Common Name	Scientific Name	Reported	IUCN Red list	WPA-72
25	Eurasian Tree Sparrow	<i>Passer montanus</i>	Sighted	LC	Schedule II
26	White Wagtail	<i>Motacilla alba</i>	Sighted	LC	Schedule II
27	Eastern Yellow Wagtail	<i>Motacilla tschutschensis</i>	Sighted	LC	Schedule II
28	Paddyfield Pipit	<i>Anthus rufulus</i>	Sighted	LC	Schedule II
29	Rosy Pipit	<i>Anthus roseatus</i>	Sighted	LC	Schedule II
30	Sand Lark	<i>Alaudala raytal</i>	Sighted	LC	Schedule II
31	Baya Weaver	<i>Ploceus philippinus</i>	Sighted	LC	Schedule II
32	Eurasian Hoopoe	<i>Upupa epops</i>	Sighted	LC	Schedule II
33	Black-hooded Oriole	<i>Oriolus xanthornus</i>	Sighted	LC	Schedule II
34	Spotted Dove	<i>Spilopelia chinensis</i>	Sighted	LC	Schedule II
35	Red-collared Dove	<i>Streptopelia tranquebarica</i>	Sighted	LC	Schedule II
36	Eurasian Collared Dove	<i>Streptopelia decaocto</i>	Sighted	LC	Schedule II
37	Long legged buzzard	<i>Buteo rufinus</i>	Sighted	LC	Schedule II
38	Black-winged Kite	<i>Elanus caeruleus</i>	Sighted	LC	Schedule II
39	Black Kite	<i>Milvus migrans</i>	Sighted	LC	Schedule II
40	Eurasian Kestrel	<i>Falco tinnunculus</i>	Sighted	LC	Schedule II
41	Spotted Owlet	<i>Athene brama</i>	Sighted	LC	Schedule II
42	Collared Scops Owl	<i>Otus bakkamoena</i>	Sighted	LC	Schedule II
43	Barn Owl	<i>Tyto alba</i>	Sighted	LC	Schedule II
44	Asian Barred Owlet	<i>Glaucidium cuculoides</i>	Sighted	LC	Schedule II
45	Brown Boobook	<i>Ninox scutulata</i>	Sighted	LC	Schedule II
46	Asian Palm Swift	<i>Cypsiurus balasiensis</i>	Sighted	LC	Schedule II
47	Greater Coucal	<i>Centropus sinensis</i>	Sighted	LC	Schedule II
48	Lesser Coucal	<i>Centropus bengalensis</i>	Sighted	LC	Schedule II
49	Asian Koel	<i>Eudynamis scolopaceus</i>	Sighted	LC	Schedule II
50	Common Hawk-Cuckoo	<i>Hierococcyx varius</i>	Sighted	LC	Schedule II
51	Rose-ringed Parakeet	<i>Psittacula krameri</i>	Sighted	LC	Schedule II
52	White-throated Kingfisher	<i>Halcyon smyrnensis</i>	Sighted	LC	Schedule II
53	Pied Kingfisher	<i>Ceryle rudis</i>	Sighted	LC	Schedule II
54	Asian Green Bee-eater	<i>Merops orientalis</i>	Sighted	LC	Schedule II
55	Indochinese Roller	<i>Coracias affinis</i>	Sighted	LC	Schedule II
56	Blue-throated Barbet	<i>Psilopogon asiaticus</i>	Sighted	LC	Schedule II
57	Coppersmith Barbet	<i>Psilopogon haemacephalus</i>	Sighted	LC	Schedule II
58	Black-rumped Flameback	<i>Dinopium benghalense</i>	Sighted	LC	Schedule II
59	Rufous Treepie	<i>Dendrocitta vagabunda</i>	Sighted	LC	Schedule II
60	Siberian Stonechat	<i>Saxicola maurus</i>	Sighted	LC	Schedule II
61	Grey-backed Shrike	<i>Lanius tephronus</i>	Sighted	LC	Schedule II
62	Red-vented Bulbul	<i>Pycnonotus cafer</i>	Sighted	LC	Schedule II
63	Dusky Warbler	<i>Phylloscopus fuscatus</i>	Sighted	LC	Schedule II
64	Common Tailorbird	<i>Orthotomus sutorius</i>	Sighted	LC	Schedule II
65	Common Iora	<i>Aegithina tiphia</i>	Sighted	LC	Schedule II
66	Swamp Francolin	<i>Francolinus gularis</i>	Sighted	VU	Schedule I

Mammalian Species

Terrestrial Mammals

250. During survey and secondary information, 18 mammalian species were recorded/sighted within construction zone and within 1 km radius. Based on secondary information and interaction with locals, about 10 species were reported to be found in the project areas and 8 were observed during the primary survey using line transect and point count methods. Four mammalian species reported during secondary information falls under IUCN red list category endangered (EN) (Asian Elephant, Ganges River Dolphin, Hog Deer and Bengal Tiger), two under Vulnerable (VU) (Sambar, Leopard), and rest 12 falls under Least concern (LC) category.

Aquatic Mammals

251. The Brahmaputra River supports significant biodiversity, including the Ganges River Dolphin (*Platanista gangetica*), a Schedule I species under the Wildlife Protection Act, 1972. This river system harbors around 30% of the global dolphin population, with approximately 877 individuals in the Brahmaputra basin, as per Qureshi et al. 2022. Key habitats include Dibru-Saikhowa, Kaziranga, and Orang National Parks. Dolphin hotspots are near Sivasagar, Kaziranga-Tezpur, Guwahati, and Goalpara-Dhubri. The primary survey indicated dolphin activity in areas with favorable habitat conditions, such as mid-channel islands and meanders, with no sightings within 100 meters of the riverbank in the project locations.

Table 5-33. Dolphin distribution throughout the project sites.

S.No.	Project area	Subdivision	Dolphin Distribution	
			Within 100 m	100m-1km
1	U/S of Bandana Check Bund to Matmara	Dhakuakhona	-	+
2	Baligaon to Papung	Dhakuakhona	-	+
3	Bonpuroi Jamuguri	North Lakhimpur	-	+
4	Bonpuroi Jamuguri	North Lakhimpur	-	-
5	Bonpuroi Jamuguri	North Lakhimpur	-	+
6	Paken	Biswanath	-	-
7	Rangchali Dalani	Biswanath	-	+
8	Zahaz Ghat	Sonitpur	-	+
9	Jarani	Sonitpur	-	+

Migratory Route of Fauna

252. The State of Assam lie within an ecologically significant region that intersects with both the Central Asian Flyway and the East Asian-Australasian Flyway, making these areas important for migratory bird species. These flyways serve as essential corridors for birds traveling between their breeding grounds in Central Asia, Siberia, and Mongolia and their wintering sites in the Indian subcontinent. The Brahmaputra River and its adjacent wetlands, which extend through the project areas, provide critical stopover, feeding, and resting habitats for migratory birds during their long-distance journeys.

253. The project area, particularly near Kaziranga National Park and the riverine stretches of Biswanath and Lakhimpur, is a well-documented migration zone for waterfowl and shorebirds. Species such as bar-headed geese (*Anser indicus*), northern pintails (*Anas acuta*), ruddy shelducks (*Tadorna ferruginea*), and black-tailed godwits (*Limosa limosa*) are commonly recorded in the wetlands and open water bodies along the Brahmaputra River. These birds use the region as a temporary refuge, stopping to feed on aquatic vegetation, fish, and invertebrates before continuing their migration southward.

254. Additionally, forested and riparian zones in Sonitpur and Dhakuakhana attract migratory raptors and passerines, including the Amur falcon (*Falco amurensis*) and various species of warblers and flycatchers. These birds navigate the flyway using a mix of riverine landscapes, agricultural fields, and fragmented forests as resting and foraging sites. The presence of seasonal wetlands and floodplains within the project areas further enhances the region's importance for migratory ducks, storks, and herons, many of which depend on the Brahmaputra River's shallow water zones during the winter months.

255. Due to the unique geographical setting of the project sites, the region continues to play a crucial role in supporting migratory bird populations moving along the flyways. The connectivity of wetlands, riverbanks, and floodplains in these areas ensures that migratory birds can safely navigate through Assam, reinforcing the ecological importance of the Brahmaputra floodplain as a key stopover region.

256. Brahmaputra River in Assam serves as a vital corridor for migratory fish species, notably Hilsa (*Tenualosa ilisha*) and freshwater eels of the genus *Anguilla*. These species exhibit distinct migratory behaviors essential for their life cycles. Hilsa is an anadromous fish, meaning it migrates from the sea into freshwater rivers to spawn. During the spawning season, mature Hilsa undertake upstream migrations from the Bay of Bengal into the Brahmaputra River and its tributaries. They prefer the main river channels and deeper zones for their journey, seeking suitable spawning grounds characterized by specific hydrological conditions. After spawning, the adult Hilsa return to the sea, while the juveniles, known locally as "jatka," gradually make their way downstream to marine environments as they mature.

257. *Anguilla* species, commonly referred to as freshwater eels, display catadromous migration, moving from freshwater habitats to the sea to reproduce. These eels spend the majority of their lives in freshwater systems, including the Brahmaputra River, and migrate to the ocean's deeper zones for spawning. Post-spawning, the larvae, called leptocephali, drift with ocean currents until they reach coastal areas, where they metamorphose into glass eels and migrate back into freshwater systems to grow and mature.

258. The proposed project interventions, focusing on riverbank stabilization and flood management, are primarily concentrated along the riverbanks and are designed to enhance flood resilience without altering the main river channels or deeper zones. Given that both Hilsa and *Anguilla* utilize the central and deeper parts of the river for their migrations, it is anticipated that these interventions will not impede their migratory routes. Moreover, the project's design includes considerations to maintain the natural flow regimes and sediment transport processes essential for these species' life cycles.

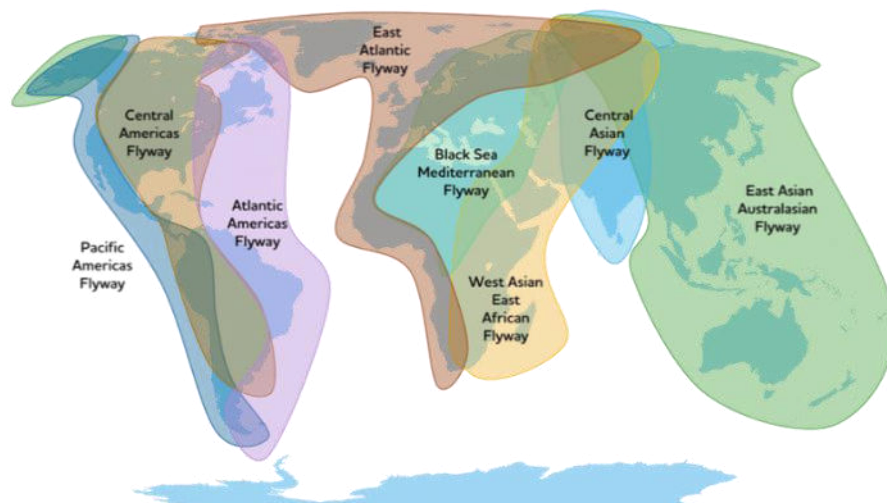


Figure 5-29. Migratory flyways across the globe.

River Dolphin and its Behavior Patterns

259. Gangetic river Dolphins prefers deep waters, in and around the confluence of two or more rivers. River dolphins are reported within 100m – 1 km in the project area as per the report of M2M. Thus, these species shall not be impacted as there are no confluences of rivers in the project area and the works are within 30m from the bank. These works furthermore shall be taken up in the dry season.

260. However, Gangetic River Dolphins have developed a unique side swimming behavior which is an adaptation to help them navigate through shallow waters, thus, it may be likely that this species of dolphins can occasionally venture within 30m of the riverbanks. The impact would occur due to accidental hitting of the dolphins by the barges carrying materials for the project and by being stuck in the shallow waters. However, the Dolphins have capacity of echolocation as validated by Herald, E. S., et al and hence the probability of the dolphins getting accidentally hit by the barges is unlikely. Similarly, the probability of dolphins getting stuck in the shallow water near the banks is also less.

IBAT Screening Assessment

261. As per information made available from IBAT 36, there are 61 IUCN red listed species within 50 km radius of the project area. These includes 23 CR (8 floral, 8 avian, 6 reptilian and 1 mammalian species), 38 EN (4 floral, 2 Chordate, 9 reptilian, 9 avian and 14 mammalian species). And 58 restricted species reported in IBAT assessment out of which 21 LC (10, Chordates, 9 amphibia, 1 Isopoda and 1 floral), 18 -DD (1, Ambibia,2, Bivalvia, 2 gastropoda,4 insecta, 3, Isopoda,10, Chrodates), 14VU (3, amphibian, 4, Chrodates, 6,Avians,1 reptilia) 4 NT (Chrodates) and one EN (mammal)

262. All the proposed sites under Additional High Priority works are located outside any forest or protected areas. However, the Rangachali Dalani site in Biswanath district is near the notified boundary of Kaziranga National Park. A No Objection Certificate has been obtained from the Field Director of Kaziranga and the Divisional Forest Officer of Biswanath. Negative impacts on the park area are not anticipated as the proposed work is on the opposite bank of the Brahmaputra River. (the NOC is annexed in Appendix 16).

263. The IBAT data shows 1,642 species that have the potential to be present within 50 km of the project area of influence (Aol). These species by their taxonomic groups and IUCN global threat status are presented below.

Table 5-34. Species present or potentially present within 50 km IBAT Report.

Area Taxonomic group	Total assessed species	Total (CR, EN and VU)	CR	EN	VU	NT	LC	DD
Reptilia	128	23	6	9	8	5	96	4
Aves	676	40	8	8	24	38	598	0
Mammalia	134	34	1	14	19	12	84	4
Actinopterygii	115	9	0	2	7	12	81	13
Amphibia	74	4	0	0	4	1	63	6
Malacostraca	30	1	0	0	1	2	13	14
Gastropoda	70	1	0	0	1	0	49	20
Insecta	135	1	0	1	0	1	122	11
Bivalvia	52	0	0	0	0	1	35	16
Polypodiopsida	4	0	0	0	0	0	4	0

³⁶ IBAT report for proposed high priority work sites

Area Taxonomic group	Total assessed species	Total (CR, EN and VU)	CR	EN	VU	NT	LC	DD
Magnoliopsida	136	14	5	3	6	2	112	8
Liliopsida	83	7	3	1	3	0	71	5
Sordariomycetes	1	1	0	0	1	0	0	0
Agaricomycetes	1	0	0	0	0	0	1	0
Arachnida	3	0	0	0	0	0	3	0
	1,642	135	23	38	74	74	1,332	101

Source: IBAT assessment of project areas

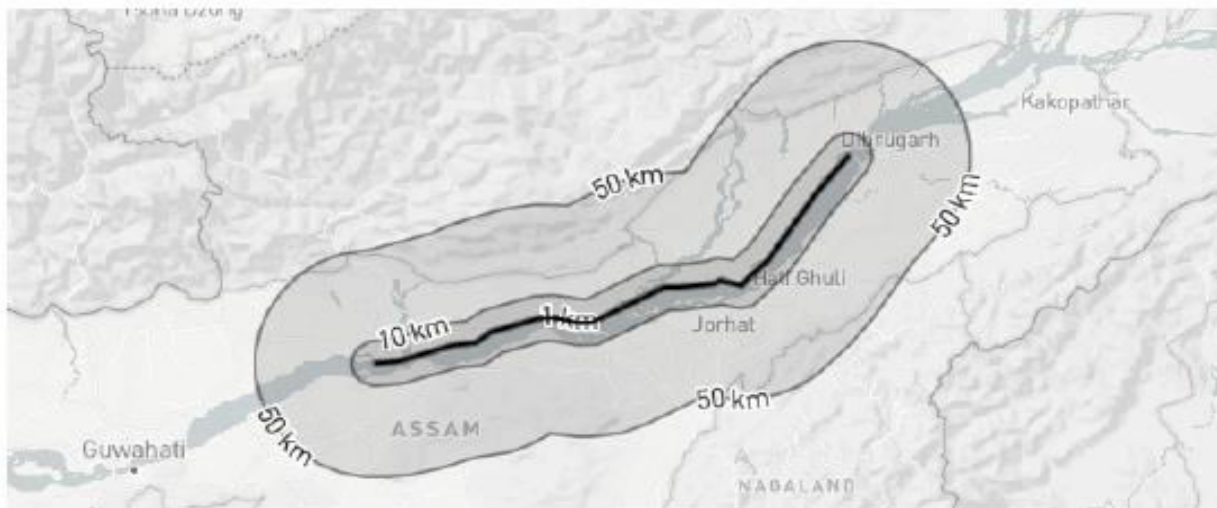


Figure 5-30. IBAT Screening map showing project locations and buffers 1 km, 10km 50 km.

Critical Habitat Assessment

264. A 1-kilometer Area of Influence (Aoi) has been established to evaluate both the direct and indirect environmental impacts of the project and to comprehensively understand the ecological patterns, processes, and functions within the project area. This Aoi encompasses not only the immediate zones of construction and intervention but also areas that could be affected by secondary impacts, such as changes in sediment flow, and human activity patterns. The Aoi includes key ecological features like Protected Areas (PAs) and Important Bird Areas (IBAs), ensuring that the biodiversity and natural resources are assessed holistically. Additionally, the Aoi has been defined in alignment with International Finance Corporation (IFC) Performance Standard 6 thresholds, which provide a global framework for identifying and managing biodiversity risks and impacts.

265. The screening process under Criterion 1 (presence of critically endangered or endangered species) and Criterion 2 (restricted-range species) from the ADB SPS 2009 identified five species that potentially meet the Critical Habitat criteria. These species either occur within the Aoi or are assumed to occur based on a precautionary approach. Among these are the Assam Roofed Turtle (*Pangshura sylhetensis*), Hog Deer (*Axis porcinus*), and Wild Water Buffalo (*Bubalus arnee*). These species are of significant conservation concern due to their restricted distributions and declining populations, making the areas they inhabit ecologically sensitive. A detailed account of these species, including their population status and distribution in the project area, is provided in Table 5-35.

266. To supplement the screening process, primary biodiversity surveys were conducted between November and December 2024. During these surveys, two Ganges River Dolphins (*Platanista gangetica*) were directly observed near the Zahajghat area, approximately 100 meters from the

riverbank. In addition to these sightings, local consultations revealed that 3 to 4 dolphins are regularly observed in the Zahajghat area. These observations are consistent with data from Qureshi et al. (2022), which categorize Sonitpur district as a moderate sighting area for this species. In other areas of the project, no dolphins were directly sighted during the surveys, but rare sightings were reported by local residents. In Jaroni (Sonitpur district), 1 to 2 individuals are occasionally observed during the monsoon season. In North Lakhimpur district, residents reported 4 to 5 individuals between the Bandana to Matmora and Baligaon to Papung stretches of the Brahmaputra River, categorizing this region as a low-sighting zone. Additionally, 1 to 2 individuals were reported in the Bonpuroi-Jamuguri stretch of North Lakhimpur during peak monsoon periods. In Paken and Rangchali Dalani of Biswanath district, extremely rare sightings of 1 to 2 dolphins were reported by residents during the monsoon season. Cumulatively, these reports suggest that 9 to 10 dolphins may inhabit the broader project area. However, the population size does not meet the ADB SPS thresholds for Critical Habitat designation, as the area does not support ≥ 25 individuals or ≥ 5 reproductive units, which would represent $\geq 0.5\%$ of the global population.

267. The project area is situated in a highly modified landscape, where anthropogenic activities such as fishing, agriculture, tea cultivation, and human settlements are prevalent along the riverbanks. These human activities have significantly shaped the region’s ecological dynamics and may influence the biodiversity present in the area. While there is potential for disturbances to Ganges River Dolphins from the transportation of construction materials via barges, the project schedule ensures that construction will occur during the dry season. During this period, dolphins typically occupy deeper river channels, reducing the likelihood of direct interactions with construction activities near the riverbanks. Furthermore, the presence of traditional fishing practices highlights the region's biodiversity significance from a social, economic, and cultural perspective, particularly for local communities that rely on the river for their livelihoods.

268. A Biodiversity Action Plan (BAP) has been prepared to outline specific actions aimed at managing risks to wildlife in the project area. The BAP provides a framework for mitigation measures and monitoring strategies to protect sensitive species and habitats (see BAP in Critical Habitat Assessment, Appendix 14). As part of the project’s ongoing environmental management, the contractor will conduct detailed biodiversity surveys throughout the four high-priority project areas during implementation. The data collected from these surveys will enhance the understanding of species population dynamics, particularly for the Ganges River Dolphin and other species identified during the Critical Habitat screening. The PISC and the PMU will integrate the survey findings and any necessary revisions into the BAP. These updates will be reflected in the IEE and submitted to the ADB for disclosure and further action. This adaptive management approach ensures that the project remains aligned with biodiversity conservation objectives throughout its lifecycle.

Table 5-35. Results of the Criterion 1 and Criterion 2 scoping assessment.

Scientific name	Common Name	Population Sizes	Assessment Results	CH Conclusion
<i>Pangshura sylhetensis</i>	Assam Roofed Turtle (CR)	Around 10-17 individuals are observed in Kaziranga National Park and 2 species in Nameri National Park only. However it is unlikely that this critically endangered species within project sites to regularly holds $\geq 10\%$ of global population and ≥ 10 reproductive units of	Unlikely to meet Criterion 1 and 2, however requires further survey during works	Low probability to trigger Critical Habitat

Scientific name	Common Name	Population Sizes	Assessment Results	CH Conclusion
		the species to qualify as Critical Habitat. No sightings of this species at the project sites.		
<i>Axis porcinus</i>	Hog Deer (EN)	14,000 -16,000 individuals out of maximum of 16,650 population are reported in Kaziranga National Park which is a stronghold of the species located around 6 km South from the project intervention area. It is very unlikely that project sites will hold population $\geq 0.5\%$ of the global population and ≥ 5 reproductive units to qualify the project area as Critical Habitat. No sightings of this species at the project sites.	Unlikely to Criterion 1, however requires further survey during works	Low probability to trigger Critical Habitat
<i>Bubalus arnee</i>	Wild Water Buffalo (EN)	The global population is almost 4,000 individuals whereas Kaziranga National Park strongholds the species and has reported 2,600 individuals as per the departmental counts in 2011. It is unlikely, that project sites will hold population above 0.5% (with 20 individuals) of the global population to qualify as critical habitat. No sightings of this species at the project sites.	Unlikely to meet Criterion 1, requires further survey during works	Low probability to trigger Critical Habitat
<i>Elephas maximus</i>	Asiatic Elephant (EN)	The global population is estimated to exceed 41,000 individuals, however, based on the baseline data collected through stakeholder consultation	100-150 individuals are not adequate to trigger critical habitat thresholds for this species under Criterion 1	Certainly not Critical Habitat under criterion 1

Scientific name	Common Name	Population Sizes	Assessment Results	CH Conclusion
		residents in the project area at Jaroni of Sonitpur district reported that the area harbour herd of 100-150 individuals of elephant species.		
<i>Platanista gangetica</i>	Dolphin	500 individuals globally known. The population present in the AoA is estimated to be between 9-10 individuals altogether.	9-10 individuals are not adequate to trigger critical habitat thresholds of 25 individuals for this species under Criterion 1	Certainly not Critical Habitat under criterion 1

Table 5-36. Summary of CH assessment for criterion 3 to 7.

Critical Habitat Criteria	Critical Habitat Requirements	Trigger present
3 and 4	Migratory and Congregatory species	Project does not constitute Critical Habitat under Criterion 3 or 4
5	Evolutionary processes and Ecosystem services	Project area does not contain Critical Habitat under Criterion 5.
6	Community importance	Project area does not contain Critical Habitat under Criterion 6
7	Protected or designated areas	Project area does not contain Critical Habitat under Criterion 7

269. The proposed project presents a low likelihood of triggering Critical Habitat under the ADB's SPS 2009 for the Assam Roofed Turtle (*Pangshura sylhetensis*), Hog Deer (*Axis porcinus*), and Wild Water Buffalo (*Bubalus arnee*). This is largely due to the fact that Kaziranga National Park is situated on the opposite side of the river from two of the project reaches (40m). The bank protection works will be strictly confined to the riverbank and will involve interventions such as the installation of geo-bags and porcupine screens, with the slope directed toward the countryside. These activities are designed to stabilize the riverbanks without encroaching on sensitive habitats. Moreover, the short duration of the construction activities, combined with the improved riverbank protection, is expected to benefit the area's biodiversity in the long term by preventing erosion and maintaining habitat stability.

270. Several other vulnerable, endangered, and critically endangered species have been identified within the project area. Although these species do not meet the criteria to trigger Critical Habitat designation under ADB SPS, they will still require careful consideration during project design and implementation. Measures will be put in place to avoid, minimize, reduce, and, if necessary, offset any potential adverse impacts on these species.

271. The project area lies within a broader migratory flyway, but the absence of major wetlands and recognized ecological or topographical features means there are no significant stopover points or bottlenecks in close proximity to the project sites. This reduces the likelihood of regular or consistent interactions between the project activities and migratory species. As a result, the project is not expected to cause significant impacts on these species.

272. The Assam Roofed Turtle, Hog Deer, and Wild Water Buffalo are considered to be at low risk from the proposed interventions, given the limited scope of the works and their geographic separation from critical habitats. Nonetheless, ongoing monitoring and mitigation will be incorporated to ensure any unforeseen impacts are promptly addressed.

Key Biological Aspects

273. Summary of the key biological aspects in the PAI are given in

274.

275. Table 5-37.

Table 5-37. Summary of Biological Setting of the PAI.

Particular	Key Features in PAI
Habitat type	<ul style="list-style-type: none"> Modified/natural degraded habitat
Protected Areas in 10 km	<ul style="list-style-type: none"> Kaziranga National Park within 10 KM from proposed interventions at Rangachali Dalani and Paken sites of Biswanath district
Key biodiversity area and IBA in 10km	<ul style="list-style-type: none"> Majuli Island – 1 km from proposed intervention of Dhakukahna Kuarbari Dalani - 2 km from proposed intervention of Dhakukahna
Forest land	<ul style="list-style-type: none"> None within project area
Wetlands	<ul style="list-style-type: none"> None within project area
Surface water bodies	<ul style="list-style-type: none"> Other than the Brahmaputra River, there are some ponds within PAI of project
Trees to be lost	<ul style="list-style-type: none"> Yet to be finalized, shall be finalized during pre-construction stage and IEE shall be accordingly updated
Critical habitat	The project sites are not critical habitat, however biodiversity action plan is prepared to protect wildlife. See Appendix 14 for Critical Habitat Assessment

F. Socio-Economic Settings

276. Lakhimpur District³⁷ was notified as Lakhimpur District through a proclamation issued by then Governor General on July, 1839. On 2nd October, 1971 the district was reorganized with two sub divisions viz. Dhemaji and North Lakhimpur . Later it was again reorganized in the year 1989 with two subdivisions viz. Dhakuakhana and North Lakhimpur leaving Dhemaji as a separate district. The district was earlier regarded as " Koliapani" because there was practically no road communication to this district till 1950. In the year 1954, the temporary aerodrome was started. From 1957 the ASTC buses started plying from Lakhimpur and from 1963 the North East Frontier Railway started train services from this district.

277. Biswanath District, was established on August 15, 2015, it was carved out from parts of the Gohpur and Biswanath subdivisions of the former Sonitpur district., is known for its rich cultural heritage, natural beauty, and economic activities. The district headquarters is in Biswanath Chariali. It includes several subdivisions and development blocks such as Gohpur, Helem, Pub-Chaiduar, and Behali.

278. Sonitpur District³⁸ attained its status as Darrang District in the year 1835 but bifurcated to Darrang district and Sonitpur District in 1983. In the year 2015 again it was bifurcated to Sonitpur and Biswanath District. Tezpur Sub- Division was named as Sonitpur District. Tezpur is a beautiful city with lots of scenic sights.

279. **Demography:** As per the Census 2011, the total population of Assam is 3.12 Cr. Thus, the population of Assam forms 2.58 percent of India in 2011. The total population of the state has

³⁷ <https://lakhimpur.nic.in/Lakhimpur/about.htm>

³⁸ District survey report

increased from in the last ten years with a growth rate of 16.93%. The total population of Assam is expected to reach 34.18 million by 2021 and 35.60 million by 2026. The subproject district with the highest population concentration is North Lakhimpur and lowest in Sonitpur. Facts and figures about demography of the project districts are summarized below in below in Table 5-38.

Table 5-38. Demography of the high priority-project districts.

Indicators	North Lakhimpur	Biswanath	Sonitpur
Area sq. km	2,277	1,415.185	5,324
Actual Population (million)	1.04	0.61	1.92
Male (million)	0.53	0.31	0.98
Female	0.51	0.30	0.94
Population Growth (%)	17.05	12.34	15.67
Density/ km ²	457	432	361
Sex Ratio (Per 1000)	965	968	960
Child Sex Ratio (0-6 Age)	960	955	957
Average Literacy (%)	78.39	76.23	74.21
Male Literacy (%)	84.64	82.45	80.12
Female Literacy (%)	71.89	69.78	68.01
Child proportion (0-6 Age) (%)	14.12	13.45	14.02

280. **Educational Facility:** In 2024, the literacy rate of Assam was estimated to be 72.19% (77.85% male and 66.27% female). The literacy rate of Assam is slightly below the national average of 74.04%. There are nearly 48,000 government lower and upper primary schools in Assam and around 5,000 private schools in the state. The male literacy and female literacy rate of all the subproject districts of North Lakhimpur, Biswanath and Sonitpur is found to be higher than the state average

281. **Health Infrastructure:** Health indicators in Assam are generally below the National average, reflecting the poorer socio-economic condition of the state relative to the rest of the country. As per National Rural Health Mission (NRHM), Assam has 4,621 sub centers, 1,014 Primary Health Centers (PHCs), 151 Community Health Centers (CHCs), 14Sub divisional hospitals, and 25 District hospitals. There are about 5 PHCs in each subproject districts of North Lakhimpur, Biswanath and Sonitpur and 3 CHCs each in North Lakhimpur and Biswanath districts whereas 5 CHCs in Sonitpur districts.

282. **Tourism:** North-East India is a paradise for tourists. Its enchanting hills, dancing rivers, roaring waterfalls, thick and dark forests, heavy rains during monsoon, innumerable varieties of flora and fauna, countless species of wild animals and plants, mysterious clouds, melodious folk music, thrilling dances and festivals, variety of delicious dishes, handlooms and handicrafts, and above all its green landscape used to attract people from different parts of the world since time immemorial. In 2019, Assam reported 5,447,805 visitors, thus, bringing forth a scenario of the subsequent increase in the graph of tourists visiting Assam with each passing year. The conspicuous fact is that an increase in the number of visitors further enhances the revenue the state receives through tourism. This is evident from the statistics that in 2017-18, Assam Tourism Development Corporation (ATDC) received earnings estimated at Rs 4.22 crore, much higher than that received in 2016-17, which was estimated at Rs 2.24 crore.

283. **Archaeological and Historical Monuments:** Assam is endowed with various historical and archeological monuments. Few of these listed monuments within the subproject districts are listed in

284. Table 5-39 below:

Table 5-39. Archaeological and Historical Monuments of the Subproject districts.

North Lakhimpur	Biswanath	Sonitpur
Bordol Temple: An ancient temple located in the Lakhimpur district, known for its historical significance and architectural beauty.	Biswanath Temple: A medieval brick-built temple located in Biswanath Chariali, known for its unique architectural style. Besides, Bordole temple, Dhandi temple	Mahabhairab Temple: An ancient temple in Tezpur, Sonitpur district, dedicated to Lord Shiva and known for its historical and religious significance.
Maguri Beel: A wetland area that is not only ecologically significant but also has historical importance due to its association with local folklore and traditions.	Grave of Lieutenant Lewis Van Sadan: Located in Biswanathghat, this grave is a reminder of the colonial history of the region.	Agnigarh Hill: A historical site in Tezpur associated with the legend of Princess Usha and Aniruddha.
	Grave of Lieutenant Thomas Kennedy: Another colonial-era grave located in Biswanathghat.	Bamuni Hills: Known for the ruins of ancient temples and sculptures, reflecting the rich cultural heritage of the region. Besides, Ruins of Singri Hill and Mound and ruins of the stone temple, Dahparbatia.
	Rock known as "Bishwanath Sivalinga": A significant religious site in Biswanathghat. Besides, the rock known as "Sakreswar" is also well known in the district.	

Economic Development

285. Assam is situated in the northeastern region of India. It is the most industrialized state in northeastern region of India and has maintained its leading position in the industrial sector in this region of the country. The state is a pioneer in small-scale industries and boasts of the largest number of special export promotion zones. It has a large base of skilled and industrial labour, making it an ideal destination for knowledge-based and manufacturing sectors. The Gross State Domestic Product (GSDP) of Assam for the financial year 2023-24 at current prices is projected to be ₹5.67 lakh crore. This represents a growth of 15% over the GSDP for 2022-23. The Net State Domestic Product (NSDP) of Assam has grown at a Compound Annual Growth Rate (CAGR) of around 10.5% over the past decade which reflects the state's economic development and improvements in various sectors, including agriculture, industry, and services.

Agriculture and Allied Sectors

286. Assam is predominantly rural, and the economy is primarily agrarian in nature with almost 70% of the population directly dependent on agriculture as a source of income and another 15% of the population directly on allied activities for its living. Contribution of agriculture and allied activities towards state GSDP in 2019-20 is 15.64%. The major kharif crops are autumn rice, winter rice, maize, pulses, kharif oilseeds like sesamum, castor, soyabean, groundnut, kharif vegetables, etc. There are some non-food crops like jute, mesta, cotton etc. also grown in some extent by the farmers in the kharif season. On the other hand, major rabi crops cultivated are summer rice, cereals, wheat, grams, rape, mustard, various rabi oilseeds, rabi vegetables, potato, etc.

287. The subproject district of North Lakhimpur has seen significant improvements in agricultural practices, with the introduction of high-yielding varieties of crops and modern farming techniques. Paddy remains the dominant crop, but there is also cultivation of mustard, potato, and pulses. Similarly, allied activities like poultry, piggery, fishery, dairy, and goat rearing are major allied agricultural activities. Sericulture, especially eri and muga rearing, is gaining popularity among villagers. The subproject district of Bishwanath is implementing various Tribal Development projects to support tribal families with agricultural development and marketing infrastructure and also educate farmers on scientific agricultural practices, from seeding to post-harvest technologies and introducing

millet cultivation in dry and upland areas, promoting sustainable agriculture and better income generation for farmers. Similarly, the subproject district of Sonitpur also promotes the adoption of advanced agricultural technologies, including high-quality seeds, irrigation facilities, and mechanization, analyzing soil health and providing recommendations for improving crop productivity under various schemes.

Industries and Mineral Resources

288. Assam is endowed with petroleum, natural gas, coal, limestone and many other minor mineral resources such as quartzite, kaolin, silliminities, clay, feldspar, granite, etc. Assam is the pioneer State in the country as far as exploration and production of petroleum is concerned. Assam accounts for about 26% of India's crude reserve and 12% of natural gas. The wells at Digboi, Duliajan, Sivasagar, etc. also produce natural gas accounting to about 50% of India's total onshore production. Although having a poor overall industrial performance, there are several other industries, including a chemical fertiliser plant at Namrup, petrochemical industries at Namrup and Bongaigaon, paper mills at Jagiroad, Panchgram and Jogighopa, sugar mills at Barua Bamun Gaon, Chargola, Kampur, cement plant at Bokajan, cosmetics plant of Hindustan Unilever (HUL) at Doom Dooma, etc. Moreover, there are other industries such as jute mills, textile and yarn mills, silk mills, etc.

289. The subproject district of North Lakhimpur has significant presence of MSMEs, focusing on sectors like food processing, handloom, and handicrafts and has potential for bamboo products, and organic farming. There are a few large-scale industries, including tea processing units and agro-based industries. It has some coal reserves, particularly in the Lakhimpur coalfield. Similarly, clay and fire clay found in the North Lakhimpur district, is used in ceramics and in refractory products industries. Biswanath district is known for its tea gardens and tea processing units, contributing significantly to the local economy. Similarly, traditional handloom and handicraft industries are also prominent in the Biswanath district. Biswanath district is also endowed with deposits of sand and gravel, used in construction. Similarly, Sonitpur district has a robust tea industry with numerous tea gardens and processing units, and a variety of agro-based industries, including rice mills, oil mills, and food processing units. The handloom and handicraft sector are also significant in Sonitpur. Sonitpur district has coal reserves, particularly in the Singrimari coalfield and some limestone deposits used in cement and construction industries. Some Granite deposits are present in Sonitpur district and used in construction and decorative purposes.

Infrastructure Facility

290. Roads: The total length of National Highways in Assam is 3,900.44 km. This includes 15 nos. of newly declared NHs for a length of 1,032.127 km. In addition, 847.00 km of road stretches have already been approved "in principle" as new NHs and another 1,253 km of state roads have been identified to be upgraded to NH. India's longest bridge, the 9.15 km long Bhupen Hazarika Setu is located in Assam. Adding new National Highways in Assam from 2014-2018 is 1,945 km. Significant investments have been made in improving road connectivity, including the construction and upgrading of highways and rural roads of the subproject districts. For example, the construction of the North Lakhimpur-Bihpuria road, Biswanath Chariali-Gohpur road project, Tezpur-Balipara road project has improved connectivity within the subproject districts of North Lakhimpur, Biswanath and Sonitpur.

291. Railway: The headquarters of Northeast Frontier Railway NFR is in Maligaon, in Guwahati. Assam got its first railway line in 1881 when the Assam Railway and Trading Company set up a metre gauge track. Mainly used for the transportation of tea and coal, a 65-km-long metre gauge line was constructed from Dibrugarh to Margherita. With a total rail route length of 2,435.13 kms, Assam has a convenient railway network connecting the state to the rest of the country. Within the State, broad gauge rail network connects all the major towns. Significant investments have been made in improving railway connectivity of the subproject districts. For example, the new Lakhimpur-Ziro Railway Line of 125 km broad gauge (BG) line from North Lakhimpur to Ziro is under development

project has improved connectivity within the subproject districts of North Lakhimpur, Biswanath and Sonitpur. Similarly, North Lakhimpur Railway station and Biswanath Chariali Railway station have been included in the Amrit Bharat Station scheme for redevelopment with modern facilities.

292. Aviation: Assam serves as the major gateway to the whole of the northeastern zone in India. The Lokapriya Gopinath Bordoloi International Airport at Guwahati is 18 km from the city centre and is well connected to New Delhi, Kolkata, Mumbai, and Chennai. All major airlines operate regular flights to and from Guwahati. There are also regular intra-state air services connecting the six civil airports (Guwahati, Tezpur, Jorhat, Dibrugarh, Silchar, and North Lakhimpur) of the state. Lilabari Airport has seen significant development, including the establishment of a Flying Training Organization (FTO) by Redbird Aviation in subproject district of North Lakhimpur. Tezpur Salonibari Airport has been included in the Amrit Bharat Station scheme for redevelopment, aimed at modernizing the airport and improving passenger amenities.

293. Power: Assam has a total installed power generation capacity of 1,599.65 MW, of which 364.7 MW is produced by APGCL. 2318 villages covering 27.5 Lakh rural households have been electrified. Assam amongst other Northeastern states has the highest potential for solar energy with an estimated potential of 14 GW solar energy. Assam has a capacity to produce 680 MW of hydro power. The Total Installed Capacity in the state is 379.7 MW. Subansiri Lower Hydroelectric project, located near North Lakhimpur, is one of the largest hydroelectric projects in India with an installed capacity of 2,000 MW and aims to provide a significant boost to the power supply in the region.

G. Physical Cultural Settings

294. Lakhimpur District in Assam is a treasure trove of cultural and natural landmarks that reflect its rich heritage and scenic beauty. The Bogi Beel Bridge, India's longest rail-cum-road bridge, offers stunning views of the Brahmaputra River while connecting the northern and southern banks. The Panbari Than, an ancient temple dedicated to Lord Shiva, is known for its architectural beauty and spiritual significance. The serene town of Narayanpur, with its lush green landscapes and tea gardens, provides a peaceful retreat for visitors. Nature enthusiasts flock to the Pabha Wildlife Sanctuary, a haven for diverse wildlife and bird species.

295. The historic town of Dhakuakhana showcases vibrant local life and traditional Assamese architecture, reflecting the region's cultural essence. These landmarks not only hold deep significance for the local communities but also attract tourists and researchers, making their conservation essential for preserving the district's identity and boosting tourism.

296. Biswanath District in Assam is a beautiful blend of cultural heritage and natural beauty. The serene Biswanath Ghat on the Brahmaputra River and the ancient Biswanath Temple, known as "Gupta Kashi," are deeply revered for their religious significance. The district also boasts the Bangaon Ruins, with intricate carvings dating back to the 8th and 9th centuries, and the historic Nagsankar Temple, believed to have been built in the 4th century. Adding to its charm are the lush tea gardens, which not only create picturesque landscapes but also drive the local economy. These landmarks reflect the district's rich heritage, making their preservation essential for promoting tourism and sustaining local culture.

297. Sonitpur District in Assam is renowned for its rich cultural heritage and diverse attractions that hold historical, religious, and natural significance. Among its treasures is Agnigarh Hill, a site steeped in legend, offering stunning views of Tezpur and the Brahmaputra River. The Mahabhairav Temple, dedicated to Lord Shiva, stands as an ancient architectural marvel and an important religious destination. Bamuni Hills, with its intricate stone carvings from the 9th and 10th centuries, showcases the district's rich archaeological history. Chitrlekha Udyan (Cole Park), a serene and scenic park in Tezpur, combines natural beauty with historical charm. Nature enthusiasts are drawn to Nameri National Park, a biodiversity hotspot teeming with unique flora and fauna. These landmarks are deeply significant to the local community and play a vital role in attracting tourists and researchers.

Preserving these resources is essential to safeguarding the district's cultural identity while promoting sustainable tourism

VI. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. Introduction

298. Potential environmental impacts of the proposed infrastructure components are presented in this section. Mitigation measures to minimize/mitigate negative impacts, if any, are recommended along with the agency responsible for implementation. Monitoring actions to be conducted during the implementation phase is also recommended to reduce the impact.

299. Screening of potential environmental impacts are categorized into three categories considering project phases: location impacts and design impacts (pre-construction phase), construction phase impacts and operations and maintenance phase impacts and mitigation is devised for any negative impacts.

- (i) **Pre-Construction impacts** include anticipated those during construction works but planning is required for proposed mitigation measures before start of construction works such as taking consents from various departments, planning for construction and workers camps, deployment of safety officer, arrangement of required barricades and caution boards etc.
 - a. **Location impacts** include those associated with site selection and loss of on-site biophysical array and encroachment either directly or indirectly on adjacent environments. It also includes impacts on people who will lose their livelihood or any other structures by the development of that site
 - b. **Design impacts** arise from investment program design, including technology used, scale of operation/throughput, waste production, discharge specifications, pollution sources and ancillary services
- (ii) **Construction impacts** are caused by site clearing, earthworks, machinery, vehicles and workers. Construction site impacts include erosion, dust, noise, traffic congestion and waste production

300. **Operation and maintenance (O&M) impacts** are from the operation and maintenance activities of the infrastructure facility. These include routine management of executed anti-erosion and embankment works, Screening of environmental impacts has been based on the impact magnitude (i.e. negligible, moderate and severe – in the order of increasing degree) and impact duration (i.e. temporary and permanent).

301. This section of the high priority project IEE reviews possible project-related impacts, in order to identify issues requiring further attention and screen out issues of no relevance. ADB SPS 2009 require that impacts and risks will be analyzed during pre-construction, construction, and operational stages in the context of the project's area of influence.

302. The ADB rapid environmental assessment checklists have been used to screen the project for environmental impacts and to determine the scope of the IEE. An environmental and social risk analysis of the project was also conducted by PMU and PISC team to determine the impacts and its significance in the project interventions.

303. In the case of this high priority projects: (i) most of the individual elements involve straight forward construction, so impacts are mainly localized and not greatly significant; (ii) most of the predicted impacts are associated with the construction process, and are produced because that process is invasive, involving excavation and earth and silt movements; and (iii) being mostly located in an rural area and not falling in any environmentally sensitive zones will not cause direct impact on biodiversity values. The proposed Paken and Rangachali Dalani reach length is located near the boundary of Kaziranga National park. Management plan of national park shall be adopted and followed during the execution of work along with regular consultation with the local DFO and Field Director of the Kaziranga National Park. The project property is held by the local government and

access to the project location is through public rights-of-way and existing village roads hence, land acquisition and encroachment on private property will be avoided. However, NOC may be required for some identified location from the concerned authority to be taken by the contractor with administrative support of both FREMAA and WRD.

Pre-Construction Impacts

304. The proposed additional high priority project activities involve following interventions under four water resources divisions

Dhakuakhana

- Anti-Erosion (underwater works) Bamuni Chapari to Tekeliphuta 8 km
- Earth work - 10 earthen check-bunds over borrow pit channels
- Pro siltation measures of 20 PSC porcupine screens 12 bamboo screens

North Lakhimpur

- Anti-Erosion (underwater works) Bonpuroi-Jamuguri– 1.28 km
- Pro siltation measure – 5 screens

Biswanath

Paken

- Anti-Erosion (underwater works) – 1.6 km
- Pro siltation measure – 13 screens
- Earthwork – Widening of existing embankment – 225 m

Rangachali Dalani

- Anti-Erosion (underwater works) – 1.34 km
- Pro siltation measure – 4 screens

Sonitpur

- Anti-Erosion (underwater works) – Jarani – 1.2 km
- Pro siltation measure – 5 screens
- Anti-Erosion (underwater works) – Zahajghat – 0.6 km

Protected Areas

305. The proposed high priority works in Dhakuakhana, Lakhimpur, Biswanath, and Sonitpur are not located within any forest or protected areas. However, the Paken and Rangachali Dalani site in Biswanath district is 40 meters from the boundary of Kaziranga National Park. FREMAA has obtained No Objection Certificates from the Divisional Forest Officers (DFOs) of all concerned divisions, including the Biswanath Wildlife Division and the Field Director of Kaziranga National Park, for the construction activities at Rangachali Dalani (see Appendix 16). No negative impacts on the protected areas are anticipated.

Impact Due to Location – Adjacent to the River

306. No impact during the design and preconstruction period is envisaged

Environmental, Social and Culturally Sensitive Resources

307. There are presence of schools and religious properties near the Zahajghat locations of Sonitpur district and Bonpuroi site of Lakhimpur, rest of the locations are away from such establishment However, no impacts from the implementation of the project are envisaged during the design and preconstruction period, thus mitigation measures are not required. However, delay in the implementation may aggravate the erosion scenario and many properties may be adversely impacted.

308. There are no archaeological monuments within 500m from any location of proposed high priority work sites. No impacts from the implementation of the project are envisaged during the design and preconstruction period and thus mitigation measures are not required. However, delay

in the implementation may aggravate the erosion scenario and many properties may be adversely impacted.

Tree Cutting at Selected Project Sites

309. As per the initial assessment, tree cutting may require at a few high-priority work sites due to anti-erosion works and embankment work (at Paken). The exact number of trees to be felled has not yet been determined and will be finalized at the pre-construction stage, with the IEE updated accordingly. Trees will only be felled once the necessary permissions have been obtained. Compensatory planting will be carried out on a 1:10 basis, meaning that for every tree cut, 10 new trees will be planted, in accordance with state government regulations policy.³⁹

Site selection of construction work camps, stockpile areas, storage areas, and disposal areas

310. The contractors for the proposed works under high priority work sites at Dhakukhana, Lakhimpur, Biswanath and Sonitpur shall identify locations for their work camps including labor camps, areas for stockpiling and storage of construction materials. In case these locations are established in private land, necessary paperwork including change of land use from the revenue department, lease agreements etc., CTE and CTOs, borewell installation (if required) etc. shall be obtained before the start of actual works.

311. The contractors shall also identify disposal areas for solid waste generated in the project areas. For works in and around the town of project sites of Dhakuakhana, Lakhimpur, Biswanath and Sonitpur, the contractor can tie up with the local municipal authorities/Village level management authorities for collection and disposal of municipal and domestic solid wastes generated in the project areas. Most of the reaches where flood protection and anti-erosion works shall take place are in largely rural areas, the contractor can either tie up with the nearest municipal authorities and in case of none, identify suitable land and obtain necessary permissions from the panchayat and district administrations for use of disposal area. The contractor shall be required to maintain all necessary records for disposal of waste.

Site selection of sources of materials

312. The materials required for the high priority project sites of Dhakuakhana, Lakhimpur, Biswanath and Sonitpur are:

- Type-A and Type -C geo-bags which shall be procured by WRD and supplied to the contractor from its nearest storage facility
- PVC coated wire netting
- Porcupines to be procured by WRD and supplied to the contractor
- River sand for filling the geo-bags and if technically permitted by Engineer⁴⁰ for embankment works – necessary permissions including mining permissions and prior EC from SEIAA to be obtained
- The pre-cast PSC Porcupine shall be procured. Therefore, all necessary approvals and permissions including CTE/CTO for the use of aggregate/stone must be obtained by the manufacture or supplier. A copy of these approvals and permissions must be submitted to the WRD at the time of supply of these material .
- Concrete -

³⁹Government of Assam, Guidelines for Compensatory Afforestation, 2000. Guwahati. https://forest.assam.gov.in/sites/default/files/swf_utility_folder/departments/pccf_lipl_in_oid_4/menu/information_and_services/hand_book_vol-i_compendium.pdf

⁴⁰ Engineer is the designated authority as per the Works contract between FREMAA/WRD and the contractor, who shall decide and approve all technical, financial, legal and safeguard documents, issues and changes.

- Cement: Contractor to procure cement bags (if required) from WRD/FREMAA/Engineer approved sources and maintain necessary documents
- Earthworks - borrow earth areas to be identified by the contractor and necessary permissions obtained. Contractor shall also follow the WRD guidelines provided for borrow areas (Appendix 5)
- Water – The contractor shall obtain permissions from the relevant authorities for use of ground water/surface water (if required) for construction works. Since the river water has high sediments, the water quality to be tested as per guidelines of the Engineer to ensure that it can be utilized for concrete mixing. For earth works, river water can be used post obtaining permissions from relevant authority
- Steel and wire netting for all the proposed works in high priority project sites shall be procured from Engineer approved sources.
- Barges (for placing geo-bags underwater) to be procured by WRD or arranged by respective contractors

Borrow Area Location and Rehabilitation

313. Substantial quantity of the earth will be required for upgrading/widening of the river embankment for a length of 225 m at Paken area of Biswanath and upgradation of check bund at Dhakuakhana. It is proposed that the demand for earth will be fulfilled by excavating borrow pits in the vicinity of the river embankment. During the pre-construction period, the contractor has to identify the borrow area locations and obtain necessary permissions and clearances from various authorities (i.e. Revenue Department, District Administration and Forest Department). No major impacts are anticipated during the pre-construction period.

314. Borrow pits in the project area should preferably be located on the riverside. This approach ensures that borrow pits on the riverside naturally silt up over time, reducing long-term environmental impacts. In contrast, borrow pits on the countryside often remain as permanent disfigurements in the landscape and can compromise the integrity of nearby embankments by inducing seepage into their foundations. However, if borrow pits must be situated on the countryside, it is recommended to select locations further away from the embankments, even if this results in longer haul distances. Such a decision should only be made with the approval of the Engineer. In unavoidable cases where earth must be sourced from the countryside, the following preferences should be considered to minimize adverse impacts and ensure sustainable practices:

- Wasteland or excavating or enlarging existing lank or any humps above general ground level
- Earth from retired embankment.
- Land which farmers want to either convert into a fish pond or lowering the agriculture field level to increase its water retention capacity
- No land acquisition shall be made for borrow areas
- Combination of soil and sand in embankment construction wherein sand is used as a filter in between soil
- Exploring the option of using combination of soil and sand in embankment construction wherein sand is used as a filter in between soil
- Exploring technical feasibility of using soil from sandbars existing away from the bank
- Follow the WRD guidelines (Appendix 5) for locating borrow pits close to the embankment if at all it is to be located next to embankment. All efforts shall be made that no tree loss takes place due to borrowing. The trucks shall be covered while transporting the earth.
- Prior environmental clearance shall be obtained from SEIAA for borrow areas

315. The Indian Road Congress (IRC):10-1961 guideline may also be referred for selection of

borrow pits. In all cases good engineering and construction practices shall be followed. The WRD Guidelines with respect to borrow area location are as below:

- For high embankments no excavation shall be done within 45 m of the river side toe of the embankment. From 45m to 60m the borrow pits must not be more than 1.8 m deep and from 60m to 90m not more than 2.4m deep and beyond 90m they can be of 3m depth
- If earth is to be taken from landside of the embankment, no borrow pits shall be excavated within 24m of the land-side toe of the embankment. The depth of excavation in 24m to 36m distance shall not be more than 0.6 m
- The borrow pits shall be staggered and on undisturbed ground 6 m wide left at regular intervals to prevent the velocity of flow through the riverside borrow pits. The staggering will also help in inducing silting and filling up of these borrow pits.
- On the countryside the water-logged areas (bandhis) shall be cut and interconnected to permit ordinary drainage. These shall be connected to the nearest drainage channel so as to carry away the drainage water
- The borrow areas selected for taking earth shall be cleared of all trees, shrubs, grass and vegetation mounds
- No borrow pits shall be made on roads, village tracks, graveyards, canals or embankments

316. The Indian Road Congress (IRC):10-1961 guidelines for selection of borrow pits and amount that can be borrowed is summarized below:

- Borrow areas shall not be located on cultivable lands. However, if it becomes necessary to borrow earth from temporarily acquired cultivated lands, their depth shall not exceed 45cm. The topsoil to a depth of 15cm shall be stripped and set aside for its later use for the purpose of turfing on slopes of the embankments. Thereafter, soil may be dug out to a further depth not exceeding 30cm and used in forming the embankment
- Borrow pit shall be selected from wasteland
- Priority shall be given to the borrowing from humps above the general ground level within the road land
- Priority shall be given to the borrowing by excavating/enlarging existing tanks
- Borrowing shall be from land acquired temporarily and located at least 500m away from the road
- Borrowing shall be from mounds resulting from the digging of well and lowering of agricultural fields in vicinity of the road
- In case of settlements, borrow pits shall not be selected within a distance 800m from towns or villages. If unavoidable, earth excavation shall not exceed 30cm in depth
- The haulage distance from site shall ideally not be too far

317. The construction contractor shall submit the borrow area identification details along with borrow area rehabilitation plan during the pre-construction period to the Engineer for approval.

Construction and Operation Phase's Impacts

Land Use Change due to Project Activities and Borrow Area

318. **Impacts.** The unplanned selection of borrow areas and/or no rehabilitation of borrow areas may lead to loss of productive use of the land. The transportation of borrow earth in high priority project areas , Dhakukahna and Biswanath (Paken) where earth work proposed) may also cause air pollution, if transported in uncovered trucks. Due to such construction activities along the river bank, the land use of about 100 m buffer (30m for embankment plus borrow areas towards the country side) around the embankment is likely to be affected or changed.

319. The access to the embankment construction site in Dhakuakhana and Biswanath (Paken) project areas is mostly through the single lane semi-urban/rural roads (paved and unpaved both). These roads would require strengthening to sustain the heavy trucking load. In addition, it is recommended that a minimum of 1-2 construction camp (even though local laborers shall be preferred and utilized), along with labor camp shall be established for the project. This will also temporarily change the land use of the area, however, the impact would be temporary and reversible.

320. Due to the proposed interventions in these areas, most of the agricultural land and homestead around the embankment site and construction camp areas may be affected. Loss of topsoil is one of the most potential impacts with respect to borrowing of earth from country side of the embankment. Besides this compaction of soil along the haulage route may also take place, if proper mitigation measures are not employed.

321. During operation phase encroachment on embankment for habitation and cultivation purpose may affect embankment stability in these project areas (this was seen almost all throughout the existing embankments in the project intervention area). Rain cuts also destabilizes embankments, if regular maintenance is not undertaken. The Villagers also cut the embankment to create approach to river side for their movement for toileting, cattle grazing, and farming. Borrow areas, if not rehabilitated may have landscape and accidental hazards.

322. **Mitigation Measures.** Diversion of land for the proposed project purposes is minimized to 40m which includes a 2:1 slope on the river side and a 3:1 slope on the country side in order to reduce the impact zone around the embankment which covers productive land used for cultivation. Adjacent cultivable lands shall not be occupied for storage and/or handling of construction materials. Construction camps in the high priority project areas shall preferably be located on uncultivated area. All requisite facilities (drinking water supply, sanitation, domestic solid waste collection and disposal, fuel supply) shall be provided at these camps. The land used for construction camp shall be made reusable/cultivable after closure of construction camp. No construction debris shall be deposited on agricultural land. Loss of crops for construction camp area shall be compensated to the landowners.

323. Provision shall be made in the embankment design for providing access to the river bank. The construction contractor shall ensure rehabilitation of the borrow area before handing over the project. The WRD/FREMAA shall ensure that regular maintenance is undertaken for upgraded embankment. All squatters and encroachers in the embankment shall be removed with the help of district administration.

Borrow Area Rehabilitation

324. **Impacts and Mitigation Measures.** For the Paken and Dhakuakhana site, the soil materials from borrow pits shall be required for upgrading of 225 m of embankments at Paken and 10 earthen check bunds for borrow pit areas of Dhakuakhana and slope stabilization for undertaking anti-erosion and flood protection works. The borrow pits shall be rehabilitated after borrowing. The WRD guidelines for rehabilitation of the pits shall be strictly followed. The construction contractor shall submit the borrow area rehabilitation plan for each borrow area in advance in consultation with the community during the pre-construction period along with the borrow area identification details to the Engineer for approval. Contractor shall prepare the rehabilitation plans for the borrow areas as per the EMP and the direction and guidance of the environmental specialist of the Engineer.

325. The borrow areas in these project areas shall be restored to a safe and secure area usable to the public enabling safe access and entry to the restored site. Some indicative rehabilitation measures could be community water storage facility, pisciculture ponds, recreational spots, landscape enhancement, use as waste disposal area (with proper mitigation measures) and rehabilitation by re-vegetation of the borrow area. Where re-vegetation is done, it should be ensured that:

- Vegetative cover is established on all affected land

- Topsoil is placed, seeded and mulched within 30 days of final grading if it is within a current growing season or within 30 days of the start of the next growing season.
- Vegetative materials to be used are grasses, legumes, herbaceous or woody plants or a mixture thereof
- Plant material must be planted during the first growing season following the reclamation phase
- Selection and use of vegetative cover should take into account soil and site characteristics such as drainage, pH, nutrient availability and climate to ensure permanent growth. Choice of plant species for the planting program shall be made in consultation with ecological consultant and local forest department
- The planning of trees and shrubs results in a permanent stand or regeneration and succession rate, sufficient to assure a 75% survival rate
- The planning results in 90% ground coverage
- The site should be inspected when the planting is completed and again at one year to ensure compliance with the reclamation plan

Land use change due to construction material sourcing (Quarrying)

326. **Impacts.** A substantial quantity of construction materials, including earth and silt, will be required for executing the subproject in the identified project areas. Illegal quarrying for these materials could result in adverse impacts, such as changes in land use and increased air and noise pollution. To address this, the aggregate demand for constructing the new embankment, which includes a passage for vehicle movement, will be met exclusively through approved stone quarries. The environmental impacts and pollution control measures for these approved quarries are regulated and monitored by the State Pollution Control Board (SPCB). As a result, no significant adverse impacts from quarrying activities are anticipated for the proposed project. Additionally, after the embankment construction is completed, the Water Resources Department (WRD) and FREMAA will hand over the embankment to the State Public Works Department (PWD) for future maintenance, including any overtopping needs.

327. **Mitigation Measures.** Aggregates required for the upgradation of 225 meters of embankment and roads will be sourced from quarries approved by the Pollution Control Board of Assam (PCBA). Air and noise emissions from these quarries must remain within the prescribed limits. If stone crushers are required, they shall be established only after obtaining the necessary consent from PCBA and implementing adequate air pollution control measures.

328. For materials procured from third-party vendors, contractors must submit all relevant documentation, including permissions, Environmental Clearance (EC) documents, and Consent to Operate (CTO) certificates, to the Engineer for source approval. If new quarries or stone crushers are to be set up for the project, the contractor must obtain prior EC from the SEIAA or MoEF&CC and the CTO from PCBA, ensuring air pollution control measures are in place.

329. When selecting sites for these operations, a thorough land use assessment must be conducted to ensure suitability. Additionally, any land designated for dumping construction waste must be free from social or Resettlement and Rehabilitation (R&R) issues to avoid conflicts and ensure compliance with regulations.

Soil Environment

Soil Erosion

330. **Impacts.** Soil erosion potential of an area depends on its topography, geological structure, rainfall, soil type and land use/land cover. In these project areas, the topography of the terrain covering the alluvial plain is nearly flat with a gentle gradient. The soils in the Dhakuakhana, Lakhimpur, Biswanath and Sonitpur areas are easily eroded during heavy rainfall. Possibility of the

occurrence of gully and rill erosion is expected in the uncovered side slopes of embankments and other freshly cut or deposited areas.

331. **Mitigation Measures.** Following mitigation measures can prevent the soil erosion:

- Construction shall be scheduled such that large areas of soil particularly at borrow areas near the embankment are not laid bare during the monsoon
- Exposed surface shall be resurfaced and stabilized as soon as possible. This shall also be covered by straw or mulch to avoid soil loss in the intervening period. Ground disturbances shall be phased so that it is limited to workable size
- Stabilizations of soil around approach roads/slopes shall be done by turfing and tree plantation in ROW
- The embankment and road design shall incorporate adequate engineering measures so that the construction could withstand the severe earthquakes
- Various soil conservation measures shall be undertaken by AADB later on to prevent erosion.
- Soil erosion shall be visually checked on potential erosion zones during construction phase. In case soils erosion is found, suitable measures shall be taken to control the same

Operation Phase

332. **Impacts.** Due to bank erosion, the bank line of the proposed reach length of these project areas shifted rapidly in past few years. Over the past 20 years, the river has not only eroded entire villages but also engulfed large areas of surrounding villages.

333. The proposed project will have net benefits in terms of soil erosion and preventing progression of land loss. It is estimated that 16017 Ha of land shall be benefited from the proposed intervention. Soil erosion may still occur during the operation phase and early detection and remedial measures shall need to be taken for safety of the embankment and roads.

334. **Mitigation Measures.** Periodic checking shall be carried out to assess the effectiveness of stabilization measures. Suitable strengthening measures shall be implemented to prevent reoccurrence of soil erosion at existing erosion prone locations and prevent erosion at newer locations in the project areas.

Soil Compaction and Contamination

335. **Impacts.** Soil around construction site, haulage road, construction camp, and workshop is likely to become compacted due to the movement of people, machinery, and materials. Except for the Jahajghat site in Sonitpur, most project locations are situated in rural areas. Since the land in these areas is primarily used for agriculture, the one-year project implementation period may lead to a substantial reduction in agricultural yield due to soil compaction. Additionally, soil contamination may occur around construction sites, machine maintenance areas, fueling stations, construction camps, and haulage roads if proper precautions are not taken.

336. **Mitigation Measures.** The movement of construction vehicles, machinery and equipment shall be restricted to the nearby embankment/road and pre-defined haulage road in the project areas. Adequate provisions for approach roads capable of handling movement and haulage of heavy vehicles and machineries shall be made to avoid damage to existing village roads, crop lands and settlement areas. The non-usable, non-saleable, non-hazardous construction waste shall be disposed-off in the properly delineated places. Usable or saleable waste shall not be disposed of to landfill.

337. All efforts shall be made to prevent soil contaminations. Following measures shall be taken to prevent the same:

- The construction vehicle shall be fueled or repaired/serviced at the designated place with proper arrangement of waste collection and disposal. The arrangement shall include

cemented floor with dyke around for fuel storage and filling as well repairing of construction equipment. To avoid soil contamination at the wash down and re-fueling areas, "oil interceptor" shall be provided.

- The demolition wastes if any shall also be used to the extent feasible for construction.
- Oil and grease spill and oil-soaked materials shall be sold off to Pollution Control Board Assam (PCB)/MoEF&CC authorized vendors.
- Oil spill kits should be available at the site to minimize the damage to soil quality in case of spillage
- Fuel and waste oil should be stored in isolated locations on paved areas only to minimize the soil contamination. These areas should be provided with the garland drains provided with the oil interceptors

Operation Phase

338. **Impacts.** During the operation phase, contamination of soil in these project areas are not likely to happen other than due to accidental spillage from vehicle movement on the embankment.

339. **Mitigation Measures.** Depending on the nature and magnitude of spill, appropriate land remediation measures shall be employed by the concerned authorities (PWD / WRD).

External Impacts on Flood and Drainage

Operation Phase

340. **Impacts.** The proposed structural flood protection works consist of anti-erosion works, widening of embankment, earthen check bunds for borrow pit channel, launching porcupine screens, and adaptation works at Lakhimpur. The proposed works will essentially confirm existing flooding behaviour and provide better protection from mainstream flooding to flood-liable areas behind the embankments. The proposed anti-erosion, pro-siltation works, and flood protection works will not significantly change flood behavior, gross cross-section-wide sediment behavior of river morphology, however, the adverse impacts of the floods will be addressed considerably. The proposed bank protection measures will stabilize the banks and have no discernible effect on flood behavior. Widening of existing embankment at Paken, no discernible change in downstream flood levels is envisaged. The proposed bank protection measures will stabilize the banks and have no discernible effect on flood behavior.

341. **Mitigation Measures.** It is proposed to develop and use a numerical hydraulic model to investigate flooding and drainage behaviour, associated with mainstream, tributary and local flooding. PIU and PISC will carry out numerical hydraulic modelling during the construction and operation stages. This model will be used to ensure that there is adequate freeboard against embankment overtopping and that adequate provision has been made for sluice gates to facilitate drainage from the protected areas. Natural drainage systems shall be left undisturbed to the greatest extent possible; the flooding behaviour of beels and wetlands will be assessed and where possible improved and/or preserved.

Changes in Water Levels

Operation Phase

342. **Impacts.** The conveyance capacity of the Brahmaputra in these high priority project districts is enormous - and will remain unchanged by the proposed works on the southern bank. Accordingly, the proposed work will have no discernible effect on river water levels. Changes in channel conveyance brought about by the natural processes of riverbank erosion, accretion and channel avulsion will play a much greater role in any future change in water levels. An improved embankment network at Paken area will reduce the risk of sudden devastating flooding in nearby village and Gohpur town and as such provide more predictable and stable water levels on the flood plains

(especially from temporary local inundation during the flood season).

343. **Mitigation Measures.** Changes in cross-section will be monitored at regular intervals to detect any changes and initiate corrective measures. The project concept allows later rectification within the concept of adaptive approach. To this end, the project has substantial contingencies. The numerical hydraulic model will be used to identify low lying areas with a potential risk of deep inundation when major floods occur.

Effect on Flow Velocity/Discharge Intensities

Operation Phase

344. **Impacts.** The proposed interventions in these areas are not expected to significantly affect the overall velocity profile of the river. This is because the works are limited to the bank or near-shore areas, and a combination of largely passive river training and flow-regulating measures will be implemented to maintain an optimal flow velocity in the section. Given the instability and unpredictability of the Brahmaputra River, two distinct scales must be considered when studying the effects of flow velocity and discharge changes: (i) the total river cross-section: spanning several kilometers in width, and (ii) near-bank channel cross-section: typically less than one kilometer in width. Limited interventions along the riverbank do not alter the average flow velocities across the alluvial river's cross-section. Areas of faster flow are naturally balanced by areas of slower flow and lower discharges, resulting in an overall equilibrium. Changes in average flow velocity and discharge are primarily influenced by different river stages, with increasing discharges leading to higher flow velocities. However, the lack of systematic measurements currently restricts the ability to quantify these dynamics accurately.

345. The discharge magnitude and its variation in the Brahmaputra River undergo significant seasonal and annual fluctuations due to the unique hydro-meteorological and geophysical characteristics of the basin. In the context of climate change, the potential increase in these natural perturbations appears more significant than any minor changes that could result from the proposed activities on or near the riverbank. The Brahmaputra's wide channel, coupled with notable channel roughness due to multitudes of sandbars and bedforms, minimizes the likelihood of minor disturbances in near-bank flow transmitting to the midstream or across the channel to the opposite bank. Only major, proactive river training interventions, such as spurs extending into the river, would have a significant impact on flow patterns and channel configuration.

346. **Mitigation Measures.** Flow velocity changes along the bank line will be systematically monitored as part of the near-bank surveys. This includes establishing systematic records of discharges and flow velocities during the hydrological cycle. It is expected that this monitoring will contribute to a better understanding and a gradual optimization of the layout of structural flood and erosion countermeasures. Open revetments, such as multi-layers of sand filled Type A geo-bags placed on geotextile filters shall be used. Impermeable bituminous or interlocked revetments are not preferred and used as they have impact on the natural environment by interrupting exchange between flowing water and ground water.

Impacts of Development Works in Upstream Catchments

347. **Impacts.** A large number of hydroelectric (HE) projects are under various stages of implementation in the upstream parts of the Brahmaputra basin in India (

348. Table 6-1). It is likely that these projects will have impacts on flood behavior in the project areas. The upstream dams, albeit mostly run-of-the-river schemes, would reduce flood peaks while acting as sediment traps that will lessen the outflow of sediments (until these reservoirs are filled up over the years). Likewise, improved watershed management pursued in upstream catchment will contribute to reduction of flood peaks and sediment transport over the long term. Any effect of this reduction in sediment inflows on the Brahmaputra main stream channel cross sections and flood behaviors is difficult to predict, but any effects are likely to lead to a reduction in flood levels and

aggradation, since reduced sediment loads supports a more stable channel pattern with deeper channels characterized by higher conveyance. The project i.e., CRBIFRERMP ADB loan shall further develop key agencies' knowledge base by improving various decision support tools initiated under AIFRERMIP and will strengthen the state's institutional capacity to deliver FRERM, thereby promoting disaster resilience of the state and affected communities.

Table 6-1. Hydroelectric Projects Upstream of Project Area in the Brahmaputra Basin in India.

Sl. No.	Name	Location	District	Capacity (MW)	Status
1	Dibang Multipurpose Project	Dibang River	Lower Dibang Valley	2,880	Pre-construction
2	Etalin HEP	Dibang River	Dibang Valley	3,097	
3	Upper Siang HEP	Siang River	Upper Siang	10,000	Under construction
4	Kameng HEP	Kameng River	West Kameng	600	
5	Ranganadi HEP	Ranganadi River	Papum Pare and Lower Subansiri	405	Commissioned
6	Pare HEP	Dikrong River	Papum Pare	110	
7	Subansiri Lower HEP	Subansiri River	Lower Subansiri and North Lakhimpur	2,000	Under construction
8	Karbi Langpi HEP	Langpi River	Karbi Anglong	180	
9	Kopili HEP	Kopili River	Dima Hasao	275	

HEP: Hydroelectric Project Source: IEE, CEBIFRERMP, Goalpara (<https://www.adb.org/projects/documents/ind-56283-001-iee-3>)

349. **Mitigation Measures.** Systematic monitoring and analysis of hydrological and geomorphological parameters will help identify any measures that may have to be considered to adapt to any unexpected changes over the longer term. The project will also promote holistic catchment management through state wide planning and coordinated implementation.

Impact on Silt Deposition and Bed Level Change

Operation Phase

350. **Impacts.** The Brahmaputra River carries the second highest sediment load of all major rivers in the world. The high amount of sediment is largely mobilized during the high flood season flows and often leads to dramatic changes of the platform (river appearance on maps). While the riverbed is largely formed by the coarser sediments especially sand and more upstream gravel, the floodplains are built from finer silts and clay. The latter constitute the wash load in the river, which means they are transported within the channels to the sea without settlement. Only after inundation and in areas without noticeable flow do the finer sediments settle.

351. **Mitigation Measures.** The bank stabilization and AE measures in the Dhakuakhana, Lakhimpur and Paken area will reduce the risk of embankment breaches with associated deposition of infertile land in the breach. This will help in supporting agriculture and livelihood of the dominant small and marginal farmers. The dynamic pattern of silt deposition in the river and areas adjacent to the bank, especially in the vicinity of anti-erosion and river training works, will be monitored at regular intervals to contribute to the knowledge base and understanding of the Brahmaputra morphology, and initiate necessary corrective measures if required.

Effect on project areas Drainage System

Operation Phase

352. **Impacts.** The existing embankment system in the Dhakuakhana, Lakhimpur, Biswanath along the Brahmaputra River acts as a barrier for the drainage of accumulating countryside water into the Brahmaputra during the monsoon season. The proposed works will have no additional adverse impacts on drainage.

353. **Mitigation Measures.** The numerical hydraulic model will be used to undertake a comprehensive analysis of the existing natural drainage system to identify drainage behavior and problems, key drainage channels/systems and drainage congestion areas by the PIU and PISC during the construction and operation phases. This model will be used to investigate the optimum location, size and method of operation of the sluice gates. The cost-effectiveness of various remedial measures will be assessed with the object of improving drainage conditions. As part of this investigation, the preservation and/or improvement of the environmental flooding regime of wetlands and beels will be investigated.

Effect on Wetlands/Beels within the project

Operation Phase

354. **Impacts.** There are no wetland which has direct connection with the Brahmaputra River along these high priority project areas.

355. With flood protection measures in place, agricultural practices are likely to intensify, leading to increased use of fertilizers and pesticides. As the land slopes towards nearby wetlands, runoff from agricultural fields may carry these chemicals into the wetlands, increasing the risk of eutrophication. This process can result in excessive nutrient buildup, which negatively impacts the ecological health of wetlands by promoting algal blooms and reducing oxygen levels. Floodwater plays a vital role in maintaining the health of wetlands by naturally flushing out pollutants. However, flood protection measures could limit this natural flushing process, potentially exacerbating the accumulation of pollutants in wetlands over time.

356. **Mitigation Measures.** To mitigate the potential impacts on wetlands, it is essential to implement a combination of preventive and corrective measures. Buffer zones with native vegetation should be established along agricultural fields to intercept runoff and filter out nutrients and pollutants before they reach the wetlands. Additionally, farmers should be encouraged to adopt sustainable agricultural practices, such as integrated pest management (IPM) and the judicious use of fertilizers and pesticides. Since various terrestrial and aquatic wildlife species depend on wetlands, due care must be taken to prevent any direct or indirect impacts, such as siltation or the flow of waste and debris, from reaching nearby wetlands due to project construction activities. Regular monitoring of water quality in wetlands should be conducted to detect early signs of eutrophication and address them promptly. Furthermore, controlled flooding or artificial wetland flushing can be explored to replicate the natural process of pollutant removal during high water levels. These measures will help preserve the ecological integrity of wetlands while balancing the benefits of flood protection infrastructure.

Water Quality

Construction Phase

357. **Impacts.** The major source of surface water pollution during project construction phase in the project areas will be sewage and wastewater generated from labor camps as well as workshop areas. The project implementation period is estimated for a period of 6 years. The contractor is expected to hire the local unskilled and semiskilled laborers, while the bulk of the skilled laborers are expected to be migrant. For the outside laborers the contractor will establish a labor camp, and it is expected that 100 – 200 laborers shall stay in each construction/labor camps. Central Public Health and

Environmental Engineering Organization (CPHEEO) recommends a maximum of 135 LPD (0.135 KLPD)⁴¹ of water for domestic use. It can be safely assumed that about 80% of the water supplied will be generated as sewage. Thus, total quantum of sewage generated is expected to be of the order of 108 LPD (0.108 KLPD). However, it may pollute land and other nearby water bodies if discharged untreated, especially during the low flow season.

358. As per the primary monitoring data conducted by FREMAA, no arsenic and fluoride pollution are noticed either in river water or ground water in the project areas. Hence no impact of arsenic is anticipated.

359. As significant quantity of groundwater is not likely to be extracted as part of this project, any appreciable quantitative impact on ground water because of the construction activities is also ruled out. In addition to that ground water is easily available in 5 m BGL even during the lean periods. Impact on ground water quality is not likely due to the project activities as the wastewater generated from the project will be trapped for treatment before it will discharge/ percolate from the project sites.

360. **Mitigation Measures.** Septic tanks shall be provided in each camp to treat the domestic sewage. Provision of mobile toilets also shall be considered with the provision of channeling the sewage to septic tank in a closed loop system. Discharge of untreated domestic sewage to the Brahmaputra River or to any natural waters will not be permitted. No debris shall be dumped in the water bodies like Hasila beel and Brahmaputra River.

Operation Phase

361. **Impacts.** No impact is anticipated due to the project in this phase.

Climate

Construction Phase

362. **Impacts.** Short term impact in terms of minor increase in temperature may happen in the immediate vicinity of the project reaches due to cutting of trees located within the project intervention zone in the project areas. However, most of these trees and grasses belong to fast-growing species like Simul, Bamboo (grasses) and the like.

363. The impact of climate change screening is based on the geographic data set, compiled from the latest scientific information on current geological, climate and related hazards together with projected changes for the future where available. These data are combined with the project's sensitivities to hazard variables, returning information on the current and potential future risks is medium. High flood is expected in future.

364. **Mitigation Measures.** The maximum possible efforts must be made for minimizing cutting of the trees while designing the embankment. The project will adopt a policy of compensatory tree plantation of planting 10 trees against each tree cut this is over and above compensatory plantation as per the state government policy.⁴² Special design consideration were made keeping water level rise due to climate change.

Operation Phase

365. **Impacts.** No direct impact is anticipated on the climate of the study area due to the proposed additional high priority works. However, changes in the catchments area of the river and extreme events due to possible climate change (global warming) can have indirect impacts on project and project area. With respect to the proposed project, climate change can play a major role due to its

⁴¹ Government of India, Ministry of Housing and Urban Affairs, Central Public Health & Environmental Engineering Organisation (CPHEEO). 1999. Manual on Water Supply and Treatment. https://cpheeo.gov.in/upload/uploadfiles/files/3_40.pdf

⁴² The rate of compensatory afforestation as per Assam Govt guidelines is 1:3.

implications on water resources, water availability, and inland/fresh water wetlands.

366. During the AIFRERMIP Tranche 2, India's Initial National Communication (Natcom 1) Project's data was studied to understand the climate change impacts on water resources of the entire country. It was found during the study that climate change impacts for inland wetlands depends on a number of variables which includes temperature increase, evaporation rate, precipitation changes in the catchment area etc. and is a very complex issue. It was established that an increase in temperature shall alter the thermal cycles of lakes, oxygen solubility and other compounds, and thus affect the ecosystem and thus an increased evaporation of water and reduced inflow from rainfall could damage the wetlands.

367. General Circulation Model (GCM) projections (by HadCM2) for India indicate an increase in precipitation by up to 30% for the north-eastern region in addition to a relatively moderate increase in temperature of about 2°C by the period 2041-2060. This could increase the incidence of flooding in the Brahmaputra basin. Since, there are divergent views on the above findings; these cannot be taken into consideration for any design change at this stage till more specific and dependable information related to climate change effect on river hydrology in this region is available.

368. **Mitigation Measures.** The likely impact framework shown above is generalized. However, more information needs to be collected based on newer studies and monitoring data. The flood pattern needs to be closely analyzed during proposed life span of the embankment and take appropriate timely protective measures in case the flood levels increase due to climatic changes.

Air Quality

369. **Impacts.** The ambient air quality of the project area is good and the levels of PM_{2.5}, PM₁₀, SO₂ and NO₂ are under the limits as per National Ambient Air Quality Standard (NAAQS) for air pollutants as per Table 5-23. While various construction activities will increase the ambient air quality, but the level is likely to remain within the prescribed standards.

370. During the construction phase, there will be two main sources of air emissions, i.e., mobile sources and stationary sources. Mobile sources are mostly vehicles involved in construction activities, whereas emissions from stationary sources include construction equipment and machinery, batching plants, diesel generator sets, excavation/grading activities etc. In addition to these, fugitive emissions will also form a major proportion of air pollution in the form of particulate matter from storage and handling of construction material.

371. Fugitive dust sources associated with construction phase include vehicular traffic generating fugitive dust on paved and unpaved roads and aggregate handling.

372. The emission of particulate matter during the construction phase will be generated from the activities like clearing and grubbing, earthworks, movement of stone aggregates, road dust emissions etc. In addition to that emissions from various construction machinery fueled by diesel and from mobile source will be in the form of PM₁₀, VOC, CO, NO_x and SO₂. The emissions from stationary and mobile diesel engines with respect to their working/movement are presented in table below:

Table VI-2. Exhaust Emissions for Stationary and Mobile Machineries.

Source	PM ₁₀	VOC	CO	NO _x	SO ₂
Diesel Exhaust emissions (idle)	0.043 g/min	0.208 g/min	1.57 g/min	0.917 g/min	18.8 g/l
Diesel Exhaust emissions (idle)	0.4 g/mile	3.18 g/mile	18.82 g/mile	8.5 g/mile	18.8 g/l

Source: ADB. India: AIFRERMIP Project 2, IEE Report (Palasbari Subproject— Palasbari and Gumi Reach, Kamrup District). May 2018

373. **Mitigation Measures.** Batching plants shall be located away from the populated areas of Golapara town and be fitted with the air pollution control devices, the emission shall meet Pollution Control Board standards. Further, the batching plants must be sited at least 1 km in the downwind

direction from the nearest human settlement.

374. It shall be ensured that the dust emissions from the crusher and vibrating screen of the stone quarries, if new ones are opened and operated for the project, do not exceed the standards. For procurement of the material from the market/third parties the contractors shall ensure that the material is procured from the legal complaint sources. The compliance certificates (i.e., valid CTO of crusher, EC of mines and other permits) the approved third parties shall be submitted to the Engineer by the contractor before commencing the procurement of material.

375. Vehicles delivering loose and fine materials like sand and fine aggregates shall be covered to reduce spills on existing road. Water may be sprayed on earthworks, on a regular basis. During and after compaction of the sub-grade, water will be sprayed at regular intervals to prevent dust generation.

376. The following mitigation measures will also be taken to mitigate the dust entrainment and fugitive emissions from the various sources in the project area:

- Covering of loads in trucks, and the paving of access areas are examples of preventive measures. Mitigation measures including sprinkling of the on the dust prone work areas and construction yard with water is recommended at regular interval to arrest dust
- Redistribution of loose material onto the travel lanes will produce a short-term increase in the emissions. In general, preventive controls are usually more cost effective than mitigation controls
- Regular maintenance of machinery and equipment will be carried out
- Ambient air quality monitoring shall be carried out during construction and the first 3 years of operation phase as per the Environmental Monitoring Plan (eMoP) through NABL accredited/MoEF&CC recognized laboratories and the test reports shared with the Engineer and reported in the periodic Environmental Monitoring Reports (EMR). If monitored parameters are above the prescribed limits, suitable control measures must be taken
- Care shall be taken to keep all material storages adequately covered and contained so that they are not exposed to situations, where winds on site could lead to dust/particulate emissions
- Fabrics and plastics for covering piles of soils and debris is an effective means to reduce fugitive dust from the material stores/warehouses
- Spills of dirt or dusty materials shall be cleaned up promptly so that the spilled materials do not become a source of fugitive emission
- All slopes and embankments will be turfed as per best engineering practices to help minimize the dust generation during operation. Plantation along the embankment shall be maintained. AADB shall pilot the NbS on the selected embankments under this project and the model will be replicated at a later date
- Speed restrictions shall be maintained for the construction vehicles while travelling on unpaved roads. The contractor shall also maintain the access roads regularly by way of (a) paving or (b) adding gravel or slag to a dirt road

Operation Phase

377. **Impacts.** The prime source for air pollution in the project area during operation phase will be the vehicular movement on the road on top of the new embankment, which will be used for transportation by general public as well as for maintenance of the embankment. However, during the operation phase, the embankment will be strengthened and will be covered with turf and construction of paved roads by PWD will reduce the fugitive emissions. Due to all these developments, impact on air quality during operation phase will be beneficial.

378. **Mitigation Measures.** Plantation along the new and existing embankments in the project area

and turfing on the embankment slopes should be maintained, and their survival rates should be monitored. In addition to that regular maintenance of the road on the top of existing embankment as well as connecting roads shall be done for reducing fugitive emissions.

Noise

Design and Construction Phase

379. **Impacts.** During construction phase, noise will be generated from various activities such as clearing and grubbing, excavation, earthworks, borrow works, etc. The general noise levels during construction phase such as due to working of heavy earth moving equipment and machineries installation may sometimes go up to 100 dB(A) or more at the work sites. As per the proposed plan and given the nature of the work, manual labor is likely to be preferred with limited use of machinery.

380. Considering expected noise levels during construction phase, it has been assumed that all these equipment generate noise from a common point. As per studies conducted for AIFRERMIP Tranche 2, an increase in noise levels due to operation of various construction equipment is expected to increase the noise level from 100.3 dB (A) at a distance of 1 m to 52.4 dB (A) at a distance of 250 m from the sources. The increase in noise levels due to operation of various equipment is presented in table below.

Table 6-3. Increase in Noise Levels due to Operation of various Construction Equipment.

Distance (m)	Ambient Noise Levels dB (A)	Increase in Noise Level dB (A)	Increase in Ambient Noise Level dB (A)
1	51.0	100.3	49.3
10		80.3	29.3
50		66.3	15.3
100		60.3	9.3
150		56.8	5.8
200		54.3	3.3
250		52.4	1.4

Source: ADB. India: AIFRERMIP Project 2, IEE Report (Palasbari Subproject— Palasbari and Gumi Reach, Kamrup District). May 2018. <https://www.adb.org/projects/documents/ind-38412-033-iee-0>

381. In addition to the above, there will be significant increase in vehicular movement for transportation of construction material. At present, vehicular movement near the project site comprises predominantly of two wheelers and some single axle vehicles (mainly official/private vehicles). During construction phase, the increase in vehicular movement due to movement of construction vehicles is expected to increase manifold as major activities are near the existing embankment in Dhakuakhana, Lakhimpur and Paken area and near the Sonitpur town at Jahajghat. However, some movement of the construction materials is proposed to take place through the river using barges which shall be procured by WRD.

382. During construction phase, thus an increase in noise level is expected. However, the increase in noise levels will be localized, temporary in nature and mostly will be during daytime only.

383. **Mitigation Measures.** Following noise control measures shall be adopted, and included in the civil work contracts:

- Site Controls: Stationary equipment shall be placed along uninhabited stretches meeting the National Noise Quality standard, particularly for residential areas (Category C) and silence zones (Category D: hospitals, educational institutions, courts, religious places, etc.). In case the noise levels are not meeting the norms, the Engineer shall guide the contractor to adopt and establish the required measures as per the norms and as stipulated in the EMP; (i) maintain the required distance of least 150m (Category C) and 250m (Category D), (ii) to make use of appropriate temporary noise barriers especially near noise sensitive receptors

identified near the construction zone

- Construction activities shall be prohibited between 9.00 pm and 6.00 am near residential areas throughout the project stretch
- Appropriate PPE devices like ear plugs or ear muffs will be provided to the workers operating in the vicinity of high noise generating machines
- Construction equipment and machinery shall be fitted with silencers and regularly maintained
- Regular noise monitoring measurements shall be carried out as per the eMoP
- Use of manual labor where ever feasible over machines shall be encouraged

Operation Phase

384. **Impacts.** The prime source of noise pollution during operation phase will be the vehicular movement. However, as the roads will be paved and will provide smooth traffic movement, the impact due to vehicular movement will be less significant.

385. **Mitigation Measures.** Adequate signage shall be provided restricting the use of pressure horn particularly in near noise sensitive locations e.g., schools, hospitals and populated areas. Noise measurements shall be carried out along the road to ensure the effectiveness of mitigation measures. Tree barriers between the road and village, semi urban and urban area shall be developed in a layered manner as suggested under air environment mitigation measures.

Terrestrial Ecology

Disturbance to Vegetation

Design and Construction Phase

386. **Impacts.** There would be no major impact on terrestrial flora except cutting of trees during project intervention in the project area. There is no diversion of forest land or presence of any PA in these project areas. The natural terrestrial ecosystem has already been damaged by the heavy floods and erosions in the past in this area. The present vegetation is primarily planted by the locals and can be easily compensated by afforestation program. It is expected that with the compensatory plantation of 1:10 and prevention of further destruction of vegetation from erosion due to the project interventions, the proposed project shall help to improve the terrestrial biodiversity of the area.

387. The major species that likely to be affected due to the proposed project interventions are Semal (*Bombax ceiba*), Jackfruit (*Artocarpus heterophyllus*), Betel nut (*Areca catechu*), Banana (*Musa sp.*), Coconut (*Cocos nucifera*), Mango (*Mangifera indica*), various species of bamboo (*Bambusa balcooa*, *Bambusa tulda*, *Melocanna hamiltonii*, *Dendrocalamus giganteus*) *Plectomia assamica*, *Plectomia bractealis*, *Cassia sophera* etc.

388. **Mitigation Measures.** Efforts shall be made to minimize the tree loss. Provision shall be made for planting trees in a ratio of 1:10 per tree cut. Plantation program shall run parallel to the construction activity. Indigenous and existing vegetation like those impacted including various species of Bamboo, Jackfruit, Ficus, Mango and Semal shall be preferred. Afforestation shall be undertaken with community participation.

Operation Phase

389. **Impacts.** No direct impact is anticipated during operation stage except accidental damages or absence of tree management.

390. **Mitigation Measures.** Arrangement shall be made for effective tree management to ensure survivability of the tree plantation. AADB along with the social forestry wing of the Forest Department may be involved in this program. A tree survivability audit shall also be conducted at least once in a year to assess the effectiveness of the program.

Habitat Fragmentation and Destruction

Construction and Operation Phase

391. **Impacts and Mitigation Measures.** No habitat fragmentation and destruction are envisaged due to the project activities in the project reach. The widening of embankment at Paken and other anti-erosion work shall not fragment the aquatic habitat as normal flow of the water in the channels shall not be obstructed and the purpose of the sluice gate is to drain the rain water from the country side during monsoon. Thus, no measures are proposed.

Animal Distribution/Migratory Route

Construction Phase

392. **Impacts.** There are no migratory routes of terrestrial mammalian wildlife species in the project stretch, and therefore, no impacts are anticipated. However, winter migratory birds were observed during the field assessments in the proposed project areas. These birds may utilize riverine charlands, islands, or sandbars for resting and foraging. Potential impacts, such as poaching by construction laborers, could arise and should be mitigated through proper management and awareness measures. River Dolphins and other aquatic animals use the river as a corridor for movement between stretches. River Dolphins are predominantly found in the main channel of the Brahmaputra River. The proposed anti-erosion and flood protection works are confined within 30 meters of the riverbanks. However, due to their unique side-swimming behavior, an adaptation to navigate shallow waters, Dolphins may occasionally venture within 30 meters of the riverbanks during the lean season, which could expose them to construction activities.⁴³ While Dolphins entering secondary channels close to the banks are not expected to face significant impacts, there is a minimal risk of accidental collisions with barges transporting materials or of Dolphins becoming stuck in shallow waters. Nonetheless, River Dolphins possess echolocation abilities, as validated by Herald, E. S., et al. (referenced in the footnote), which significantly reduces the likelihood of accidental collisions with barges. Additionally, the probability of Dolphins being stuck in shallow waters near the banks is also low. Overall, no or minimal impacts on the movement and migration routes of aquatic animals and avifauna are envisaged, provided appropriate mitigation measures are implemented.

393. **Mitigation Measures.** In case of accidental trappings of the River Dolphins due to construction works in the shallow water, the wildlife department shall be immediately contacted for necessary actions. Poaching, hunting and fishing by the construction workers shall be strictly prohibited and awareness workshops for the laborers shall be conducted by the contractor. All care shall be taken to ensure that construction waste does not find its way to water and pollute it. Care shall also be taken to ensure that channels are not permanently obstructed during the construction period in any way outside the work zone. If river dolphins are sighted in the secondary channels near to the riverbanks, during the construction period, works shall be temporarily suspended till the Dolphins move out into the main channel. The sightings of the Dolphins shall be recorded, and the wildlife department shall also be intimated.

Operation Phase

394. **Impacts.** No impact is anticipated during operation stage with regards to animal distribution and migration.

⁴³ Herald, E. S., Brownell, J. R. L., Frye, F. L., Morris, E. J., Evans, W., E., & Scott, A. B. (1969). Blind river Dolphin: first side-swimming cetacean. *Science*, 166, 1408-1410.

Threatened Species

Design and Construction Phase

395. **Impacts.** As per information made available from IBAT ⁴⁴, there are 105 IUCN red listed species within 50 km radius of the project area. These includes 14 CR (1 floral, 7 avian, 5 reptilian and 1 mammalian species), 38 EN (2 floral, 1 Arthropoda, 9 reptilian, 4 Pisces, 8 avian and 14 mammalian species) and 53 VU species (5 floral, 1 Arthropoda, 8 reptilian, 4 Pisces, 18 avian and 17 mammalian species).

396. Construction activities of the proposed high priority works may impact species found at the areas. Riparian habitats for terrestrial species may be modified or lost due to embankment widening and check bund construction, while sandbars used by birds could face reduced availability. Additionally, the presence of construction labor camps poses poaching risks, particularly for migratory birds. Pollution from fuel spills, machinery, and improper waste disposal may degrade aquatic and terrestrial habitats, while altered sedimentation and flow patterns could affect spawning grounds and aquatic ecosystems. Vehicular traffic transporting construction materials may further disturb wildlife through noise pollution, air emissions, and an increased risk of roadkill for terrestrial animals. Soil erosion and sedimentation caused by earthwork and borrow pit activities may also harm wetland ecosystems and water-dependent species, underscoring the need for mitigation efforts to minimize these impacts.

397. **Mitigation Measures.** To mitigate the impacts of construction activities on wildlife along the Brahmaputra River, several measures should be implemented. Noise and vibration control technologies, such as mufflers and quiet machinery, should be employed to minimize disturbances to wildlife species. Turbidity levels must be monitored regularly, and sediment traps or silt curtains should be installed to reduce water pollution. Riparian and sandbar habitats can be protected by establishing buffer zones and restricting construction activities near critical areas. In case of accidental trappings or sightings of endangered species, the wildlife department must be immediately contacted for necessary actions. Poaching, hunting, and fishing by construction workers shall be strictly prohibited, with awareness workshops conducted by the contractor to educate laborers about wildlife protection. Proper waste management systems, including designated waste disposal sites and spill containment measures, must be in place to prevent construction waste from polluting water bodies. Additionally, care must be taken to ensure that water channels are not permanently obstructed outside the work zone during construction. Sustainable construction practices, such as bioengineering for embankment stabilization, can reduce soil erosion and sedimentation impacts. Vehicular movement should also be regulated to minimize noise pollution and roadkill risks, including implementing speed limits and creating wildlife crossings where necessary.

Aquatic Ecology

Effect on Fishing Activities/productivity

Design and Construction Phase

398. **Impacts.** There are no major fish landing sites in the project area hence fishing activities and productivity will not be disturbed during the project implementation period. Locals were found to be fishing on the bank of the river with bamboo poles and nets and also using boats to lay nets across the smaller channels. Temporary flushing of the fish species towards the deeper part of the river may happen during the anti-erosion and flood protection works. The construction work will not affect the fish activity in the river as they move with the river current. The construction activity may increase the turbidity on the bank temporarily, however the impact is temporary and reversible.

⁴⁴ IBAT report of proposed project areas

399. **Mitigation Measures.** Adequate provision shall be made in the design to ensure access to the temporary ghats. Adequate requisite facilities shall be restored or maintained for undisturbed movement of the fisherman. During the construction, the contractors must provide a clear signage to guide which areas that fishing boat should not pass by or make a temporary landing.

Operation Phase

400. **Impacts.** No impact is anticipated during operation stage with regards to fish activities.

Effect on River Dolphins

Construction Phase

401. **Impacts.** Primary studies conducted in the project area indicate that River Dolphins have been reported by local fishermen during the monsoon season, typically more than 100 meters from the riverbank in the Jahajghat and Jaroni areas, where anti-erosion and flood protection works are proposed. These dolphins are predominantly found in the main and deeper water channels of the Brahmaputra River. A technical study by IUCN estimated the presence of approximately 36 dolphins between Guwahati and Jugighopa, and another 35 between Jugighopa and the Bangladesh border stretch of the Brahmaputra River.⁴⁵ The proposed anti-erosion and flood protection works will be limited to within 30 meters of the riverbanks. While River Dolphins generally inhabit the main channel, they have developed a unique side-swimming behavior that allows them to navigate shallow waters. This behavior increases the likelihood of dolphins occasionally venturing within 30 meters of the banks during the lean season, potentially exposing them to construction activities. However, no significant impacts are expected even if dolphins enter the secondary channels near the riverbanks. The primary risks include accidental collisions with barges transporting construction materials and the possibility of dolphins becoming stuck in shallow waters. Nevertheless, dolphins possess echolocation abilities, as validated by Herald, E. S., et al. (referenced in the footnote), which significantly reduces the likelihood of collisions. Additionally, the probability of dolphins becoming stranded in shallow waters near the banks is considered low. Overall, minimal or no impacts on the movement and migration routes of aquatic animals and avifauna are anticipated.

402. **Mitigation Measures.** Works shall be limited to 30m from the river banks into the low flow level (LFL) of the river channels. The reported sightings of the Dolphin are at a distance and away from the river banks mainly in the main channel of Brahmaputra River. In case, River Dolphins is sighted in the secondary channels near to the riverbanks, during the construction period, works shall be temporarily suspended till the Dolphins move out into the main channel. No works are to be done during the monsoon season. In case of accidental trappings of the Dolphins due to construction works in the shallow water, the wildlife department shall be immediately contacted for necessary actions. The sightings of the Dolphins shall be recorded, and the wildlife department shall also be intimated.

Migratory Routes

Design and Construction Phase

403. **Impacts.** There is no migratory route of fishes in the project area, which can be affected due to the proposed project. The migratory fish species like Hilsa (anadromous)⁴⁶ and *Anguilla* (catadromous)⁴⁷ migrate through the main channel of the river i.e., through the deeper zones of the river. Therefore, project will not have any impact on the migratory route of these fishes. Other fish species like *Crossocheilus spp.*, *Tor spp.* also show only local migration from upper to lower reaches of the river, but these also normally migrate in the deeper zone of the river. The construction works

⁴⁵ Wakid, A. & Braulik, G. (2009): Protection of endangered Gangetic Dolphin in Brahmaputra River, Assam, India. Final report to IUCN-Sir Peter Scott Fund. pp 44.

⁴⁶ Migration of fish from sea to fresh water for breeding.

⁴⁷ Fish that lives in fresh water and breeds in sea.

involved in the project will not have any effect on the migratory routes.

Effect on Spawning and Breeding Grounds

Design and Construction Phase

404. **Impacts.** Studies conducted during the AIFRERMIP project have observed that all fish species do not breed in same place. Breeding grounds varies from fish to fish as well as location. It has been reported in the AIFRERMIP project IEE reports that most of the riverine smaller fish species, prefer the shallow courses of river for breeding and spawning. Some fish species like *Channa spp.*, *Labeo spp.* and major carps prefer wetlands and beel for breeding. Fish spawning seasons also vary from fish to fish. However, most normal seasons for almost 80% of fish species starts from April and ends in August (i.e., during pre-monsoon and monsoon seasons).

405. Increase in siltation due to construction activity in the project area particularly during the breeding season, may disturb the breeding activities. However, anti-erosion works shall primarily be executed in the river bed and LFL area during the winter season.

406. **Mitigation Measures.** The construction of the anti-erosion works in the project area shall primarily be executed in the river bed and LFL area during the winter season. The construction activity in the river bed shall be prohibited during the breeding period of April to August. All care shall be taken to ensure that construction waste does not find its way to water in these area and cause pollution.

Operation Phase

407. **Impacts.** No impact is anticipated during operation stage with regards to fish activities.

Effect on Pond Fisheries

Design and Construction Phase

408. **Impacts.** No pond fisheries activities were found along the proposed project intervention area. However, pond fisheries are found in the study areas of these districts, Lakhimpur, Biswanath and Sonitpur. The current productivity of these places is low. Once flood scenario is stabilized, siltation problems will be minimized, and the fish productivity of these areas will be improved.

409. **Mitigation Measures.** The fish productivity can be improved substantially with use of better fish culture and increasing the capacity of fish ponds as well institutional strengthening support. Fish productivity audit may also be undertaken to assess the effect of institutional support.

Socio Economic

Construction and Operation Phases

410. **Impacts and Mitigation.** A large number of households are affected by flood and erosion. The proposed project will bring relief to the entire population in this project area. The project will also provide employment to a large number of people during the construction period and thus will boost the local economy as small businessmen and entrepreneurs will provide the daily needs of the workers and officers of the proposed project.

411. With the stabilization of the area and prevention of land loss due to erosion every year, land availability for multiple crops will increase bringing positive impact on the local economy. Since the proposed project interventions shall have a positive impact on the socio economics of the area, no mitigation measures are warranted.

Land Acquisition and Resettlement

Design, Construction and Operation Phases

412. **Impacts.** The land acquisition and resettlement impacts are likely triggered in the anti-erosion works at few locations, involving both legal title holders and squatters. The land required for the widening of the embankment at Paken and the construction of the check bund at Dhakuakhana belongs to the government.

413. **Mitigation Measures.** The Resettlement Plan (RP) is being prepared parallelly for these districts, Lakhimpur, Biswanath and Sonitpur shall cover the details of the households likely to be affected and compensation to the affected persons as applicable per ADB SPS, national and state laws.

Social conflict

Construction Phases

414. **Impacts.** Most of the unskilled and semi-skilled workers will be from the local areas with some skilled migrant workers for which contractor may establish a labor camp. They may conflict in culture and lifestyle and compete with local laborers over some job opportunities and may also create potential health issues such as human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS).

415. **Mitigation Measures.** Early consultations will be made by the contractor with the local communities of the project area to determine the appropriate location of work camp sites. The contractor shall ensure that all migrant laborers are housed in the labor camps. Preference shall be given to locals for employment as unskilled and semi-skilled workers. All migrant workers will undergo workshop/briefings to sensitize them on local culture and lifestyle awareness. Appropriate measures for addressing potential health issues such as HIV/AIDS shall be taken as stipulated in the EMP.

Establishment and Operation of Construction Camps and Workers Facilities

416. **Impacts.** It is likely that the contract may employ some skilled workers from outside project area, and therefore may provide temporary workers accommodation during the construction phase. Proper provision and maintenance of facilities is necessary for proper living conditions and avoid health, environment and safety issues. Workers camps may also have adverse impacts on surrounding communities. Operation of construction camps can cause temporary air and noise pollution from machine operation, water pollution from storage and use of fuels, oils, solvents, and lubricants. Potential impacts are negative but short-term and reversible by mitigation measures.

417. **Mitigation Measures.** Ensure conditions of livability at work camps established for the project are maintained at the highest standards possible at all times; living quarters and construction camps shall be provided with standard materials (as far as possible to use portable ready to fit-in reusable cabins with proper ventilation); thatched huts, and facilities constructed with materials like GI sheets, tarpaulins, etc., shall not be used as accommodation for workers; accommodation shall meet the IFC standards for workers accommodation⁴⁸ which include: provision of safe housing, availability of electricity, plumbing, water and sanitation, adequate fire protection and dormitory/room facilities; accommodation shall be in the range from 10 to 12.5 cubic meters (volume) or 4 to 5.5 square meters (surface) per worker, a minimum ceiling height of 2.10 meters; a reasonable number of workers are allowed to share the same room – (standards range from 2 to 8 workers); workers with accompanying families shall be provided with a proper and safe accommodation. Prohibit

⁴⁸ https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/publications/publications_gpn_workersaccommodation

employees from poaching wildlife and cutting of trees for firewood.

Establishments

Design and Construction Phase

418. **Impacts.** Few number of houses and establishments are located near to the proposed project interventions areas in Lakhimpur, Jamuguri areas one temple is directly impacted and shall be required to be relocated. The RP prepared for the project shall cover the details of the properties likely to be affected and compensation to the affected properties as applicable per ADB SPS, national and state laws. Various educational, physical, or religious properties are located close to the project area and may be affected partially or fully due to project.

419. **Mitigation Measures.** Efforts shall be made to prevent any relocation or demolition of these establishments, unless absolutely required. Where required, the social infrastructure shall be rehabilitated taking account of social and cultural values in consultation with the local community and district/local administrations. Temporary noise barriers will be installed close to school and place of worships during the construction stage at project area.

Archaeological Sites to be Impacted

420. **Impacts.** There is no ASI protected archaeological sites located within 500m of the proposed project reaches and thus there shall be no impact due to the proposed project interventions. Any chance findings shall be immediately reported to the PIU, PMU and district administrations and necessary measures directed by the Engineer shall be implemented. A chance find protocol shall be prepared (sample is provided Appendix 12).

Places of Pilgrimage and Tourism to be Impacted

421. There is no pilgrimage or tourist spot along the project intervention area. People thought have been noted to visit the Jahajghat area in the Sonitpur town. However, the stretch where people visit are not in areas where project interventions are proposed and hence no impacts are expected. In fact, with the riverbank protection will have positive impact by preventing further erosion of the area.

Water Supply and Sanitation

Construction and Operation Phase

422. **Impacts.** Local residents primarily depend on groundwater to meet their drinking water needs, and the quality of groundwater in the project area has been found suitable for consumption. The proposed project activities are not expected to impact the water supply in the region. However, river water is commonly used by residents for other domestic purposes, such as washing and bathing.

423. Sanitation facilities in the project areas, particularly in rural regions, are inadequate. During floods, access to safe drinking water and proper sanitation becomes a significant challenge for local communities. To address this, the design of the embankment should include provisions for proper disposal sites for materials used during emergency flood protection, such as geo-bags. Ensuring the safe and environmentally sound disposal of such materials is crucial to maintaining hygiene and preventing environmental contamination.

424. **Mitigation Measures.** Awareness should be created among the residents about the upkeep of the embankment. Wastes generated during construction and especially at construction camps shall be collected at designated locations. The contractor may tie up with the local municipal authorities for disposal of the municipal wastes. Incineration of wastes shall be prohibited. Construction labor camps shall have toilets along with septic tanks. The proper disposal of the geo-bags and other material used earlier by WRD as temporary anti-erosion and flood protection measures shall be ensured contractor as stipulated in the EMP. During operation phases, encroachment and squatters shall be prevented by WRD with active assistance of the district

administration.

Accidents and Safety

Design and Construction Phase

425. **Impacts.** The risks associated with the proposed high priority project are minimal. However, roads being narrow near the project interventions, efforts shall be made that no hazardous traffic conditions are created due to construction vehicle movement. Locals may out of curiosity crowd around the construction camp and zones and get hurt.

426. **Mitigation Measures.** The construction zones and the camps in the project areas shall be barricaded and proper fences provided. Drivers shall be provided adequate trainings to drive in narrow roads. Adequate lighting and signage (including road signages) to be provided at the construction sites to aware the locals of the dangers. All signage shall be in multiple language (Assamese, Hindi/Bengali besides English, if Engineer desires). Speed limits shall be prescribed for construction vehicular movement on the access road to avert the accidents.

427. The workers shall be provided with necessary personal protective equipment and a first aid unit including adequate supply of dressing materials, transport means, nursing staff and an attending doctor, shall be available at each construction site. Regular health checkup camps to be organized at a frequency defined in EMP. Mandatory health checkups of laborers to be done during joining and periodically during the construction phase.

Navigation

Design and Construction Phase

428. **Impacts.** This river section under project area is navigated by people for moving from one place to another located at river bank and moving to char lands for fishing and farming. They use small motor boats and fish landing sites or *ghats* for these movements. These landing sites (*ghats*) could be temporarily disturbed due to project activities. However, there will not be any impact on the general navigability of the river due to the project since project activities are limited to river bank and beyond.

429. **Mitigation Measures.** During construction phase, contractors shall be required to provide alternate landing sites (*ghats*) with berthing facilities, access, and other common infrastructure, as part of the tender documents. In places the riverbank protection will provide steps to facilitate landing of local boats in support of trade and river crossings in project area.

Occupational Health and Safety Plan due to COVID 19 Pandemic

430. **Impacts.** Though the effect of COVID 19 pandemic has subsided in the India but the threat remains that COVID 19 outbreak may reoccur. In case of recurrence of the COVID 19 outbreak in India the local community members involved in project activities may be at a heightened risk of virus exposure.

431. **Mitigation Measures.** Project shall also adhere to necessary protocols in response to infectious diseases such as the corona virus disease (COVID-19) consistent with the guidelines of relevant government healthcare agencies and the World Health Organization. Ensure that the project related staff at all levels are appropriately vaccinated. Ensure project staff, consultants, contractors, and workers have in their mobile devices the Aarogya Setu App, which is a mobile application developed and recommended by the Government of India to proactively reach out to and inform the users of the app regarding risks, best practices and relevant advisories pertaining to the containment of COVID-19. In case of the recurrent outbreak of the pandemic mandatory isolation of the personnel or workers, either asymptomatic or showing symptoms, who have had direct contact with anyone tested positive for COVID-19. The isolation procedures issued by the government shall be followed along with proper disposal of used PPE following guidelines and procedures issued by the

government.

B. Summary of Impacts

432. The environmental impacts of the proposed high priority works have been categorized by project phases—pre-construction, construction, and operation & maintenance (O&M). The chapter evaluates potential environmental impacts and identifies mitigation strategies, assigns responsibilities for implementation, and outlines monitoring actions. Screening has been conducted following ADB SPS 2009 and the rapid environmental assessment checklists to determine the significance of impacts in the project's area of influence (Aol), encompassing both direct and indirect effects.

433. **Pre-Construction Phase Impacts.** Site selection can lead to loss of biophysical resources and potential encroachment on adjacent environments, particularly near sensitive areas like Kaziranga National Park. While the project avoids protected areas, locations such as Paken and Rangachali Dalani are within 40 meters of Kaziranga's boundary, necessitating strict adherence to the park's management plan. NOCs from the DFOs and Kaziranga Field Director ensure regulatory compliance.

434. Design-related impacts stem from decisions regarding the scale of operations, technology, and waste management practices. The use of geo-bags, porcupine screens, and anti-erosion measures minimizes ecological disruption but necessitates careful planning to avoid unnecessary land alteration or deforestation.

435. **Construction Phase Impacts.** The construction activities—particularly earthworks in Dhakuakhana and Biswanath (Paken)—may alter land use patterns, potentially affecting agricultural lands and compacting soil along haulage routes. The unplanned selection of borrow areas could lead to loss of productive land and increased soil erosion, especially along embankments and approach roads. However, the adoption of WRD guidelines for borrow pit rehabilitation and the use of covering materials during transport aim to mitigate these risks.

436. Potential water pollution during construction is primarily linked to sewage from labor camps and fuel leaks from machinery. The Brahmaputra River is used by locals for domestic activities, making it crucial to prevent untreated sewage discharge. Septic tanks and mobile toilets are planned for waste management to safeguard both surface and groundwater quality.

437. The use of construction machinery and increased vehicular movement will generate dust and noise. However, these impacts are expected to be localized and temporary, mitigated through measures like dust suppression, vehicle maintenance, and restricted working hours near residential and sensitive areas. Noise barriers will be installed near schools and places of worship to minimize disturbances.

438. Although most construction sites do not fall within protected areas, the proximity of Paken and Rangachali Dalani to Kaziranga National Park will have low risk to species given the localized nature of the works. However, the presence of River Dolphins in the Jahajghat and Jaroni areas requires careful monitoring, as these mammals may venture near construction zones. The project will limit activities to 30 meters from the riverbanks and suspend operations if dolphins are sighted nearby.

439. **Operation and Maintenance (O&M) Phase Impacts.** The project is expected to provide net benefits by stabilizing riverbanks and reducing soil erosion, protecting over 16,000 hectares of land from flooding and erosion. Periodic inspections and maintenance will be essential to ensure the embankments' stability and prevent breaches that could affect nearby villages and agricultural lands.

440. The structural works are designed to preserve the natural flood regime without altering river hydrology. However, long-term changes in sediment load due to upstream hydropower projects and climate change may affect the river's morphology. The project will employ numerical hydraulic

modeling to monitor flood patterns, sediment deposition, and drainage behavior, allowing for adaptive management as needed.

441. In the long term, the project aims to enhance biodiversity by stabilizing habitats along the riverbanks. However, increased agricultural activity in protected floodplains could lead to nutrient runoff and potential eutrophication of nearby wetlands. Buffer zones and sustainable agricultural practices will be promoted to mitigate these risks.

442. The project will generate employment opportunities during construction, benefiting local communities through increased economic activity. Stabilized flood conditions will enhance agricultural productivity, contributing to long-term socio-economic growth. The project avoids private land acquisition wherever possible. However, certain interventions, particularly the embankment widening at Paken, may necessitate limited land acquisition and resettlement. A Resettlement Plan is being prepared in compliance with ADB SPS and national regulations to ensure fair compensation and livelihood restoration. The project sites are generally distant from cultural and religious landmarks, minimizing risks to heritage sites. Where necessary, mitigation measures will ensure noise control and accessibility for local communities.

443. The project's environmental impacts are predominantly associated with the construction phase, with most effects being localized, temporary, and manageable. Long-term impacts are expected to be positive, enhancing the resilience of flood-prone areas, protecting biodiversity, and fostering socio-economic development. The proposed mitigation measures, combined with robust monitoring and adaptive management, will ensure the project complies with environmental standards while delivering its intended benefits.

VII. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

A. Overview

444. The active participation of stakeholders including local community, NGOs/CBOs, and the media in all stages of project preparation and implementation is essential for successful implementation of the project. It will ensure that the projects are designed, constructed, and operated with utmost consideration to local needs, ensures community acceptance, and will bring maximum benefits to the people. Public consultation and information disclosure are a must as per the ADB policy.

445. Most of the main stakeholders have already been identified and their representatives consulted during preparation of this IEE, and any others that are identified during project implementation will be brought into the process in the future. Primary stakeholders in the high priority project areas are local residents, farmers, shopkeepers, and business people who reside and work nearby river bank/ embankments of Brahmaputra River, particularly where anti-erosion and river protection works are proposed under this high priority work. The secondary stakeholders are the government and utility agencies responsible for provision of services in project area, District Administration authorities, Forest and Wildlife Department, Field Director Kaziranga National Park, Agriculture and Fisheries departments, Executive Engineers of concerned W.R. Divisions, Circle officers etc., Both primary and secondary stakeholders were consulted during the preparation of this IEE.

446. Public consultation meetings were held at few of the proposed project intervention locations. Consultations were carried out in November and December 2024 at the proposed high priority work areas. Stakeholder's consultations were also held on in between in same period with the Forest and Wildlife department of concerned division of project areas, Field Director, Kaziranga National Park and district administration authorities of concerned districts.

447. ADB's SPS requires that FREMAA carry out consultations with affected people and other concerned stakeholders and facilitate their informed participation. Meaningful consultation goes beyond information disclosure. It involves two-way communication between FREMAA and the affected communities and stakeholders, and active participation of affected communities and stakeholders in project design and implementation. Consultations includes presentations on environmental impacts, benefits, mitigation measures and project interventions

448. The public consultation and disclosure program are a continuous process throughout the project implementation, including project planning, design and construction.

449. **Focus-group discussions** with affected persons and other stakeholders were conducted to learn their views and concerns over the proposed project. A socio-economic household survey has been conducted in the project area, covering sample households, to understand the household characteristics, health status, and the infrastructure service levels and their demand. General public who are the people residing along the target project activity areas were consulted during visits. Formal panchayat-level consultation meetings were conducted in November/December 2024 in the proposed project areas. Besides, several other meetings also conducted at village-level with communities. The summary of stakeholder's consultations is provided in Appendix 9. Main issues discussed are:

- (i) Brief introduction about the project components
- (ii) Benefits of project for the economic and social upliftment of community
- (iii) Labor availability in the project area or requirement of outside labor involvement
- (iv) Possible environmental impacts due to the project activity
- (v) Local disturbances due to project construction work

- (vi) Necessity of tree felling at project sites
- (vii) Challenges during flooding season if any
- (viii) Climatic conditions
- (ix) Movement of wild animals any elephant corridor
- (x) Forest and sensitive area nearby the project site
- (xi) Dolphin habitat
- (xii) Fish caught with their nets
- (xiii) Pollution level during construction period specially dust and noise pollution
- (xiv) Health and hygiene
- (xv) Safety of residents during construction phase
- (xvi) Solid waste disposal system
- (xvii) Requirement of enhancement of other facilities and discussion about ghat.

450. In line with the ADB's requirements, consultations were conducted with key stakeholders and community people pertaining to environmental and social considerations. These consultations helped in identifying felt needs/concerns and apprehensions of the communities related to the proposed project and their priorities. Consultations were held with stakeholders including temporarily affected persons, farmers, beneficiaries/local people, poorest of poor households (non-titleholders on government land), gram panchayat pradhans, panchayat members/public representatives, FREMAA, WRD engineers and field staff.

451. Public consultation meetings were held at two or three locations of each of the proposed high priority project areas and the Table 7-1 provides a summary of the locations, and participants in the consultation meetings. A total of 101 participants were present in the consultation meetings out of which 37 % were female participants. Details public consultation are provided in Appendix 9.

452. Consultations were also held with various institutional stakeholders at their offices.

453. Table 7-2 provides the summary of the consultations, the issues and the suggestions provided by the stakeholders. Since the consultations are an ongoing procedure, the column related to issues, suggestions and request shall be updated on the progress of various requests and suggestions that may be received through official channels.

Table 7-1. Summary of Public Consultation held for High priority projects.

S. N.	Name of High priority project area	Name of Village	Date of Consultation	Participants		
				Male	Female	Total
1	Dhakuakhana	Amlokhi Bandana(Bahir Bandana)	21/11/2024	3	3	6
2		Papung	22/11/2024	9	0	9
3		Baghchuk(Kolbari)	22/11/2024		5	5
4	Sonitpur	Sonitpur	25/11/2024	7		7
5		Jarony	25/11/2024	12	0	12
6		Jarony	12/12/2024	0	10	10
7	Biswanath	Paken	27/12/2024	14	0	14
8		Rangchali Dalani	27/12/2024	11	4	15
9	Lakhimpur	Jamuguri	13/12/2024	8	5	13
10		Jamuguri	13/12/2024	0	10	10
		Total		64	37	101

Source: M/s Infer Consulting, 2024

Table 7-2. Consultations held with Institutional Stakeholders

Sl. No.	Name	Designation	Date	Issues, Suggestions and Requests
1	Mr. Kartik Kalita, ACS Mr. Biswajit Dutta, ACS	SDO, Dhakuakhana and Circle officer, Dhakuakhana	3 rd October 2024	<ul style="list-style-type: none"> • SDO was informed about the proposed high-priority interventions in the Dhakuakhana division. • SDO had an in-depth discussion with the team and mentioned that most of the land in the project areas is NC land. He advised the Circle Officer to conduct a joint survey and provide the land status for onward process
2		Fisheries Department, Dhakuakhana	3 rd October 2024	<ul style="list-style-type: none"> • FREMAA team met with fisheries department and apprised about the proposed interventions under Dhakuakhana • Official confirmed that wetlands are not within the proposed work areas and provided a list of fish species present in the project areas. • Team apprised the officer that, proposed work will not be undertaken during the monsoon hence it will not impact on breeding of fishes
3		Range officer, Dhakuakhana	3 rd October 2024	<ul style="list-style-type: none"> • Ranger was informed about the proposed high priority works under the Dhakuakhana Water Resource Division. • He confirmed that none of the project reach lengths fall within any forest or protected areas
4	Mr. Garga Mohan Das, ACS	Additional District Commissioner, Sonitpur, District	26 th November, 2024	<ul style="list-style-type: none"> • ADC was informed about the proposed high-priority interventions at Jahajghat and Jaroni in Sonitpur district. • ADC had an in-depth discussion with the team about the ADB policy for resettlement and rehabilitation and extended his support to initiate a joint survey along with the Circle Officer and onwards process required for the preparation of Safeguard documents
5	Mr. Nripendra Nath Kalita, AFS	Divisional Forest Officer, Sonitpur Division	26 th November, 2024	<ul style="list-style-type: none"> • FREMAA team apprised the DFO about the proposed interventions under Sonitpur districts . • The DFO checked with the wildlife division and confirmed that the proposed intervention falls outside the notified boundary of the 6th edition. • The DFO confirmed that the proposed interventions do not fall within any forest or protected areas

Sl. No.	Name	Designation	Date	Issues, Suggestions and Requests
				and assured to provide the NOC as requested by the WRD (NOC has been obtained and placed at Appendix 16)
6	Mr. Munindra Nath Ngatey, ACS	District Commissioner, Biswanath		<ul style="list-style-type: none"> • FREMAA team along with WRD engineer apprised to DC about the proposed project and requested his support in R&R and obtaining NoC from Forest department • DC assured team to provide all support , as this project is high important to protect the Embankment at Paken and land from further erosion in Rangachali and Paken areas
7	Mr. Biswajyoti Das, AFS Mr. Khagesh Pegu, IFS	DFO, (Territorial) , Biswanath and DFO (Wildlife), Biswanath		<ul style="list-style-type: none"> • The DFO (Wildlife Warden) was informed about the proposed high priority works in the Biswanath district. • FREMAA requested a formal NoC to carry out the work in the Rangachali area. • The DFO agreed in principle, stating that the NoC would be issued based on an assessment report to be prepared by the rangers. (NoC has been obtained and appended at Appendix 16) • The DFO (Territorial) confirmed that the proposed interventions are located outside the forest area
8	Dr. Sonali Ghosh IFS	Director Kaziranga	4 th December 2024 and 14 th December 2024	<p>4th December 2024</p> <ul style="list-style-type: none"> • The Director of Kaziranga was briefed on the project interventions in the Biswanath district, and she expressed her support for the initiative. • The FREMAA team requested Dr. Sonali to share the management plan to be followed during the implementation of works for projects near the park boundary. • The team requested for NoC to take up the Anti Erosion work at Rangachali area, and apprised her about the discussion with the DFO (Wildlife) in Biswanath. • She agreed in principle to grant the NoC, subject to the report provided by the DFO. <p>14th December 2024</p> <ul style="list-style-type: none"> • Dr. Sonali Ghosh, IFS, Director, KNP and Field Director, KTR pointed that Maklung is at present

Sl. No.	Name	Designation	Date	Issues, Suggestions and Requests
				<p>the only challenge in terms of active erosion of the Protected Area (PA).</p> <ul style="list-style-type: none"> • KNP and TR in its Management Plan has no such action for River erosion control. The Management Plan puts more emphasis on the natural ecological process as floods are vital for the sustenance of the grassland, prey-predator ratio, food chain and ecological succession of the PA. • Dr. Ghosh emphasized that for anti-erosion measures within the KNP park area, nature-based solutions should be explored, as hardcore construction activities are not permitted within the park boundaries.
9	Mr. Lachit Kumar Das, ACS	DC, North Lakhimpur	28 th November 2024	<ul style="list-style-type: none"> • FREMAA team informed the DC) about the proposed project and requested his support in resettlement and rehabilitation (R&R) and obtaining the NoC from the Forest Department. • DC emphasized that work should start immediately after acquiring the land. Any delay might cause shifting of the Bankline, necessitating a fresh survey. • DC requested the submission of a drone video of the proposed reach lengths to assess the existing alignment of the land. • DC assured full cooperation for the preparatory work, highlighting that this project will help prevent further erosion of the river bank and strengthen the existing embankment, which connects several villages in the area.
10	Mr Manoj Kumar Goswami, AFS	DFO, North Lakhimpur	29 th November	<ul style="list-style-type: none"> • DFO was informed about the proposed high priority project locations and interventions. • DFO confirmed that the proposed interventions do not fall within any forest or protected areas and handed over the NoC as requested by the WRD division engineer.
11	Mr. Deep Pegu	Dy CEO Works, FREMAA	30 th December	<ul style="list-style-type: none"> • The Deputy CEO (works) was briefed about the status of the draft IEE and additional priority works. • He confirmed that the procurement of contractors will follow the same

Sl. No.	Name	Designation	Date	Issues, Suggestions and Requests
				arrangements as in the original works under CRBIFRERMP. Materials like geo bags (type – A and C), and porcupines will be procured by WRD and supplied to the civil work contractors.

B. Public Consultation

454. ADB's SPS requires that FREMAA carry out consultations with affected people and other concerned stakeholders and facilitate their informed participation. Meaningful consultation goes beyond information disclosure. It involves two-way communication between FREMAA and the affected communities and stakeholders, and active participation of affected communities and stakeholders in project design and implementation. Consultations includes presentations on environmental impacts, benefits, mitigation measures and project interventions

455. The public consultation and disclosure program are a continuous process throughout the project implementation, including project planning, design and construction.

C. Information Disclosure

456. Executive summary of the IEE will be translated in local language— Assamese and made available at the offices of FREMAA, WRD, PIUs, village panchayat offices, and displayed on their notice boards. Hard copies of the IEE will be accessible to citizens to disclose the document and at the same time creating wider public awareness. Electronic version of the IEE (in English) and executive summary (in Assamese) will be placed in the official website of the FREMAA after approval of the IEE by the Government and ADB. Stakeholders will also be made aware of grievance register and redress mechanism.

457. Public information campaigns to explain the project details to a wider population will be conducted. Public disclosure meetings will be conducted at key project stages to inform the public of progress and future. Prior to start of construction, the PMU/PIU will issue notification on the start date of implementation in local newspapers. A board showing the details of the project will be displayed at the construction site for the information of general public.

458. Local communities will be continuously consulted regarding location of construction camps, access and hauling routes and other likely disturbances during construction. The road closure together with the proposed detours will be communicated via advertising, pamphlets, radio broadcasts, road signage, etc.

459. Project related information shall be disclosed through public consultation and making relevant documents available in public locations. PMU and PIUs shall provide relevant safeguards information in a timely manner, in an accessible place and in a form and languages understandable to affected person and other stakeholders. For illiterate people, other suitable communication methods, like audio visual methods will be used.

460. At minimum, the following documents shall be made available at the offices of project agencies – FREMAA, WRD, PMU, PIU and block level offices for public reference, and shall also be uploaded on respective websites.

1. Executive summary of the IEE (in Assamese).
2. Draft IEE Report (in English).
3. Final IEE Report (in English).
4. Updated/amended IEE, whenever updated/amended (in English).
5. Corrective action plans prepared during project implementation (English).

6. Annual Environmental Monitoring Reports (English)

461. A concise executive summary of project (in Assamese) and final IEE report, providing all necessary details of proposals, implementation arrangements, project locations, environmental impacts and mitigation and monitoring measures, and grievance redress mechanism, shall be made available to the stakeholders at consultation meetings. This should also provide contact information of project agency. This summary shall also be displayed at the notice boards of PMU, PIU and other public places. During project implementation, relevant information about any major changes to project scope will be shared with beneficiaries, affected persons, vulnerable groups, and other stakeholders. The above documents shall be submitted to ADB for disclosure on ADB website.

D. Adaptive Mechanism

462. In case of recurrence of COVID-19, pandemic adaptive mechanisms will be used to address limitations on environmental safeguard activities and consultations due to any government restrictions and COVID-19 risks. Surveys and data collection will be conducted through online platforms, brochures, questionnaires, and other forms of media as applicable to provide information and receive feedback from the people, beneficiaries, government agencies and other stakeholders.

VIII. GRIEVANCE REDRESSAL MECHANISM

A. Need for Project Specific GRM

463. A project-specific grievance redress mechanism (GRM) will be established to receive, evaluate and facilitate the resolution of displaced people's concerns, complaints and grievances about the social and environmental performance at the level of the Project. The GRM will aim to provide a time-bound and transparent mechanism to voice and resolve social and environmental concerns linked to the project. The project-specific GRM is not intended to bypass the government's own redress process, rather it is intended to address displaced people's concerns and complaints promptly, making it readily accessible to all segments of the displaced people and is scaled to the risks and impacts of the project. The complainant may access the formal legal system at any time.

464. During plan preparation, information regarding GRM will be disclosed as part of the public consultation process. Grievances related to the implementation of the project will be acknowledged, evaluated, and responded to the complainant with corrective action proposed. The outcome shall also form part of the annual monitoring report that will be submitted to ADB.

465. The GRM will work within existing legal and cultural frameworks, providing an additional opportunity to resolve grievances at the local and project level. The key objectives of the GRM are:

- Educate stakeholders on the GRM
- Receive and record the grievances
- Resolve and close the grievances
- Escalate unsolved grievances to concerned authority
- Notify/update the stakeholders of the solutions

466. The types of grievances the stakeholders may file for all the project components include, but are not limited to:

- Non-payment, or inadequate compensation and/or due R&R assistances.
- Wrong measurement of land parcel
- Construction related impacts – damages to structures; dust damaging crops/trees
- Health and safety risks.
- Negative impacts on the environment.
- Negative impacts on communities
- Physical harm and nuisance from construction or operational activities.
- Impacts arising from migrant labor on local communities
- Exclusion from beneficiary lists
- Lack of information and opportunities for participation

467. Presently, FREMAA and WRD are also addressing grievances raised through the Centralized Public Grievance Redress and Monitoring System (CPGRAMS), which is an online portal implemented by the Govt. of India and hosted by National Informatics Centre (NIC). The Chief Minister of Assam can be contacted for any help at phone numbers 0361-2262222/ 2237043, Fax Number 0361-2262069 and email cm@assam.gov.in.

468. Under CRBIFRERMP, Grievance Redressal Committee (GRC) has been established and functional at three levels, one at the project (Division/PIU) level, another at the districts level, and the third at Executing Agency (or PMU) level, to receive, evaluate and facilitate the resolution of affected person concerns, complaints, and grievances. The GRM for the additional high-priority work districts and Division (PIU) levels shall be established following the same framework and procedures as those

implemented under the ongoing CRBIFRERMP.

469. The GRM system and the committees to be formed at various levels would be intended to address stakeholders' grievances and dissatisfaction about actual or perceived impacts and to find a satisfactory solution. The Project specific GRM is not binding, and the affected persons can approach the Judiciary any time if they wish to do so. Taking grievances to Judiciary will be avoided as far possible and the resettlement plan-implementing agency will make utmost efforts and reconciliation at the level of GRC.

B. Division/PIU Level GRC

470. The concerned Project Implementation Unit (PIU)/Water Resources Division (WRD) will nominate 1 (one) official to oversee the implementation of RP and to provide response to the grievances raised by the community and affected persons. The GRC at Division/PIU Level will be constituted with the following members:

Table 8-1. GRC Members at Division/PIU Level.

Sl. No.	Members	Designation
1.	Executive Engineer (WRD) – concerned Division	Chairperson
2.	Assistant Executive Engineer (WRD) – concerned Division	Member-Secretary
3.	Nominated official from RP implementing NGO	Member
4.	Gaon Bura (Village Head) of the concerned village	Member
5.	Two Community Members (Female)	Members

Source: FREEMA

C. District Level GRC

471. The second level GRC will be constituted at each Project District headed by the Deputy Commissioner. The GRC at district level will be constituted with the following members:

Table 8-2. GRC Members at District Level.

Sl. No.	Members	Designation
1.	Deputy Commissioner of the District or his representative	Chairperson
2.	Additional Deputy Commissioner (LA)	Member-Secretary
3.	Revenue Circle Officer(s) – concerned Revenue Circles	Member
4.	Executive Engineer (WRD) – concerned Division	Member
5.	Nominated official from RP implementing NGO	Member
6.	Members of the Panchayat/ULB	Member
7.	One Representative of the Affected Person	Members

Source: FREEMA

472. There shall be not more than 7 (seven) members in the committee. There shall be minimum one-third women representation in the committee.

D. PMU Level GRC

473. The PMU level GRC is already established and actively redressing the complaints, the structure of PMU level GRC is constituted with following members.

Table 8-3. GRC Members at PMU Level.

Sl. No.	Members	Designation
1.	Chief Executive Officer (CEO) FREMAA	Chairperson
2.	Deputy Chief Executive Officer (Dy. CEO) FREMAA	Member
3.	Chief Executive Officer (CEO) AADB	Member-Secretary

Sl. No.	Members	Designation
4.	Secretary to the Govt. of Assam, Revenue and Disaster Management Department	Member
5.	Chief Engineer, WRD	Member
6.	Chief Technical Officer (CTO)	Member

Source: FREEMA

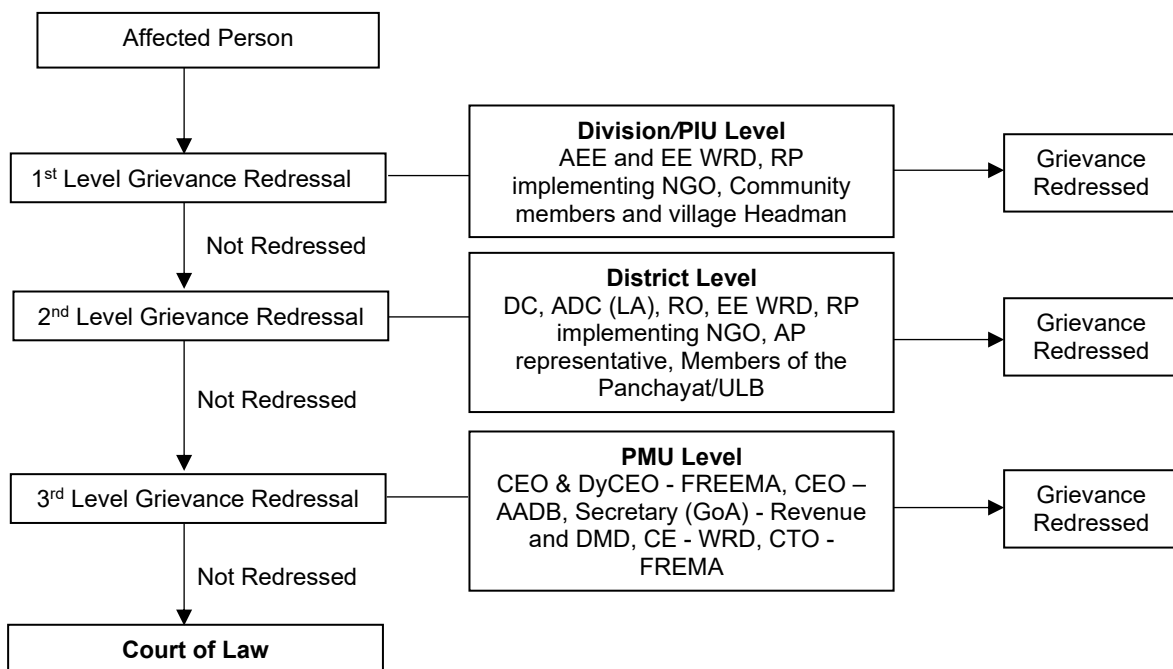


Figure 8-1. Grievance Redress Process.

Source: FREEMA

E. Key Elements of GRM under the project

474. The project GRM has the following key elements and procedures for satisfactory functioning:

475. **Flexible Grievance Registration Process:** The grievances can be registered by person, phone, text message, mail, email, via website, verbal, etc. Prior to registering the complaint/ query, a procedural step will be in place to assess its eligibility and check that issues raised in the complaint fall within the scope that the GRM is mandated to address. Queries or complaints may be received in a variety of forms ranging from verbal communications to formal and written complaints; also, directly from APs or via third parties. Whatever the source and the form in which the query or complaint is received, it will be accepted by the focal points and registered in a grievance register and online portal. It is also to be mentioned that uniformity will be maintained in the complaint registration systems across different sections and agencies of the project.

476. **Log of Grievances and Database:** A Grievance Register will be maintained in which all grievances are recorded and digitized and maintained as a database at the PIU level by the designated official to document the grievance as per the prescribed format attached including details of the date and type of grievance received, the date of personal hearing provided to the complainant, the date when grievance was redressed or if not redressed date of forwarding the grievance to GRC. Provision will be made to record and maintain grievances received directly on-site and incorporated in the Grievance Register. This register will be placed at the Executive Engineer's office of the

concerned division. This will serve as the First Level of Grievance resolution.

477. **Redressal Durations and Disclosed Procedures:** The GRM procedures will be publicly advertised and popularized for use by the stakeholders. The GRM will also set out the length of time users can expect to wait for acknowledgement, response, and resolution of their grievances. The GRM system will be popularized among the communities through IEC campaigns, IEC material, wall writings, etc. In addition to this, the length of time the complaints can expect to wait for acknowledgement, response, and resolution of different types of grievances. The response time prescribed for the GRC would be three weeks at each level. Since the entire resettlement component of the project has to be completed before the construction starts for the whole project, the GRC will meet at least once a month, or as needed, to resolve the grievances. Sixty percent attendance of the committee members at all three levels will constitute the quorum for the meeting. However, in case of divisional and district level GRC, participation of community members and representative of APs and RP implementing agency will be mandatory. The PIU will also ensure installation of Display Boards at site with GRM information with support from the civil works contractors/implementing support NGO and in consultation with project Management Unit (PMU), FREMAA. The GRC will meet once in a month.

478. **Transparency and Good Governance:** The GRM procedures, governing structure and decision-making process will be popularized among the communities through IEC materials and campaigns. For transparency and good governance, community members are selected as members of the GRC at field level, Grievances that cannot be resolved at the PIU/ PMU level and in cases where the complainant is not satisfied with the decision, will be referred to the district level GRC. Consultative meetings along with distribution of leaflets with the community and PAPs will also be conducted to educate them on the GRM and its escalation matrix for resolving grievances to encourage them to use and access it in case of need. The PMU and PIU and adhere to the principle of confidentiality while informing the same to the district level GRC (if required) as the case may be. The designated official at the PIU will also be responsible to ensure that a mechanism is put in place to address grievances of labors and staff deployed at project sites by the Contractors.

479. **Escalation:** The project GRM provides for escalation at different levels, so that the unresolved grievances might be redressed at higher levels of GRM. Mediation is also encouraged as an option when the users are not satisfied with the grievance redressal.

480. Further, for land related grievances, the GRC will provide an opportunity to have their grievances redressed prior to approaching the State level LARR Authority, constituted by Government of Assam in accordance with Section 51(1) of the RFCTLARR Act, 2013. Decision of the District Level GRC will be final, unless an appeal is preferred with the PMU level. If the committee is unable to arrive at a decision through consensus, the matter will be referred to the appellate authority with a note on opinion of the committee members. Other than disputes relating to ownership rights and apportionment issues, on which the LARR Authority has jurisdiction, GRC will review grievances involving eligibility, valuation, all resettlement and rehabilitation benefits, relocation, and payment of assistance.

481. People who are, or may in the future be, adversely affected by the project may submit complaints to ADB's Accountability Mechanism. The Accountability Mechanism provides an independent forum and process whereby people adversely affected by ADB-assisted projects can voice, and seek a resolution of their problems, as well as report alleged violations of ADB's operational policies and procedures. Before submitting a complaint to the Accountability Mechanism, affected people should make a good faith effort to solve their problems by working with the concerned ADB operations department. Only after doing that, and if they are still dissatisfied, should they approach the Accountability Mechanism.⁴⁹

⁴⁹For further information see: <http://www.adb.org/Accountability-Mechanism/default.asp>.

IX. ENVIRONMENTAL MANAGEMENT PLAN

A. EMP and EMoP

482. An Environmental Management Plan (EMP) has been developed to provide mitigation measures to reduce all negative impacts to acceptable level and monitoring the same. This is presented in the Table 9-1, which shows the potential environmental impacts, proposed mitigation measures and responsible agencies for implementation and monitoring.

483. The purpose of the environmental management plan (EMP) is to ensure that the activities are undertaken in a responsible, non-detrimental manner with the objectives of:

- (i) providing a proactive, feasible, and practical working tool to enable the measurement and monitoring of environmental performance on-site.
- (ii) guiding and controlling the implementation of findings and recommendations of the environmental assessment conducted for the project.
- (iii) detailing specific actions deemed necessary to assist in mitigating the environmental impact of the project; and
- (iv) ensuring that safety recommendations are complied with.

484. A copy of the EMP must be kept at work sites at all times. The EMP will be included in the bid documents, and it may be reviewed and updated during implementation. The EMP will be made binding on all contractors operating on the site and will be included in the contractual clauses. Non-compliance with, or any deviation from, the conditions set out in this document constitutes a failure in compliance.

485. For civil works, the contractor will be required to

- (i) establish an operational system for managing environmental impacts.
- (ii) carry out all of the monitoring and mitigation measures set forth in the EMP; and
- (iii) implement any corrective or preventative actions set out in safeguards monitoring reports that the employer will prepare from time to time to monitor implementation of this IEE and EMP. The contractor shall allocate budget for compliance with these EMP measures, requirements, and actions.

486. The following Table 9-1 show the potential environmental impacts, proposed mitigation measures and responsible agencies for implementation and monitoring during pre-construction, construction, and operation and maintenance phases

Table 9-1. Environmental Management Plan (EMP).

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
Pre-Construction Phase					
Preparatory works	Protected areas	<ul style="list-style-type: none"> • Proposed high priority work areas falls outside the forest boundary and protected areas. • NoC from Forest department, wild life and Director Kaziranga National Park has been obtained for same 	<ul style="list-style-type: none"> • During the execution of the project, contractor shall follow the management plan of Kaziranga National park, as Paken and Ranchali Dalani site of Biswanath district falls near the notified boundary of KNP 	PIU and Contractor	PIU, PMU and Project Implementation Support Consultant (PISC)
	Tree cutting at all work sites	The number of trees to be felled is yet to be determined as of the time of preparation of this IEE. The IEE shall be updated once the number of trees to felled is finalized.	<ul style="list-style-type: none"> • Minimize removal of trees by adopting to site condition and with appropriate layout design of various components or select any other site without trees for construction/labor camps. • Obtain prior permission for tree cutting at construction sites or at any other site that may require tree cutting during detailed design from forest department and district administration. • Plant and maintain 10 trees/seedlings for each tree that is removed. • Select native and ecologically appropriate tree species for replanting to restore biodiversity. • Conduct a detailed tree survey to identify tree species for protection. • Rehabilitate areas impacted by tree removal through soil stabilization and vegetation restoration. • Establish a monitoring plan to ensure the survival of replanted trees, with 	PIU and Contractor	PIU, PMU and Project Implementation Support Consultant (PISC)

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
			<p>maintenance for at least three to five years.</p> <ul style="list-style-type: none"> Obtain necessary permissions for tree felling from the Forest Department and ensure adherence to regulatory requirements. 		
Preparatory works	Consents, permits, clearances, NGOs, etc.	Failure to obtain necessary consents, permits, NOCs, etc. can result to design revisions and/or stoppage of works	<ul style="list-style-type: none"> Obtain all necessary consents (including consent to establish (CTE) and consent to operate (CTO) for construction plants), permits, clearance, and no objection clearances (NOCs) prior to award of civil works. Following consents are required: <ol style="list-style-type: none"> Tree cutting permissions from local authorities. Storage, handling, and transport of hazardous materials if any from PCB Assam Opening of new sand mining, quarries, borrow areas from Department of mines and Geology, SEIAA/MoEF&CC Traffic diversion/ road cutting from local authorities and police department. Ensure that all necessary approvals for construction from various authorities are obtained by contractor before start of construction. Submit all copies of the various consents, permissions, clearances, and NOCs to the Engineer and submit regular reports on compliance all obtained consents, permits, clearance, NOCs, etc. as required by the authorities. 	Contractor	PIU, PMU and PISC

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
			<ul style="list-style-type: none"> • Include in detailed design drawings and documents all conditions and provisions if necessary. • Obtain all necessary approvals from the Engineer including but not limited to setting up of labor camps, construction methodologies, and construction. Schedule before the start of construction. 		
Clearing and grubbing, site preparation	Disposal of solid waste and site preparation	Removal of solid waste and other nuisance materials	<ul style="list-style-type: none"> • Ensure that the project sites are cleared of solid waste or other nuisance materials. • Dispose solid waste from existing sites and materials into designated locations (dumping in vacant lot is not allowed). • Garbage generated during construction and especially at construction camps shall be collected and disposed at designated locations. The contractor may tie up with the local municipal authorities for disposal of the municipal wastes. • Incineration of wastes shall be prohibited. • Construction labor camps shall have toilets along with septic tanks, and garbage bins for segregation of wastes. • Develop a solid waste management plan that includes measures for waste reduction, reuse, and recycling wherever possible. • Provide awareness training to construction workers on waste segregation and proper disposal practices. • Ensure regular monitoring of waste collection, transportation, and disposal processes to prevent environmental contamination. 	Contractor	PIU, PMU and PISC

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
			<ul style="list-style-type: none"> • The proper disposal of the geo- bags and other material used earlier by WRD as temporary anti-erosion and flood protection measures shall be ensured by the contractor. • Ensure that no waste materials are dumped into water bodies, wetlands, or ecologically sensitive areas. 		
Sourcing of materials	Extraction of materials	<ul style="list-style-type: none"> • Extraction of materials can disrupt natural land contours and vegetation resulting in accelerated erosion, disturbance in natural drainage patterns, ponding and water logging, and water pollution. • Illegal quarrying may lead to land use change, unstable rock formation, air, and noise pollution 	<ul style="list-style-type: none"> • Conduct material extraction only in designated and approved areas. • Restore and rehabilitate extraction sites by stabilizing slopes and planting native vegetation after use. • Implement erosion control measures such as silt fences and sediment traps. • Obtain materials from aggregate and sand quarries/crusher sites which has necessary permissions from the Department of Mines and Geology, Prior environmental clearance (EC) from SEIAA/MoEF&CC and CTO from Pollution Control Board of Assam (PCBA) • If other sites are necessary, contractor to verify the suitability of all material sources and to obtain the approval of Engineer • If additional quarries will be required after construction is started, contractor to obtain necessary approvals from Engineer • Where materials are obtained from 3rd party vendors, contractors to submit all necessary documents including permission, EC documents, and CTE and CTO to the Engineer before obtaining source approvals. 	Contractor to prepare and submit list of approved quarry sites and sources of materials for the approval of Engineer.	PIU, PMU and PISC

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
			<ul style="list-style-type: none"> • Borrow earth areas to be identified by the contractor and necessary permissions obtained from Engineer. • Fly ash for use in embankment in lieu of borrow earth if technically permitted by Engineer. 		
Construction and Operation Stages					
Borrow pit excavations	Change in land use and borrow area	<ul style="list-style-type: none"> • Adverse effect on agricultural land and homestead around the site and construction camp areas. • Unplanned selection of borrow areas/no rehabilitation of borrow areas may lead to loss of productive use of the land. • Transportation of borrow earth may also cause air pollution. • Restricted access to the embankment construction site. • Encroachment on embankment for habitation and cultivation • Cutting of embankment to create approach to river side 	<ul style="list-style-type: none"> • Avoid adjacent cultivable lands for storage and/or handling of construction materials. • Ensure construction camps is preferably be located on uncultivated area. Provision of all requisite facilities (drinking water supply, sanitation, domestic solid waste collection and disposal, fuel supply) at the camps. • Provision shall be made in the embankment design for providing access to river bank close to the habitats. • Minimize the project footprint by limiting construction activities to designated areas. • Avoid using productive agricultural land and homesteads for construction camps and material storage. • Provide compensation for any loss of crops or land use to affected farmers and landowners. • Rehabilitate disturbed agricultural land post-construction to restore its productivity. • Cover trucks carrying borrow earth with tarpaulins to prevent dust emissions. • Sprinkle water on haulage roads regularly to minimize dust generation. • Schedule material transportation during off-peak hours to reduce traffic congestion and emissions. 	Contractor	PIU, PMU and PISC

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
			<ul style="list-style-type: none"> • Provide temporary access roads for local communities around the construction areas. • Clearly mark construction zones and provide alternative routes wherever possible. • Maintain open communication with local stakeholders to address access-related grievances. • Collaborate with local authorities to prevent encroachment through regular monitoring and enforcement. • Establish buffer zones around embankments and enforce land use restrictions. • Conduct awareness campaigns for local communities about the risks of encroachment on embankments. 		
Borrow pit excavations	Borrow area location and rehabilitation	<ul style="list-style-type: none"> • Loss of agricultural land and homestead plantation due to borrowing earth from country side of embankment • Permanent disfiguration of land • Seepage to the foundations of embankment • Non- rehabilitation of borrow areas 	<ul style="list-style-type: none"> • Borrow pits shall be preferred on river side to embankment as these can get silted in the course of time or earth from retired embankment • Preference shall be given to utilization of waste lands. • Limit the extent of borrow areas to the minimum required for construction and avoid affecting productive lands wherever possible. • Use of dredge material from river if technically permitted by the Engineer • Using fly ash in lieu of borrow earth if technically permitted by Engineer • Use the combination of soil and sand in embankment construction. • Conduct regular inspections and maintenance to identify and address seepage issues promptly. 	Contractor	PIU, PMU and PISC

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
			<ul style="list-style-type: none"> Follow the WRD guidelines for locating borrow pits close to the embankment (See Appendix 5) Contractor shall ensure rehabilitation of borrow areas in line with WRD guidelines before handing over the project sites Develop site-specific borrow areas rehabilitation plans, including filling, leveling, and revegetating borrow areas. PIU to monitor the progress of rehabilitation to ensure compliance with environmental requirements. 		
Quarrying and mining	Land use change due to construction material sourcing (quarrying)	<ul style="list-style-type: none"> Illegal quarrying for fulfilling the requirement of significant amount of construction material may lead to land use change, unstable rock formation, air, and noise pollutions. Quarrying operations, if not regulated may lead to adverse impact on ambient environment. 	<ul style="list-style-type: none"> Aggregates required for construction of embankment shall be procured from quarries and crushers which have obtained Prior EC from SEIAA/MoEF&CC and CTO from PCBA Where materials are obtained from 3rd party vendors, contractors to submit all necessary documents including permission, EC documents, CTO, etc. to the Engineer before obtaining source approvals While finalizing the site, proper land use assessment shall be done. The land to be earmarked for dumping construction waste if any shall be free from any social or R&R issue. 	Contractor	PIU, PMU and PISC
Earthworks and borrow areas	Soil environment	<p><u>Construction phase:</u></p> <ul style="list-style-type: none"> Soil erosion potential of an area depends on its topography, geological structure, rainfall, soil type and land use/land cover. 	<p><u>Construction phase:</u></p> <ul style="list-style-type: none"> Construction shall be scheduled such that large areas of soil particularly at borrow areas near the embankment are not laid bare during the monsoon. The construction methodology and schedule shall be approved by the Engineer before start of work. 	Contractor during construction and Defect Notification Period (DNP).	PIU, PMU and PISC during construction PMU during operations

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
		<ul style="list-style-type: none"> • The topography of the terrain in project area covering the alluvial plain is nearly flat with a gentle gradient towards south west. • The soils in the high priority project area are easily eroded during heavy rainfall. • Possibility of occurrence of gully and rill erosion is expected in the uncovered side slopes of embankments and other freshly cut or deposited areas. <p><u>Operation Phase</u></p> <ul style="list-style-type: none"> • Likelihood of soil erosion during the operation phase resulting in shifting of bank line 	<ul style="list-style-type: none"> • Exposed surface shall be resurfaced and stabilized as soon as possible and covered by straw or mulch to avoid soil loss in the intervening period. • Ground disturbances shall be phased so that it is limited to workable size. • Stabilizations of soil around approach roads/slopes shall be done by turfing and tree plantation in right of way (ROW) • The embankment design shall incorporate adequate engineering measures so that the construction could withstand the severe earthquakes. • Soil erosion shall be visually checked on potential erosion zones during construction phase. In case soils erosion is found, suitable measures shall be taken to control the same. <p><u>Operation Phase</u></p> <ul style="list-style-type: none"> • Periodic checking shall be carried out to assess the effectiveness of stabilization measures. Suitable strengthening measures shall be implemented to prevent reoccurrence of soil erosion at existing erosion prone locations and prevent erosion at newer locations. 	PIU and PISC during operation stage.	
Earthworks and activities in construction camps	Soil compaction and contamination	<ul style="list-style-type: none"> • Soil around construction site, haulage road, construction camp, and workshop, will get compacted due to transportation of man, machine, and materials. 	<ul style="list-style-type: none"> • Restricting movement of construction vehicles, machinery and equipment to the embankment site and pre- defined haulage road. • Adequate provision for approach roads capable of handling movement and haulage of heavy vehicles and machineries shall be made to avoid damage to existing 	Contractor during construction and DNP. PIU and PISC during operation stage.	PIU, PMU and PISC during construction PMU during operations

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
		<ul style="list-style-type: none"> • The agricultural yield will be reduced substantially due to soil compaction. • Soil may also get contaminated around construction site, machine maintenance area, fueling station, construction camp, hot mix plant site, if any and haulage road. 	<p>village roads, crop lands and settlement areas.</p> <ul style="list-style-type: none"> • The non-usable, non-saleable, non-hazardous construction waste shall be disposed of in the properly designated places. • Usable or saleable waste shall not be disposed of to landfill. • Limiting vehicle movement to specific routes to minimize soil compaction. • Restoring compacted soil after construction activities. • Following efforts to prevent soil contamination shall be made: <ul style="list-style-type: none"> i) The construction vehicle shall be fueled or repaired/serviced at designated places with proper arrangement of waste collection and disposal. The arrangement shall include cemented floor with dyke around for fuel storage and filling as well repairing of construction equipment. To avoid the soil contamination at the wash down and re-fueling areas, "oil interceptors" shall be provided. ii) The demolition waste if any shall also be used to the extent feasible for construction. iii) Oil and grease spill and oil-soaked materials shall be sold off to PCBA/MoEF&CC authorized vendors. iii) Oil spill kits should be available at the site to minimize the damage to soil quality in case of spillage. iv) Fuel and waste oil should be stored in isolated locations on 		

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
			paved areas only to minimize the soil contamination. These areas should be provided with the garland drains provided with the oil interceptors		
Construction of embankment, AE works and activities within construction camps	Water quality	<ul style="list-style-type: none"> • The major source of surface water pollution during project construction phase will be sewage and wastewater generated from labor camps as well as workshop areas. • It is expected that approx. 100 laborers shall stay in each construction/labor camps. Total quantum of sewage generated is expected to be of the order of 108 LPD (0.108 KLPD). However, it may pollute land and other nearby water bodies if discharged untreated, especially during the low flow season. 	<ul style="list-style-type: none"> • Septic tanks shall be provided in each camp to treat the domestic sewage generated from the camps. • Provision of mobile toilets also shall be considered with the provision of channeling the sewage to septic tank in a closed loop system. • Discharge of untreated domestic sewage to the Brahmaputra River or to any natural waters will not be permitted. • No debris shall be dumped in the water bodies • Ensure proper collection and disposal of solid and liquid waste from labor camps to prevent water contamination • Avoid discharging untreated sewage into water bodies, especially during the low flow season. • Conduct regular monitoring of wastewater treatment systems to ensure proper functioning and compliance with local environmental standards. • Monitor nearby water bodies for potential contamination during construction. • Construct proper drainage systems in labor camps and workshop areas to prevent water stagnation and reduce the risk of surface water pollution. 	Contractor	PIU, PMU and PISC

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
Felling of trees	Micro-climate	<ul style="list-style-type: none"> Short term impact in terms of minor increase in temperature may happen in the immediate vicinity of the embankment due to cutting of trees located within the project intervention zone. 	<p><u>Construction Phase</u></p> <ul style="list-style-type: none"> Prior approval shall be obtained if tree cutting required at any of the project sites as per the policies of the state forest department and government of Assam. The project will adopt a policy of compensatory tree plantation as per the state government policy.⁵⁰ Use native tree species for replantation to ensure ecological balance and quick restoration of vegetation cover. Optimize project designs to minimize the number of trees felled and avoid cutting large, mature trees wherever possible. Establish vegetative buffer zones along embankments using shrubs and grasses to provide shade and reduce localized temperature increases. Schedule tree cutting and construction activities in phases to limit the extent of exposed areas and reduce immediate temperature impacts. Involve local communities in tree plantation drives to create a sense of ownership and accelerate re-greening efforts. <p><u>Operation Phase</u></p> <ul style="list-style-type: none"> The flood pattern needs to be closely analyzed from hydrological engineering perspective during 	<p>Contractor during construction and DNP.</p> <p>PIU and PISC during operation stage.</p>	<p>PIU, PMU and PISC during construction</p> <p>PMU during operations</p>

⁵⁰ The rate of compensatory afforestation as per Assam Govt guidelines is 1:3.

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
			<p>proposed life span of the embankment and take appropriate timely protective measures in case the flood levels increase due to climatic changes.</p> <ul style="list-style-type: none"> • Monitor reforestation efforts to ensure survival and growth of the planted trees, replacing any that fail to establish. 		
Construction of embankment, AE works and activities within construction camps	Air quality	<ul style="list-style-type: none"> • Various construction activities will decrease the ambient air quality, but the level is likely to remain within the prescribed standards. • Mobile sources of pollution are mostly vehicles involved in construction activities, whereas emissions from stationary sources include construction equipment and machinery, diesel generator sets, excavation/grading activities etc. In addition to these, fugitive emissions will also form a major proportion of air pollution in the form of particulate matter from storage and handling of construction material. • Fugitive dust sources associated with construction phase include vehicular 	<ul style="list-style-type: none"> • For procurement of the material from the market/third parties the contractors shall ensure that the material is procured from the legal complaint sources. The compliance certificates (valid CTO of crusher, EC of mines etc.) the approved third parties shall be submitted to the Engineer by the contractor before commencing the procurement of material. • Vehicles delivering loose and fine materials like sand and fine aggregates shall be covered to reduce spills on existing road. Water may be sprayed on earthworks, on a regular basis. During and after compaction of the sub-grade, water will be sprayed at regular intervals to prevent dust generation. • The following mitigation measures will also be taken to mitigate the dust entrainment and fugitive emissions from the various sources in the high priority project area: <ul style="list-style-type: none"> (i) Covering of loads in trucks, and the paving of access areas are examples of preventive measures. Mitigation measures including 	<p>Contractor during construction and DNP.</p> <p>PIU and PISC during operation stage.</p>	<p>PIU, PMU and PISC during construction</p> <p>PMU during operations</p>

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
		<p>traffic generating fugitive dust on paved and unpaved roads and aggregate handling.</p> <ul style="list-style-type: none"> The emission of particulate matter during the construction phase will be generated from the activities like clearing and grubbing, earthworks, movement of stone aggregates, road dust emissions etc. In addition to that emissions from various construction machinery fueled by diesel and from mobile source will be in the form of PM₁₀, VOC, CO, NO_x and SO₂. <p><u>Operation Phase</u></p> <ul style="list-style-type: none"> The prime source for air pollution during operation phase will be the vehicular movement on the road on top of the embankment, which will be used for transportation by general public as well as for maintenance of the embankment. However, during the 	<p>sprinkling of the on the dust prone work areas and construction yard with water is recommended at regular interval to arrest dust</p> <p>(iii) Regular maintenance of machinery and equipment will be carried out</p> <p>(iii) Ambient air quality monitoring shall be carried out during construction and the first year of operation phase as per the Environmental Monitoring Plan (EMoP) through National Accreditation Board for Testing and Calibration Laboratories (NABL) accredited/ MoEF&CC recognized laboratories and the test reports will be shared with the concerned W.R. Divisional Engineer. If monitored parameters are above the prescribed limits, suitable control measures must be taken.</p> <p>(iv) Care shall be taken to keep all material storages adequately covered and contained so that they are not exposed to situations, where winds on site could lead to dust/particulate emissions.</p> <p>(v) Fabrics and plastics for covering piles of soils and debris is an effective means to reduce fugitive dust from the material stores/warehouses.</p> <p>(vi) Spills of dirt or dusty materials shall be cleaned up promptly so that the spilled materials do not become a source of fugitive emission.</p> <p>(vii) Speed restrictions shall be maintained for the construction</p>		

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
		<p>operation phase, the embankment will be strengthened and will be covered with turf and construction of paved roads by PWD will reduce the fugitive emissions. Due to all these developments, impact on air quality during operation phase will be beneficial.</p>	<p>vehicles while travelling on unpaved roads. The contractor shall also maintain the access roads regularly by way of (a) paving or (b) adding gravel or slag to a dirt road</p> <p><u>Operation Phase</u> Selected Plantation along the embankment (265m and turfing on the embankment slopes should be maintained, and their survival rates should be monitored. In addition to that regular maintenance of the road on the top of embankment as well as connecting roads shall be done for reducing fugitive emissions.</p>		
Construction of embankment, AE works and activities within construction camps	Noise levels	<ul style="list-style-type: none"> Noise will be generated from various activities such as clearing and grubbing, excavation, earthworks, borrow works, etc. During construction phase, the increase in vehicular movement due to movement of construction vehicles is expected to increase multifold as major activities are in the vicinity of the project area. During construction phase, thus an increase in noise level is expected. However, the increase in noise levels 	<p>Following noise control measures shall be adopted, and included in the civil work contracts:</p> <ul style="list-style-type: none"> Site Controls: Stationary equipment shall be placed along uninhabited stretches meeting the National Noise Quality standard, particularly for residential areas (Category C) and silence zones (Category D: hospitals, educational institutions, courts, religious places, etc.). In case the noise levels are not meeting the norms, the Engineer shall guide the contractor to adopt and establish the required measures as per the norms and as stipulated in the EMP; (i) maintain the required distance of least 150m (Category C) and 250m (Category D), (ii) to make use of appropriate temporary noise barriers especially 	Contractor	PIU, PMU and PISC

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
		will be localized, temporary in nature and mostly will be during daytime only.	<p>near noise sensitive receptors identified near the construction zone</p> <ul style="list-style-type: none"> • Construction activities shall be prohibited between 9.00 pm and 6.00 am near residential areas throughout the high priority project stretch • Appropriate PPE devices like ear plugs or ear muffs will be provided to the workers operating in the vicinity of high noise generating machines • Construction equipment and machinery shall be fitted with silencers and regularly maintained • Regular noise monitoring measurements shall be carried out as per the EMoP during the construction period and 1st year of the operation period • Use of manual labor where ever feasible over machines shall be encouraged. 		
Construction of embankment, AE works and activities within construction camps	Terrestrial ecology	<p>There would be no major impact on terrestrial flora except cutting of trees (if required) during project intervention in the high priority project areas</p> <p><u>Operation Phase</u> No direct impact is anticipated during operation stage except accidental</p>	<ul style="list-style-type: none"> • Efforts shall be made to minimize the tree loss. • Provision shall be made for planting trees in a ratio of 1:10 per tree cut. Plantation program shall run parallel to the construction activity. Indigenous and existing vegetation like those impacted including various species of Bamboo, Jackfruit, Ficus, Mango and Semal shall be preferred. • Afforestation shall be undertaken with community participation. Prevention of further destruction of vegetation from erosion due to the project interventions, the proposed 	<p>Contractor during construction and DNP.</p> <p>PIU and PISC during operation stage.</p>	<p>PIU, PMU and PISC during construction</p> <p>PMU during operations</p>

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
		damages or absence of tree management.	<p>project shall help to improve the terrestrial biodiversity of the area</p> <p><u>Operation Phase</u></p> <ul style="list-style-type: none"> Arrangement shall be made for effective tree management to ensure survivability of the tree plantation. AADB along with the social forestry wing of the Forest Department may be involved in this program. A tree survivability audit shall also be conducted at least once in a year to assess the effectiveness of the program. 		
Construction of embankment, AE works	Animal distribution/migratory route	<ul style="list-style-type: none"> Winter migratory birds may use the riverine charland/islands/sand bars River Dolphins and other aquatic animals use the river for movement from one stretch to other. The river Dolphins are reportedly found mainly in the main channel of the Brahmaputra River and the proposed anti-erosion and flood protection works shall be limited within 30m of the river banks, no or minimal impacts on the movement and migration routes of the aquatic animals and avifauna are envisaged. 	<ul style="list-style-type: none"> In case of accidental trappings due to construction works or sightings of the endangered species, the wildlife department shall be immediately contacted for necessary actions. Poaching, hunting, and fishing by the construction workers shall be strictly prohibited and workshops for the laborers shall be conducted by the contractor. The contractor for the Rangchali Dalani site in Biswanath shall implement the Kaziranga National Park management plan. This will ensure that the construction activities align with the conservation and protection measures necessary for the park and its surrounding regions All care shall be taken to ensure that construction waste does not go to water and pollute it. Care shall also be taken to ensure that channels are not permanently obstructed during the construction 	Contractor	PIU, PMU and PISC

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
			<p>period in any way outside the work zone.</p> <ul style="list-style-type: none"> • Maintain undisturbed buffer zones around riverine charlands, islands, and sandbars used by migratory birds. • Educate construction workers on the importance of protecting migratory birds and enforce strict penalties for poaching or harassment of birds. • Deploy wildlife experts to monitor construction activities near the river to ensure no harm comes to dolphins and other aquatic animals. • Enforce speed restrictions on barges and other vessels transporting construction materials to avoid accidental collisions with dolphins. • Ensure that no construction waste, oil, or debris enters the river to prevent water contamination that could affect aquatic life. 		
Construction of embankment and AE works	Threatened species	<p>Design and Construction phase</p> <ul style="list-style-type: none"> • As per the initial assessment and from IBAT⁵¹ assessment, there are IUCN red listed species within radius of the project area. 	<ul style="list-style-type: none"> • In case of accidental trappings due to construction works or sightings of the endangered species, the wildlife department shall be immediately contacted for necessary actions. • Construction activities shall be restricted during the breeding periods of Gangetic Dolphin and other aquatic animal (June to September) 	Contractor during implementation and DNP.	PIU, PMU and PISC

⁵¹ www.ibat-alliance.org

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
			<ul style="list-style-type: none"> • Poaching, hunting, and fishing by the construction workers shall be strictly prohibited and workshops for the laborers shall be conducted by the contractor. • All care shall be taken to ensure that construction waste does not find its way to water and pollute it. Care shall also be taken to ensure that channels are not permanently obstructed during the construction period in any way outside the work zone. • The contractor for the Rangchali Dalani site in Biswanath must implement the Kaziranga National Park management plan, as the site is located near a 6th Schedule area. This ensures that the construction activities align with the conservation and protection measures necessary for the park and its surrounding regions. • Implement Biodiversity Action Plan (see Appendix 14 in Annexure-2). 		
Construction of embankment and AE works	Aquatic Ecology	Design and Construction phase <ul style="list-style-type: none"> • Temporary impact on fishing by local resident during construction phase on the bank of the river with conventional methods anticipated. • Temporary flushing of the fish species towards the deeper part of the river may happen during the anti- 	<ul style="list-style-type: none"> • Adequate provision shall be made in the design to ensure access to the temporary ghats. • Adequate requisite facilities shall be restored or maintained for undisturbed movement of the fisherman. • During the construction, the • contractors must provide a clear signage to guide the area for fishing boat should avoid. Biodiversity and ecology assessment including surveys/census of IUCN Red listed species shall be carried out prior to 	Contractor	PIU, PMU and PISC

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
		<p>erosion and flood protection works.</p> <ul style="list-style-type: none"> The construction activity may increase the turbidity on the bank temporarily, however the impact is temporary and reversible. 	<p>start of the construction activities by specialized Ecologists appointed by contractor.</p> <ul style="list-style-type: none"> Additional biodiversity and ecology assessment including surveys/census of IUCN Red listed species shall be carried out during the operation period for the entire project by specialized Ecologists appointed by contractor 		
Construction of embankment and AE works	Effect on Riverine Dolphins	Minimal impacts on the movement and migration routes of the are envisaged.	<ul style="list-style-type: none"> Works shall be limited to 30m (maximum) from the river banks into the low flow level (LFL) of the river channels. The reported sightings of the dolphin are at a distance and away from the river banks mainly in the main channel of Brahmaputra River. No works are to be done during the monsoon season. In case of accidental trappings due to construction works, the wildlife department shall be immediately contacted for necessary actions. 	Contractor	PIU, PMU and PISC
Construction of embankment and AE works	Effect on spawning and breeding grounds	<p><u>Design and Construction phase</u></p> <ul style="list-style-type: none"> Increase in siltation due to construction activity in the high priority project area particularly during the breeding season, may disturb the breeding activities. However, anti-erosion works shall primarily be executed in the river bed and LFL area during the winter season 	<ul style="list-style-type: none"> The construction of the anti- erosion works shall primarily be executed in the river bed and LFL area during the winter season. The construction activity in the river bed shall be prohibited during the breeding period of April to September . All care shall be taken to ensure that construction waste does not find its way to water in these area and cause pollution Limit construction activities, especially those generating siltation, to the non-breeding season to avoid interference with the breeding activities of aquatic species. 	Contractor during implementation and DNP.	PIU, PMU and PISC

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
			<ul style="list-style-type: none"> • Install silt curtains and sediment traps near construction sites to prevent sedimentation in downstream areas. • Conduct regular monitoring of sediment levels in the water to ensure construction activities do not exceed acceptable siltation thresholds. • Ensure that all construction waste, debris, and soil excavated during anti-erosion works are promptly removed and disposed of in designated areas. • Identify critical breeding zones prior to construction and establish buffer zones to protect these areas from construction-related siltation. • Implement erosion control practices, such as slope stabilization and vegetative cover, to minimize loose soil entering the river system. • Train construction workers on the importance of protecting breeding habitats and implementing mitigation measures during the construction phase. 		
Construction of embankment, AE works and activities within construction camps	Social conflict	<p>Construction stage</p> <ul style="list-style-type: none"> • Conflict in culture and lifestyle and competition with local laborers over some job opportunities may take place besides triggering potential health issues such as HIV/AIDS. 	<ul style="list-style-type: none"> • Early consultations will be made by the contractor with the local communities to determine the appropriate location of work camp sites. • The contractor shall ensure that all migrant laborers are housed in the labor camps. Preference shall be given to locals for employment as unskilled and semi-skilled workers. • All migrant workers will undergo workshop/briefings to sensitize them on local culture and lifestyle awareness. • Appropriate measures for addressing potential health issues such as 	Contractor	PIU, PMU and PISC

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
			<p>HIV/AIDS shall be taken like awareness and training, HIV testing, if required.</p> <ul style="list-style-type: none"> • Prioritize hiring local laborers for jobs where skills match, reducing competition and potential conflict with migrant workers. • Publicize grievance redressal mechanism for resolving disputes between local and migrant workers in a timely and transparent manner. • Organize regular health awareness sessions on HIV/AIDS, sexually transmitted infections (STIs), and general hygiene practices for all workers. • Collaborate with local health departments to implement HIV/AIDS prevention and care programs at the project sites. 		
Activities within construction camps	Establishment and operation of construction camps and workers facilities	<ul style="list-style-type: none"> • Proper provision and maintenance of facilities is necessary for proper living conditions and avoid health, environment, and safety issues • Operation of construction camps can cause temporary air and noise pollution from machine operation, water pollution from storage and use of 	<ul style="list-style-type: none"> • Ensure conditions of livability at work camps are maintained at the highest standards possible at all times • Living quarters and construction camps shall be provided with standard materials (as far as possible to use portable ready to fit-in reusable cabins with proper ventilation); thatched huts, and facilities constructed with materials like GI sheets, tarpaulins, etc., shall not be used as accommodation for workers; accommodation shall meet the IFC standards for workers accommodation⁵² which include: 	Contractor	PIU, PMU and PISC

⁵² https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/publications/publications_gpn_workersaccommodation

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
		<p>fuels, oils, solvents, and lubricants. Potential impacts are negative but short-term and reversible by mitigation measures.</p>	<p>provision of safe housing, availability of electricity, plumbing, water and sanitation, adequate fire protection and dormitory/room facilities; accommodation shall be in the range from 10 to 12.5 cubic meters (volume) or 4 to 5.5 square meters (surface) per worker, a minimum ceiling height of 2.10 meters; a reasonable number of workers are allowed to share the same room – (standards range from 2 to 8 workers).</p> <ul style="list-style-type: none"> • Proper beds with mosquito nets, potable drinking water, separate toilets for men and women connected to the septic tanks and soak pits, separate kitchen and dining facilities, Condom boxes/vending machines to be mandatorily provided in the labor camps. Laborers shall not be sleeping on the ground. Spraying of insecticides, carbolic acids etc. shall be done regularly (at least once a week). First aid boxes as per Factory Act and first aiders to be provided in the construction sites and labor camps. • Prohibit employees from poaching wildlife and cutting of trees for firewood. 		
Construction of embankment, AE works and activities within construction camps	Nearby establishments (educational and/or religious) and households	<p><u>Construction phases</u></p> <ul style="list-style-type: none"> • At few locations houses and establishments are located close to the proposed project interventions and 	<ul style="list-style-type: none"> • Efforts shall be made to prevent any relocation or demolition of these establishments, unless absolutely required. Where required, the social infrastructure shall be rehabilitated taking account of social and cultural values in consultation with the local 	Contractor during implementation and DNP.	PIU, PMU and PISC

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
		<p>some shall be directly impacted and shall be required to be relocated.</p> <ul style="list-style-type: none"> Noise and emissions generating from the construction activity may adversely impact the establishments in the vicinity, however, the impact is temporary and reversible. 	<p>community and district/local administrations in compliance to R&R.</p> <ul style="list-style-type: none"> Temporary noise barriers will be installed close to school and place of worship during the construction stage. 		
<p>Clearing and grubbing, site preparation, construction of embankment, AE works and activities within construction camps</p>	<p>Accident and safety</p>	<ul style="list-style-type: none"> Roads in project area being narrow may lead to hazardous traffic conditions due to movement of construction vehicles. The execution of work on the river front and use of barges may lead to safety and accident risks. Locals may out of curiosity crowd around the construction camp and zones and get hurt. 	<ul style="list-style-type: none"> Drivers shall be provided adequate trainings to drive in narrow roads. Proper river safety gears shall be provided to the personnel working on the river front. The construction zones and the camps shall be barricaded, and proper fences shall be provided. Adequate lighting and signage (including road signages) to be provided at the construction sites to aware the locals of the dangers. All signage shall be in multiple language (Assamese, Hindi/Bengali besides English, if Engineer desires). Speed limits shall be prescribed for construction vehicular movement on the access road to avert the accidents. The workers shall be provided with necessary personal protective 	<p>Contractor during implementation and DNP.</p>	<p>PIU, PMU and PISC</p>

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
			<p>equipment and a first aid unit including adequate supply of dressing materials, transport means, nursing staff and an attending doctor, shall be available at each construction site.</p> <ul style="list-style-type: none"> • Regular health checkup camps to be organized. • Mandatory health checkups of laborers to be done during joining and periodically during the construction phase. • Construction and/or strengthening of landing ghats for barges to transport materials instead of using public roads. 		
Construction of embankment and AE works	Navigation	<ul style="list-style-type: none"> • People use small motor boats/country boats for navigations between fish landing sites or ghats for movements between 2 banks/chars. These landing sites/ghats could be temporarily disturbed due to project activities. 	<ul style="list-style-type: none"> • During construction phase, contractors will provide alternate landing sites (ghats) with berthing facilities, access, and other common infrastructure, as part of the tender documents • In places the riverbank protection will provide steps to facilitate landing of local boats in support of trade and river crossings • Identify and establish temporary alternative fish landing sites/ghats in consultation with the local community to ensure uninterrupted navigation during project activities. • Schedule construction activities to avoid peak times of boat movement or fish landing activities to minimize disruption. • Inform local communities and boat operators in advance about construction timelines and any 	Contractor	PIU, PMU and PISC

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
			<p>temporary closures of landing sites/ghats.</p> <ul style="list-style-type: none"> • Install clear signage and navigation aids at construction zones and nearby waterways to ensure safe navigation for boats. • Construct temporary access ramps or pathways at alternative sites to facilitate the movement of boats and people. • Restore disturbed landing sites/ghats to their original condition or better after construction activities are completed. • Publicize grievance redressal mechanism to address concerns raised by boat operators or the local community regarding disruptions. • Ensure construction zones near landing sites/ghats are cordoned off with appropriate barriers to prevent accidents. • Restrict the construction footprint to the smallest possible area near landing sites to reduce disturbances. • Work with local navigation authorities to ensure smooth operations and minimal disruption to boat traffic. 		
Clearing and grubbing, site preparation, construction of embankment, AE works and activities within construction camps	Occupational Health and Safety Plan. Due to COVID 19 Pandemic	<ul style="list-style-type: none"> • In case of recurrence of the COVID-19 pandemic in India the local community members involved in project activities may be at a heightened 	<ul style="list-style-type: none"> • In case of recurrence of pandemic ensure that the project related staff at all levels are appropriately vaccinated. • Ensure project staff, consultants, contractors, and workers have in their mobile devices the Aarogya Setu App, which is a mobile application developed and 	Contractor during implementation and DNP.	PIU, PMU and PISC

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
		risk of virus exposure.	<p>recommended by the government of India to proactively reach out to and inform the users of the app regarding risks, best practices and relevant advisories pertaining to the containment of COVID-19.</p> <ul style="list-style-type: none"> • Ensure mandatory isolation of the personnel or workers, either asymptomatic or showing symptoms, who have had direct contact with anyone tested positive for COVID-19. • The isolation procedures issued by the government shall be followed along with proper disposal of used PPE following guidelines and procedures issued by the government. 		
Operation phase	External impacts on flood and drainage during operation phase	<ul style="list-style-type: none"> • The proposed anti-erosion, pro-siltation works, and flood protection works will not significantly change flood behavior, gross cross-section-wide sediment behavior of river morphology, however, the adverse impacts of the floods will be addressed considerably. 	<ul style="list-style-type: none"> • Numerical hydraulic model to investigate flooding and drainage behavior, both within and outside project areas, associated with mainstream, tributary and local flooding will be developed to ensure that there is adequate freeboard against embankment overtopping and that adequate provision has been made for sluice gates to facilitate drainage from the protected areas. • Regularly monitor river morphology to ensure that anti-erosion and pro-siltation works do not create unintended alterations to sediment transport or flow patterns. • Ensure periodic inspection and maintenance of anti-erosion and flood protection works to retain their structural integrity and effectiveness over time. 	PIU/WRD and PISC	PMU

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
			<ul style="list-style-type: none"> Restrict construction activities to designated zones to avoid encroachment on sensitive ecological areas and habitats along the river. 		
Operation phase	Changes in water levels during operation phase	<ul style="list-style-type: none"> The proposed works will have no discernable effect on river water levels. Changes in channel conveyance brought about by the natural processes of riverbank erosion, accretion and channel avulsion will play a much greater role in any future change in water levels An improved embankment network will reduce the risk of sudden devastating flooding and as such provide more predictable and stable water levels on the flood plains (especially from temporary local inundation during the flood season) 	<ul style="list-style-type: none"> Changes in cross-section will be monitored at regular intervals to detect any changes and initiate corrective measures. Numerical hydraulic model of the project area will be used to identify low lying areas with a potential risk of deep inundation when major floods occur. Conduct periodic inspections and maintenance of anti-erosion structures such as porcupine screens and embankments to ensure their functionality and durability. Track the health of aquatic and riparian ecosystems to ensure that anti-erosion measures do not adversely affect biodiversity. Remove debris or blockages from anti-erosion structures and channels to maintain optimal flow and prevent localized flooding. Develop and implement emergency response plans to address any unforeseen failures or adverse impacts of the structures during extreme flood events. 	PIU/WRD and PISC	PMU
Operation phase	Effect on flow velocity/discharge intensities during operation phase	<ul style="list-style-type: none"> Only major proactive river training interventions like spurs protruding into the river may have direct impact on the flow pattern and channel 	<ul style="list-style-type: none"> Flow velocity changes along the bank line will be systematically monitored as part of the near-bank surveys including establishing systematic records of discharges and flow velocities during the hydrological cycle. It is expected that this monitoring will contribute to a 	PIU/WRD and PISC	PMU

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
		configuration affecting it significantly	better understanding and a gradual optimization of the layout of structural flood and erosion countermeasures.		
Operation phase	Impact on silt deposition and bed level change during operation phase	<ul style="list-style-type: none"> • The high amount of sediment in Brahmaputra River is due to the high flood season flows and often leading to changes of the river appearance . The deposition increases the siltation in the floodplains and creates sand bars/chars in the river • The transported silt gets deposited downstream where the area widens, and the flow velocities drop. The resulting sand carpets are disastrous for the overwhelmingly small and marginal farmers as they render the fertile floodplain land unusable and can only be removed at great cost 	<ul style="list-style-type: none"> • The dynamic pattern of silt deposition in the river and areas adjacent to the bank, especially in the vicinity of anti-erosion and river training works, will be monitored at regular intervals to contribute to the knowledge base and understanding of the Brahmaputra morphology, and initiate necessary corrective measures if required. • Monitor sediment deposition and erosion near spurs to prevent localized flooding or riverbed instability. • Assess the impact of spurs on aquatic and riparian ecosystems, including habitats for fish and other species, and take corrective measures if adverse effects are observed. 	PIU/WRD and PISC	PMU

Environmental Monitoring Plan (EmoP)

Environmental Component	Project stage	Parameter	Standards	Location	Duration / Frequency	Implementation	Supervision
Air Quality	Construction Phase	PM2.5, PM10, SO2, NOX, CO, Pb	National Ambient Air Quality Standards and Central Pollution Control Board (CPCB) guidelines for collection of samples and testing	At 2 locations within 100m of construction camp, crusher and near sensitive locations/settlements identified by the contractor and approved by the Engineer	Continuous 24-hourly, twice a week for two weeks. Twice every year (summer and winter) during construction period	Contractor through NABL accredited/ MoEF&CC approved Environmental Laboratories	PMU, PIU and PISC
	Operation Phase			At 2 locations near sensitive locations /Settlements identified by the contractor and approved by the Engineer	Continuous 24-hourly, twice a week for two weeks. Only once in the first summer season of operation period/DNP at 1 locations		
Surface Water Quality inclusive of sampling for fisheries	Construction Stage	pH, BOD, COD, TDS, TSS, DO, Oil and grease and other physio-chemical and biological parameters	Grab sample collected from source and analyzed as per standard methods for examination of water and wastewater and CPCB Water	At 2 locations including Brahmaputra River, wetlands/ponds at locations identified by the contractor and approved by the Engineer	Twice a year during pre-monsoon (between March - May) and post monsoon seasons (between October – December) every year during construction period.	Contractor through NABL accredited/ MoEF&CC approved Environmental Laboratories	PMU, PIU and PISC
	Operation Phase				Only once either during pre-monsoon		

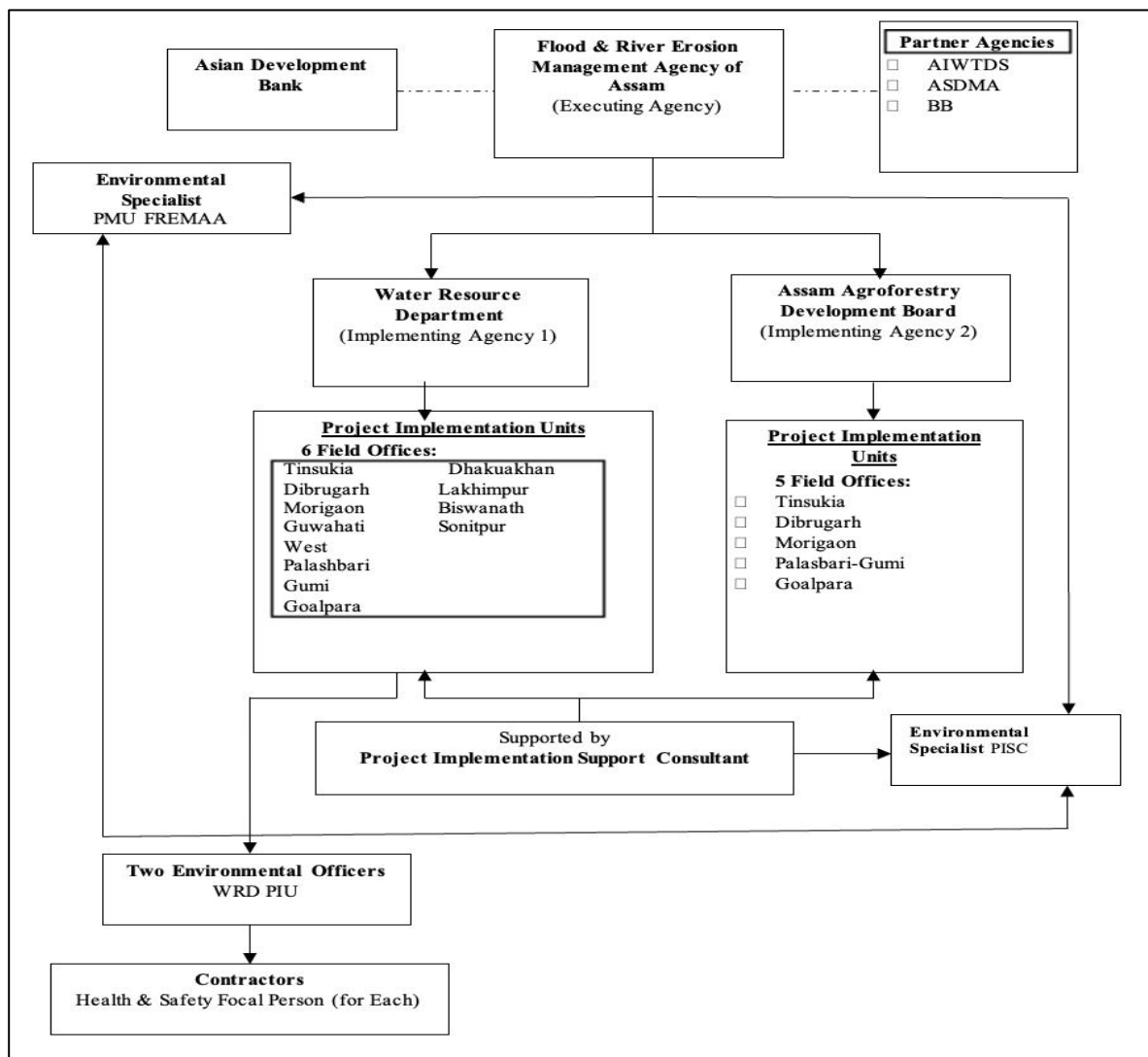
Environmental Component	Project stage	Parameter	Standards	Location	Duration / Frequency	Implementation	Supervision
			Quality Criteria		(between March - May) or post monsoon seasons (between October – December) in the first year of operation period/DNP		
Ground and surface water and Drinking Water Quality	Construction Stage	pH, BOD, TDS, DO, Fl, Cl, As, Cd, MG, Mn, total coliform, and other physio-chemical and biological parameters	Grab sample collected from source and analyzed as per standard methods for examination of water and IS 10500:1991	At 2 locations including construction and labor camp sites and other locations/settlements identified by the contractor and approved by the Engineer	Twice a year during pre-monsoon (between March - May) and post monsoon seasons (October – December) every year during construction period	Contractor through NABL accredited/ MoEF&CC approved Environmental Laboratories	PMU, PIU and PISC
	Operation Phase			At 2 locations/ settlements identified by the contractor and approved by the Engineer	Only once either during pre-monsoon (between March - May) or post monsoon seasons (between October – December) in the first year of operation period/DNP		
Noise	Construction Phase	Noise levels in dB (A) for	As per National Standards for Noise	At 2 locations including construction sites, equipment yards and other noise sensitive	One day hourly measurements for continuous 24 hours.	Contractor through NABL accredited/MoEF &CC approved	PMU, PIU and PISC

Environmental Component	Project stage	Parameter	Standards	Location	Duration / Frequency	Implementation	Supervision
		day, night, L10, L90, Lmax, Lmin	and CPCB guidelines for collection of samples and testing	locations/settlements identified by the contractor and approved by the Engineer	Twice a year for every year (i.e. summer and winter seasons) during construction period	Environmental Laboratories	
	Operation Phase			At 2 noise sensitive locations/settlements identified by the contractor and approved by the Engineer	Only once either during summer (between March - May) or winter seasons (between December - February) in the first year of operation period/DNP		
Soil quality	Construction Phase	Monitoring of NPK and heavy metals, grease, and other baseline parameters	ICAR Criteria of Soil Quality	At 1 locations including agricultural fields identified by the contractor and approved by the Engineer	Twice a year during pre-monsoon (between March - May) and post monsoon seasons (between October December) every year during construction period	Contractor through NABL accredited/MoEF &CC approved Environmental Laboratories	PMU, PIU and PISC
	Operation Phase				Once either during pre-monsoon (between March - May) or post monsoon seasons (between		

Environmental Component	Project stage	Parameter	Standards	Location	Duration / Frequency	Implementation	Supervision
					October – December) in the first year of operation period/DNP		
Terrestrial and aquatic ecology (Biodiversity assessment)	Pre-Construction Phase and Operation	Census and Habitat Study	Wildlife Institute of India guidelines and Good Industry Practices	All throughout the project area (encompassing the four high priority project areas)	One season during pre-construction phase One season during the operation period	Contractor	PMU, PIU and PISC

B. Implementation Arrangement and Responsibilities of EMP implementation

487. All the policy decisions, including incorporation of the EMP requirements in compliance to loan covenants shall be the responsibility of the recommended FREMAA as the executing authority which is registered under the Societies Act. The FREMAA is completed execution of ADB project AIFRERMIP and is currently executing World Bank project Assam Integrated River Bank Management Program (AIRBMP). The project management unit (PMU) FREMAA will have responsibility to implement overall EMP. The PMU is responsible for the full compliance of the project with the loan agreement, ADB's SPS, and all applicable laws and rules of the government. The PMU is supported by an environment specialist to ensure compliance with environmental safeguards. The PMU will be assisted by WRD and AADB as PIUs. WRD PIU will be supported by two Environment Officers for implementing the environmental safeguard requirements. There will be 6 PIUs at WRD for execution of anti-erosion and flood protection works and 5 PIUs at AADB for implementing nature-based solutions. The organizational structure for implementation arrangement for safeguard implementation in the project is shown in the figure below.



Source: WRD and FREMAA

Figure 9-1. Organizational Structure for Environmental Safeguards.

488. The **PMU** will:

- (i) comply with the government policies, standards, and other environment-related statutory requirements of the project.
- (ii) review and approve the construction EMP(s) prepared by the contractor(s) with the support of PISC and PIUs.
- (iii) be responsible for application of key documents and forwarding to government agencies for the processing of clearances and permits including, but not limited to environmental clearance certificate, forest clearance, tree cutting permit, and other relevant permits and license, prior to awarding any works contracts to any contractor.
- (iv) ensure the preparation, review, and submission of EMRs (as stated on the loan agreement) for disclosure on the ADB and FREMAA websites.
- (v) conduct training and workshops on environmental management, and site induction of all staff and workers involved in the project implementation. The staff and workers will include all engineers, and field supervisors and laborers of contractors.
- (vi) guided by the IEEs submitted to ADB, implement effective environmental monitoring during pre-construction, construction, and operation phases. This includes, but is not limited to, inspections, review of monitoring forms prepared by the contractors, and documentation of the issues received through GRM.
- (vii) take proactive and timely measures to address any environment safeguards related challenges at the national, state or district levels such as (a) delays in processing of clearances during pre-construction stage and (b) significant grievances during construction and operation stages).
- (viii) review and approve, for submission to ADB, annual EMRs prepared by the PIUs and PISC.
- (ix) lead in complying with disclosure of annual EMRs.
- (x) review and approve corrective action plans (CAPs) for environment safeguard noncompliance.
- (xi) inform ADB on any unanticipated environmental impact/s occurred during project implementation phase; and
- (xii) ensure GRM, as envisaged in the IEEs and in this PAM, is in place and fully operational from the onset of project implementation.

489. As **PIU**, the WRD will:

- (i) ensure that the project, and all contractors obtain permits, licenses, etc. for activities such quarries, borrow areas etc. before the implementation of the respective construction activity.
- (ii) carry out regular field verification and review environmental compliances by the contractor during project implementation, in coordination with the PISC and the contractor's environmental focal person.
- (iii) with PMU's support through environment specialist and field supervisors, provide and record environmental observations during any site visits that may include, but not limited to, excessive dust, loud noises, improper disposal of wastes, chemical/oil spills, camp hygiene, health and safety, and improper borrow area management; and
- (iv) in case of potential risks and hazards to health, environmental quality, and properties that may result from poor EMP implementation, immediately instruct the contractor to cease the construction activities that pose risk and conduct immediate containment and mitigation activities.

490. If there are any unanticipated environment impacts during project implementation, the PMU, with support from the PISC, will update the IEE/s and EMP/s. Both documents will be reviewed by

ADB and disclosed on ADB's website.

491. **Contractor:** The contractor is the principal agent to implement the EMP and environmental quality monitoring during the pre- and construction, and operation stages. Specifically, the contractor will:

- (i) appoint the contractor's environment, health and safety focal person and attend the site induction workshop to be organized by the PMU and WRD.
- (ii) obtain necessary environmental license(s), permits etc. from relevant agencies as specified in the IEE and this PAM for the ancillary facilities such as quarries, tree cutting, etc. prior to commencement of works.
- (iii) as part of detailed survey, collect the baseline data on environmental quality of the construction sites before the start of physical works and continue collection of information (e.g., air quality, noise level, and water quality) during civil works as per the initial EMP.
- (iv) revise and finalize the construction EMP and environmental quality monitoring plan.
(Implement and document all mitigation measures in the EMP and environmental quality monitoring plan.
- (v) ensure that all workers, site agents, including site supervisors and management, participate in all environmental safeguard related training sessions.
- (vi) ensure compliance with environmental statutory requirements and contractual obligations.
- (vii) participate in resolving issues as a member of the GRM.
- (viii) respond promptly to grievances raised by the local community or any stakeholder and implement environmental corrective actions or additional environmental mitigation measures as necessary and inform WRD; and
- (ix) based on the results of EMP monitoring, cooperate with WRD to implement environmental corrective actions and corrective action plans, as necessary.

492. If there are any environment safeguard non-compliance during project implementation, the PMU will prepare necessary Corrective Action Plans (CAP) and reflect them in the periodic Environmental Monitoring Reports (EMRs). ADB will monitor WRD performance on the CAP.

493. ADB is responsible for the following:

- (i) review EMRs and disclose the final reports and on ADB's website.
- (ii) explain policy requirements and safeguard covenants in the loan and project agreements to PMU and PIUs.
- (iii) monitor implementation of the EMP through due diligence missions.
- (iv) assist PMU and PIUs, if required, in carrying out its responsibilities and in building capacity for safeguard compliance.
- (v) monitor overall compliance of the projects to this PAM; and
- (vi) if necessary, provide further guidance to PMU and PIUs on the format, content, and scope of the periodic monitoring reports for submission to ADB.

494. The environmental management plan and resettlement plan will be updated from time to time during project implementation, upon availability of detailed engineering design, and to reflect adaptive management of project changes and unforeseen circumstances or in response to project performance, ensuring that standards originally planned are not lowered.

495. **Capacity Building and Training:** Executing and implementing agencies need to have a sustained capacity to manage and monitor environmental safeguards. Although specialist, consultants support will be available to PMU and PIUs, it is necessary to mainstream safeguards in day-to-day working. Therefore, PMU and PIUs require capacity building measures for (i) a better understanding of the project-related environmental issues; and (ii) to strengthen their role in

preparation of IEE, implementation of mitigation measures, and subsequent monitoring. Trainings and awareness workshops are included in the project with the primary focus of enabling the PMU and PIU staff to understand impact assessments and carry out environmental monitoring and implement EMPs. After participating in such activities, the participants will be able to review environmental assessments, conduct monitoring of EMPs, understand government and ADB requirements for environmental assessment, management, and monitoring (short- and long-term), and incorporate environmental features into future project designs, specifications, and tender documents and carry out necessary checks and balances during project implementation.

496. The PISC will facilitate the implementation of capacity building program for the PMU, PIU, and contractors, with specific topics on environmental safeguards such as but not limited to the list below. The contractors will be responsible for conducting site-specific/work-specific orientation on environmental safeguards for their workers prior to deployment to work sites. Typical modules would be as follows: (i) sensitization; (ii) introduction to environment and environmental considerations in Flood risk management project; (iii) review of IEEs and integration into the project detailed design; (iv) improved coordination within nodal departments; (v) monitoring and reporting system; and (vi) project GRM. Specific modules customized for the available skill set will be devised after assessing the capabilities of the target participants and the requirements of the project. The proposed training program along with the frequency of sessions, is presented below.

Table 9-2. Capacity Building Program on EMP Implementation.

Description	Target Participants and Venue	Estimate (INR)	Cost and Source of Funds
<p>1. Introduction and Sensitization to Environmental Issues (1 day)</p> <ul style="list-style-type: none"> • ADB Safeguards Policy Statement • Subproject selection criteria, categorization etc., • Government of India and Government of Assam applicable environmental safeguard laws, regulations and policies including but not limited to core labor standards, OEHS, Covid -19, safety etc. • IEE preparation and EMP formulation • Incorporation of EMP into the project design and contracts • Monitoring, reporting and corrective action planning 	<p>Participants: All staff and consultants involved in the project</p> <p>Venue: PMU, FREMAA</p>	<p>100,000 (Lump sum)</p>	<p>PMU cost</p>
<p>2. Implementing EMP (1/2 day - once at the beginning and at a frequency of once in six months during implementation)</p> <ul style="list-style-type: none"> • Site-specific mitigation and monitoring measures • Roles and responsibilities • Public relations, Consultations and Grievance redress • Monitoring and corrective action planning • Reporting and disclosure • Construction site standard operating procedures (SOP) • Chance findings (archeological) protocol • Traffic management plan • Waste management plan 	<p>Participants: All staff and consultants involved in the high priority project. All contractors immediately after mobilization of the contractor</p> <p>Venue: PIUs</p>	<p>50,000 (Lump sum)</p>	<p>PMU cost</p>

Description	Target Participants and Venue	Estimate (INR)	Cost and Source of Funds
<ul style="list-style-type: none"> Site clean-up and restoration 			
3. Contractors Orientation to Workers (1/2 day) <ul style="list-style-type: none"> Environment, health and safety in project construction (OEHS, Covid-19 safety, core labor laws, spoils management, etc.) 	Participants: Once before the start of work, and thereafter regular briefing every month once. Daily briefing on safety prior to start of work to all workers (including unskilled laborers)	100,000 (Lump sum)	Contractor's cost

497. Summary of Capacity Building cost for EMP Implementation

- Contractor Cost - INR 100,000.00
- PMU Cost - INR 200,000.00
- **Total - INR 300,000.00**

498. **Environmental Monitoring Reports (EMRs).** The EMRs will be submitted annually to document the progress on the EMP implementation. The PMU and PIUs will be supported by the PISC to monitor EMP implementation (pre-construction, construction and post construction phases) and implementation of proposed piloting of nature-based solutions. An outline of the EMR is in Appendix 10. This outline is a template but additions, such as additional text, tables, charts, figures, may be made to ensure appropriate documentation of (i) project implementation progress, (ii) compliance with safeguard measures and their progress, and (iii) necessary corrective actions. The annual EMRs will be due for submission to ADB within one month following the end of the EMR period. The submission of EMRs to ADB will continue until the project completion report is issued by ADB.

499. The EMRs will be disclosed on the official websites of ADB, FREMAA AND wrd after review and acceptance by ADB.

C. EMP Implementation Cost

Most of the mitigation measures require the contractors to adopt good site practice, which should be part of their normal procedures already, so there are unlikely to be major costs associated with compliance. There are some of the provisions in bid documents like compliance of the requirements of health and safety during construction works as per applicable labor laws, labor insurance, equipment fitness, provision of labor welfare facilities, healthcare facilities etc. which are unanimously bound to contractor bidding for the project therefore it is understood that costs for such requirements are bound to contractor and no need to consider as cost of EMP implementation. Regardless of this, any costs of mitigation by the construction contractors or consultants are included in the budgets for the civil works and do not need to be estimated separately here. Mitigation that is the responsibility of PMU/PIU will be provided as part of their management of the project, Cost for the capacity building program is included as part of the project. Cost of environmental management is given in Table IX-3

Table IX-3. EMP implementation Cost.

SI. No.	Particulars	Stages	Unit	Total Number	Rate	Cost (INR)	Costs Covered By
					(INR)		
A. Mitigation Measures							
1	Provision for tree cutting and compensatory plantation (1:10) measures, monitoring and maintenance	Pre-Construction and Construction	Per tree	200	4,000	8,00,000	Civil works contract
2	Obtaining and submission of copies (to PMU) all consents, permits, clearances, no objection clearances or NOCs, tree cutting permissions, and other relevant permits from various authorities before the start of construction	Pre-Construction and Construction	Lump sum	-	-	8,00,000	Civil works contract
3	Disposal of existing old geo-bags and other materials used as temporary anti-erosion and flood protection measures, and disposal of all solid wastes during construction to designated locations and/or use of local municipal services	Pre-Construction and Construction	Lump sum	-	-	10,00,000	Civil works contract
4	Provision of all requisite facilities (i.e. drinking water supply, sanitation, domestic solid waste collection and disposal, fuel supply etc.) at construction camps.	Construction and Operation	Lump sum	-	-	20,00,000	Civil works contract
	Ensuring rehabilitation of borrow areas and other impacted lands in line with WRD guidelines, and decommissioning of construction camp before handing over the project.						
5	Traffic management at work sites (i.e. pavement markings, channelizing devices, arrow panels and warning lights) along with construction and/or strengthening of landing ghats for barges	Construction	Lump sum	-	-	20,00,000	Civil works contract
6	Water sprinkling for dust suppression, barricading, temporary noise barriers, and provision of personal protective equipment (such as boots, life-saving-jackets, etc.)	Construction	Lump sum	-	-	20,00,000	Civil works contract
7	Implementation of biodiversity action plan and other biodiversity conservation and mitigation measures	Construction and Operation	Lump sum	-	-	20,00,000	Civil works contract
8	Construct temporary alternative ghats and landing facilities. Restore disturbed sites post-construction.	Construction and Operation	Lump sum	-	-	20,00,000	Civil works contract
Subtotal (A)						12,600,000	
B. Monitoring Measures							

SI. No.	Particulars	Stages	Unit	Total Number	Rate	Cost (INR)	Costs Covered By
					(INR)		
1	Air quality monitoring	Construction and Operation	Per sample	28	10,000	2,80,000	Civil works contract
2	Noise levels monitoring	Construction and Operation	Per sample	28	6,000	1,68,000	Civil works contract
3	Surface water monitoring	Construction and Operation	Per sample	28	15,000	4,20,000	Civil works contract
4	Groundwater monitoring	Construction and Operation	Per sample	28	15,000	4,20,000	Civil works contract
5	Soil monitoring	Construction and Operation	Per sample	8	10,000	80,000	Civil works contract
Subtotal (B)						13,68,000	
C.	Capacity Building						
1	Training on EMP Implementation, COVID-19 protocols and other health and safety topics	Pre-construction and Construction	Lump sum	-	-	3,00,000	Civil works contract
2	Preparation of plans and protocols (i.e. traffic management plan, waste or spoil management plan, chance find protocol, and other relevant activities)	Pre-construction and Construction	Lump sum	-	-	400,000	Civil works contract
3	Biodiversity Assessment	Pre-Construction and Post Construction	Lump sum			8,00,000	Civil works contract
4	Engagement of one Environment Expert and one OHS Expert for each High Priority Project areas	Pre-Construction and Construction	No	8	50,000	4,00,000	Civil works contract
Subtotal (C)						19,00,000	
Total (A+B+C)						1,54,68,000	
Miscellaneous, provisional sum and contingency @ 5% of the subtotal						7,93,400	
Grand Total						1,62,41,400	

X. CONCLUSIONS AND RECOMMENDATIONS

500. The conclusions are based on environmental assessment carried out for additional high priority project areas of Dhakuakhana, Lakhimpur, Biswanath and Sonitpur. The identification and selection proposed reaches as high priority work area is based on the Severe erosion in Brahmaputra River in Assam during recent monsoon season. The proposed high priority work is needed to safeguard the people, property and environment from frequent and devastating floods of the Brahmaputra River.

501. The proposed high priority project work in Dhakuakhana, Lakhimpur, Biswanath and Sonitpur sub-district/districts was considered as environmental category B under ADB SPS 2009, and the findings of the IEE study support this categorization as no significant impact are anticipated to be generated from the project.

502. This additional high priority works are proposed in identified reaches of and IEE focuses on continuation of flood protection works along the Brahmaputra River in (i) Bamuni Chapari to Tekeliphuta area (under Dhakuakhana WRD division), (ii) Bonpuroi-Jamuguri and its adjoining areas (under North Lakhimpur WRD division), (iii) Rangchali Dalani area and Paken area (under Biswanath WRD division), and (iv) Jarani and Zahaz Ghat in Tezpur and Biswanath District (under Sonitpur WRD division)., Districts. There are three project components under the project: (i) construction of riverbank revetment and apron works with geo-bags at 9 locations for a total of 15.170 km (Dhakuakhana area for 8 km, Lakhimpur area for 1.280 km, Biswanath for 2.940 km, and Sonitpur for 1.80 km, (ii) Widening of embankment works at Paken for 225m, earth work for 10 check bunds at Dhaukuakhana (iii) adaption works at Lakhimpur for 1.150 km and (iv) 14 locations for porcupine screens (Dhakuakhana – 2, Lakhimpur – 5, Biswanath – 6 and Sonitpur – 1) over 3 layers of pre-stressed concrete

503. Nature-based solutions (NbS) e.g., bioengineering techniques such as the planting of reeds will be pilot tested in a hybrid mode at Dhakukahna sites and to provide local stakeholders with income generating activities opportunities. AADB, in coordination with WRD divisional engineers will be responsible for implementing the nature-based solutions for proposed projects. AADB in support of WRD will develop, implement, improve, guide, and supervise pilot nature-based solutions including relevant research and dissemination of research results. The pilots will provide employment opportunities for riverine rural poor and as the pilots can be upscaled to broader implementation, more employment opportunities will be created in the next phases.

504. All potential impacts associated with proposed anti-erosion and flood protection works were identified in relation to pre-construction, construction, and operation phases. Planning principles and design considerations have been reviewed and incorporated into the site planning and design process wherever possible.

505. Construction activities will be confined to the selected sites along the banks of Brahmaputra River spread over the proposed reach lengths in high priority work areas, Dhakuakhana, Lakhimpur, Biswanath and Sonitpur, and the interference with the general public and community around is minimal. There will be temporary negative impacts, arising mainly from construction dust and noise, hauling of construction material, waste and equipment on local roads (traffic, dust, safety etc.), mining of construction material, occupational health and safety aspects. During the construction phase impacts will arise from the dust and noise, increase in traffic by the construction vehicles, and from the need to dispose of large quantities of waste soil and also the disposal of geo-bags used earlier for temporary flood protection works by WRD. General temporary reversible impacts around inhabited project area due to setting up of the construction camp by the contractor are expected, and there are well developed methods of mitigation that are suggested in the EMP. Other specific measures include safe handling of wastes, minimize tree cutting and vegetation removal at various sites.

506. The project area is primarily a rural area (other than Zahazghat area of Sonitpur) and no project component is located within protected or sensitive environmental areas such as forest areas, WLS and NP, Ramsar wetlands or archeologically protected areas.

507. All the proposed sites under Additional High Priority works are located outside any forest or protected areas. However, the Rangachali Dalani site in Biswanath district is near the notified boundary of Kaziranga National Park. A No Objection Certificate has been obtained from the Field Director of Kaziranga and the Divisional Forest Officer of Biswanath Wildlife Division. Negative impacts on the park area are not anticipated as the proposed work is on the opposite bank of the Brahmaputra River and limited to the bank protection with installation of porcupine screening at some selected locations.

508. As per information made available from IBAT, there are 61 IUCN red listed species within 50 km radius of the project area. These includes 23 CR (8 floral, 8 avian, 6 reptilian and 1 mammalian species), 38 EN (4 floral, 2 Chordate, 9 reptilian, 9 avian and 14 mammalian species). However, no negative impact is anticipated on any endangered species as the works shall be restricted on the river banks since these are not found in this area currently.

509. Dolphin and other endangered species found in the Brahmaputra River and other nearby areas are not exclusive to the project site (except Zahazghat site of Sonitpur). As Anti Erosion work will be restricted to Bankline only and work will remain suspended during the monsoon season, hence no damage to the habitat of these species is anticipated due to proposed interventions. There are no other environmental sensitive resources found in the project area which is likely to be affected by the project.

510. Biodiversity and ecology assessments including census of IUCN Red listed species and sites that are critical for the survival of migratory and congregatory species shall be carried out by contractor before start of the construction period (winter season) for all four high priority project areas under CRBFRERP by specialized Ecologists appointed by respective contractors. The methodology shall include belt and transect walks, point counts, quadrat methods etc. as per approved standard methodologies. PMU shall obtain necessary permissions from the forest and wildlife departments before start of the assessment surveys. The assessments shall be undertaken within a 1km radius of the proposed interventions in the project including at but not limited to riverine chars, bank lines, beels having direct connection with the Brahmaputra River in the project area and at other locations identified by the Engineer. In case of any affected species in the proposed project areas (i.e., 4 WR, Division sites) findings that requires mitigation measures, BAP will be implemented, and the IEE shall be updated by PISC and FREEMA and submitted to ADB for necessary actions.

511. A second biodiversity and ecology assessments including census of IUCN Red listed species shall be carried out during the summer season after completion of civil work or in DNP period for the entire project area (all the 4 W.R. division project areas) by specialized ecologists appointed by Contractors under the supervision of FREMAA adopting similar methodologies and at similar locations where surveys were carried out during construction period to ascertain the benefits of the BAP and necessary course corrections. The assessment report and the status of the monitoring shall be part of the environmental monitoring reporting.

512. The project entails various impacts on the environmental setting of the area. While some are negative, there are many bearing benefits, these include the following:

- (i) The Brahmaputra River carries more water per unit area of basin than any other river in the world, The area experiences heavy rainfall during monsoon with average annual rainfall of 2000 mm. The proposed project, through strengthening the reliability of the existing embankments and riverbank protection works will prevent people from the impacts of devastating floods

- (ii) The proposed high priority works areas are prone to extreme hazards of bank erosion, and embankment breaches (at Dhakuakhana and Lakhimpur). This results in loss of productive agriculture land, infrastructure and damage to environment. The proposed project will result in protecting loss of precious agriculture productivity
- (iii) All the proposed high priority work areas are outside protected areas. However, both reaches under Biswanath district is near the extended boundary of Kaziranga National Park for which NOC has been obtained from the Field Director, Kaziranga National Park as well as from the DFO, Biswanath Wildlife Division. Management Plan of Kaziranga National Park shall be adopted during the implementation of EMP in these reaches under Biswanath district.
- (iv) The afforestation will not only help in compensating losses of trees but also increase tree cover in the long run due to the compensatory afforestation at the rate of 1:10 as per the state government policy
- (v) There are numbers of beels and other water bodies (fish ponds) in the study area, however these are not likely to be affected by the project intervention. The proposed project is likely to enhance the fish productivity in these water bodies due to protection from flooding and siltation under this project
- (vi) The people are largely poor in the area, many of them depend on fisheries, agricultural activities and forest resources. The area is vulnerable to the floods and erosion and the project is aimed at strengthening the flood protection measures in the area and addressing the soil erosion problem. The economic gain is expected to be high

513. Provided that the recommended mitigation measures are implemented, no impact is anticipated on endangered species like river Dolphin due to project activities. Some of the trees along the RoW for Anti Erosion works and embankment (225m) at Paken are likely to be cut under the supervision and guidance of local forest officials. The recommended compensatory afforestation requirement will be implemented, survival rate is monitored and sustained, and the positive benefits are likely to be accrued. The project will bring positive impact to wetlands around the project area, pond fisheries and agricultural productivity due to protection from flood and reduced sedimentation. Project activities are likely to generate some adverse environmental impacts during construction. However, these will be temporary. Implementation of the prescribed mitigation measures will minimize impacts. Moreover, the impacts shall be monitored continually by implementing the EMP and EMoP.

514. The project is welcomed by all the stakeholders. Stakeholders were involved in developing the IEE through face-to-face discussions, on site meetings, and village level consultation workshops, which was conducted for larger public participation in the project. Views expressed by the stakeholders were incorporated into the IEE and the planning and development of the project. The IEE will be made available at public locations and will be disclosed to a wider audience via the PMU, PIU and ADB websites. The consultation process will be continued during project implementation to ensure that stakeholders are engaged in the project and have the opportunity to participate in its development and implementation. The project's grievance redress mechanism will provide the citizens with a platform for redress their grievances, and describes the informal and formal channels, time frame, and mechanisms for resolving complaints about environmental performance

515. There is a possibility that the high priority project areas may be affected by the impacts of climate change and other external events including major earthquakes and upstream development works such as hydropower development. While the impacts of these events may well extend beyond the economic life of the project investments (of 30 years), available study indicates the possible climate change impact of increased precipitation by up to 30% in the north-eastern region by 2040-60, although diverse anticipation still coexists. A large-scale earthquake (and landslides) may exacerbate the sediment loads of the Brahmaputra, whereas the hydropower dams upstream may reduce the sediment inflow. On these accounts, the systematic monitoring of the river dynamics to

be strengthened under the project will facilitate the identification and implementation of necessary measures to adapt to any emerging changes in the construction and post-construction phase of the project.

516. The project involves strip acquisition of land for strengthening the existing embankments and associated structural relocation. The concerned land acquisition and resettlement cases will be addressed following the Government of India's and Government of Assam's laws and regulations, and ADB's Involuntary Resettlement Policy, which has been stipulated in the resettlement framework, based on which resettlement plans are being parallelly prepared and implemented to address all the cases. Extensive public consultation has been carried out, consistent with state guidelines. For affected people, support will be provided to improve, or at least restore, the pre-intervention income and livelihoods standards, and productive capacity. In addition, the project will provide construction labor opportunities and community development assistance to nearby communities and to landowners whose land will be acquired, or structures be affected, including non-title holders.

517. Though the impact of COVID-19 pandemic has subsided with a sustained vaccination campaign and following of appropriate behavior. The recurrence of pandemic like situation cannot be ruled out. In case of recurrence of the COVID-19 pandemic in India the local community members involved in project activities may be at a heightened risk of virus exposure. Project shall also adhere to necessary protocols in response to infectious diseases such as the corona virus disease (COVID-19) consistent with the guidelines of relevant government healthcare agencies and the World Health Organization.

518. The IEE and EMP will be referred in the bid and contract documents to ensure compliance with the conditions set out in this document. The EMP will assist the PMU, PIU, PISC, and contractors in mitigating the environmental impacts, and guide them in the environmentally sound execution of the proposed project. The EMP will also ensure efficient lines of communication between PIU, PMU, PISC, and contractor. The EMP shall be made binding on all contractors operating on the site and will be included in the contractual clauses. Non-compliance with, or any deviation from, the conditions set out in this document shall constitute a failure in compliance. Copy of the EMP will be kept on site during the construction period at all times.

519. These additional high priority project works will benefit the general public by contributing to the long-term improvement of anti-erosion, flood protection, and community livability in the project coverage area. The potential adverse environmental impacts are mainly related to the construction period, which can be minimized by the mitigation measures and environmentally sound engineering and construction practices. Therefore, as per ADB SPS, the project is classified as environmental Category B and does not require environmental impact assessment. However, to conform with government guidelines all necessary permissions and NOCs shall be obtained from the concerned departments prior to start of construction.

520. This IEE shall be updated by PMU to reflect any changes in design, locations, interventions, amendments etc. and will be reviewed and approved by ADB. Where unanticipated environmental impacts become apparent during project implementation, this IEE will be updated and its EMP or prepare a new environmental assessment and EMP to assess the potential impacts, evaluate the alternatives, and outline mitigation measures and resources to address those impacts.

Appendix 1: Summary of Flood and Riverbank Erosion Assets to be Constructed

Sl. No	Name of Division	Type of Works	Quantity of work
1	Dhakuakhana W.R. Division	Anti-Erosion	Reach Length= 8 KM
		Pro-siltation	20 PSC screens
			12 bamboo screens
		Earthwork	Construction of 10 Nos. of earthen check-bund over borrow pit channels
		Others (Preliminary, etc.	
2	N. Lakhimpur W.R. Division	Anti-Erosion	Reach Length= 1.28 KM
		Adaptation work	Reach Length= 1.15 KM
		Pro-siltation	5 PSC screens
		Others (Preliminary, etc.	
3	Biswanath W.R. Division (Paken)	Anti-Erosion	Reach Length=1.6 KM
		Pro-siltation	13 PSC porcupine screens
		Earthwork	widening of embankment=225m
		Others (Preliminary, etc	
4	BiswanathW.R. Division (Rangachali dalani)	Anti-Erosion	Reach Length=1.34 KM
		Pro-siltation	4 PSC porcupine screens
		Others	
5	Sonitpur W.R. Division	Anti-Erosion	Jarani= 1.2 KM
			Zahaz ghat=0. 60 KM
		Pro-siltation	5 PSC Porcupine screens (at Jarani)
		Others (Preliminary, etc	

Appendix 2: Details of Scope of Works

Sl.	Name	District	W.R Div.	Length	Geo-coordinates
Apron Protection and Riverbank Revetment Works					
1	Bonpuroi Jamuguri	Lakhimpur	North Lakhimpur	1020 m	26.857429°N, 93.815014°E to 26.850334°N, 93.808962° E
2	Bonpuroi Jamuguri	Lakhimpur	North Lakhimpur	1150 m	26.850334°N, 93.808962° E to 26.846926° N, 93.799465° E
3	Bonpuroi Jamuguri	Lakhimpur	North Lakhimpur	260 m	26.846926° N, 93.799465° E to 26.846504° N, 93.797156° E
4	U/S of Bandana Check Bund to Matmara	Lakhimpur	Dhakuakhana	4500 m	27°14'22.03"N, 94°33'10.83"E to 27°12'23.68"N, 94°31'51.32"E
5	Baligaon to Papung	Lakhimpur	Dhakuakhana	3500 m	27°11'14.65"N, 94°31'21.08"E to 27°09' 27.97"N, 94°30'37.15"E
Pro-siltation works					
6	Bonpuroi Jamuguri	Lakhimpur	North Lakhimpur		26.848580°N, 93.824112°E
7	Bonpuroi Jamuguri	Lakhimpur	North Lakhimpur		26.849088°N, 93.819027°E
8	Bonpuroi Jamuguri	Lakhimpur	North Lakhimpur		26.847355°N, 93.796382°E
9	Bonpuroi Jamuguri	Lakhimpur	North Lakhimpur		26.847535°N, 93.795818°E
10	Bonpuroi Jamuguri	Lakhimpur	North Lakhimpur		26.847797°N, 93.795153°E
11	Bamuni Chapori	Lakhimpur	Dhakuakhana		27°17'17.79"N, 94°36'5.39"E
12	In between Matmara and Baligaon	Lakhimpur	Dhakuakhana		27°11'21.93"N, 94°31'17.55"E
Embankment works/Earthwork					
13	U/S of Lutasur 1 st Check Bund	Lakhimpur	Dhakuakhana		27°17'10.70"N, 94°34'56.10"E
14	D/S of Lutasur 1 st Check Bund	Lakhimpur	Dhakuakhana		27°16'56.99"N, 94°34'52.05"E
15	D/S of Lutasur near 2 nd Check Bund	Lakhimpur	Dhakuakhana		27°16'47.40"N, 94°34'57.18"E
16	D/S of Lutasur near 2 nd Check Bund	Lakhimpur	Dhakuakhana		27°16'25.24"N, 94°34'32.43"E
17	U/S of Jugisuti Check Bund	Lakhimpur	Dhakuakhana		27°16'2.34"N, 94°34'10.86"E
18	D/S of Jugisuti Check Bund	Lakhimpur	Dhakuakhana		27°15'44.84"N, 94°33'41.32"E
19	U/S of Bandana Check Bund	Lakhimpur	Dhakuakhana		27°30'57.91"N, 94°32'40.15"E
20	D/S of Matmara Check Bund	Lakhimpur	Dhakuakhana		27°12'42.73"N, 94°31'51.38"E
21	D/S of Matmara Check Bund	Lakhimpur	Dhakuakhana		27°12'34.62"N, 94°31'39.15"E
22	D/S of Matmara Check Bund	Lakhimpur	Dhakuakhana		27°12'30.59"N, 94°31'28.36"E
Apron Protection and Riverbank Revetment Works					
23	Paken	Biswanath	Biswanath	1600 m	26°47'56.66"N, 93°38'3.28"E to 26°47'42.43"N,

Sl.	Name	District	W.R Div.	Length	Geo-coordinates
					93°37'33.18"E
24	Rangchali Dalani	Biswanath	Biswanath	1340 m	26°46'35.78"N, 93°21'59.68"E to 26°46'23.76"N, 93°21'25.69"E
Embankment works/Earthwork					
25	Paken	Biswanath	Biswanath	225 m	26°47'14.61"N, 93°41'34.82"E
Pro-siltation works					
26	Amguri Pichala, Aliguri	Biswanath	Biswanath		26°50'14.00"N, 93°45'58.32"E
27	Kharoiati	Biswanath	Biswanath		26°49'11.09"N, 93°45'0.67"E
28	Bhalukaguri	Biswanath	Biswanath		26°48'5.58"N, 93°43'29.52"E
29	Gospuria	Biswanath	Biswanath		26°47'14.61"N, 93°41'34.82"E
30	Rangchali Dalani	Biswanath	Biswanath		26°46'36.05"N, 93°22'9.64"E
31	Gai Tapu	Biswanath	Biswanath		26°46'36.03" N, 93°22'6.89" E
Apron Protection and Riverbank Revetment Works					
32	Zahaz Ghat	Sonitpur	Sonitpur	600 m	26°36'57.29"N, 92°47'34.65"E to 26°37'2.55"N, 92°47'13.82"E
33	Jarani	Sonitpur	Sonitpur	1200 m	26°37'55.27"N, 92°40'41.46"E to 26°37'39.78"N, 92°40'2.34"E
Pro-siltation works					
34	Borchalla	Sonitpur	Sonitpur		26°37'47.57"N, 92°41'11.59"E to 26°37'54.66"N, 92°40'59.70"E

Appendix 3: Rapid Environmental Assessment (REA) Checklist

Dhakuakhana

Rapid Environmental Assessment (REA) Checklist

Country/ Project Title: India: Climate Resilient Brahmaputra Integrated Flood and Riverbank Erosion Risk

<p>Instructions:</p> <p>(i) The project team completes this checklist to support classification of a project. It is to be attached to the environmental categorization form and submitted to the Environment and Safeguards Division (SDES), for endorsement by Director, SDES and for approval by the Chief Compliance Officer.</p> <p>(ii) This checklist focusses on environment issues and concerns. To ensure that social dimensions are adequately considered, refer also to ADB's (a) checklists on involuntary resettlement and Indigenous Peoples; (b) poverty reduction handbook; (c) staff guide to consultation and participation; and (d) gender checklists.</p> <p>(iii) Answer the questions assuming the "without mitigation" case. The purpose is to identify potential impacts. Use the "remarks" sections to discuss any anticipated mitigation measures.</p>
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Management Project (CRBIFRERMP) in Assam – High priority works under Dhakuakhana

Sector Division: AFNR/SARD

Screening Questions	Yes	No	Remarks
A. Project Siting			
Is the Project area adjacent to or within any of the following environmentally sensitive areas?			
<ul style="list-style-type: none"> Cultural Heritage Site 		✓	There is no cultural heritage site in the proposed project area under Dhakuakhana. All the project related activities will be confined within 20-30 m of right of way (RoW).
<ul style="list-style-type: none"> Legally protected Area (core zone or buffer zone) 		✓	The proposed reaches under Dhakuakhana high priority works do not fall into any core zone or buffer zone of legally protected area.
<ul style="list-style-type: none"> Wetland 		✓	The proposed reaches under Dhakuakhana high priority works do not fall under any perennial wetland. However, temporary water channels often form during rainy season nearby the proposed work sites.
<ul style="list-style-type: none"> Mangrove 		✓	The proposed reaches under Dhakuakhana high priority works are not located along side any coastal zone. Hence, no such sensitive ecosystem exists nearby.
<ul style="list-style-type: none"> Estuarine 		✓	The proposed reaches under Dhakuakhana high priority works are not located along side any coastal zone. Hence, no such sensitive ecosystem exists nearby.
<ul style="list-style-type: none"> Special area for protecting biodiversity 		✓	The proposed reaches under Dhakuakhana high priority works are neither within nor adjacent to any special area for biodiversity protection. No objection certificate from Divisional Forest Officer has been obtained.

Screening Questions	Yes	No	Remarks
			Vide letter no...FLKT/B/NOC/2024/5600 – 601 dated 5/9/2024.
B. Potential Environmental Impacts Will the project cause....			
<ul style="list-style-type: none"> • Impairment of historical/ cultural areas; disfiguration of landscape or potential loss/ damage to physical cultural resources? 		✓	There are neither historical sites nor areas of cultural importance in the proposed reaches under Dhakuakhana high priority works.
<ul style="list-style-type: none"> • Disturbance to precious ecology (e.g. sensitive or protected areas)? 		✓	The proposed project activities will not cause disturbance to precious ecology such as sensitive or protected areas. No objection certificate from Divisional Forest Officer has been obtained. Vide letter no...FLKT/B/NOC/2024/5600 – 601 dated 5/9/2024.
<ul style="list-style-type: none"> • Alteration of surface water hydrology of waterways resulting in increased sediment in streams affected by increased soil erosion at construction site? 		✓	The project activities in the proposed reaches will not cause alteration of surface water hydrology of waterways by increased soil erosion at construction sites. The project activities, such as launching of geotextiles bags will reduce the risk of riverbank erosion and enhance land reclamation in the vicinity of the project sites.
<ul style="list-style-type: none"> • Deterioration of surface water quality due to silt runoff and sanitary wastes from worker-based camps and chemicals used in construction? 	✓		Workers-base camps will be set up away from the main channel towards countryside. These camps will generate minimal sanitary waste. Potential contamination of water induced by camp operations is expected. However, these impacts are of local and temporary nature (i.e. during the construction phase only). Chemicals shall not be used during the construction phases.
<ul style="list-style-type: none"> • Increased air pollution due to project construction and operation? 	✓		During the construction phases, increase of air pollution may result due to construction activities such as movement of vehicles, use of generators in the workers camps etc.
<ul style="list-style-type: none"> • Noise and vibration due to project construction and operation? 	✓		The project activities are expected to increase noise and vibration levels associated with the use of construction machineries (geotextile bags stitching machines, use of generators in workers' camps) and use of vehicles.
<ul style="list-style-type: none"> • Involuntary resettlement of people? (physical displacement and/or economic displacement) 	✓		The project activities will be focused on the existing underwater and immediate vicinity of the above riverbank of the Brahmaputra River. Hence, there is no scope of physical or economic displacement and resettlement of people in near vicinity.
<ul style="list-style-type: none"> • Disproportionate impacts on the poor, women and children, indigenous people or other vulnerable groups? 		✓	Disproportionate impacts on the poor, women, children, indigenous people or other vulnerable groups are not anticipated due to the project activities. The project aims to address the people, their welfare who are affected by floods and riverbank erosion. After the completion of the works in the project area, there will be growth in economic activities in the area benefitting the riparian population.

Screening Questions	Yes	No	Remarks
<ul style="list-style-type: none"> Poor sanitation and solid waste disposal in construction camps and work sites, and possible transmission of communicable diseases (such as STIs and HIV/ AIDS) from workers to local population? 	✓		<p>Setting up of workers-base camps will temporarily add to the population in the project areas and likely to have poor sanitation and solid waste disposal in the camps and work sites, where transmission of communicable diseases from the workers to local population is possible.</p> <p>As the workers are expected to be from the same or adjacent districts within the state which will maintain the cultural balance among the workers and local population as well.</p>
<ul style="list-style-type: none"> Creation of temporary breeding habitats for diseases such as those transmitted by mosquitoes and rodents. 	✓		<p>The project activities will not directly create any breeding habitats for diseases such as those transmitted by mosquitoes and rodents. However, improper disposal of domestic solid waste generated from worker-based camps can provide suitable conditions for rodents and mosquitoes.</p>
<ul style="list-style-type: none"> Social conflicts if workers from other regions or countries are hired? 		✓	<p>Most of the workers will be engaged by the contractors from the nearby area of project sites.</p>
<ul style="list-style-type: none"> Large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)? 		✓	<p>Large population of workers are not expected considering the limited scope of the work. Most of the workers (unskilled) will be hired locally and some (skilled/technical) may be from the nearby districts.</p>
<ul style="list-style-type: none"> Risks and vulnerabilities related to occupational health and safety due to physical, chemical, biological, and radiological hazards during the project construction and operation? 	✓		<p>There are potential risks and vulnerabilities related to occupational health and safety due to physical hazards during construction.</p>
<ul style="list-style-type: none"> Risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation? 		✓	<p>No explosive will be used for any of the works. Fuelling of vehicles used for the project purpose will be undertaken in the public fuel stations.</p>
<ul style="list-style-type: none"> Community safety risks due to both accidental and natural causes, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning? 	✓		<p>During the construction phase, health and safety risk of nearby communities may increase due to the operation of vehicles and machines.</p>
<ul style="list-style-type: none"> Generation of solid waste and/ or hazardous waste? 	✓		<p>Worker-based camps and storage facilities will only generate solid waste.</p>
<ul style="list-style-type: none"> Use of chemicals? 		✓	<p>Chemicals will not be used for any of the project activities.</p>
<ul style="list-style-type: none"> Generation of wastewater during the construction or operation? 	✓		<p>During the construction phase, worker-based camps will generate some amount of wastewater.</p>

Lakhimpur

Rapid Environmental Assessment (REA) Checklist

Country/ Project Title: India: Climate Resilient Brahmaputra Integrated Flood and Riverbank Erosion

Risk Management Project (CRBIFRERMP) in Assam – High priority works under, North Lakhimpur

Sector Division: AFNR/SARD

Screening Questions	Yes	No	Remarks
C. Project Siting Is the Project area adjacent to or within any of the following environmentally sensitive areas?			
<ul style="list-style-type: none"> Cultural Heritage Site 		✓	There is no cultural heritage site in the proposed project area under North Lakhimpur. All the project related activities will be confined within 20-30 m of right of way (RoW).
<ul style="list-style-type: none"> Legally protected Area (core zone or buffer zone) 		✓	The proposed reaches under North Lakhimpur high priority works do not fall into any core zone or buffer zone of legally protected area.
<ul style="list-style-type: none"> Wetland 		✓	The proposed reaches under North Lakhimpur high priority works do not fall under any perennial wetland.
<ul style="list-style-type: none"> Mangrove 		✓	The proposed reaches under North Lakhimpur high priority works are not located along side any coastal zone. Hence, no such sensitive ecosystem exists nearby.
<ul style="list-style-type: none"> Estuarine 		✓	The proposed reaches under North Lakhimpur, high priority works are not located along side any coastal zone. Hence, no such sensitive ecosystem exists nearby.
<ul style="list-style-type: none"> Special area for protecting biodiversity 		✓	The proposed reaches under North Lakhimpur, high priority works are neither within nor adjacent to any special area for biodiversity protection. No objection certificate from Divisional Forest Officer has been obtained. Vide letter no...FLKT/B/NOC/2024/6640 – 411 dated 20/11/2024.
D. Potential Environmental Impacts Will the project cause....			
<ul style="list-style-type: none"> Impairment of historical/ cultural areas; disfiguration of landscape or potential loss/ damage to physical cultural resources? 		✓	There are neither historical sites nor areas of cultural importance within the proposed reaches under North Lakhimpur high priority works.
<ul style="list-style-type: none"> Disturbance to precious ecology (e.g. sensitive or protected areas)? 		✓	The proposed project activities will not cause disturbance to precious ecology such as sensitive or protected areas.
<ul style="list-style-type: none"> Alteration of surface water hydrology of waterways resulting in increased sediment in streams affected by increased soil erosion at construction site? 		✓	The project activities in the proposed reaches will not cause alteration of surface water hydrology of waterways by increased soil erosion at construction sites. The project activities, such as launching of geotextiles bags will reduce the risk of riverbank erosion and enhance land reclamation in the vicinity of the project sites.

Screening Questions	Yes	No	Remarks
<ul style="list-style-type: none"> Deterioration of surface water quality due to silt runoff and sanitary wastes from worker-based camps and chemicals used in construction? 	✓		Workers-base camps will be set up away from the main channel towards countryside. These camps will generate minimal sanitary waste. Potential contamination of water induced by camp operations is expected. However, these impacts are of local and temporary nature (i.e. during the construction phase only). Chemicals shall not be used during the construction phases.
<ul style="list-style-type: none"> Increased air pollution due to project construction and operation? 	✓		During the construction phases, increase of air pollution may result due to construction activities such as movement of vehicles, use of generators in the workers camps etc.
<ul style="list-style-type: none"> Noise and vibration due to project construction and operation? 	✓		The project activities are expected to increase noise and vibration levels associated with the use of construction machineries (geotextile bags stitching machines, use of generators in workers' camps) and use of vehicles.
<ul style="list-style-type: none"> Involuntary resettlement of people? (physical displacement and/or economic displacement) 		✓	The project activities will be focused on the existing underwater and immediate vicinity of the above riverbank of the Brahmaputra River. Hence, there is no scope of physical or economic displacement and resettlement of people in near vicinity. Separate resettlement plan is being prepared to address if any such displacement is required
<ul style="list-style-type: none"> Disproportionate impacts on the poor, women and children, indigenous people or other vulnerable groups? 		✓	Disproportionate impacts on the poor, women, children, indigenous people or other vulnerable groups are not anticipated due to the project activities. The project aims to address the people, their welfare who are affected by floods and riverbank erosion. After the completion of the works in the project area, there will be growth in economic activities in the area benefitting the riparian population.
<ul style="list-style-type: none"> Poor sanitation and solid waste disposal in construction camps and work sites, and possible transmission of communicable diseases (such as STIs and HIV/ AIDS) from workers to local population? 	✓		Setting up of workers-base camps will temporarily add to the population in the project areas and likely to have poor sanitation and solid waste disposal in the camps and work sites, where transmission of communicable diseases from the workers to local population is possible. As the workers are expected to be from the same or adjacent districts within the state which will maintain the cultural balance among the workers and local population as well.
<ul style="list-style-type: none"> Creation of temporary breeding habitats for diseases such as those transmitted by mosquitoes and rodents. 	✓		The project activities will not directly create any breeding habitats for diseases such as those transmitted by mosquitoes and rodents. However, improper disposal of domestic solid waste generated from worker-based camps can provide suitable conditions for rodents and mosquitoes.
<ul style="list-style-type: none"> Social conflicts if workers from other regions or countries are hired? 		✓	Most of the workers will be engaged by the contractors from the nearby area of project sites.

Screening Questions	Yes	No	Remarks
<ul style="list-style-type: none"> Large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)? 		✓	Large population of workers are not expected considering the limited scope of the work. Most of the workers (unskilled) will be hired locally and some (skilled/technical) may be from the nearby districts.
<ul style="list-style-type: none"> Risks and vulnerabilities related to occupational health and safety due to physical, chemical, biological, and radiological hazards during the project construction and operation? 	✓		There are potential risks and vulnerabilities related to occupational health and safety due to physical hazards during construction.
<ul style="list-style-type: none"> Risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation? 		✓	No explosive will be used for any of the works. Fuelling of vehicles used for the project purpose will be undertaken in the public fuel stations.
<ul style="list-style-type: none"> Community safety risks due to both accidental and natural causes, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning? 	✓		During the construction phase, health and safety risk of nearby communities may increase due to the operation of vehicles and machines.
<ul style="list-style-type: none"> Generation of solid waste and/ or hazardous waste? 	✓		Worker-based camps and storage facilities will only generate solid waste.
<ul style="list-style-type: none"> Use of chemicals? 		✓	Chemicals will not be used for any of the project activities.
<ul style="list-style-type: none"> Generation of wastewater during the construction or operation? 	✓		During the construction phase, worker-based camps will generate some amount of wastewater.

Biswanath

Rapid Environmental Assessment (REA) Checklist

Country/ Project Title: India: Climate Resilient Brahmaputra Integrated Flood and Riverbank Erosion

Risk Management Project (CRBIFRERMP) in Assam – High priority works under Biswanath

Sector Division: AFNR/SARD

Screening Questions	Yes	No	Remarks
E. Project Siting Is the Project area adjacent to or within any of the following environmentally sensitive areas?			
<ul style="list-style-type: none"> Cultural Heritage Site 		✓	There is no cultural heritage site in the proposed project area under Biswanath. All the project related activities will be confined within 20-30 m of right of way (RoW).
<ul style="list-style-type: none"> Legally protected Area (core zone or buffer zone) 		✓	The proposed reaches under Biswanath high-priority works do not fall within the core zone, protected areas, or eco-sensitive areas. The proposed work sites at Paken and Rangachali dalani fall near the notified boundary of Kaziranga National Park, NoC from Filed Director Kaziranga National Park and DFO, Wildlife Biswanath vide letter no KNP/FG.827/PPEP of KNP dated 06/12/2024 and A/WBC/NOC/2024/2547-48 dated 06/12/2024.
<ul style="list-style-type: none"> Wetland 		✓	The proposed reaches under Biswanath high priority works do not fall under any perennial wetland.
<ul style="list-style-type: none"> Mangrove 		✓	The proposed reaches under Biswanath high priority works are not located along side any coastal zone. Hence, no such sensitive ecosystem exists nearby.
<ul style="list-style-type: none"> Estuarine 		✓	The proposed reaches under Biswanath high priority works are not located along side any coastal zone.
<ul style="list-style-type: none"> Special area for protecting biodiversity 		✓	The proposed reaches under Biswanath high-priority works do not fall within the core zone, protected areas, or eco-sensitive areas. As per the IBAT assessment, the proposed interventions at Paken and Ranhachali Dalani sites are located 10 km from Kaziranga National Park, and both locations fall outside the notified boundary of KNP. NoCs have been obtained from the Field Director of Kaziranga National Park (vide letter no. KNP/FG.827/PPEP dated 06/12/2024) and the DFO, Wildlife Biswanath (vide letter no. A/WBC/NOC/2024/2547-48 dated 06/12/2024).
F. Potential Environmental Impacts Will the project cause....			

Screening Questions	Yes	No	Remarks
<ul style="list-style-type: none"> Impairment of historical/ cultural areas; disfiguration of landscape or potential loss/ damage to physical cultural resources? 		✓	There are neither historical sites nor areas of cultural importance in the proposed reaches under Biswanath high priority works.
<ul style="list-style-type: none"> Disturbance to precious ecology (e.g. sensitive or protected areas)? 		✓	The proposed project activities will not cause disturbance to precious ecology such as sensitive or protected areas. The proposed works do not fall into sensitive zone ; however, sites are located near the notified boundary of the Kaziranga National Park, and NoC from Field Director Kaziranga and DFO, wildlife ,Biswanath has been obtained.
<ul style="list-style-type: none"> Alteration of surface water hydrology of waterways resulting in increased sediment in streams affected by increased soil erosion at construction site? 		✓	The project activities in the proposed reaches will not cause alteration of surface water hydrology of waterways by increased soil erosion at construction sites. The project activities, such as launching of geotextiles bags will reduce the risk of riverbank erosion and enhance land reclamation in the vicinity of the project sites.
<ul style="list-style-type: none"> Deterioration of surface water quality due to silt runoff and sanitary wastes from worker-based camps and chemicals used in construction? 	✓		Workers-base camps will be set up away from the main channel towards countryside. These camps will generate minimal sanitary waste. Potential contamination of water induced by camp operations is expected. However, these impacts are of local and temporary nature (i.e. during the construction phase only). Chemicals shall not be used during the construction phases.
<ul style="list-style-type: none"> Increased air pollution due to project construction and operation? 	✓		During the construction phases, increase of air pollution may result due to construction activities such as movement of vehicles, use of generators in the workers camps etc. The KNP area management plan/guideline will be followed during the execution of work
<ul style="list-style-type: none"> Noise and vibration due to project construction and operation? 	✓		The project activities are expected to increase noise and vibration levels associated with the use of construction machineries (geotextile bags stitching machines, use of generators in workers' camps) and use of vehicles. The KNP area management plan/guideline will be followed during the execution of work
<ul style="list-style-type: none"> Involuntary resettlement of people? (physical displacement and/or economic displacement) 	✓		The project activities will be focused on the existing underwater and immediate vicinity of the above riverbank of the Brahmaputra River. Hence, there is no scope of physical or economic displacement and resettlement of people in near vicinity. Separate resettlement plan is being prepared to address if any such displacement is required
<ul style="list-style-type: none"> Disproportionate impacts on the poor, women and children, indigenous people or other vulnerable groups? 		✓	Disproportionate impacts on the poor, women, children, indigenous people or other vulnerable groups are not anticipated due to the project activities. The project aims to address the

Screening Questions	Yes	No	Remarks
			people, their welfare who are affected by floods and riverbank erosion. After the completion of the works in the project area, there will be growth in economic activities in the area benefitting the riparian population.
<ul style="list-style-type: none"> Poor sanitation and solid waste disposal in construction camps and work sites, and possible transmission of communicable diseases (such as STIs and HIV/ AIDS) from workers to local population? 	✓		<p>Setting up of workers-base camps will temporarily add to the population in the project areas and likely to have poor sanitation and solid waste disposal in the camps and work sites, where transmission of communicable diseases from the workers to local population is possible.</p> <p>As the workers are expected to be from the same or adjacent districts within the state which will maintain the cultural balance among the workers and local population as well.</p>
<ul style="list-style-type: none"> Creation of temporary breeding habitats for diseases breeding habitats for diseases such as those transmitted by mosquitoes and rodents. 	✓		<p>The project activities will not directly create any breeding habitats for diseases such as those transmitted by mosquitoes and rodents. However, improper disposal of domestic solid waste generated from worker-based camps can provide suitable conditions for rodents and mosquitoes. The KNP area management plan/guideline will be followed during the execution of work</p>
<ul style="list-style-type: none"> Social conflicts if workers from other regions or countries are hired? 		✓	<p>Most of the workers will be engaged by the contractors from the nearby area of project sites.</p>
<ul style="list-style-type: none"> Large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)? 		✓	<p>Large population of workers are not expected considering the limited scope of the work. Most of the workers (unskilled) will be hired locally and some (skilled/technical) may be from the nearby districts. The KNP area management plan/guideline will be followed during the execution of work</p>
<ul style="list-style-type: none"> Risks and vulnerabilities related to occupational health and safety due to physical, chemical, biological, and radiological hazards during the project construction and operation? 	✓		<p>There are potential risks and vulnerabilities related to occupational health and safety due to physical hazards during construction.</p>
<ul style="list-style-type: none"> Risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation? 		✓	<p>No explosive will be used for any of the works. Fuelling of vehicles used for the project purpose will be undertaken in the public fuel stations. The KNP area management plan/guideline will be followed during the execution of work</p>
<ul style="list-style-type: none"> Community safety risks due to both accidental and natural causes, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning? 	✓		<p>During the construction phase, health and safety risk of nearby communities may increase due to the operation of vehicles and machines.</p>

Screening Questions	Yes	No	Remarks
<ul style="list-style-type: none"> • Generation of solid waste and/ or hazardous waste? 	✓		<p>Worker-based camps and storage facilities will only generate solid waste.</p> <p>The KNP area management plan/guideline will be followed during the execution of work</p>
<ul style="list-style-type: none"> • Use of chemicals? 		✓	<p>Chemicals will not be used for any of the project activities. The KNP area management plan/guideline will be followed during the execution of work</p>
<ul style="list-style-type: none"> • Generation of wastewater during the construction or operation? 	✓		<p>During the construction phase, worker-based camps will generate some amount of wastewater. The KNP area management plan/guideline will be followed during the execution of work</p>

Sonitpur

Rapid Environmental Assessment (REA) Checklist

Country/ Project Title: India: Climate Resilient Brahmaputra Integrated Flood and Riverbank Erosion

Risk Management Project (CRBIFRERMP) in Assam – High priority works under Sonitpur

Sector Division: AFNR/SARD

Screening Questions	Yes	No	Remarks
G. Project Siting Is the Project area adjacent to or within any of the following environmentally sensitive areas?			
<ul style="list-style-type: none"> Cultural Heritage Site 		✓	There is no cultural heritage site in the proposed project area under Sonitpur. All the project related activities will be confined within 20-30 m of right of way (RoW).
<ul style="list-style-type: none"> Legally protected Area (core zone or buffer zone) 		✓	The proposed reaches under Sonitpur high priority works do not fall into any core zone or buffer zone of legally protected area.
<ul style="list-style-type: none"> Wetland 		✓	Area do not fall under any perennial wetland. However, temporary water channels often form during rainy season nearby the proposed work sites.
<ul style="list-style-type: none"> Mangrove 		✓	The proposed reaches under Sonitpur high priority works are not located along side any coastal zone. Hence, no such sensitive ecosystem exists nearby.
<ul style="list-style-type: none"> Estuarine 		✓	The proposed reaches under Sonitpur high priority works are not located along side any coastal zone. Hence, no such sensitive ecosystem exists nearby.
<ul style="list-style-type: none"> Special area for protecting biodiversity 		✓	The proposed reaches under Sonitpur high priority works do not fall within the core zone, protected areas, or eco-sensitive areas. No objection certificate from Divisional Forest Officer has been obtained. Vide letter no... No.FSWT/BNOCI2024-25/ 8140 dated 4/12/2024.
H. Potential Environmental Impacts Will the project cause....			
<ul style="list-style-type: none"> Impairment of historical/ cultural areas; disfiguration of landscape or potential loss/ damage to physical cultural resources? 		✓	There are neither historical sites nor areas of cultural importance within the proposed reaches under Sonitpur high priority works.
<ul style="list-style-type: none"> Disturbance to precious ecology (e.g. sensitive or protected areas)? 		✓	The proposed project activities will not cause disturbance to precious ecology such as sensitive or protected areas. The proposed works do not fall into sensitive zone ; however, one reach (Zahazghat) is located on vicinity i.e. within 10km from the boundary of the Kaziranga National Park, no objection certificate from Divisional Forest Officer has been obtained. Vide letter no...

Screening Questions	Yes	No	Remarks
			No.FSWT/BNOCI2024-25/ 8140 dated 4/12/2024.
<ul style="list-style-type: none"> Alteration of surface water hydrology of waterways resulting in increased sediment in streams affected by increased soil erosion at construction site? 		✓	The project activities in the proposed reaches will not cause alteration of surface water hydrology of waterways by increased soil erosion at construction sites. The project activities, such as launching of geotextiles bags will reduce the risk of riverbank erosion and enhance land reclamation in the vicinity of the project sites.
<ul style="list-style-type: none"> Deterioration of surface water quality due to silt runoff and sanitary wastes from worker-based camps and chemicals used in construction? 	✓		Workers-base camps will be set up away from the main channel towards countryside. These camps will generate minimal sanitary waste. Potential contamination of water induced by camp operations is expected. However, these impacts are of local and temporary nature (i.e. during the construction phase only). Chemicals shall not be used during the construction phases.
<ul style="list-style-type: none"> Increased air pollution due to project construction and operation? 	✓		During the construction phases, increase of air pollution may result due to construction activities such as movement of vehicles, use of generators in the workers camps etc.
<ul style="list-style-type: none"> Noise and vibration due to project construction and operation? 	✓		The project activities are expected to increase noise and vibration levels associated with the use of construction machineries (geotextile bags stitching machines, use of generators in workers' camps) and use of vehicles.
<ul style="list-style-type: none"> Involuntary resettlement of people? (physical displacement and/or economic displacement) 		✓	The project activities will be focused on the existing underwater and immediate vicinity of the above riverbank of the Brahmaputra River. Hence, there is no scope of physical or economic displacement and resettlement of people in near vicinity. Separate resettlement plan is being prepared to address if any such displacement is required
<ul style="list-style-type: none"> Disproportionate impacts on the poor, women and children, indigenous people or other vulnerable groups? 		✓	Disproportionate impacts on the poor, women, children, indigenous people or other vulnerable groups are not anticipated due to the project activities. The project aims to address the people, their welfare who are affected by floods and riverbank erosion. After the completion of the works in the project area, there will be growth in economic activities in the area benefitting the riparian population.
<ul style="list-style-type: none"> Poor sanitation and solid waste disposal in construction camps and work sites, and possible transmission of communicable diseases (such as STIs and HIV/ AIDS) from workers to local population? 	✓		Setting up of workers-base camps will temporarily add to the population in the project areas and likely to have poor sanitation and solid waste disposal in the camps and work sites, where transmission of communicable diseases from the workers to local population is possible. As the workers are expected to be from the same or adjacent districts within the state which will maintain the cultural balance among the workers and local population as well.

Screening Questions	Yes	No	Remarks
<ul style="list-style-type: none"> Creation of temporary breeding habitats for diseases such as those transmitted by mosquitoes and rodents. 	✓		The project activities will not directly create any breeding habitats for diseases such as those transmitted by mosquitoes and rodents. However, improper disposal of domestic solid waste generated from worker-based camps can provide suitable conditions for rodents and mosquitoes.
<ul style="list-style-type: none"> Social conflicts if workers from other regions or countries are hired? 		✓	Most of the workers will be engaged by the contractors from the nearby area of project sites with preference to the workers from the same district.
<ul style="list-style-type: none"> Large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)? 		✓	Large population of workers are not expected considering the limited scope of the work. Most of the workers (unskilled) will be hired locally and some (skilled/technical) may be from the nearby districts.
<ul style="list-style-type: none"> Risks and vulnerabilities related to occupational health and safety due to physical, chemical, biological, and radiological hazards during the project construction and operation? 	✓		There are potential risks and vulnerabilities related to occupational health and safety due to physical hazards during construction.
<ul style="list-style-type: none"> Risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation? 		✓	No explosive will be used for any of the works. Fuelling of vehicles used for the project purpose will be undertaken in the public fuel stations.
<ul style="list-style-type: none"> Community safety risks due to both accidental and natural causes, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning? 	✓		During the construction phase, health and safety risk of nearby communities may increase due to the operation of vehicles and machines.
<ul style="list-style-type: none"> Generation of solid waste and/ or hazardous waste? 	✓		Worker-based camps and storage facilities will only generate solid waste.
<ul style="list-style-type: none"> Use of chemicals? 		✓	Chemicals will not be used for any of the project activities.
<ul style="list-style-type: none"> Generation of wastewater during the construction or operation? 	✓		During the construction phase, worker-based camps will generate some amount of wastewater.

Appendix 4: National and International Environmental Quality Standards and Guidelines

NATIONAL ENVIRONMENTAL QUALITY STANDARDS

National Ambient Air Quality Standards

Pollutants	Time-weighted average	Concentration in Ambient Air		Methods of Measurement
		Industrial, Residential, Rural and Other Areas	Ecologically Sensitive Areas (notified by Central Government)	
Particulate Matter (size less than 10 µm) or PM ₁₀ µg/m ₃	Annual*	60	60	<ul style="list-style-type: none"> Gravimetric Tapered Element Oscillating Microbalances (TOEM) Beta attenuation
	24 hours**	100	100	
Particulate Matter (size less than 2.5µm) or PM _{2.5} µg/m ₃	Annual*	40	40	<ul style="list-style-type: none"> Gravimetric TOEM Beta attenuation
	24 hours**	60	60	
Sulphur Dioxide (SO ₂) µg/m ₃	Annual*	50	20	<ul style="list-style-type: none"> Improved West and Gaeke Ultraviolet fluorescence
	24 hours**	80	80	
Nitrogen Dioxide (NO ₂) µg/m ₃	Annual*	40	30	<ul style="list-style-type: none"> Modified Jacob and Hochheiser (Na-Arsenite) Chemiluminescence
	24 hours**	80	80	
Carbon Monoxide (CO) (mg/m ₃)	8 hours**	2	2	<ul style="list-style-type: none"> Non-Dispersive Infra-Red (NDIR) spectroscopy
Ozone (O ₃) µg/m ₃	8 hours**	100	100	<ul style="list-style-type: none"> UV photometric Chemiluminescence Chemical Method
	1 hour**	180	180	
Lead (Pb) µg/m ₃	Annual*	0.5	0.5	<ul style="list-style-type: none"> Atomic Absorption Spectrophotometry/ Inductively Coupled Plasma (AAS/ICP) method after sampling on EPM 2000 or equivalent filter paper Energy Dispersive X-ray Fluorescence (ED-XRF) using Teflon filter
	24 hours**	1	1	
	1 hour**	4	4	
Ammonia (NH ₃) µg/m ₃	Annual*	100	100	<ul style="list-style-type: none"> Chemiluminescence Indophenol Blue Method
	24 hours**	400	400	
Benzene (C ₆ H ₆) µg/m ₃	Annual*	5	5	<ul style="list-style-type: none"> Gas chromatography based continuous analyzer Adsorption and Desorption followed by Gas Chromatography (GC) analysis
Benzo(a) Pyrene Particulate Phase only ng/m ₃	Annual*	1	1	<ul style="list-style-type: none"> Solvent Extraction followed by High performance liquid chromatography (HPLC)/ GC analysis

Pollutants	Time-weighted average	Concentration in Ambient Air		Methods of Measurement
		Industrial, Residential, Rural and Other Areas	Ecologically Sensitive Areas (notified by Central Government)	
As ng/m ₃	Annual*	6	6	• AAS/ICP method after sampling on EPM 2000 or equivalent filter paper
Ni ng/m ₃	Annual*	20	20	• AAS/ICP method after sampling on EPM 2000 or equivalent filter paper

* Annual Arithmetic mean of minimum 104 measurements in a year taken twice a week, 24 hourly at uniform interval.; ng: nano gram

** 24 hourly or 8 hourly or 1 hourly monitored values, as applicable, shall be compiled with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

Note: Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, it shall be considered adequate reason to institute regular or monitoring and further investigation.

Source: MoEF&CC Notification dated 16 November 2009

Emission Standards for Diesel Engines ≤ 800 kW for DG sets (2014)

Power Category	Emission limits (g/kW-hr)			Smoke Limit (Light absorption coefficient, m-1)
	CO	NOx + HC	PM	
P ≤ 19 kW	≤ 3.5	≤ 7.5	≤ 0.3	0.7
More than 19 kW up to 75 kW	≤ 3.5	≤ 4.7	≤ 0.3	0.7
More than 75 kW up to 800 kW	≤ 3.5	≤ 4.0	≤ 0.2	0.7

Notes:

1. The abbreviations used in the Table shall mean as under NOx – Oxides of Nitrogen; HC – Hydrocarbon; CO – Carbon Monoxide; and PM – Particulate Matter.
2. Smoke shall not exceed above value throughout the operating load points of the test cycle.
3. The testing shall be done as per D2 – 5 mode cycle of ISO: 8178- Part 4.
4. The above-mentioned emission limits shall be applicable for Type Approval and Conformity of Production (COP) carried out by authorised agencies.
5. Every manufacturer, importer or, assembler (hereinafter referred to as manufacturer) of the diesel engine (hereinafter referred to as 'engine') for genset application manufactured or imported into India or, diesel genset (hereinafter referred to as 'product'), assembled or imported into India shall obtain Type Approval and comply with COP of their product(s) for the emission limits which shall be valid for the next COP year or, the date of implementation of the revised norms specified above, whichever earlier. Explanation — The term 'COP year' means the period from 1 April to 31 March.
6. Stack height (in meters), for genset shall be governed as per Central Pollution Control Board (CPCB) guidelines

Source: MoEF&CC Notification dated 11th December 2013, g/kW-hr: gram per kilowatt hour

Noise Standards

National Ambient Noise Quality Standards

Category of Area/Zone	Limits in dB(A) Leq	
	Day Time	Night-time
Industrial area	75	70
Commercial area	65	55
Residential area	55	45
Silence Zone	50	40

Note: (1) Day time shall mean from 6.00 a.m. to 10.00 p.m. (2) Nighttime shall mean from 10.00 p.m. to 6.00 a.m. (3) Silence zone is an area comprising not less than 100 meters around hospitals, educational institutions, courts, religious places or any other area which is declared as such by the competent authority (4) Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority. Source: Gazette of India, vide S.O. 123(E), dated 14.2.2000 and subsequently amended by the Noise Pollution (Regulation and Control) (Amendment) Rules, 2000 vide S.O. 1046(E), dated 22.11.2000 and by the Noise Pollution (Regulation and Control) (Amendment) Rules, 2002 vide S.O. 1088(E), dated 11.10.2002, under the Environment (Protection) Act, 1986.

National Occupational Noise

Occupational permissible exposure limit is permitted to 90 dB(A) for 8 hours/day and shall not be exposed to a noise level exceeding 115 dB(A) at any time. The permissible levels for noise exposure for work zone areas have been prescribed under the Model Rules of the Factories Act, 1948:

Peak sound pressure level in dB	Permitted number of impulses or impacts/day
140	100
135	315
130	1000
125	3160
120	10000

Notes: No exposure in excess of 140 dB peak sound pressure level is permitted. For any peak sound pressure level falling in between any figure and the next higher or lower figure as indicated in column 1, the permitted number of impulses or impacts per day is to be determined by extrapolation on a proportionate basis.

Source: https://moef.gov.in/wp-content/uploads/2017/06/moef_gov_in_citizen_specinfo_noise_html.pdf

Total time of exposure to sound pressure level (continuous or a number in dB(A) of short-term exposures) per day, in hours	Sound pressure level in dB(A)
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
0.5	107
0.25	110

Notes: No exposure in excess of 115 dB(A) is to be permitted. For any period of exposure falling in between any figure and the next higher or lower figure as indicated in column 1, the permissible sound pressure level is to be determined by extrapolation on a proportionate basis.

Source: https://moef.gov.in/wp-content/uploads/2017/06/moef_gov_in_citizen_specinfo_noise_html.pdf

National Ambient Noise Quality Standards for DG sets

Category	Limits in dB(A) Leq
Diesel generator sets (up to 1000 KVA) manufactured on or after the 1 January 2005 at 1 meter from the enclosure surface	75

Source: Noise Limit for Generator Sets run with Diesel were notified by Environment (Protection) second Amendment Rules vide GSR 371(E), dated 17 May 2002 at serial no.94 and its amendments vide GSR No 520(E) dated 1 July 2003; GSR 448(E), dated 12 July 2004; GSR 315(E) dated 16 May 2005; GSR 464(E) dated 7 August 2006; GSR 566(E) dated 29 August 2007 and GSR 752(E) dated 24 October 2008; G.S.R. 215 (E), dated 15 March, 2011 under the Environment (Protection) Act, 1986

Water Quality Standards

Surface Water Quality Standard

Sl. No.	Designated Best Use	Class of Water	Criteria
1	Drinking Water source (with conventional treatment)	A	<ul style="list-style-type: none"> Total Coliform MPN/100 ml shall be 50 or less pH between 6.5 to 8.5 Dissolved Oxygen 6 mg/l or more Biochemical Oxygen demand (BOD) 5 days 20°C 2 mg/l or less
2	Outdoor bathing (organized)	B	<ul style="list-style-type: none"> Total Coliform MPN/100 ml shall be 500 or less pH between 6.5 to 8.5 Dissolved Oxygen 5 mg/l or more Biochemical Oxygen demand (BOD) 5 days 20°C 3 mg/l or less
3	Drinking Water source (without conventional treatment)	C	<ul style="list-style-type: none"> Total Coliform MPN/100 ml shall be 5000 or less pH between 6 to 9 Dissolved Oxygen 4 mg/l or more Biochemical Oxygen demand (BOD) 5 days 20°C 3 mg/l or less
4	Propagation of Wildlife	D	<ul style="list-style-type: none"> pH between 6.5 to 8.5 for fisheries Dissolved Oxygen 4 mg/l or more Free Ammonia (N) 1.2 mg/l or less
5	Irrigation, Industrial Cooling, Controlled Waste	E	<ul style="list-style-type: none"> pH between 6.0 to 8.5 Electrical Conductivity at 25°C µmhos/cm Max. 2250 Sodium absorption rations Max. 26 Boron, Max.2 mg/l

Source: CPCB (1999). Bio mapping of rivers, Parivesh New Letter, 5 (iv), Central Pollution Control Board, Delhi, PP.20.

General Standards for Discharge of Environmental Pollutants: Effluents⁵³

Sl. No.	Parameter	Inland surface water	Public sewers	Land for irrigation	Marine/coastal areas
1	Colour and odour	All efforts should be made to remove colour and unpleasant odour as far as practicable		All efforts should be made to remove colour and unpleasant odour as far as practicable	All efforts should be made to remove colour and unpleasant odour as far as practicable
2	Suspended solids mg/l, max.	100	600	200	(a) For process wastewater (b) For cooling water effluent 10 per cent above total suspended matter of influent.
3	Particle size of suspended solids	Shall pass 850 micron IS Sieve	-	-	(a) Floatable solids, solids max. 3 mm (b) Settleable solids, max 856 microns
4	pH value	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
5	Temperature	shall not exceed 5oC above the receiving water temperature	-	-	shall not exceed 5oC above the receiving water temperature
6	Oil and grease, mg/l max,	10	20	10	20
7	Total residual chlorine, mg/l max	1.0	-	-	1.0
8	Ammoniacal nitrogen (N),mg/l, max.	50	50	-	50
9	Total kjeldahl nitrogen (N) ;mg/l, max. mg/l, max.	100	-	-	100
10	Free ammonia (NH3), mg/l, max.	5.0	-	-	5.0
11	Biochemical oxygen demand (3 days at 27oC), mg/l, max.	30	350	100	100
12	Chemical oxygen demand, mg/l, max.	250	-	-	250
13	Arsenic(As).	0.2	0.2	0.2	0.2
14	Mercury (Hg), mg/l, max.	0.01	0.01	-	0.01
15	Lead (Pb) mg/l, max	0.1	1.0	-	2.0
16	Cadmium (Cd) mg/l, max	2.0	1.0	-	2.0

⁵³ These standards shall be applicable for industries, operations or processes other than those industries, operations or process for which standards have been specified in Schedule of the Environment Protection Rules, 1989.

Sl. No.	Parameter	Inland surface water	Public sewers	Land for irrigation	Marine/coastal areas
17	Hexavalent chromium (Cr + 6),mg/l, max.	0.1	2.0	-	1.0
18	Total chromium (Cr) mg/l, max.	2.0	2.0	-	2.0
19	Copper (Cu) mg/l, max.	3.0	3.0	-	3.0
20	Zinc (Zn) mg/l, max.	5.0	15	-	15
21	Selenium (Se)	0.05	0.05	-	0.05
22	Nickel (Ni) mg/l, max.	3.0	3.0	-	5.0
23	Cyanide (CN) mg/l, max.	0.2	2.0	0.2	0.2
24	Fluoride (F) mg/l, max.	2.0	15	-	15
25	Dissolved phosphates (P),mg/l, max.	5.0	-	-	-
26	Sulphide (S) mg/l, max.	2.0	-	-	5.0
27	Phenolic compounds (C6H5OH)mg/l, max.	1.0	5.0	-	5.0
28	Radioactive materials: (a) Alpha emitters micro curie mg/l, max. (b)Beta emitters micro curie mg/l	10-7 10-6	10-7 10-6	10-8 10-7	10-7 10-6
29	Bio-assay test	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent
30	Manganese	2 mg/l	2 mg/l	-	2 mg/l
31	Iron (Fe)	3mg/l	3mg/l	-	3mg/l
32	Vanadium (V)	0.2mg/l	0.2mg/l	-	0.2mg/l
33	Nitrate Nitrogen	10 mg/l	-	-	20 mg/l

Notes:

Annexure 1: the state boards shall follow the following guidelines in enforcing the standards specified under Schedule IV:

The wastewater and gases are to be treated with the best available technology (BAT) in order to achieve the prescribed standards.

The industries need to be encouraged for recycling and reuse of waste materials as far as practicable in order to minimize the discharge of wastes into the environment.

The industries are to be encouraged for recovery of biogas, energy and reusable materials.

While permitting the discharge of effluents and emissions into the environment, State Boards have to take into account the assimilative capacities of the receiving bodies, especially water bodies so that quality of the intended use of the receiving waters is not affected. Where such quality is likely to be affected, discharges

should not be allowed into water bodies.

The central and state boards shall put emphasis on the implementation of clean technologies by the industries in order to increase fuel efficiency and reduce the generation of environmental pollutants.

All efforts should be made to remove color and unpleasant odour as far as practicable.

The standards mentioned in this Schedule shall also apply to all other effluents discharged such as mining, and mineral processing activities and sewage.

The limit given for the total concentration of mercury in the final effluent of caustic soda industry, is for the combined effluent from (a) cell house; (b) brine plant; (c) chlorine handling; (d) hydrogen handling; and (e) hydrochloric acid plant.

All effluents discharged including from the industries such as cotton textile, composite woolen mills, synthetic rubber, small pulp and paper, natural rubber, petrochemicals, tanneries, paint, dyes, slaughterhouses, food and fruit processing and dairy industries into surface waters shall conform to the BOD limit specified above, namely, 30 mg/l. For discharge of an effluent having a BOD more than 30 mg/l, the standards shall conform to those given above for other receiving bodies, namely, sewers, coastal waters and land for irrigation.

Bioassay shall be made compulsories for all the industries, where toxic and nonbiodegradable chemicals are involved.

In case of fertilizer industry, the limits in respect of chromium and fluoride shall be complied with at the outlet of chromium and fluoride removal units respectively.

In case of pesticides.

- The limits should be complied with at the end of the treatment plant before dilution.
- Bio-assay test should be carried out with the available species of fish in the receiving water, the COD limits to be specified in the consent conditions should be correlated with the BOD limits.
- In case metabolites and isomers of the pesticides in the given list are found in significant concentrations, standards should be prescribed for these also in the same concentration as the individual pesticides.
- Industries are required to analyze pesticides in wastewater by advanced analytical methods such as GLC/HPLC.

The chemical oxygen demand (COD) concentration in a treated effluent, if observed to be persistently greater than 250 mg/l before disposal to any receiving body (public sewer, land for irrigation, inland surface water and marine coastal areas), such industrial units are required to identify chemicals causing the same. In case these are found to be toxic as defined in the Schedule-I of the Hazardous Rules, 1989, the state boards in such cases shall direct the industries to install tertiary treatment stipulating time limit.

Standards specified in Part A of Schedule VI for discharge of effluents into the public sewer shall be applicable only if such sewer leads to a secondary treatment including biological treatment system otherwise the discharge into sewers shall be treated as discharge into inland surface waters.

Source: GSR 801 (E), EPA, 1986, dated 31 December 1993

Drinking Water Specifications: IS 10500:2012

Sl. No.	Substance/ Characteristics	Requirement (acceptable limit)	Undesirable effect outside the desirable limit	Permissible limit in the absence of alternate source	Methods of Test (ref. To IS)	Remarks
Essential Characteristics						
1	Colour, Hazen Units, Max.	5	Above 5, consumer acceptance decreases	15	IS 3025 (Part 4)	Extended to 15 only if toxic substances, in absence of alternate sources.
2	Odour	Agreeable	-	Agreeable	IS 3025 (Part 5)	A test cold and when heated. Test at several

Sl. No.	Substance/ Characteristics	Requirement (acceptable limit)	Undesirable effect outside the desirable limit	Permissible limit in the absence of alternate source	Methods of Test (ref. To IS)	Remarks
						dilution
3	Taste	Agreeable	-	Agreeable	IS 3025 (Part 7 and 8)	Test to be conducted only after safety has been established
4	Turbidity NTU, Max.	1	Above 5, consumer acceptance decreases	5	3025 (Part 10): 1984	
5	pH value	6.5 to 8.5	Beyond this range the water will not affect the mucous membrane and/or water supply system	No relaxation	IS 3025 (Part 11)	
6	Total hardness (CaCO ₃) mg/l, Max.	300	Encrustation in water supply structures an adverse effect on domestic use	600	IS 3025 (Part 21)	
7	Iron (Fe) mg/l Max.	0.3	Beyond this limit taste/appearance are affected has adverse effect on domestic uses and water supply structures and promotes iron bacteria	No relaxation	IS 3025 (Part 53)	Total concentration of manganese (Mn) and iron (as Fe) shall not exceed 0.3 mg/l
8	Chlorides (Cl) mg/l Max.	250	Beyond this limit, taste corrosion and palatability are affected	1000	IS 3025 (Part 32)	
9	Residual, free chloride, mg/l Min.	0.2		1	IS 3025 (Part 26)	To be applicable only when water is chlorinated. Tested at consumer end. When protection against viral infection is required, it should be Min. 0.5 mg/l
Desirable characteristics						
1	Dissolved solids mg/l Max.	500	Beyond the palatability decreases and may cause gastrointestinal irritation	2000	IS 3025 (Part 16)	
2	Calcium (Ca) mg/l	75	Encrustation in	200	IS 3025	

Sl. No.	Substance/ Characteristics	Requirement (acceptable limit)	Undesirable effect outside the desirable limit	Permissible limit in the absence of alternate source	Methods of Test (ref. To IS)	Remarks
	Max.		water supply structure and adverse effects on domestic use		(Part 40)	
3	Magnesium (Mg) mg/1, Max.	30	Encrustation in water supply structure and adverse effects on domestic use	100	IS 3025 (Part 46)	
4	Copper (Cu) mg/1 Max.	0.05	Beyond taste, discoloration of pipes, fitting and utensils will be caused beyond this	1.5	IS 3025 (Part 42)	
5	Manganese (Mn) mg/1, Max.	0.1	Beyond this limit taste/appearance are affected, has adverse effect on domestic uses and water supply structures.	0.3	IS 3025 (Part 59)	
6	Sulphate (SO ₄), mg/1, Max.	200	Beyond this causes gastro-intestinal irritation when magnesium or sodium are present	400	IS 3025 (Part 24)	May be extended up to 400 provided (Mg) does not exceed 30
7	Nitrate (NO ₃) mg/l, Max.	45	Beyond this methemoglobinemia take place	No relaxation	IS 3025 (Part 34)	To be tested when pollution is suspected
8	Fluoride (F) mg/1, Max.	1.0	Fluoride may be kept as low as possible. High fluoride may cause fluorosis	1.5	IS 3025 (Part 60)	To be tested when pollution is suspected
9	Phenolic compounds (C ₆ H ₅ OH) mg/1, Max.	0.001	Beyond this it may cause objectionable taste and odour	0.002	IS 3025 (Part 43)	To be tested when pollution is suspected
10	Mercury (Hg) mg/1, Max.	0.001	Beyond this the water becomes toxic	No relaxation	IS 3025 (Part 48)	To be tested when pollution is suspected
11	Cadmium (cd), mg/1, Max.	0.003	Beyond this the water becomes toxic	No relaxation	IS 3025 (Part 41)	To be tested when pollution is suspected
12	Selenium, (Se). mg/l, Max.	0.01	Beyond this the water becomes toxic	No relaxation	IS 3025 (Part 56)	To be tested when pollution is suspected
13	Arsenic (As) mg/1, Max.	0.01	Beyond this the water becomes toxic	0.05	IS 3025 (Part 37)	To be tested when pollution is suspected

Sl. No.	Substance/ Characteristics	Requirement (acceptable limit)	Undesirable effect outside the desirable limit	Permissible limit in the absence of alternate source	Methods of Test (ref. To IS)	Remarks
14	Cyanide (CN) mg/1, Max.	0.05	Beyond this the water becomes toxic	No relaxation	IS 3025 (Part 27)	To be tested when pollution is suspected
15	Lead (Pb), mg/1, Max.	0.01	Beyond this the water becomes toxic	No relaxation	IS 3025 (Part 47)	To be tested when pollution is suspected
16	Zinc (Zn) mg/1, Max.	5	Beyond this limit it can cause astringent taste and an opalescence in water	15	IS 3025 (Part 49)	To be tested when pollution is suspected
17	Anionic detergents (MBAS) mg/1, Max.	0.2	Beyond this it can cause a light froth in water	1	Annex K of IS 13428	To be tested when pollution is suspected
18	Chromium (Cr6+) mg/1, Max.	0.05	May be carcinogenic above this limit	No relaxation	IS 3025 (Part 52)	To be tested when pollution is suspected
19	Poly nuclear aromatic hydrocarbons (PAH) mg/1, Max.	0.0001	May be carcinogenic above this limit	No relaxation	APHA 6440	-
20	Mineral oil mg/1, Max.	0.5	Beyond this limit undesirable taste and odour after chlorination take place.	0.03	IS 3025 (Part 39)	-
21	Pesticides mg/1, Max.	-	Toxic	-	-	-
22	Radioactive material	-	-	-	IS 14194	-
23	Alpha emitters bq/1, Max.	0.1	-	No Relaxation	-	-
24	Beta emitter pci/1, Max.	1.0	-	No Relaxation	-	-
25	Total alkalinity (CaCO ₃), mg/l, max	200	Beyond this limit taste becomes unpleasant	600	IS 3025 (Part 23)	-
26	Aluminium (Al) mg/1, Max.	0.03	Cumulative effect is reported to cause dementia	0.2	IS 3025 (Part 55)	-
27	Boron mg/1, Max.	0.5	-	1.0	IS 3025 (Part 57)	-

Source: Indian Standard Drinking Water Specification – IS 10500:2012

INTERNATIONAL (WB/IFC- EHS GUIDELINE) ENVIRONMENTAL QUALITY STANDARDS⁵⁴

WHO Ambient Air Quality Guidelines

	Averaging Period	Guideline value in mg/m ³
Sulfur dioxide (SO ₂)	24-hour	125 (Interim target-1) 50 (Interim target-2)
	10 minutes	20 (guideline) 500 (guideline)
Nitrogen dioxide (NO ₂)	1-year	40 (guideline)
	1-hour	200 (guideline)
Particulate Matter PM ₁₀	1-year	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline)
	24-hour	150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)
Particulate Matter PM _{2.5}	1-year	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10 (guideline)
	24-hour	75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (guideline)
Ozone	8-hour daily maximum	160 (Interim target-1) 100 (guideline)

Source: https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/ehs-guidelines

Ambient Noise Level Guidelines

Receptor	One Hour LAeq (dBA)	
	Daytime 07:00 - 22:00	Nighttime 22:00 - 07:00
Residential; institutional; educational ⁵⁵	55	45
Industrial; commercial	70	70

Source: Guidelines for Community Noise, World Health Organization (WHO), 1999.

Noise Limits for Various Working Environments

Location/activity	Equivalent level LAeq,8h	Maximum L _{Amax} , fast
Heavy Industry (no demand for oral communication)	85 dB(A)	110 dB(A)
Light industry (decreasing demand for oral communication)	50-65 dB(A)	110 dB(A)
Open offices, control rooms,	45-50 dB(A)	-

⁵⁴ https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/ehs-guidelines

⁵⁵ For acceptable indoor noise levels for residential, institutional, and educational settings refer to WHO (1999).

Location/activity	Equivalent level LAeq,8h	Maximum LAmax, fast
service counters or similar		
Individual offices (no disturbing noise)	40-45 dB(A)	-
Classrooms, lecture halls	35-40 dB(A)	-
Hospitals	30-35 dB(A)	40 dB(A)

Source: Guidelines for Community Noise, World Health Organization (WHO), 1999

Water Quality

Indicative Values for Treated Sanitary Sewage Discharges

Pollutants	Units	Guideline Value
pH	pH	6 – 9
BOD mg/l 30	mg/l	30
COD mg/l 125	mg/l	125
Total nitrogen mg/l 10	mg/l	10
Total phosphorus mg/l 2	mg/l	2
Oil and grease	mg/l	10
Total suspended solids	mg/l	50
Total coliform bacteria	MPN/100 ml	400

MPN = Most Probable Number

Source: <https://www.ifc.org/wps/wcm/connect/3d9a54ae-c44c-488d-9851-afeb368cb9f9/1-3%2BWastewater%2Band%2BAmbient%2BWater%2BQuality.pdf?MOD=AJPERES&CVID=Is4Xbfn>

Appendix 5: WRD guidelines for Locating, Operating and Rehabilitating Borrow Pits Near the Embankment

1. Follow the WRD guidelines for locating borrow pits near the embankment. All efforts shall be made to avoid or minimize tree loss due to borrowing. The trucks shall be covered while transporting the earth.
2. While borrowing the earth top soil shall be preserved. The borrow pits shall be rehabilitated after borrowing the earth. The WRD guidelines for rehabilitation of the pits shall be strictly followed. The Indian Road Congress (IRC):10-1961 guideline will govern the selection of borrow pits. In all cases good engineering and construction practices shall be followed. The construction contractor shall submit in advance the borrow area identification details along with borrow area rehabilitation plan.
3. WRD Guidelines with respect to borrow area location and rehabilitation:
 - (i) For high embankments no excavation shall be done within 45 m of the riverside toe of the embankment. From 45 m to 60 m the borrow pits must not be more than 1.8 m deep and from 60 m to 90 m not more than 2.4 m deep and beyond 90 m they can be of 3 m depth.
 - (ii) If earth is to be taken from landside of the embankment, no borrow pits shall be excavated within 24 m of the land-side toe of the embankment. The depth of excavation in 24 m to 36 m shall not be more than 0.6 m. For low embankments the borrow pits on the riverside and on the landside shall not be located at less than 24 m from the toe.
 - (iii) For low embankments the borrow pits on the riverside and on the landside shall not be located at less than 24 m from the toe.
 - (iv) The borrow pits shall be staggered and on undisturbed ground 6 m wide left at regular intervals to prevent the velocity of flow through the riverside borrow pits. The staggering will also help in inducing silting and filling up of these borrow pits.
 - (v) On the countryside the waterlogged areas (bandhis) shall be cut and interconnected to permit ordinary drainage. These shall be connected to the nearest drainage channel so as to carry away the drainage water.
 - (vi) The borrow areas selected for taking earth shall be cleared of all trees, shrubs, grass and vegetation mounds.
 - (vii) No borrow pits shall be made on roads, village tracks, graveyards, canals or embankments.

Appendix 6: IBAT Analysis



Integrated Biodiversity Assessment Tool

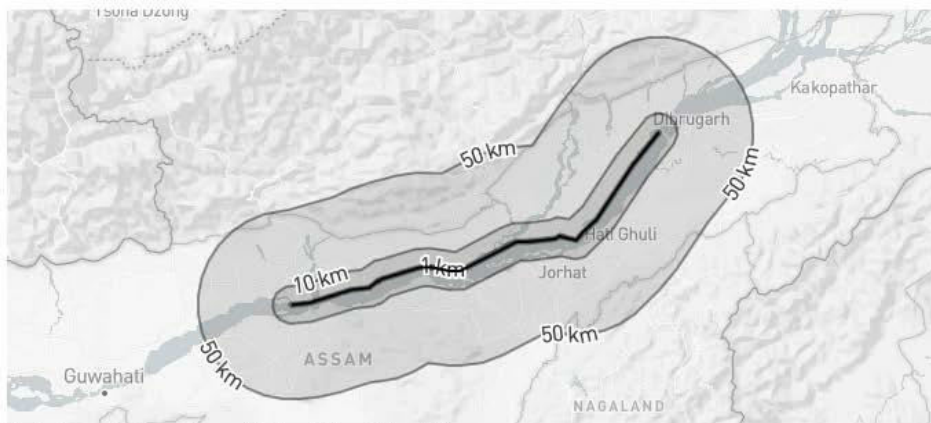
World Bank Group Biodiversity Risk Screen

CRBIFREMIP EMERGENCY WORKS

- Country: India
- Location: [26.9, 93.8]
- IUCN Red List Biomes: Freshwater, Terrestrial
- Created by: Brando Angeles

Overlaps with:

Protected Areas	1 km: 0	10 km: 1	50 km: 0	1
World Heritage (WH)	1 km: 0	10 km: 1	50 km: 0	1
Key Biodiversity Areas	1 km: 1	10 km: 5	50 km: 21	27
Alliance for Zero Extinction (AZE)	1 km: 0	10 km: 0	50 km: 1	1
IUCN Red List				61
Critical Habitat				Likely



Displaying project location and buffers: 1 km, 10 km, 50 km



This report is based on IFC Performance Standard 6 (PS6) but applies to World Bank Environmental and Social Standard 6 (ESS6)



About this report

The recommendations stated alongside any Protected Areas and Key Biodiversity Areas identified in this report are determined by the following:

Protected Areas:

- 'Highest risk. Seek expert help' is stated if the report identifies a designation that includes either 'natural' or 'mixed world heritage site'.
- 'Assess for Critical Habitat' is stated if the report identifies a Strict Nature Reserve, Wilderness Area or National Park as coded by IUCN protected area categories Ia, Ib and II.
- 'Assess for biodiversity risk' is stated if the report identifies any other type of protected area.

Key Biodiversity Areas:

- 'Highest risk. Seek expert help' is stated if the report identifies an Alliance for Zero Extinction site.
- 'Assess for Critical Habitat' is stated if the report identifies Critically Endangered or Endangered species OR species with restricted ranges OR congregatory species as coded in the IUCN Red List of Threatened Species.
- 'Assess for biodiversity risk' is stated if the report identifies any other type of Key Biodiversity Area.

IBAT provides initial screening for Critical Habitat values. Performance Standard 6 (PS6) defines these values for Critical Habitat (PS6: para. 16) and legally protected and internationally recognized areas (PS6: para. 20). PS6 will be triggered when IFC client activities are located in modified habitats containing "significant biodiversity value," natural habitats, Critical Habitats, legally protected areas, or areas that are internationally recognized for biodiversity. References to PS6 and Guidance Note 6 (GN6) are provided to guide further assessment and detailed definitions where necessary. Please see <https://www.ifc.org/ps6> for full details on PS6 and GN6.

This report identifies restricted range species according to the KBA Standard definition (hyperlink KBA Standard <https://portals.iucn.org/library/sites/library/files/documents/2016-048.pdf>):

Species having a global range size less than or equal to the 25th percentile of range-size distribution in a taxonomic group within which all species have been mapped globally, up to a maximum of 50,000 km². If all species in a taxonomic group have not been mapped globally, or if the 25th percentile of range-size distribution for a taxonomic group falls below 10,000 km², restricted range should be defined as having a global range size less than or equal to 10,000 km². For coastal, riverine and other species with linear distributions that do not exceed 200 km width at any point, restricted range is defined as having a global range less than or equal to 500 km linear geographic span (i.e. the distance between occupied locations furthest apart).

Note, sites supporting restricted range species can qualify as KBAs under criterion B2. These are sites that hold a significant proportion of the global population size of multiple restricted-range species, and so contribute significantly to the global persistence of biodiversity at the genetic and species level.

The report screens for known risks within a standard 50km buffer of the coordinates used for analysis. This buffer is not intended to indicate the area of impact. The report can be used to:

- Scope risks to include within an assessment of risks and impacts
- Identify gaps within an existing assessment of risks and impacts
- Prioritize between sites in a portfolio for further assessment of risks and impacts
- Inform a preliminary determination of Critical Habitat
- Assess the need for engaging a biodiversity specialist



- Identify additional conservation experts or organizations to inform further assessment or planning

WARNING: IBAT aims to provide the most up-to-date and accurate information available at the time of analysis. There is however a possibility of incomplete, incorrect or out-of-date information. All findings in this report must be supported by further desktop review, consultation with experts and/or on-the-ground field assessment as described in PS6 and GN6. Please consult IBAT for any additional disclaimers or recommendations applicable to the information used to generate this report.

Please note, sensitive species data are currently not included in IBAT reports in line with the [Sensitive Data Access Restrictions Policy for the IUCN Red List](#). This relates to sensitive Threatened species and KBAs triggered by sensitive species.

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Priority Species

Habitat of significant importance to priority species will trigger Critical Habitat status (See PS6: para 16). IBAT provides a preliminary list of priority species that could occur within the 50km buffer. This list is drawn from the IUCN Red List of Threatened Species (IUCN RL). This list should be used to guide any further assessment, with the aim of confirming known or likely occurrence of these species within the project area. It is also possible that further assessment may confirm occurrence of additional priority species not listed here. It is strongly encouraged that any new species information collected by the project be shared with species experts and/or IUCN wherever possible in order to improve IUCN datasets.

IUCN Red List of Threatened Species - CR & EN

The following species are potentially found within 50km of the area of interest. For the full IUCN Red List please refer to the associated csv in the report folder.

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
<i>Nilssonia nigricans</i>	Black Softshell Turtle	REPTILIA	CR	Decreasing	Terrestrial, Freshwater
<i>Gavialis gangeticus</i>	Gharial	REPTILIA	CR	Increasing	Terrestrial, Freshwater
<i>Pangshura sylhetensis</i>	Assam Roofed Turtle	REPTILIA	CR	Decreasing	Terrestrial, Freshwater
<i>Batagur dhongoka</i>	Three-striped Roofed Turtle	REPTILIA	CR	Decreasing	Terrestrial, Freshwater
<i>Aythya baeri</i>	Baer's Pochard	AVES	CR	Decreasing	Freshwater
<i>Heliopais personatus</i>	Masked Finfoot	AVES	CR	Decreasing	Terrestrial, Freshwater
<i>Ardea insignis</i>	White-bellied Heron	AVES	CR	Decreasing	Terrestrial, Freshwater
<i>Emberiza aureola</i>	Yellow-breasted Bunting	AVES	CR	Decreasing	Terrestrial, Freshwater

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Bubalus arnee	Wild Water Buffalo	MAMMALIA	EN	Decreasing	Terrestrial, Freshwater
Cuora amboinensis	Southeast Asian Box Turtle	REPTILIA	EN	Decreasing	Terrestrial, Freshwater
Geoclemys hamiltonii	Spotted Pond Turtle	REPTILIA	EN	Decreasing	Terrestrial, Freshwater
Hardella thurjii	Crowned River Turtle	REPTILIA	EN	Decreasing	Terrestrial, Freshwater
Morenia petersi	Indian Eyed Turtle	REPTILIA	EN	Decreasing	Terrestrial, Freshwater
Nilssonina gangetica	Indian Softshell Turtle	REPTILIA	EN	Decreasing	Terrestrial, Freshwater
Nilssonina hurum	Indian Peacock Softshell Turtle	REPTILIA	EN	Decreasing	Terrestrial, Freshwater
Platanista gangetica	Ganges River Dolphin	MAMMALIA	EN	Decreasing	Freshwater
Axis porcinus	Hog Deer	MAMMALIA	EN	Decreasing	Terrestrial, Freshwater
Cuora mouhotii	Keeled Box Turtle	REPTILIA	EN	Decreasing	Terrestrial, Freshwater
Amblyceps arunchalensis		ACTINOPTERYGII	EN	Unknown	Freshwater
Perdicula manipurensis	Manipur Bush-quail	AVES	EN	Decreasing	Terrestrial, Freshwater

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
<i>Asarcornis scutulata</i>	White-winged Duck	AVES	EN	Decreasing	Terrestrial, Freshwater
<i>Rynchops albicollis</i>	Indian Skimmer	AVES	EN	Decreasing	Terrestrial, Freshwater
<i>Sterna acuticauda</i>	Black-bellied Tern	AVES	EN	Decreasing	Terrestrial, Freshwater
<i>Haliaeetus leucoryphus</i>	Pallas's Fish-eagle	AVES	EN	Decreasing	Terrestrial, Freshwater
<i>Laticilla cinerascens</i>	Swamp Grass-babbler	AVES	EN	Decreasing	Terrestrial, Freshwater
<i>Tor putitora</i>		ACTINOPTERYGII	EN	Decreasing	Freshwater
<i>Indotestudo elongata</i>	Elongated Tortoise	REPTILIA	CR	Decreasing	Terrestrial
<i>Manis pentadactyla</i>	Chinese Pangolin	MAMMALIA	CR	Decreasing	Terrestrial
<i>Manouria emys</i>	Asian Giant Tortoise	REPTILIA	CR	Decreasing	Terrestrial
<i>Magnolia gustavii</i>	Champi Doi	MAGNOLIOPSIDA	CR	Decreasing	Terrestrial
<i>Houbaropsis bengalensis</i>	Bengal Florican	AVES	CR	Decreasing	Terrestrial
<i>Gyps bengalensis</i>	White-rumped Vulture	AVES	CR	Decreasing	Terrestrial
<i>Sarcogyps calvus</i>	Red-headed Vulture	AVES	CR	Decreasing	Terrestrial

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
<i>Gyps tenuirostris</i>	Slender-billed Vulture	AVES	CR	Decreasing	Terrestrial
<i>Nardostachys jatamansi</i>	Indian Nard	MAGNOLIOPSIDA	CR	Decreasing	Terrestrial
<i>Parakaempferia synantha</i>		LILIOPSIDA	CR	Unknown	Terrestrial
<i>Beilschmiedia brandisii</i>		MAGNOLIOPSIDA	CR	Unknown	Terrestrial
<i>Cinnamomum champokianum</i>	Pati-hunda	MAGNOLIOPSIDA	CR	Unknown	Terrestrial
<i>Cryptocarya simonsii</i>		MAGNOLIOPSIDA	CR	Unknown	Terrestrial
<i>Cheirostylis tippica</i>		LILIOPSIDA	CR	Decreasing	Terrestrial
<i>Oberonia jhae</i>		LILIOPSIDA	CR	Unknown	Terrestrial
<i>Ailurus fulgens</i>	Red Panda	MAMMALIA	EN	Decreasing	Terrestrial
<i>Bhutanitis ludlowi</i>	Ludlow's Bhutan Glory	INSECTA	EN	Unknown	Terrestrial
<i>Caprolagus hispidus</i>	Hispid Hare	MAMMALIA	EN	Decreasing	Terrestrial
<i>Cuon alpinus</i>	Dhole	MAMMALIA	EN	Decreasing	Terrestrial
<i>Elephas maximus</i>	Asian Elephant	MAMMALIA	EN	Decreasing	Terrestrial
<i>Manis crassicaudata</i>	Indian Pangolin	MAMMALIA	EN	Decreasing	Terrestrial

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Manouria impressa	Impressed Tortoise	REPTILIA	EN	Decreasing	Terrestrial
Melanochelys tricarinata	Tricarinate Hill Turtle	REPTILIA	EN	Decreasing	Terrestrial
Panthera tigris	Tiger	MAMMALIA	EN	Decreasing	Terrestrial
Sloanea tomentosa	Xin Ye Hou Huan Xi	MAGNOLIOPSIDA	EN	Decreasing	Terrestrial
Nycticebus bengalensis	Bengal Slow Loris	MAMMALIA	EN	Decreasing	Terrestrial
Trachypithecus pileatus ssp. brahma	Capped Langur	MAMMALIA	EN	Decreasing	Terrestrial
Trachypithecus pileatus ssp. tenebricus	Tenebrous Capped Langur	MAMMALIA	EN	Decreasing	Terrestrial
Hoolock hoolock	Western Hoolock Gibbon	MAMMALIA	EN	Decreasing	Terrestrial
Magnolia pealiana		MAGNOLIOPSIDA	EN	Decreasing	Terrestrial
Trillium tschonoskii	Keun-yeon-yeong-cho	LILIOPSIDA	EN	Decreasing	Terrestrial
Aquila nipalensis	Steppe Eagle	AVES	EN	Decreasing	Terrestrial
Ploceus megarhynchus	Finn's Weaver	AVES	EN	Decreasing	Terrestrial
Tectona grandis	Teak	MAGNOLIOPSIDA	EN	Decreasing	Terrestrial

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Trachypithecus pileatus ssp. pileatus	Blond-bellied Langur	MAMMALIA	EN	Decreasing	Terrestrial

Restricted Range Species

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Bubalus arnee	Wild Water Buffalo	MAMMALIA	EN	Decreasing	Terrestrial, Freshwater
Uperodon assamensis	Assamese Balloon Frog	AMPHIBIA	VU	Decreasing	Terrestrial, Freshwater
Amolops assamensis	Assamese Cascade Frog	AMPHIBIA	VU	Decreasing	Terrestrial, Freshwater
Aborichthys tikaderi		ACTINOPTERYGII	VU	Unknown	Freshwater
Aborichthys garoensis		ACTINOPTERYGII	VU	Unknown	Freshwater
Devario acuticephala		ACTINOPTERYGII	VU	Unknown	Freshwater
Devario assamensis		ACTINOPTERYGII	VU	Unknown	Freshwater
Minervarya chilapata	Chilapata Rainpool Frog	AMPHIBIA	VU	Decreasing	Terrestrial, Freshwater
Chrysomma altirostre	Jerdon's Babbler	AVES	VU	Decreasing	Terrestrial, Freshwater
Paradoxornis flavirostris	Black-breasted	AVES	VU	Decreasing	Terrestrial, Freshwater

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
	Parrotbill				
Garo khajuriai		ACTINOPTERYGII	NT	Unknown	Freshwater
Ompok pabda		ACTINOPTERYGII	NT	Decreasing	Freshwater
Ctenops nobilis		ACTINOPTERYGII	NT	Decreasing	Freshwater
Channa bleheri	Rainbow Snakehead	ACTINOPTERYGII	NT	Unknown	Freshwater
Megophrys robusta	Bengal Spadefoot Toad	AMPHIBIA	LC	Decreasing	Terrestrial, Freshwater
Kalophrynus orangensis	Orang Sticky Frog	AMPHIBIA	LC	Decreasing	Terrestrial, Freshwater
Liurana medogensis	Medog Papilla-tongued Frog	AMPHIBIA	LC	Decreasing	Terrestrial, Freshwater
Pterorana khare	Khare's Frog	AMPHIBIA	LC	Decreasing	Terrestrial, Freshwater
Rohanixalus shyamrupus	Hornbill Bubble-nest Frog	AMPHIBIA	LC	Decreasing	Terrestrial, Freshwater
Chirixalus simus	Assam Asian Treefrog	AMPHIBIA	LC	Stable	Terrestrial, Freshwater
Salvinia natans	Floating Fern	POLYPODIOPSIDA	LC	Decreasing	Freshwater
Bengala elanga	Bengala barb	ACTINOPTERYGII	LC	Unknown	Freshwater
Hemibagrus menoda		ACTINOPTERYGII	LC	Unknown	Freshwater

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Amblyceps mangois		ACTINOPTERYGII	LC	Unknown	Freshwater
Xenentodon cancula		ACTINOPTERYGII	LC	Unknown	Freshwater
Batasio batasio		ACTINOPTERYGII	LC	Unknown	Freshwater
Schistura multifasciata		ACTINOPTERYGII	LC	Unknown	Freshwater
Badis bloysrus	Dwarf Chameleon Fish	ACTINOPTERYGII	LC	Unknown	Freshwater
Schistura tirapensis		ACTINOPTERYGII	LC	Unknown	Freshwater
Psilorhynchus homaloptera	Homaloptera minnow	ACTINOPTERYGII	LC	Unknown	Freshwater
Oreichthys cosuatis		ACTINOPTERYGII	LC	Unknown	Freshwater
Macrobrachium rosenbergii	Giant River Prawn	MALACOSTRACA	LC	Unknown	Freshwater
Leptobranchium rakhinense	Rakhine Bicolor-eyed Toadfrog	AMPHIBIA	LC	Unknown	Terrestrial, Freshwater
Rhacophorus tuberculatus	Warty Flying Frog	AMPHIBIA	DD	Decreasing	Terrestrial, Freshwater
Tiwaripotamon austenianum		MALACOSTRACA	DD	Unknown	Freshwater
Sartoriana trilobata		MALACOSTRACA	DD	Unknown	Freshwater

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
<i>Pila olea</i>		GASTROPODA	DD	Unknown	Freshwater
<i>Lymnaea horae</i>		GASTROPODA	DD	Unknown	Freshwater
<i>Parreysia corbis</i>		BIVALVIA	DD	Unknown	Freshwater
<i>Parreysia annandalei</i>		BIVALVIA	DD	Unknown	Freshwater
<i>Elattonaura campioni</i>		INSECTA	DD	Unknown	Terrestrial, Freshwater
<i>Badis assamensis</i>	Assam Badis	ACTINOPTERYGII	DD	Unknown	Freshwater
<i>Badis kanabos</i>		ACTINOPTERYGII	DD	Unknown	Freshwater
<i>Batasio merianiensis</i>		ACTINOPTERYGII	DD	Unknown	Freshwater
<i>Psilorhynchus arunachalensis</i>		ACTINOPTERYGII	DD	Unknown	Freshwater
<i>Channa aurantimaculata</i>	Orange-spotted snakehead	ACTINOPTERYGII	DD	Unknown	Freshwater
<i>Gynacantha bainbriggei</i>		INSECTA	DD	Unknown	Terrestrial, Freshwater
<i>Protosticta fraseri</i>		INSECTA	DD	Unknown	Terrestrial, Freshwater
<i>Badis dibruensis</i>		ACTINOPTERYGII	DD	Unknown	Freshwater
<i>Caridina excavata</i>		MALACOSTRACA	DD	Unknown	Freshwater

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Oligodon erythrorhachis	Namsang Kukri Snake	REPTILIA	VU	Unknown	Terrestrial
Tragopan blythii	Blyth's Tragopan	AVES	VU	Decreasing	Terrestrial
Apus acuticauda	Dark-rumped Swift	AVES	VU	Stable	Terrestrial
Argya longirostris	Slender-billed Babbler	AVES	VU	Decreasing	Terrestrial
Spelaeornis chocolatinus	Naga Wren-babbler	AVES	VU	Decreasing	Terrestrial
Nasutixalus jerdonii	Jerdon's Bubble-nest Frog	AMPHIBIA	LC	Decreasing	Terrestrial
Theleoderma baibungense	Baibung Small Treefrog	AMPHIBIA	LC	Decreasing	Terrestrial
Onthophagus planifrons		INSECTA	DD	Unknown	Terrestrial

Biodiversity features which are likely to trigger Critical Habitat

Protected Areas

The following protected areas are found within 1 km and 10 km and 50 km of the area of interest. For further details please refer to the associated csv file in the report folder.

Area name	Distance	IUCN Category	Status	Designation	Recommendation
Kaziranga National Park	10 km	Not Applicable	Inscribed	World Heritage Site (natural or mixed)	Highest risk. Seek expert help

Key Biodiversity Areas

The following key biodiversity areas are found within 1 km and 10 km and 50 km of the area of interest. For further details please refer to the associated csv file in the report folder.

Area name	Distance	IBA	AZE	Recommendation
Majuli	1 km	Yes	No	Assess for critical habitat
Jhanjimukh - Kokilamukh	10 km	Yes	No	Assess for critical habitat
Kaziranga National Park	10 km	Yes	No	Assess for critical habitat
Kuarbari Dalani	10 km	Yes	No	Assess for critical habitat
Laokhowa and Burhachapori Sanctuaries	10 km	Yes	No	Assess for critical habitat
Pani-Dihing Bird Sanctuary	10 km	Yes	No	Assess for critical habitat

Area name	Distance	IBA	AZE	Recommendation
Behali Reserve Forest	50 km	Yes	No	Assess for critical habitat
Bordoibam-Bilmukh Bird Sanctuary	50 km	Yes	No	Assess for critical habitat
Bordoloni - Sampora	50 km	Yes	No	Assess for critical habitat
Deobali Jalah	50 km	Yes	No	Assess for critical habitat
Deobali Jalah, Sialmari, Haibargaon, Khutikatia (Nagaon)	50 km	No	No	Assess for critical habitat
Dibru - Saikhowa Complex	50 km	Yes	Yes	Highest risk. Seek expert help
East and North Karbi Anglong Wildlife Sanctuaries	50 km	Yes	No	Assess for critical habitat
Garampani, Nambor and Doigrung	50 km	Yes	No	Assess for critical habitat
Gibbon (Hollongapar) Sanctuary	50 km	Yes	No	Assess for critical habitat
Itanagar Wildlife Sanctuary	50 km	Yes	No	Assess for critical habitat
Jamjing and Sengajan	50 km	Yes	No	Assess for critical habitat
Kane Wildlife Sanctuary	50 km	Yes	No	Assess for critical habitat
Nagaon Township	50 km	No	No	Assess for critical habitat

Area name	Distance	IBA	AZE	Recommendation
Nameri National Park	50 km	Yes	No	Assess for critical habitat
Orang National Park	50 km	Yes	No	Assess for critical habitat
Pabho Reserve Forest	50 km	Yes	No	Assess for critical habitat
Pakhui or Pakke Wildlife Sanctuary	50 km	Yes	No	Assess for critical habitat
Papum Reserve Forest	50 km	Yes	No	Assess for critical habitat
Sibsagar Tanks	50 km	Yes	No	Assess for critical habitat
Sonai-Rupai Wildlife Sanctuary	50 km	Yes	No	Assess for critical habitat
Subansiri	50 km	Yes	No	Assess for critical habitat

Species with potential to occur

Area Taxonomic group	Total assessed species	Total (CR, EN & VU)	CR	EN	VU	NT	LC	DD
REPTILIA	128	23	6	9	8	5	96	4
AVES	676	40	8	8	24	38	598	0
MAMMALIA	134	34	1	14	19	12	84	4
ACTINOPTERYGII	115	9	0	2	7	12	81	13

Area Taxonomic group	Total assessed species	Total (CR, EN & VU)	CR	EN	VU	NT	LC	DD
AMPHIBIA	74	4	0	0	4	1	63	6
MALACOSTRACA	30	1	0	0	1	2	13	14
GASTROPODA	70	1	0	0	1	0	49	20
INSECTA	135	1	0	1	0	1	122	11
BIVALVIA	52	0	0	0	0	1	35	16
POLYPODIOPSIDA	4	0	0	0	0	0	4	0
MAGNOLIOPSIDA	136	14	5	3	6	2	112	8
LILIOPSIDA	83	7	3	1	3	0	71	5
SORDARIOMYCETES	1	1	0	0	1	0	0	0
AGARICOMYCETES	1	0	0	0	0	0	1	0
ARACHNIDA	3	0	0	0	0	0	3	0



Recommended citation

IBAT PS6 & ESS6 Report. Generated under licence 1078-73553 from the Integrated Biodiversity Assessment Tool on 24 October 2024 (GMT). www.ibat-alliance.org

Recommended Experts and Organizations

For projects located in Critical Habitat, clients must ensure that external experts with regional expertise are involved in further assessment (GN6: GN22). Clients are encouraged to develop partnerships with recognized and credible conservation organizations and/or academic institutes, especially with respect to potential developments in natural or Critical Habitat (GN6: GN23). Where Critical Habitats are triggered by priority species, species specialists must be involved. IBAT provides data originally collected by a large network of national partners, while species information is sourced via the IUCN Red List and affiliated Species Specialist Groups. These experts and organizations are listed below. **Please note that this is not intended as a comprehensive list of organizations and experts. These organizations and experts are under no obligation to support any further assessment and do so entirely at their discretion and under their terms. Any views expressed or recommendations made by these stakeholders should not be attributed to the IFC or IBAT for IFC partners.**

Birdlife Partners

URL: <https://www.birdlife.org/worldwide/partnership/birdlife-partners>

Directory for Species Survival Commission (SSC) Specialist Groups and Red List Authorities

URL: <https://www.iucn.org/commissions/ssc-groups>

Appendix 7: Biodiversity Survey Report

BIODIVERSITY SURVEY REPORT

Conducted on the months of November and December 2024

METHODOLOGY ADOPTED FOR BASELINE DATA COLLECTION

To collect floral data in the project sites, all the sites has been visited and surveyed by our team members. The project sites for data collection have been divided into three sub zones. They are as follows:

Core Zone: protection, embankment work area (Right of Way) of the project.

Inner Buffer Zone: Boundary of Right of Way of Project up to 500 meters of project area

Outer Buffer Zone: area delineated between 500 meters to 1000 meters (1 km area).



Photo: During flora and faunal survey at Jarani and Bandana

Site selection: 100% of sites given in the list were visited. Out of total length of bank protection work, about 100 % of total length for small length project where length varies between 260m to 1600 m were visited on foot. For 2 projects, bigger of length more than 1600 m, the whole project was divided into segments. The visit include start point up to 1000 meters walk followed by 500 m no survey, then again 1000 m on walk and 500 m stretch avoided.

Methods adopted for Survey and data collection

Different ecological methods have been adopted to find out the better result to get the idea of the composition of the biodiversity in the project areas.

- Transect belt method
- Walk Through method
- Spot Method
- Call detection method
- Pug mark of animals on sandy riverbeds
- Fishing point

Transect belt method:

The transect belt method is a systematic sampling technique widely employed in ecological research to assess spatial distribution, species composition, and habitat characteristics across a defined area. This method involves laying out a linear transect, along which contiguous or systematically spaced rectangular plots, referred to as belts, are established for detailed sampling. Within these belts, researchers record data on species presence, abundance, density, and environmental parameters, providing a comprehensive representation of ecological patterns. The transect belt method is particularly effective for studying vegetation gradients, habitat transitions, and biodiversity in terrestrial and aquatic ecosystems. Its systematic approach facilitates quantitative analyses, enabling comparisons across spatial and temporal scales to understand ecological processes and monitor environmental changes.

Walk Through method:

The Walk-Through method is a systematic ecological survey technique employed to assess biodiversity, species distribution, and habitat characteristics within a defined study area. Researchers traverse predetermined routes, often delineated by transects, to collect observational and quantitative data on species composition, abundance, and ecological interactions. Data acquisition may involve visual identification, sampling with quadrats, and geospatial recording using GPS devices. This method is particularly effective for characterizing vegetation structure, detecting spatial patterns, and monitoring ecological changes over time. Its efficiency and adaptability make it a valuable approach for ecological assessments in diverse environments.

Spot Method:

The spot method in ecological research is a localized sampling technique used to assess biodiversity, habitat characteristics, or ecological processes within a specific, well-defined area. This method involves selecting representative locations, or "spots," within the study area where detailed observations and measurements are conducted. Data collected may include species composition, population densities, abiotic factors, and ecological interactions. The spot method is particularly effective for studying microhabitats, stationary organisms, or site-specific phenomena. It allows researchers to obtain high-resolution data at fine spatial scales, facilitating the analysis of local ecological patterns and their broader implications. The technique is often integrated with broader survey methods to enhance the spatial and temporal understanding of ecological systems.

Call detection method:

Call detection methods in ecological research involve the use of bioacoustics techniques to monitor and analyse vocalizations of target species within an ecosystem. These methods rely on specialized equipment, such as microphones, autonomous recording units (ARUs), and acoustic sensors, to capture sound signals in terrestrial, aquatic, or aerial environments. Recorded calls are subsequently analysed using software to identify species, estimate population density, or study behavioural patterns. Call detection is particularly effective for monitoring cryptic, nocturnal, or migratory species that may be difficult to observe visually. This non-invasive approach provides valuable insights into species distribution, activity patterns, and habitat use while minimizing disturbance to the ecosystem.

Pug mark of animals on sandy riverbeds:

The study of pugmarks on sandy riverbeds is a non-invasive method in ecological research for monitoring terrestrial animal presence, distribution, and movement patterns. Pugmarks, which are the footprints left by animals, provide valuable information on species identification, population estimation, and individual recognition through morphological characteristics such as size, shape, and stride length. This method is particularly useful in tracking large mammals, including carnivores and herbivores, in their natural habitats. Sandy substrates on riverbeds offer an ideal medium for capturing clear imprints, which can be photographed, measured, and analysed for further interpretation. Pugmark analysis contributes to understanding habitat utilization, territoriality, and ecological connectivity, aiding in wildlife management and conservation planning.

Fishing point:

The study of fishing points in ecological research involves the identification and analysis of specific locations within aquatic systems where fishing activities are concentrated due to high biodiversity or resource availability. These points are often characterized by unique ecological parameters, such as water depth, flow velocity, substrate type, and the presence of target fish species. Research at fishing points aims to assess fish diversity, population dynamics, and habitat preferences, providing insights into the ecological roles of these areas. Additionally, studies at fishing points can evaluate the impacts of fishing pressure on aquatic ecosystems, informing sustainable management practices and conservation strategies. Data collection methods may include direct observations, catch records, and the use of sampling tools such as nets, traps, and sonar technologies.

STUDY AREA –

The project areas fall in the north bank of Brahmaputra River in the districts of Sonitpur, Biswanath and Lakhimpur. Based on the Biogeographic Classification Zoning Map of India, the project site falls in Zone 9 – Northeast and on the basis of Biogeographic Province map of India, the project sites fall in 9A- North -East (Brahmaputra Valley).

Forest Resources of Assam

Overall, Forest Cover

According to the India State of Forest Report (ISFR) 2021, forest Cover in the State is 28,311.51 sq km which is 36.09 % of the State's geographical area. In terms of forest canopy density classes, the State has 3016.67 sq km under Very Dense Forest (VDF), 9991.02 sq km under Moderately Dense Forest (MDF) and 15,303.82 sq km under Open Forest (OF).

Sonitpur District

Sonitpur, located in the northern part of Assam, has significant forested areas, including parts of protected reserves such as Nameri National Park and Sonai Rupai Wildlife Sanctuary. However, the district faces challenges like deforestation and habitat degradation. As per district administration report, Sonitpur has a forest cover of 935.38 sq.km which is 45% of its total geographical area.

Biswanath District

Biswanath, carved out of Sonitpur, has a mix of forest types, including areas connected to Kaziranga National Park. This district contributes to Assam's biodiversity, with forest areas serving as critical corridors for wildlife. As the district survey report, the district has a forest cover of 474 sq.km which is around 26% of its Geographic area.

Lakhimpur District

Lakhimpur, in north-eastern Assam, has a relatively smaller proportion of forest cover, primarily comprising open and moderately dense forests. The district is important for its role in water catchment and flood control, with forests playing a crucial role in managing the Brahmaputra River basin's ecological health. As per ISFR, 2021, Lakhimpur has a forest cover of 310.55 sq.km, which is 13.64% of its total geographical area.



Photo: During flora and faunal survey at Paken and Bonpuroi Jamuguri

Biodiversity assessment of the project areas in Sonitpur, Biswanath and Lakhimpur districts.

Field surveys were conducted in 9 project locations in three districts (Table1, Figure 1) using various ecological sampling techniques such as transect belt, point counts, call detection method, Pug mark identification, opportunistic surveys, personal interviews, focus group discussions etc. Desktop reviews were conducted to find secondary information on key biodiversity area and key species present in the area. The following sections have detailed information about the flora and fauna of the proposed project locations.

Table 1: Locations of Transect Belt Method adopted for Flora and Fauna Study

S. No	Project Name	Length to Protection Work (m)	District	Transect Code	Geographical Coordinate				Length of Transect (m)	Remarks
					Start Point		End Point			
					Latitude	Longitude	Latitude	Longitude		
1	Zahaz Ghat	600 m	Sonitpur	T1	26°36'57.29"N	92°47'34.65"E	26°37'2.55"N	92°47'13.82"E	600 m	Waste Land
2	Jarani	1200 m		T2	26°37'55.27"N	92°40'41.46"E	26°37'39.78"N	92°40'2.34"E	1200 m	Settlement, Agriculture Land
3	Rangchali Dalani	1340 m	Biswanath	T3	26°46'35.78"N	93°21'59.68"E	26°46'23.76"N	93°21'25.69"E	1340 m	Agriculture Land, Tea Garden
4	Paken	1600 m		T4	26°47'56.66"N	93°38'3.28"E	26°47'42.43"N	93°37'33.18"E	1600 m	Agricultural land
5	Bonpuroi Jamuguri	1020 m	Lakhimpur	T5	26.857429°N	93.815014°E	26.850334°N	93.808962° E	1020 m	Agriculture, homestead
6	Bonpuroi Jamuguri	1150 m		T6	26.850334°N	93.808962° E	26.846926°N	93.799465° E	1150 m	Agriculture, homestead
7	Bonpuroi Jamuguri	260 m		T7	26.846926° N	93.799465° E	26.846504°N	93.797156°E	260 m	Agriculture, homestead
8	Bandana Check Bund to Matmara	4500 m		T8	27°14'22.03"N	94°33'10.83"E	27°12'23.68"N	94°31'51.32"E	1000m	Sandbar, Agriculture
9				T9	27°13'29.96"N	94°32'56.33"E	27°13'8.54"N	94°32'26.38"E	1000m	Sandbar, Agriculture
10				T10	27°13'1.39"N	94°32'21.79"E	27°12'33.93"N	94°32'1.95"E	1000m	Sandbar, Agriculture
11				Baligaon to Papung	3500 m	T11	27°12'24.32"N	94°31'50.33"E	27°12'3.70"N	94°31'22.42"E
12	T12	27°11'58.67"N	94°31'22.71"E			27°11'26.70"N	94°31'18.08"E	1000m	Sandbar, Agriculture	

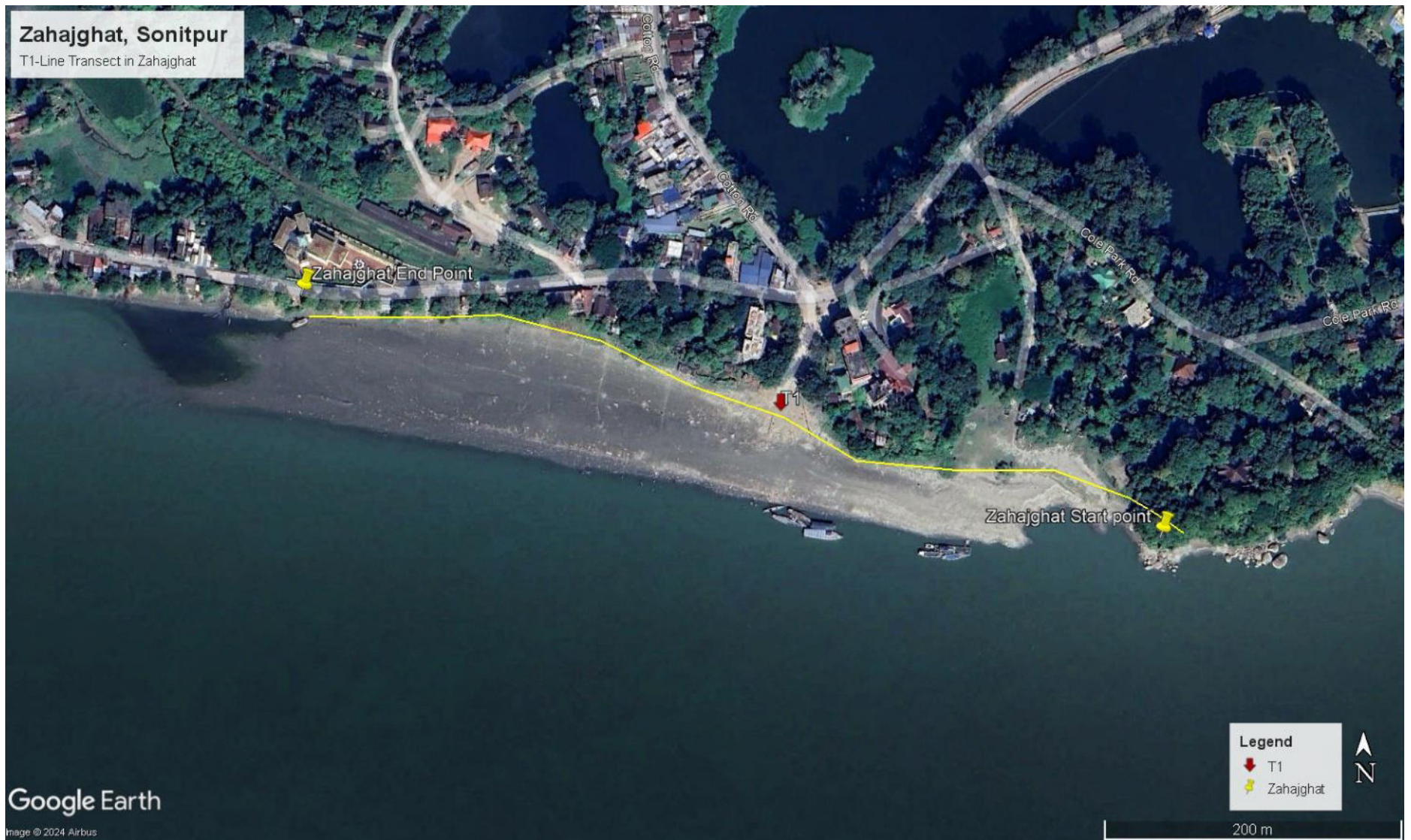


Figure 1: Map showing Location of Transect for Flora and Fauna Study in Zahaz Ghat



Figure 2: Map showing Location of Transect for Flora and Fauna Study in Jarani



Figure 3: Map showing Location of Transect for Flora and Fauna Study in Rangchali Dalani



Figure 4: Map showing Location of Transect for Flora and Fauna Study in Paken



Figure 5: Map showing Location of Transects for Flora and Fauna Study in Bonpuroi Jamuguri



Figure 6: Map showing Location of Transects for Flora and Fauna Study in Bandana Check Bund to Matmara



Figure 7: Map showing Location of Transects for Flora and Fauna Study in Baligaon to Papung

FLORA DIVERSITY OF STUDY AREA

As all the study sites are riverbanks and the surveys are done in the winter month with less water in the river, we found most of the core areas as sand bars and buffer zones as agricultural land with human settlement in the outer buffer zones. Core areas are mostly with very less plants. Some grass species like *Cyperus brevifolius*, *Cynodon dactylon*, *Eragrostis atrovirens*, *Oplismenus compositus* along with invasive herbs Gundhua Bon (*Chromolaena corymbosa*), Parthenium (*Parthenium hysterophorus*) and shrubs like Germany Bon (*Chromolaena odorata*), Pohukata Bon (*Lippia javanica*) are scattered over the core areas. Trees like Bhelkol or Bhelou (*Mallotus nudiflorus*) and Simolu (*Bombax ceiba*) along with Bogori (*Ziziphus mauritiana*) is found near core areas in some sites. Taking about the buffer zones, trees like Kathal (*Artocarpus heterophyllus*), Khakasa Dimoru (*Ficus hispida*), Aajar (*Lagerstroemia speciosa*), Pujar (*Ehretia acuminata*), Xualu (*Litsea monopetala*), Xoura (*Streblus aspera*) and Jamuk (*Syzygium cumini*) are common.

As a result of the documentation of the flora of the study areas, we found 110 plant species. 39 of them are trees, 26 numbers of plants are shrubs and 39 herbs which include cultivated, ornamental and few climbers. 2 bamboo species Bholuka baah (*Bambusa balcooa*), Jati Baah (*Bambusa tulda*) and one cane species Jati Bet (*Calamus tenuis*) were also found in the study areas. Along with them, we found 3 Banana species; namely Jahaji Kol (*Musa acuminata*), Aathia Kol (*Musa balbisiana*) and Kas Kol (*Musa × paradisiaca*).

Aegle marmelos, *Albizia chinensis*, *Alstonia scholaris*, *Areca catechu*, *Artocarpus heterophyllus*, *Averrhoa carambola*, *Bischofia javanica*, *Bombax ceiba*, *Carica papaya*, *Cocos nucifera*, *Corymbia maculate*, *Delonix regia*, *Ehretia acuminata*, *Erythrina variegata*, *Ficus hispida*, *Ficus racemose*, *Ficus rumphii*, *Heteropanax fragrans*, *Lagerstroemia speciosa*, *Litsea monopetala*, *Mallotus nudiflorus*, *Mallotus tetracoccus*, *Mangifera indica*, *Melia azedarach*, *Moringa oleifera*, *Neolamarckia cadamba*, *Oroxylum indicum*, *Peltophorum pterocarpum*, *Phyllanthus emblica*, *Pongamia pinnata*, *Psidium guajava*, *Spondias pinnata*, *Streblus asper*, *Syzygium cumini*, *Tamarindus indica*, *Terminalia arjuna*, *Terminalia chebula*, *Toona ciliate* and *Ziziphus mauritiana* are the 39 trees found in the present study. A list of all the trees found in the study sites according to the laid transects along with their density, frequency and abundance are given in Table 2.

Calotropis gigantean, *Camellia sinensis*, *Chromolaena odorata*, *Citrus maxima*, *Citrus × limon*, *Clerodendrum indicum*, *Clerodendrum infortunatum*, *Datura Metel*, *Glycosmis pentaphylla*, *Hibiscus mutabilis*, *Hibiscus × rosa-sinensis*, *Ipomoea carnea*, *Jatropha curcas*, *Lippia javanica*, *Mallotus roxburghianus*, *Malvaviscus arboreus*, *Ocimum americanum*, *Pandanus odorifer*, *Passiflora foetida*, *Ricinus communis*, *Sarcochlamys pulcherrima*, *Senna alata*, *Senna tora*, *Tabernaemontana divaricate*, *Tamarix dioica*, *Urena lobata* and *Xanthium strumarium* are the 26 shrubs found in the study sites. Among them, *Lippia javanica* (Pohukota Bon) was the most common shrub found in all the 7 study areas followed by *Tamarix dioica* (Jhau Bon), *Xanthium strumarium* (Agara Guti), *Ipomoea carnea* (Panibhutura or Bor Kolmou) and *Glycosmis pentaphylla* (Hengenapoka); which were present in 6 study areas. *Ricinus communis* (Era), *Chromolaena odorata* (Germany Bon), *Malvaviscus arboreus* (Ghanta Ful), *Senna alata* (Khar pat, Medelua) and *Urena lobata* (Hun Borolua) were other few common species across the study sites.

Among the herb species, we found both short and tall grasses, 1 ornamental species, 3 cultivated species, 1 fern and 4 climbers along with other herbs. Nol (*Arundo donax*), Birina (*Chrysopogon zizanioides*), Horon Kher (*Imperata cylindrica*), Khagari (*Phragmites karka*) and Ikora (*Tripidium ravennae*) were the tall grasses found in the study sites. *Cynodon dactylon*, *Cyperus brevifolius*, *Cyperus iria*, *Cyperus rotundus*, *Eleusine indica*, *Eragrostis atrovirens* and *Oplismenus compositus* were the short grasses present in all the study sites. Among these *Cynodon dactylon*, *Cyperus brevifolius*, *Cyperus rotundus* and *Oplismenus compositus* were present in all the study areas. *Thelypteris parasitica* commonly called as Bih dhekia was the only fern found in the study and was present in all the study areas. *Cuscuta reflexa*, *Ficus heterophylla*, *Ipomoea quamoclit*, *Piper thomsonii* and *Mikania micrantha* were the climbers found in the study sites. *Mikania micrantha* commonly called as Amor lota was present in all the study areas. Rongalau (*Cucurbita maxima*), Halodhi (*Curcuma longa*) and Til (*Sesamum indicum*) are the cultivated crop plants found in the study area. Nargi Ful (*Tagetes erecta*) was the only ornamental herb from the study sites. One aeroid Kolakosu (*Colocasia esculenta*) was present in all the study sites. Same way, *Chromolaena corymbosa* locally called as Gundhua Bon is an invasive herb which was present in all the study sites. *Lemna perpusilla* and *Pontederia crassipes* were two aquatic plants found in the study sites which we listed along with the herbs. Other herb species found in the study areas were *Achyranthes*

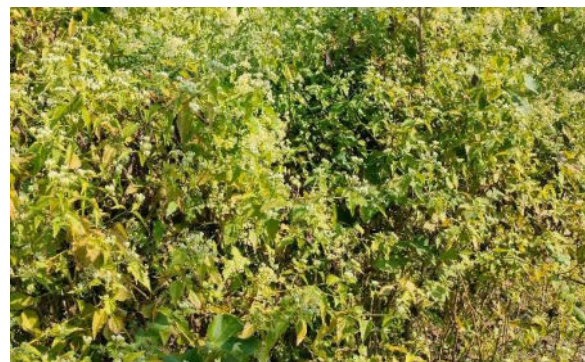
aspera, *Amaranthus spinosus*, *Cleome viscosa*, *Euphorbia hirta*, , *Leucas zeylanica*, *Nicotiana plumbaginifolia*, *Parthenium hysterophorus*, *Persicaria barbata*, *Persicaria hydropiper*, *Physalis angulate*, *Portulaca oleracea*, *Scoparia dulcis* and *Solanum lasiocarpum*. Among these, *Leucas zeylanica* was present in all the study areas.

Invasive Plant Species

In the present survey, we found different invasive species from all the study sites. All the invasive species were herbs including climbers and shrubs. No tree invasive species were found. The shrub non-native species reported from the study area are Panibhutura (*Ipomoea carnea*), Germany Bon (*Chromolaena odorata*) and Pohukata Bon (*Lippia javanica*). All the three species are common throughout the study sites. Sameway, two herbs; namely Gundhua Bon (*Chromolaena corymbosa*) and Parthenium (*Parthenium hysterophorus*) are the invasive species common in most of the study sites. In some study sites, we found Amar Lota (*Mikania micrantha*), which is a climber and very invasive in nature. Some greases found in the project sites including Xoron Kher (*Imperata cylindrica*) are also non-native. Water Hyacinth or Meteka (*Pontederia crassipes*), the most common aquatic plant of Assam in the present day is also a non-native plant and we found it in some study sites.



Parthenium (*Parthenium hysterophorus*)



Germany Bon (*Chromolaena odorata*)

Aquatic plants

We found a very few aquatic plants in the study sites. Because of the present survey is done in the dry season, most of the temporary water bodies near the study sites were dried up. Also, there is water current in the Brahmaputra River. Meteka (*Pontederia crassipes*) and Horu-Puni (*Lemna perpusilla*) were reported from some sites along with two *Persicaria* species; *Persicaria barbata* and *Portulaca oleracea*. Some terrestrial plants which also shows semi aquatic nature are listed with the terrestrial plants.

Sandbars and Sandy Riverbeds vegetative Cover

Main core areas of our study were sandbar areas. Because of the winter season, the areas are almost dry areas. Some grasses like Dubori Bon (*Cynodon dactylon*), Keya Bon (*Cyperus brevifolius*), Mutha Bon (*Cyperus rotundus*) and Bahpotia Bon (*Oplismenus compositus*) were present in the sandbars. Two invasive plants; Parthenium (*Parthenium hysterophorus*) and Pohukata Bon (*Lippia javanica*) were also present in some areas. Jhau Bon (*Tamarix dioica*), a shrub common in the riverbeds were also present in some areas.



Sesamum indicum



Oroxylum indicum

Table 2: Distribution of trees in different study sites

S. N.	Species Name	IUCN Category	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	Total no. of Individuals	Frequency	Density	Abundance
1	<i>Aegle marmelos</i> (L.) Corrêa	LC						2							2	8.33	0.17	2.00
2	<i>Albizia chinensis</i> (Osbeck) Merr.	LC			12										12	8.33	1.00	12.00
3	<i>Alstonia scholaris</i> (L.) R.Br.	LC		6						1					7	16.67	0.58	3.50
4	<i>Areca catechu</i> L.	LC		12	7	15	21	18	8	2			3	5	91	75.00	7.58	10.11
5	<i>Artocarpus heterophyllus</i> Lam.	LC	2		4	3		3		2	3		2	2	21	66.67	1.75	2.63
6	<i>Averrhoa carambola</i> L.	LC					1								1	8.33	0.08	1.00
7	<i>Bischofia javanica</i> Blume	LC								2			2		4	16.67	0.33	2.00
8	<i>Bombax ceiba</i> L.	LC	3	11	20	14	8	7	2	14	13	4	10	14	120	100.00	10.00	10.00
9	<i>Carica papaya</i> L.	NE		4	8	10		3	1		2				28	50.00	2.33	4.67
10	<i>Cocos nucifera</i> L.	NE	1		2	2	2	3							10	41.67	0.83	2.00
11	<i>Corymbia maculate</i> (Hook.) K.D.Hill and L.A.S.Johnson	NE	1												1	8.33	0.08	1.00
12	<i>Delonix regia</i> (Bojer ex Hook.) Raf.	NE	2	2											4	16.67	0.33	2.00
13	<i>Ehretia acuminata</i> R.Br.	NE		6	7					8	5		5	4	35	50.00	2.92	5.83
14	<i>Erythrina variegata</i> L.	NE	2	1	2										5	25.00	0.42	1.67
15	<i>Ficus hispida</i> L.f.	LC	1		4	3	2						2	7	19	50.00	1.58	3.17
16	<i>Ficus racemosa</i> L.	LC				2				2	3		4	2	13	41.67	1.08	2.60
17	<i>Ficus rumphii</i> Blume	NE	2		2		1								5	25.00	0.42	1.67
18	<i>Heteropanax fragrans</i> (Roxb.) Seem.	LC		6											6	8.33	0.50	6.00
19	<i>Lagerstroemia speciosa</i> (L.) Pers.	LC	3	8	8	7	8	6	2				5	4	51	75.00	4.25	5.67
20	<i>Litsea monopetala</i> (Roxb.) Pers.	NE		3	2	13		3	5	5					31	50.00	2.58	5.17

S. N.	Species Name	IUCN Category	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	Total no. of Individuals	Frequency	Density	Abundance
21	<i>Mallotus nudiflorus</i> (L.) Kulju and Welzen	NE	5	15	7	18	8	13	11	11	9	20	8	12	137	100.00	11.42	11.42
22	<i>Mallotus tetracoccus</i> (Roxb.) Kurz	NE		4				3							7	16.67	0.58	3.50
23	<i>Mangifera indica</i> L.	LC		2	5		3	4						1	15	41.67	1.25	3.00
24	<i>Melia azedarach</i> L.	LC							1				2		3	16.67	0.25	1.50
25	<i>Moringa oleifera</i> Lam.	LC		10											10	8.33	0.83	10.00
26	<i>Neolamarckia cadamba</i> (Roxb.) Bosser	LC					3	1							4	16.67	0.33	2.00
27	<i>Oroxylum indicum</i> (L.) Kurz	LC		3											3	8.33	0.25	3.00
28	<i>Peltophorum pterocarpum</i> (DC.) Backer ex K. Heyne	LC	2												2	8.33	0.17	2.00
29	<i>Phyllanthus emblica</i> L.	LC			1										1	8.33	0.08	1.00
30	<i>Pongamia pinnata</i> (L.) Pierre	LC	5												5	8.33	0.42	5.00
31	<i>Psidium guajava</i> L.	LC		5			2	1							8	25.00	0.67	2.67
32	<i>Spondias pinnata</i> (L.f.) Kurz	LC			4										4	8.33	0.33	4.00
33	<i>Streblus asper</i> Lour.	NE		9	3	4		3		6	7		5	7	44	66.67	3.67	5.50
34	<i>Syzygium cumini</i> (L.) Skeels	LC	2	2	3		2			2			3	1	15	58.33	1.25	2.14
35	<i>Tamarindus indica</i> L.	LC									1				1	8.33	0.08	1.00
36	<i>Terminalia arjuna</i> (Roxb. ex DC.) Wight and Arn.	LC	1							2					3	8.33	0.25	3.00
37	<i>Terminalia chebula</i> Retz.	LC			6										6	8.33	0.50	6.00
38	<i>Toona ciliata</i> M. Roem.	LC	1	4	2					2			3	4	16	50.00	1.33	2.67
39	<i>Ziziphus mauritiana</i> Lam.	LC	4	8	3	9		3	5	15	12	1	4	7	71	91.67	5.92	6.45

Table 3: Study sites with total no. of plants

Sl. No.	Study Sites	Total No. of Trees	Total No. of Shrubs	Total No. of herbs
1	Zahaz Ghat	16	8	14
2	Jarani	21	18	21
3	Rangchali Dalani	21	14	23
4	Paken	12	7	17
5	Bonpuroi Jamuguri	19	11	20
6	Bandana Check Bund to Matmara	17	13	21
7	Baligaon to Papung	17	14	20

The vegetation assessment of the study areas revealed a diverse array of plant species including trees, shrubs and herbs. Some bamboo and banana species were also documented. Predominantly native, these plants thrive in the Brahmaputra floodplains, supporting soil stability, local fauna habitats, and ecosystem resilience. The vegetation primarily supports the agricultural and ecological systems by stabilizing the soil. None of the species are listed as threatened or endangered by the IUCN or other conservation bodies, indicating their adaptability to regional environmental changes. Hence, they do not require immediate conservation interventions or protective measures. Their prevalence reflects the adaptability of the region's flora to anthropogenic and natural environmental changes. However, sustainable management of these resources is essential to maintain their ecological roles. Awareness programs on the significance of native plants, coupled with sustainable land-use practices, can help in preserving this diversity. Additionally, periodic monitoring can ensure the continued health of these plant populations while identifying any emerging threats that might necessitate conservation action in the future.

Though the study sites almost show similar kind of vegetation (all are Brahmaputra riverbanks). But the sites are located in far distances from each other. Only exception is the 3 sites of Bonpuroi Jamuguri, which are adjacent to each other. So, lists of plants documented in each study area are given below separately for better understanding (Table 4 to 10).

Study Site - Zahaighat

Table 4: List of plants in Zahajghat Area

Tree species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Arecaceae	<i>Cocos nucifera</i> L.	Coconut	Narikol
2	Combretaceae	<i>Terminalia arjuna</i> (Roxb. ex DC.) Wight and Arn.	Arjuna	Arjun
3	Euphorbiaceae	<i>Mallotus nudiflorus</i> (L.) Kulju and Welzen	False White Teak	Bhelkol, Bheleu
4	Fabaceae	<i>Delonix regia</i> (Bojer ex Hook.) Raf.	Peacock flower	Krishnachura
5	Fabaceae	<i>Erythrina variegata</i> L.	Indian Coral Tree	Madar
6	Fabaceae	<i>Peltophorum pterocarpum</i> (DC.) Backer ex K.Heyne	Yellow Flametree	
7	Fabaceae	<i>Pongamia pinnata</i> (L.) Pierre	Indian Beech Tree	Korosh
8	Lythraceae	<i>Lagerstroemia speciosa</i> (L.) Pers.	Pride of India	Aajar
9	Malvaceae	<i>Bombax ceiba</i> L.	Silk Cotton Tree	Himolu
10	Meliaceae	<i>Toona ciliata</i> M.Roem.	Indian Mahogany	Poma
11	Moraceae	<i>Artocarpus heterophyllus</i> Lam.	Jackfruit	Kathal
12	Moraceae	<i>Ficus rumphii</i> Blume	Rumph's Fig	Jori
13	Moraceae	<i>Ficus hispida</i> L.f.	Opposite Leaf Fig	Khaksa- Dimoru
14	Myrtaceae	<i>Corymbia maculata</i> (Hook.) K.D.Hill and L.A.S.Johnson	Eucalyptus	Eucalyptus
15	Myrtaceae	<i>Syzygium cumini</i> (L.) Skeels	Jamun, Black Plum	Jamuk
16	Rhamnaceae	<i>Ziziphus mauritiana</i> Lam.	Indian Jujube	Bogori

Shrub species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Asteraceae	<i>Chromolaena odorata</i> (L.) R.M.King and H.Rob.	Siam weed, Rouge plant	Germany Bon
2	Asteraceae	<i>Xanthium strumarium</i> L.	rough cocklebur	Agara Guti
3	Convolvulaceae	<i>Ipomoea carnea</i> Jacq.	Bush Ipomea	Panibhutura, Bor Kolmou
4	Euphorbiaceae	<i>Ricinus communis</i> L.	Castor Oil Plant	Era
5	Lamiaceae	<i>Clerodendrum indicum</i> (L.) Kuntze	Tuber flower	Okalbih
6	Malvaceae	<i>Malvaviscus arboreus</i> Dill. ex Cav.	Sleeping Hibiscus	Ghanta Ful
7	Rutaceae	<i>Glycosmis pentaphylla</i> (Retz.) DC.	Gin Berry	Hengenapoka
8	Verbenaceae	<i>Lippia javanica</i> (Burm.f.) Spreng.	Fever Tea, Lemon Bush	Pohukota Bon

Herb Species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Amaranthaceae	<i>Amaranthus spinosus</i> L.	Spiny Amaranth	Hati-Khutora
2	Araceae	<i>Colocasia esculenta</i> (L.) Schott	Taro	Kolakosu
3	Aspleniaceae	<i>Thelypteris parasitica</i> (L.) Tardieu		Bihdhekia
4	Asteraceae	<i>Chromolaena corymbosa</i> (Aubl.) R.M.King and H.Rob.	Billygoat Weed	Gundhua Bon
5	Asteraceae	<i>Mikania micrantha</i> Kunth	Chinese Creeper, American Rope	Amor Lota
6	Asteraceae	<i>Parthenium hysterophorus</i> L.	Congress Grass	Parthenium
7	Convolvulaceae	<i>Ipomoea quamoclit</i> L.	Cypress Vine	
8	Cyperaceae	<i>Cyperus brevifolius</i> (Rottb.) Hassk.	Shortleaf Spike Sedge	Keya Bon
9	Cyperaceae	<i>Cyperus rotundus</i> L.	Nut Grass	Mutha Bon
10	Lamiaceae	<i>Leucas zeylanica</i> (L.) W.T.Aiton	Ceylon Slitwort	Durun Bon
11	Moraceae	<i>Ficus heterophylla</i> L.f.	Creeping Fig	Kanai- Dimoru
12	Plantaginaceae	<i>Scoparia dulcis</i> L.	Sweet broom	Seni Bon
13	Poaceae	<i>Cynodon dactylon</i> (L.) Pers.	Bermuda Grass	Dubori Bon
14	Poaceae	<i>Oplismenus compositus</i> (L.) P.Beauv.	Running Mountain Grass	Bahpotia Bon

Bamboo and Cane Species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Poaceae	<i>Bambusa tulda</i> Roxb.	Indian Timber Bamboo	Jati Baah

Banana Species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Musaceae	<i>Musa balbisiana</i> Colla		Aathia Kol

Study Site - Jarani

Table 5: List of plants in Jarani Area

Tree species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Anacardiaceae	<i>Mangifera indica</i> L.	Mango	Aam
2	Apocynaceae	<i>Alstonia scholaris</i> (L.) R.Br.	devil's tree	Sotiona
3	Araliaceae	<i>Heteropanax fragrans</i> (Roxb.) Seem.		Keseru
4	Arecaceae	<i>Areca catechu</i> L.	Areca Nut Palm	Tamul
5	Arecaceae	<i>Cocos nucifera</i> L.	Coconut	Narikol
6	Bignoniaceae	<i>Oroxylum indicum</i> (L.) Kurz	Indian Trumpet Tree	Bhatghila

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
7	Boraginaceae	<i>Ehretia acuminata</i> R.Br.		Poojar
8	Caricaceae	<i>Carica papaya</i> L.	Papaya	Amita
9	Euphorbiaceae	<i>Mallotus nudiflorus</i> (L.) Kulju and Welzen	False White Teak	Bhelkol, Bheleu
10	Euphorbiaceae	<i>Mallotus tetracoccus</i> (Roxb.) Kurz	Rusty Kamala	Larubandha
11	Fabaceae	<i>Delonix regia</i> (Bojer ex Hook.) Raf.	Peacock flower	Krishnachura
12	Fabaceae	<i>Erythrina variegata</i> L.	Indian Coral Tree	Madar
13	Lauraceae	<i>Litsea monopetala</i> (Roxb.) Pers.		Xualu
14	Lythraceae	<i>Lagerstroemia speciosa</i> (L.) Pers.	Pride of India	Aajar
15	Malvaceae	<i>Bombax ceiba</i> L.	Silk Cotton Tree	Himolu
16	Meliaceae	<i>Toona ciliata</i> M.Roem.	Indian Mahogany	Poma
17	Moraceae	<i>Streblus asper</i> Lour.	Toothbrush tree	Xoura
18	Moringaceae	<i>Moringa oleifera</i> Lam.	Drumstick tree	Sajina
19	Rhamnaceae	<i>Ziziphus mauritiana</i> Lam.	Indian Jujube	Bogori
20	Myrtaceae	<i>Psidium guajava</i> L.	Guava	Modhuri
21	Myrtaceae	<i>Syzygium cumini</i> (L.) Skeels	Jamun, Black Plum	Jamuk

Shrub species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Apocynaceae	<i>Calotropis gigantea</i> (L.) W.T.Aiton		Aakon
2	Asteraceae	<i>Chromolaena odorata</i> (L.) R.M.King and H.Rob.	Siam weed, Rouge plant	Germany Bon
3	Asteraceae	<i>Xanthium strumarium</i> L.	rough cocklebur	Agara_Guti
4	Convolvulaceae	<i>Ipomoea carnea</i> Jacq.	Bush Ipomea	Panibhutura, Bor Kolmou
5	Euphorbiaceae	<i>Jatropha curcas</i> L.	Physic Nut	Bhut Era
6	Euphorbiaceae	<i>Mallotus roxburghianus</i> Müll.Arg.		
7	Euphorbiaceae	<i>Ricinus communis</i> L.	Castor Oil Plant	Era
8	Fabaceae	<i>Senna alata</i> (L.) Roxb.	Ringworm shrub	Medelua, Khar paat
9	Fabaceae	<i>Senna tora</i> (L.) Roxb.		Medelua
10	Lamiaceae	<i>Clerodendrum indicum</i> (L.) Kuntze	Tuber flower	Okalbih
11	Lamiaceae	<i>Clerodendrum infortunatum</i> L.	Hill Glory Bower	Dhapat tita
12	Malvaceae	<i>Hibiscus × rosa-sinensis</i> L.		Joba
13	Malvaceae	<i>Malvaviscus arboreus</i> Dill. ex Cav.	Sleeping Hibiscus	Ghanta Ful
14	Passifloraceae	<i>Passiflora foetida</i> L.	Stinking Passionflower	
15	Rutaceae	<i>Glycosmis pentaphylla</i> (Retz.) DC.	Gin Berry	Hengenapoka
16	Solanaceae	<i>Datura Metel</i> L.	Devil's Trumpet	Dhatura
17	Tamaricaceae	<i>Tamarix dioica</i> Roxb. ex Roth		Jhau Bon
18	Verbenaceae	<i>Lippia javanica</i> (Burm.f.) Spreng.	Fever Tea, Lemon Bush	Pohukota Bon

Herb Species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Amaranthaceae	<i>Amaranthus spinosus</i> L.	Spiny Amaranth	Hati-Khutora
2	Araceae	<i>Colocasia esculenta</i> (L.) Schott	Taro	Kolakosu
3	Aspleniaceae	<i>Thelypteris parasitica</i> (L.) Tardieu		Bihdhekia
4	Asteraceae	<i>Chromolaena corymbosa</i> (Aubl.) R.M.King and H.Rob.	Billygoat Weed	Gundhua Bon
5	Asteraceae	<i>Mikania micrantha</i> Kunth	Chinese Creeper, American Rope	Amor Lota

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
6	Asteraceae	<i>Parthenium hysterophorus</i> L.	Congress Grass	Parthenium
7	Asteraceae	<i>Tagetes erecta</i> L.	Marigold	Narji Ful
8	Cyperaceae	<i>Cyperus brevifolius</i> (Rottb.) Hassk.	Shortleaf Spike Sedge	Keya Bon
9	Cyperaceae	<i>Cyperus rotundus</i> L.	Nut Grass	Mutha Bon
10	Euphorbiaceae	<i>Euphorbia hirta</i> L.	Asthma-plant	Gakhiroti Bon
11	Lamiaceae	<i>Leucas zeylanica</i> (L.) W.T.Aiton	Ceylon Slitwort	Durun Bon
12	Moraceae	<i>Ficus heterophylla</i> L.f.	Creeping Fig	Kanai- Dimoru
13	Poaceae	<i>Arundo donax</i> L.	Giant Reed	Nol
14	Poaceae	<i>Chrysopogon zizanioides</i> (L.) Roberty	Vetiver	Birina
15	Poaceae	<i>Cynodon dactylon</i> (L.) Pers.	Bermuda Grass	Dubori Bon
16	Poaceae	<i>Eleusine indica</i> (L.) Gaertn.	Yard-Grass	Bobosa Bon
17	Poaceae	<i>Oplismenus compositus</i> (L.) P.Beauv.	Running Mountain Grass	Bahpotia Bon
18	Polygonaceae	<i>Persicaria hydropiper</i> (L.) Delarbre	Water Pepper	Biholongoni
19	Pontederiaceae	<i>Pontederia crassipes</i> Mart.	Water Hyacinth	Meteka
20	Portulacaceae	<i>Portulaca oleracea</i> L.	Common Purslane	Malbhug Khutura
21	Solanaceae	<i>Nicotiana plumbaginifolia</i> Viv.	Tex-Mex Tobacco	Ululai

Bamboo and Cane Species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Poaceae	<i>Bambusa tulda</i> Roxb.	Indian Timber Bamboo	Jati Baah

Banana Species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Musaceae	<i>Musa acuminata</i> Colla		Jahaji Kol
2	Musaceae	<i>Musa balbisiana</i> Colla		Aathia Kol
3	Musaceae	<i>Musa × paradisiaca</i> L.		Kas Kol

Study Site - Rangchali Dalani

Table 6: List of plants in Rangchali Dalani

Tree species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Anacardiaceae	<i>Mangifera indica</i> L.	Mango	Aam
2	Anacardiaceae	<i>Spondias pinnata</i> (L.f.) Kurz	Hog Plum	Amara
3	Arecaceae	<i>Areca catechu</i> L.	Areca Nut Palm	Tamul
4	Arecaceae	<i>Cocos nucifera</i> L.	Coconut	Narikol
5	Boraginaceae	<i>Ehretia acuminata</i> R.Br.		Poojar
6	Caricaceae	<i>Carica papaya</i> L.	Papaya	Amita
7	Combretaceae	<i>Terminalia chebula</i> Retz.	Chebulic myrobala	Hilikha
8	Euphorbiaceae	<i>Mallotus nudiflorus</i> (L.) Kulju and Welzen	False White Teak	Bhelkol, Bheleu
9	Fabaceae	<i>Albizia chinensis</i> (Osbeck) Merr.	Chinese Albizia	Chau Koroi, Sirish
10	Fabaceae	<i>Erythrina variegata</i> L.	Indian Coral Tree	Madar
11	Lauraceae	<i>Litsea monopetala</i> (Roxb.) Pers.		Xualu
12	Lythraceae	<i>Lagerstroemia speciosa</i> (L.) Pers.	Pride of India	Aajar
13	Malvaceae	<i>Bombax ceiba</i> L.	Silk Cotton Tree	Himolu
14	Meliaceae	<i>Toona ciliata</i> M.Roem.	Indian Mahogany	Poma
15	Moraceae	<i>Artocarpus heterophyllus</i> Lam.	Jackfruit	Kathal
16	Moraceae	<i>Ficus rumphii</i> Blume	Rumph's Fig	Jori

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
17	Moraceae	<i>Ficus hispida</i> L.f.	Opposite Leaf Fig	Khaksa- Dimoru
18	Moraceae	<i>Streblus asper</i> Lour.	Toothbrush tree	Xoura
19	Myrtaceae	<i>Syzygium cumini</i> (L.) Skeels	Jamun, Black Plum	Jamuk
20	Phyllanthaceae	<i>Phyllanthus emblica</i> L.	Indian Gooseberry	Aamlokhi
21	Rhamnaceae	<i>Ziziphus mauritiana</i> Lam.	Indian Jujube	Bogori

Shrub species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Apocynaceae	<i>Tabernaemontana divaricata</i> (L.) R.Br. ex Roem. and Schult.	East India rosebay	Kathanda
2	Asteraceae	<i>Xanthium strumarium</i> L.	rough cocklebur	Agara Guti
3	Convolvulaceae	<i>Ipomoea carnea</i> Jacq.	Bush Ipomea	Panibhutura, Bor Kolmou
4	Euphorbiaceae	<i>Jatropha curcas</i> L.	Physic Nut	Bhut Era
5	Euphorbiaceae	<i>Ricinus communis</i> L.	Castor Oil Plant	Era
6	Fabaceae	<i>Senna alata</i> (L.) Roxb.	Ringworm shrub	Medelua, Khar paat
7	Malvaceae	<i>Malvaviscus arboreus</i> Dill. ex Cav.	Sleeping Hibiscus	Ghanta Ful
8	Malvaceae	<i>Urena lobata</i> L.	Caesarweed	Hun Borolua
9	Pandanaceae	<i>Pandanus odorifer</i> (Forssk.) Kuntze	Fragrant Screw-Pine	Keteki Ful
10	Rutaceae	<i>Citrus maxima</i> (Burm.) Merr.	Pomelo	Bor Tenga
11	Rutaceae	<i>Glycosmis pentaphylla</i> (Retz.) DC.	Gin Berry	Hengenapoka
12	Tamaricaceae	<i>Tamarix dioica</i> Roxb. ex Roth		Jhau Bon
13	Theaceae	<i>Camellia sinensis</i> (L.) Kuntze	Tea Plant	Saah Gos
14	Verbenaceae	<i>Lippia javanica</i> (Burm.f.) Spreng.	Fever Tea, Lemon Bush	Pohukota Bon

Herb Species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Amaranthaceae	<i>Achyranthes aspera</i> L.	Chaff-flower	Uvota Xoth
2	Araceae	<i>Colocasia esculenta</i> (L.) Schott	Taro	Kolakosu
3	Aspleniaceae	<i>Thelypteris parasitica</i> (L.) Tardieu		Bihdhekia
4	Asteraceae	<i>Chromolaena corymbosa</i> (Aubl.) R.M.King and H.Rob.	Billygoat Weed	Gundhua Bon
5	Asteraceae	<i>Mikania micrantha</i> Kunth	Chinese Creeper, American Rope	Amor Lota
6	Convolvulaceae	<i>Cuscuta reflexa</i> Roxb.	Giant Dodder	Aakakhi Lota
7	Cucurbitaceae	<i>Cucurbita maxima</i> Duchesne	Pumpkin	Rongalau
8	Cyperaceae	<i>Cyperus brevifolius</i> (Rottb.) Hassk.	Shortleaf Spike Sedge	Keya Bon
9	Cyperaceae	<i>Cyperus iria</i> L.	Rice Flat Sedge	Mutha Bon
10	Cyperaceae	<i>Cyperus rotundus</i> L.	Nut Grass	Mutha Bon
11	Lamiaceae	<i>Leucas zeylanica</i> (L.) W.T.Aiton	Ceylon Slitwort	Durun Bon
12	Euphorbiaceae	<i>Euphorbia hirta</i> L.	Asthma-plant	Gakhiroti Bon
13	Piperaceae	<i>Piper thomsonii</i> (C.DC.) Hook.f.		Aauni Paan
14	Plantaginaceae	<i>Scoparia dulcis</i> L.	Sweet broom	Seni Bon
15	Poaceae	<i>Arundo donax</i> L.	Giant Reed	Nol
16	Poaceae	<i>Cynodon dactylon</i> (L.) Pers.	Bermuda Grass	Dubori Bon
17	Poaceae	<i>Eleusine indica</i> (L.) Gaertn.	Yard-Grass	Bobosa Bon
18	Poaceae	<i>Oplismenus compositus</i> (L.) P.Beauv.	Running Mountain Grass	Bahpotia Bon

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
19	Poaceae	<i>Phragmites karka</i> (Retz.) Trin. ex Steud.		Khagari
20	Polygonaceae	<i>Persicaria hydropiper</i> (L.) Delarbre	Water Pepper	Biholongoni
21	Pontederiaceae	<i>Pontederia crassipes</i> Mart.	Water Hyacinth	Meteka
22	Portulacaceae	<i>Portulaca oleracea</i> L.	Common Purslane	Malbhug Khutura
23	Solanaceae	<i>Solanum lasiocarpum</i> Dunal		Tita Bhekuri

Bamboo and Cane Species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Arecaceae	<i>Calamus tenuis</i> Roxb.	Ratten	Jati Bet
2	Poaceae	<i>Bambusa balcooa</i> Roxb.		Bholuka Baah
3	Poaceae	<i>Bambusa tulda</i> Roxb.	Indian Timber Bamboo	Jati Baah

Banana Species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Musaceae	<i>Musa acuminata</i> Colla		Jahaji Kol
2	Musaceae	<i>Musa balbisiana</i> Colla		Aathia Kol
3	Musaceae	<i>Musa × paradisiaca</i> L.		Kas Kol

Study Site - Paken

Table 7: List of plants in Paken

Tree species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Arecaceae	<i>Areca catechu</i> L.	Areca Nut Palm	Tamul
2	Arecaceae	<i>Cocos nucifera</i> L.	Coconut	Narikol
3	Caricaceae	<i>Carica papaya</i> L.	Papaya	Amita
4	Euphorbiaceae	<i>Mallotus nudiflorus</i> (L.) Kulju and Welzen	False White Teak	Bhelkol, Bheleu
5	Lauraceae	<i>Litsea monopetala</i> (Roxb.) Pers.		Xualu
6	Lythraceae	<i>Lagerstroemia speciosa</i> (L.) Pers.	Pride of India	Aajar
7	Malvaceae	<i>Bombax ceiba</i> L.	Silk Cotton Tree	Himolu
8	Moraceae	<i>Artocarpus heterophyllus</i> Lam.	Jackfruit	Kathal
9	Moraceae	<i>Ficus hispida</i> L.f.	Opposite Leaf Fig	Khaksa- Dimoru
10	Moraceae	<i>Ficus racemosa</i> L.	Cluster Fig	Jogyo- Dimoru
11	Moraceae	<i>Streblus asper</i> Lour.	Toothbrush tree	Xoura
12	Rhamnaceae	<i>Ziziphus mauritiana</i> Lam.	Indian Jujube	Bogori

Shrub species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Asteraceae	<i>Xanthium strumarium</i> L.	rough cocklebur	Agara Guti
2	Convolvulaceae	<i>Ipomoea carnea</i> Jacq.	Bush Ipomea	Panibhutura, Bor Kolmou
3	Malvaceae	<i>Urena lobata</i> L.	Caesarweed	Hun Borolua
4	Rutaceae	<i>Glycosmis pentaphylla</i> (Retz.) DC.	Gin Berry	Hengenapoka
5	Solanaceae	<i>Datura Metel</i> L.	Devil's Trumpet	Dhatura
6	Tamaricaceae	<i>Tamarix dioica</i> Roxb. ex Roth		Jhau Bon

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
7	Verbenaceae	<i>Lippia javanica</i> (Burm.f.) Spreng.	Fever Tea, Lemon Bush	Pohukota Bon

Herb Species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Amaranthaceae	<i>Amaranthus spinosus</i> L.	Spiny Amaranth	Hati-Khutora
2	Araceae	<i>Colocasia esculenta</i> (L.) Schott	Taro	Kolakosu
3	Aspleniaceae	<i>Thelypteris parasitica</i> (L.) Tardieu		Bihdhekia
4				
5	Asteraceae	<i>Chromolaena corymbosa</i> (Aubl.) R.M.King and H.Rob.	Billygoat Weed	Gundhua Bon
6	Asteraceae	<i>Mikania micrantha</i> Kunth	Chinese Creeper, American Rope	Amor Lota
7	Asteraceae	<i>Parthenium hysterophorus</i> L.	Congress Grass	Parthenium
8	Cyperaceae	<i>Cyperus brevifolius</i> (Rottb.) Hassk.	Shortleaf Spike Sedge	Keya Bon
9	Cyperaceae	<i>Cyperus iria</i> L.	Rice Flat Sedge	Mutha Bon
10	Cyperaceae	<i>Cyperus rotundus</i> L.	Nut Grass	Mutha Bon
11	Lamiaceae	<i>Leucas zeylanica</i> (L.) W.T.Aiton	Ceylon Slitwort	Durun Bon
12	Pedaliaceae	<i>Sesamum indicum</i> L.	Sesame	Til
13	Poaceae	<i>Cynodon dactylon</i> (L.) Pers.	Bermuda Grass	Dubori Bon
14	Poaceae	<i>Eleusine indica</i> (L.) Gaertn.	Yard-Grass	Bobosa Bon
15	Poaceae	<i>Imperata cylindrica</i> (L.) Raeusch.	Cogongrass	Horon-Kher
16	Poaceae	<i>Oplismenus compositus</i> (L.) P.Beauv.	Running Mountain Grass	Bahpotia Bon
17	Pontederiaceae	<i>Pontederia crassipes</i> Mart.	Water Hyacinth	Meteka

Bamboo and Cane Species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Poaceae	<i>Bambusa balcooa</i> Roxb.		Bholuka Baah
2	Poaceae	<i>Bambusa tulda</i> Roxb.	Indian Timber Bamboo	Jati Baah

Banana Species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Musaceae	<i>Musa acuminata</i> Colla		Jahaji Kol
2	Musaceae	<i>Musa balbisiana</i> Colla		Aathia Kol
3	Musaceae	<i>Musa × paradisiaca</i> L.		Kas Kol

Study Site - Bonpuroi Jamuguri

Table 8: List of plants in Bonpuroi Jamuguri

Tree species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Anacardiaceae	<i>Mangifera indica</i> L.	Mango	Aam
2	Arecaceae	<i>Areca catechu</i> L.	Areca Nut Palm	Tamul
3	Arecaceae	<i>Cocos nucifera</i> L.	Coconut	Narikol
4	Caricaceae	<i>Carica papaya</i> L.	Papaya	Amita
5	Euphorbiaceae	<i>Mallotus nudiflorus</i> (L.) Kulju and Welzen	False White Teak	Bhelkol, Bheleu
6	Euphorbiaceae	<i>Mallotus tetracoccus</i> (Roxb.) Kurz	Rusty Kamala	Larubandha
7	Lauraceae	<i>Litsea monopetala</i> (Roxb.) Pers.		Xualu
8	Lythraceae	<i>Lagerstroemia speciosa</i> (L.) Pers.	Pride of India	Aajar
9	Malvaceae	<i>Bombax ceiba</i> L.	Silk Cotton Tree	Himolu

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
10	Moraceae	<i>Artocarpus heterophyllus</i> Lam.	Jackfruit	Kathal
11	Moraceae	<i>Ficus rumphii</i> Blume	Rumph's Fig	Jori
12	Moraceae	<i>Ficus hispida</i> L.f.	Opposite Leaf Fig	Khaksa- Dimoru
13	Moraceae	<i>Streblus asper</i> Lour.	Toothbrush tree	Xoura
14	Myrtaceae	<i>Psidium guajava</i> L.	Guava	Modhuri
15	Myrtaceae	<i>Syzygium cumini</i> (L.) Skeels	Jamun, Black Plum	Jamuk
16	Oxalidaceae	<i>Averrhoa carambola</i> L.	Star Fruit	Kordoi
17	Rhamnaceae	<i>Ziziphus mauritiana</i> Lam.	Indian Jujube	Bogori
18	Rubiaceae	<i>Neolamarckia cadamba</i> (Roxb.) Bosser	Burflower-tree, Cadamba	Kadam
19	Rutaceae	<i>Aegle marmelos</i> (L.) Corrêa	Wood Apple	Bel

Shrub species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Apocynaceae	<i>Tabernaemontana divaricata</i> (L.) R.Br. ex Roem. and Schult.	East India rosebay	Kathanda
2	Asteraceae	<i>Xanthium strumarium</i> L.	Rough cocklebur	Agara_Guti
3	Convolvulaceae	<i>Ipomoea carnea</i> Jacq.	Bush Ipomea	Panibhutura, Bor Kolmou
4	Lamiaceae	<i>Clerodendrum indicum</i> (L.) Kuntze	Tuber flower	Okalbih
5	Lamiaceae	<i>Clerodendrum infortunatum</i> L.	Hill Glory Bower	Dhapat tita
6	Malvaceae	<i>Hibiscus × rosa-sinensis</i> L.		Joba
7	Malvaceae	<i>Malvaviscus arboreus</i> Dill. ex Cav.	Sleeping Hibiscus	Ghanta Ful
8	Malvaceae	<i>Urena lobata</i> L.	Caesarweed	Hun Borolua
9	Rutaceae	<i>Citrus × limon</i> (L.) Osbeck	Assam Lemon	Kaji Nemu
10	Tamaricaceae	<i>Tamarix dioica</i> Roxb. ex Roth		Jhau Bon
11	Verbenaceae	<i>Lippia javanica</i> (Burm.f.) Spreng.	Fever Tea, Lemon Bush	Pohukota Bon

Herb Species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Amaranthaceae	<i>Achyranthes aspera</i> L.	Chaff-flower	Uvota Xoth
2	Amaranthaceae	<i>Amaranthus spinosus</i> L.	Spiny Amaranth	Hati-Khutora
3	Araceae	<i>Colocasia esculenta</i> (L.) Schott	Taro	Kolakosu
4	Aspleniaceae	<i>Thelypteris parasitica</i> (L.) Tardieu		Bihdhekia
5	Asteraceae	<i>Chromolaena corymbosa</i> (Aubl.) R.M.King and H.Rob.	Billygoat Weed	Gundhua Bon
6	Asteraceae	<i>Mikania micrantha</i> Kunth	Chinese Creeper, American Rope	Amor Lota
7	Asteraceae	<i>Tagetes erecta</i> L.	Marigold	Narji Ful
8	Cleomaceae	<i>Cleome viscosa</i> L.	Asian Spider Flower	Aatharua
9	Cyperaceae	<i>Cyperus brevifolius</i> (Rottb.) Hassk.	Shortleaf Spike Sedge	Keya Bon
10	Cyperaceae	<i>Cyperus iria</i> L.	Rice Flat Sedge	Mutha Bon
11	Cyperaceae	<i>Cyperus rotundus</i> L.	Nut Grass	Mutha Bon
12	Euphorbiaceae	<i>Euphorbia hirta</i> L.	Asthma-plant	Gakhiroti Bon
13	Lamiaceae	<i>Leucas zeylanica</i> (L.) W.T.Aiton	Ceylon Slitwort	Durun Bon
14	Piperaceae	<i>Piper thomsonii</i> (C.DC.) Hook.f.		Aauni Paan
15	Plantaginaceae	<i>Scoparia dulcis</i> L.	Sweet broom	Seni Bon
16	Poaceae	<i>Cynodon dactylon</i> (L.) Pers.	Bermuda Grass	Dubori Bon
17	Poaceae	<i>Oplismenus compositus</i> (L.) P.Beauv.	Running Mountain Grass	Bahpotia Bon

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
18	Polygonaceae	<i>Persicaria hydropiper</i> (L.) Delarbre	Water Pepper	Biholongoni
19	Solanaceae	<i>Physalis angulata</i> L.	Native Gooseberry	Pokmou
20	Zingiberaceae	<i>Curcuma longa</i> L.	Turmeric	Halodhi

Bamboo and Cane Species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Arecaceae	<i>Calamus tenuis</i> Roxb.	Ratten	Jati Bet
2	Poaceae	<i>Bambusa balcooa</i> Roxb.		Bholuka Baah
3	Poaceae	<i>Bambusa tulda</i> Roxb.	Indian Timber Bamboo	Jati Baah

Banana Species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Musaceae	<i>Musa acuminata</i> Colla		Jahaji Kol
2	Musaceae	<i>Musa balbisiana</i> Colla		Aathia Kol
3	Musaceae	<i>Musa × paradisiaca</i> L.		Kas Kol

Study Site – Bandana Check Bund to Matmara

Table 9: List of plants in Bandana Check Bund to Matmara

Tree species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Apocynaceae	<i>Alstonia scholaris</i> (L.) R.Br.	devil's tree	Sotiona
2	Arecaceae	<i>Areca catechu</i> L.	Areca Nut Palm	Tamul
3	Boraginaceae	<i>Ehretia acuminata</i> R.Br.		Poojar
4	Caricaceae	<i>Carica papaya</i> L.	Papaya	Amita
5	Combretaceae	<i>Terminalia arjuna</i> (Roxb. Ex DC.) Wight and Arn.	Arjuna	Arjun
6	Euphorbiaceae	<i>Mallotus nudiflorus</i> (L.) Kulju and Welzen	False White Teak	Bhelkol, Bheleu
7	Fabaceae	<i>Tamarindus indica</i> L.	Tamarind	Teteli
8	Lauraceae	<i>Litsea monopetala</i> (Roxb.) Pers.		Xualu
9	Malvaceae	<i>Bombax ceiba</i> L.	Silk Cotton Tree	Himolu
10	Meliaceae	<i>Melia azedarach</i> L.	Persian Lilac	Ghora Neem
11	Meliaceae	<i>Toona ciliata</i> M.Roem.	Indian Mahogany	Poma
12	Moraceae	<i>Artocarpus heterophyllus</i> Lam.	Jackfruit	Kathal
13	Moraceae	<i>Ficus racemosa</i> L.	Cluster Fig	Jogyo- Dimoru
14	Moraceae	<i>Streblus asper</i> Lour.	Toothbrush tree	Xoura
15	Myrtaceae	<i>Syzygium cumini</i> (L.) Skeels	Jamun, Black Plum	Jamuk
16	Phyllanthaceae	<i>Bischofia javanica</i> Blume	Bishop Wood	Uriaam
17	Rhamnaceae	<i>Ziziphus mauritiana</i> Lam.	Indian Jujube	Bogori

Shrub species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Apocynaceae	<i>Calotropis gigantea</i> (L.) W.T.Aiton		Aakon
2	Asteraceae	<i>Chromolaena odorata</i> (L.) R.M.King and H.Rob.	Siam weed, Rouge plant	Germany Bon

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
3	Asteraceae	<i>Xanthium strumarium</i> L.	Rough Cocklebur	Agara Guti
4	Convolvulaceae	<i>Ipomoea carnea</i> Jacq.	Bush Ipomea	Panibhutura, Bor Kolmou
5	Euphorbiaceae	<i>Ricinus communis</i> L.	Castor Oil Plant	Era
6	Fabaceae	<i>Senna alata</i> (L.) Roxb.	Ringworm shrub	Medelua, Khar paat
7	Lamiaceae	<i>Ocimum americanum</i> L.	American Basil	Bon-Tulokhi
8	Malvaceae	<i>Hibiscus mutabilis</i> L.	Cotton Rose	Sthalapadma
9	Malvaceae	<i>Hibiscus</i> × <i>rosa-sinensis</i> L.		Joba
10	Rutaceae	<i>Glycosmis pentaphylla</i> (Retz.) DC.	Gin Berry	Hengenapoka
11	Tamaricaceae	<i>Tamarix dioica</i> Roxb. Ex Roth		Jhau Bon
12	Urticaceae	<i>Sarcochlamys pulcherrima</i> (Roxb.) Gaudich.		Mesaki
13	Verbenaceae	<i>Lippia javanica</i> (Burm.f.) Spreng.	Fever Tea, Lemon Bush	Pohukota Bon

Herb Species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Amaranthaceae	<i>Amaranthus spinosus</i> L.	Spiny Amaranth	Hati-Khutora
2	Araceae	<i>Colocasia esculenta</i> (L.) Schott	Taro	Kolakosu
3	Araceae	<i>Lemna perpusilla</i> Torr.	Tiny Duckweed	Horu-Puni
4	Aspleniaceae	<i>Thelypteris parasitica</i> (L.) Tardieu		Bihdhekia
5	Asteraceae	<i>Chromolaena 266orymbose</i> (Aubl.) R.M.King and H.Rob.	Billygoat Weed	Gundhua Bon
6	Asteraceae	<i>Mikania micrantha</i> Kunth	Chinese Creeper, American Rope	Amor Lota
7	Asteraceae	<i>Parthenium hysterophorus</i> L.	Congress Grass	Parthenium
8	Cyperaceae	<i>Cyperus brevifolius</i> (Rottb.) Hassk.	Shortleaf Spike Sedge	Keya Bon
9	Cyperaceae	<i>Cyperus rotundus</i> L.	Nut Grass	Mutha Bon
10	Lamiaceae	<i>Leucas zeylanica</i> (L.) W.T.Aiton	Ceylon Slitwort	Durun Bon
11	Moraceae	<i>Ficus heterophylla</i> L.f.	Creeping Fig	Kanai- Dimoru
12	Plantaginaceae	<i>Scoparia dulcis</i> L.	Sweet broom	Seni Bon
13	Poaceae	<i>Arundo donax</i> L.	Giant Reed	Nol
14	Poaceae	<i>Chrysopogon zizanioides</i> (L.) Roberty	Vetiver	Birina
15	Poaceae	<i>Cynodon dactylon</i> (L.) Pers.	Bermuda Grass	Dubori Bon
16	Poaceae	<i>Eragrostis atrovirens</i> (Desf.) Trin. Ex Steud.		Bon-Guti
17	Poaceae	<i>Imperata cylindrica</i> (L.) Raeusch.	Cogongrass	Horon-Kher
18	Poaceae	<i>Oplismenus compositus</i> (L.) P.Beauv.	Running Mountain Grass	Bahpotia Bon
19	Poaceae	<i>Triplidium ravennae</i> (L.) H.Scholz	Elephant Grass	Ikora
20	Polygonaceae	<i>Persicaria barbata</i> (L.) H.Hara	Bearded Knotweed	
21	Polygonaceae	<i>Persicaria hydropiper</i> (L.) Delarbre	Water Pepper	Biholongoni

Bamboo and Cane Species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Arecaceae	<i>Calamus tenuis</i> Roxb.	Ratten	Jati Bet

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
2	Poaceae	<i>Bambusa tulda</i> Roxb.	Indian Timber Bamboo	Jati Baah

Study Site – Baligaon to Papung

Table 10: List of plants in Baligaon to Papung

Tree species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Anacardiaceae	<i>Mangifera indica</i> L.	Mango	Aam
2	Arecaceae	<i>Areca catechu</i> L.	Areca Nut Palm	Tamul
3	Boraginaceae	<i>Ehretia acuminata</i> R.Br.		Poojar
4	Euphorbiaceae	<i>Mallotus nudiflorus</i> (L.) Kulju and Welzen	False White Teak	Bhelkol, Bheleu
5	Fabaceae	<i>Tamarindus indica</i> L.	Tamarind	Teteli
6	Lauraceae	<i>Litsea monopetala</i> (Roxb.) Pers.		Xualu
7	Lythraceae	<i>Lagerstroemia speciosa</i> (L.) Pers.	Pride of India	Aajar
8	Malvaceae	<i>Bombax ceiba</i> L.	Silk Cotton Tree	Himolu
9	Meliaceae	<i>Melia azedarach</i> L.	Persian Lilac	Ghora Neem
10	Meliaceae	<i>Toona ciliata</i> M.Roem.	Indian Mahogany	Poma
11	Moraceae	<i>Artocarpus heterophyllus</i> Lam.	Jackfruit	Kathal
12	Moraceae	<i>Ficus hispida</i> L.f.	Opposite Leaf Fig	Khaksa- Dimoru
13	Moraceae	<i>Ficus racemosa</i> L.	Cluster Fig	Jogyo- Dimoru
14	Moraceae	<i>Streblus asper</i> Lour.	Toothbrush tree	Xoura
15	Myrtaceae	<i>Syzygium cumini</i> (L.) Skeels	Jamun, Black Plum	Jamuk
16	Phyllanthaceae	<i>Bischofia javanica</i> Blume	Bishop Wood	Uriaam
17	Rhamnaceae	<i>Ziziphus mauritiana</i> Lam.	Indian Jujube	Bogori

Shrub species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Apocynaceae	<i>Calotropis gigantea</i> (L.) W.T.Aiton		Aakon
2	Asteraceae	<i>Chromolaena odorata</i> (L.) R.M.King and H.Rob.	Siam weed, Rouge plant	Germany Bon
3	Asteraceae	<i>Xanthium strumarium</i> L.	Rough Cocklebur	Agara Guti
4	Convolvulaceae	<i>Ipomoea carnea</i> Jacq.	Bush Ipomea	Panibhutura, Bor Kolmou
5	Euphorbiaceae	<i>Ricinus communis</i> L.	Castor Oil Plant	Era
6	Fabaceae	<i>Senna alata</i> (L.) Roxb.	Ringworm shrub	Medelua, Khar paat
7	Lamiaceae	<i>Clerodendrum infortunatum</i> L.	Hill Glory Bower	Dhapat tita
8	Malvaceae	<i>Hibiscus mutabilis</i> L.	Cotton Rose	Sthalapadma
9	Malvaceae	<i>Hibiscus × rosa-sinensis</i> L.		Joba
10	Malvaceae	<i>Urena lobata</i> L.	Caesarweed	Hun Borolua
11	Rutaceae	<i>Glycosmis pentaphylla</i> (Retz.) DC.	Gin Berry	Hengenapoka
12	Tamaricaceae	<i>Tamarix dioica</i> Roxb. ex Roth		Jhau Bon
13	Urticaceae	<i>Sarcochlamys pulcherrima</i> (Roxb.) Gaudich.		Mesaki

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
14	Verbenaceae	<i>Lippia javanica</i> (Burm.f.) Spreng.	Fever Tea, Lemon Bush	Pohukota Bon

Herb Species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Amaranthaceae	<i>Amaranthus spinosus</i> L.	Spiny Amaranth	Hati-Khutora
2	Araceae	<i>Colocasia esculenta</i> (L.) Schott	Taro	Kolakosu
3	Araceae	<i>Lemna perpusilla</i> Torr.	Tiny Duckweed	Horu-Puni
4	Aspleniaceae	<i>Thelypteris parasitica</i> (L.) Tardieu		Bihdhekia
5	Asteraceae	<i>Chromolaena corymbosa</i> (Aubl.) R.M.King and H.Rob.	Billygoat Weed	Gundhua Bon
6	Asteraceae	<i>Mikania micrantha</i> Kunth	Chinese Creeper, American Rope	Amor Lota
7	Asteraceae	<i>Parthenium hysterophorus</i> L.	Congress Grass	Parthenium
8	Cyperaceae	<i>Cyperus brevifolius</i> (Rottb.) Hassk.	Shortleaf Spike Sedge	Keya Bon
9	Cyperaceae	<i>Cyperus rotundus</i> L.	Nut Grass	Mutha Bon
10	Lamiaceae	<i>Leucas zeylanica</i> (L.) W.T.Aiton	Ceylon Slitwort	Durun Bon
11	Moraceae	<i>Ficus heterophylla</i> L.f.	Creeping Fig	Kanai- Dimoru
12	Plantaginaceae	<i>Scoparia dulcis</i> L.	Sweet broom	Seni Bon
13	Poaceae	<i>Arundo donax</i> L.	Giant Reed	Nol
14	Poaceae	<i>Chrysopogon zizanioides</i> (L.) Roberty	Vetiver	Birina
15	Poaceae	<i>Cynodon dactylon</i> (L.) Pers.	Bermuda Grass	Dubori Bon
16	Poaceae	<i>Eragrostis atrovirens</i> (Desf.) Trin. ex Steud.		Bon-Guti
17	Poaceae	<i>Imperata cylindrica</i> (L.) Raeusch.	Cogongrass	Horon-Kher
18	Poaceae	<i>Oplismenus compositus</i> (L.) P.Beauv.	Running Mountain Grass	Bahpotia Bon
19	Poaceae	<i>Tripsidium ravennae</i> (L.) H.Scholz	Elephant Grass	Ikora
20	Polygonaceae	<i>Persicaria hydropiper</i> (L.) Delarbre	Water Pepper	Biholongoni

Bamboo and Cane Species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Arecaceae	<i>Calamus tenuis</i> Roxb.	Ratten	Jati Bet
2	Poaceae	<i>Bambusa balcooa</i> Roxb.		Bholuka Baah
3	Poaceae	<i>Bambusa tulda</i> Roxb.	Indian Timber Bamboo	Jati Baah

Banana Species

Sl. No.	Family	Botanical Name	English Common Name	Vernacular Name
1	Musaceae	<i>Musa acuminata</i> Colla		Jahaji Kol
2	Musaceae	<i>Musa balbisiana</i> Colla		Aathia Kol
3	Musaceae	<i>Musa × paradisiaca</i> L.		Kas Kol

TERRESTRIAL FAUNA

MAMMALIAN SPECIES

During survey and secondary information, 18 mammalian species were recorded and/or sighted within construction zone and within 1 km radius. Based on secondary information and interaction with locals, about 10 species were reported to be found in the project areas and 8 were observed during the primary survey using line transect and point count methods. Details are listed in Table 11.

Four mammalian species reported during the survey falls under IUCN red list category Endangered (EN) (Asian Elephant, Ganges River dolphin, Hog deer and Bengal Tiger), two under Vulnerable (VU) (Sambar, Leopard), and rest 12 falls under Least concern (LC) category. List of mammalian fauna reported from study area is given in Table 11.

Table 11: List of mammalian fauna reported from different project locations.

SN	Scientific Name	Common Name	IUCN Status*	Project location	Source	Method	WPA Schedule
1	<i>Platanista gangetica</i>	Ganges river Dolphin	EN	Zahajghat	Sighted	Point count	Schedule I
				Jaroni, Rangchali Doloni, Matmora, Jamuguri, Papung	Secondary information and personal interview	Desktop review and PI**	
2	<i>Callosciurus pygerythrus</i>	Hoary-bellied Squirrel	LC	Zhajghat, Jaroni, Rangchali Doloni, Matmora, Jamuguri, Papung	Sighted	Line transects	Not listed
3	<i>Urva edwardsii</i>	Indian grey mongoose	LC	Jroni, Rangchali doloni	Sighted	Line transects	Schedule II
4	<i>Pteropus giganteus</i>	Giant Fruit Bat	LC	Zhajghat, Jaroni, Rangchali Doloni, Matmora, Jamuguri, Papung	Sighted	Line transects	Schedule II
5	<i>Scotophilus heathii</i>	Evening Bat	LC	Zhajghat, Jaroni, Rangchali Doloni, Matmora, Jamuguri, Papung	Sighted	Line transects	Not listed
6	<i>Canis aureus</i>	Golden Jackal	LC	Jaroni, Rangchali Doloni, Matmora, Jamuguri, Papung	Secondary information and personal interview	Desktop review and PI	Schedule I
7	<i>Lepus nigricollis</i>	Indian Hare	LC	Jaroni, Rangchali Doloni, Matmora, Jamuguri, Papung	Secondary information and personal interview	desktop review and PI	Schedule II
8	<i>Macaca mulatta</i>	Rhesus macaque	LC	Matmora	Sighted	Line transects	Not listed
9	<i>Viverricula indica</i>	Small Indian civet	LC	Jaroni, Rangchali Doloni, Matmora, Jamuguri, Papung	Secondary information and personal interview	Desktop review and PI	Schedule I
10	<i>Viverra zibetha</i>	Large Indian Civet	LC	Jaroni, Rangchali Doloni, Matmora, Jamuguri, Papung	Secondary information and personal interview	Desktop review and PI	Schedule I
11	<i>Elephus maximus</i>	Asian Elephant	EN	Jaroni, Rangchali doloni	Footprints	Line transects	Schedule I
12	<i>Sus scrofa</i>	Wild boar	LC	Jaroni, Rangchali doloni	Footprints	Line transects	Schedule II
13	<i>Bubalus arnee</i>	Asiatic wild buffalo	EN	Jaroni, Rangchali doloni, Matmora	Secondary information and personal interview	Desktop review and PI	Schedule I

SN	Scientific Name	Common Name	IUCN Status*	Project location	Source	Method	WPA Schedule
14	<i>Rusa unicolor</i>	Sambar deer	VU	Ranchali doloni	Secondary information and personal interview	Desktop review and PI	Schedule I
15	<i>Axis porcinus</i>	Hog deer	EN	Ranchali doloni	Secondary information and personal interview	Desktop review and PI	Schedule I
16	<i>Panthera tigris</i>	Royal bengal Tiger	EN	Ranchali doloni	Secondary information and personal interview	Desktop review and PI	Schedule I
17	<i>Panthera pardus</i>	Leopard	VU	Jaroni, Ranchali doloni	Secondary information and personal interview	Desktop review and PI	Schedule I
18	<i>Felis chaus</i>	Jungle cat	LC	Jaroni, Rangchali doloni, Matmora	Secondary information and personal interview	Desktop review and PI	Schedule II

*IUCN Categories: LC: Least concern, VU: Vulnerable, EN: Endangered; **PI: Personal interview

AVIFAUNA

Based on primary survey and secondary findings, 66 species of birds are reported in the core and buffer areas of the proposed project sites. One vulnerable (VU) species i.e Swamp francolin *Francolinus gularis* was reported in Jaroni area of Sonitpur. Remaining 65 species of birds are listed under Least Concern (LC) as per IUCN Red List of threatened species. One species i.e Swamp francolin is listed under Schedule -I and others are listed under Schedule II of Wildlife protection act 1972 (2022 amendments). Based on Habitat distribution about 11 species are found in agricultural areas, 17 are from forested areas, one from the grassland areas, 10 are from riverbanks, 9 are riverine, one from sand bar, 4 are from swampy areas, and 4 are cosmopolitan species.

To record the species distribution 12, transect survey method, 12 walk through survey methods and 12-point count methods were adopted. Line transect and walk through methods were adopted to carry out avifaunal study. The location of Transect were same as those for Flora study proposed, refer Table 12. The spot study locations for avifauna are same as proposed for floral Quadrant Locations. Based on random count methods, The total population avifauna reported are 2560 individuals within 1 km radius. These are not the actual population of avifauna in study area, but project population based on primary survey. Based on the logbook, it has been reported that 54 species of birds are recorded by transect methods, 11 species were recorded during point count method, and one was recorded by call detection method The details of avifauna reported in the study area is given in Table 12.

Table 12: List of avifauna recorded in different project areas

o z ∅	Common Name	Scientific Name	Reported	Study Method	Sonitpur		Biswanath		Lakhimpur						Study area	Habitat	IUCN Red list	WPA-72		
					Zahajghat (T1)	Jaroni (T2)	Rangchali Dalani (T3)	Paken (T4)	Bonpuroi Jamuguri (T5, T6, T7)			Bandana Check Bund to Matmara (T8, T9, T10)							Baligaon to Papung (T11, T12)	
1	Lesser Whistling Duck	<i>Dendrocygna javanica</i>	Sighted	Line transects		3	4	-	3	-	-	2	6	12	2	3	Core	Riverine	LC	Schedule II
2	Ruddy Shelduck	<i>Tadorna ferruginea</i>	Sighted	Line transects		4	4	-	-	4	-	-	4	4	3	4	Core	Riverine	LC	
3	Little Cormorant	<i>Microcarbo niger</i>	Sighted	Line transects		7	3	2	2	1	-	-	1	3	6	3	Core and buffer	Riverine	LC	
4	Common Myna	<i>Acridotheres tristis</i>	Sighted	Line transects	18	12	22	5	8	5	4	6	12	21	11	22	Cosmopolitan	Cosmopolitan	LC	
5	Jungle Myna	<i>Acridotheres fuscus</i>	Sighted	Line transects	6	7	9	4	2	2	1	4	8	7	5	9	Cosmopolitan	Cosmopolitan	LC	
6	Chestnut-tailed Myna	<i>Sturnia malabarica</i>	Sighted	Line transects	8	4	6	3	4	-	2	6	2	4	3	6	Cosmopolitan	Cosmopolitan	LC	

o z o	Common Name	Scientific Name	Reported	Study Method	Sonitpur		Biswanath		Lakhimpur						Study area	Habitat	IUCN Red list	WPA-72	
					Zahajghat (T1)	Jaroni (T2)	Rangchali Dalani (T3)	Paken (T4)	Bonpuroi Jamuguri (T5, T6, T7)			Bandana Check Bund to Matmara (T8, T9, T10)							Baligaon to Papung (T11, T12)
7	Asian Pied Starling	<i>Gracupica contra</i>	Sighted	Line transects	6	10	9	7	7	2	8	3	2	12	11	9	Cosmopolitan	Cosmopolitan	LC
8	Barn Swallow	<i>Hirundo rustica</i>	Sighted	Line transects	7	22	60	12	12	6	-	44	6	12	21	60	Cosmopolitan	Riverine	LC
9	Grey-throated Martin	<i>Riparia paludicola</i>	Sighted	Line transects	-	53	31	-	12	-	8	12	4	13	44	31	Core	Riverine	LC
10	Cattle Egret	<i>Bubulcus ibis</i>	Sighted	Line transects	8	22	4	6	2	2	1	3	2	1	12	4	Buffer	Agriculture	LC
11	Intermediate Egret	<i>Ardea intermedia</i>	Sighted	Line transects	2	6	5	3	2	-	1	1	1	1	6	5	Core	Riverine	LC
12	Little Egret	<i>Egretta garzetta</i>	Sighted	Line transects	1	3	4	2	-	1	1	4	1	1	3	4	Core	Riverine	LC

o z o	Common Name	Scientific Name	Reported	Study Method	Sonitpur		Biswanath		Lakhimpur						Study area	Habitat	IUCN Red list	WPA-72	
					Zahajghat (T1)	Jaroni (T2)	Rangchali Dalani (T3)	Paken (T4)	Bonpuroi Jamuguri (T5, T6, T7)			Bandana Check Bund to Matmara (T8, T9, T10)							Baligaon to Papung (T11, T12)
13	Grey Heron	<i>Ardea cinerea</i>	Sighted	Line transects	-	7	2	-	-	-	-	-	-	-	-	Core	Riverine	LC	
14	Indian Pond Heron	<i>Ardeola grayii</i>	Sighted	Line transects	4	7	3	3	1	2	1	2	3	2	7	3	Cosmopolitan	Riverine	LC
15	White-breasted Waterhen	<i>Amaurornis phoenicurus</i>	Sighted	Line transects	2	9	7	2	3	1	1	2	1	1	9	7	Buffer	Swampy area	LC
16	Little Ringed Plover	<i>Charadrius dubius</i>	Sighted	Line transects	-	3	2	-	1	-	-	1	3	3	3	2	Core	Riverbank	LC
17	Red-wattled Lapwing	<i>Vanellus indicus</i>	Sighted	Line transects	4	6	5	2	1	-	1	1	3	4	6	5	Cosmopolitan	Agriculture	LC
18	Green Sandpiper	<i>Tringa ochropus</i>	Sighted	Line transects	-	2	2	-	1	1	-	1	1	1	2	2	Buffer	Riverbank	LC

o z o	Common Name	Scientific Name	Reported	Study Method	Sonitpur		Biswanath		Lakhimpur						Study area	Habitat	IUCN Red list	WPA-72		
					Zahajghat (T1)	Jaroni (T2)	Rangchali Dalani (T3)	Paken (T4)	Bonpuroi Jamuguri (T5, T6, T7)			Bandana Check Bund to Matmara (T8, T9, T10)							Baligaon to Papung (T11, T12)	
19	Wood Sandpiper	<i>Tringa glareola</i>	Sighted	Line transects	-	2	2	-	1	-	1	1	2	2	2	2	Buffer	Riverbank	LC	
20	Common Sandpiper	<i>Actitis hypoleucos</i>	Sighted	Line transects	-	2	1	-	1	1	-	1	1	-	2	1	Buffer	Riverbank	LC	
21	House Crow	<i>Corvus splendens</i>	Sighted	Line transects	22	8	1	4	4	2	1	1	2	1	8	1	Cosmopolitan	Cosmopolitan	LC	
22	Large-billed Crow	<i>Corvus macrorhynchos</i>	Sighted	Line transects	4	3	8	1	1	1	1	2	1	1	3	8	Cosmopolitan	Cosmopolitan	LC	
23	Cinereous Tit	<i>Parus cinereus</i>	Sighted	Line transects	4	6	5	-	4	1	6	6	1	2	6	5	Buffer	Forested area	LC	
24	House Sparrow	<i>Passer domesticus</i>	Sighted	Line transects	18	8	7	4	2	3	6	6	2	1	8	7	Buffer	Cosmopolitan	LC	

o z s	Common Name	Scientific Name	Reported	Study Method	Sonitpur		Biswanath		Lakhimpur						Study area	Habitat	IUCN Red list	WPA-72	
					Zahajghat (T1)	Jaroni (T2)	Rangchali Dalani (T3)	Paken (T4)	Bonpuroi Jamuguri (T5, T6, T7)			Bandana Check Bund to Matmara (T8, T9, T10)							Baligaon to Papung (T11, T12)
25	Eurasian Tree Sparrow	<i>Passer montanus</i>	Sighted	Line transects	2	9	12	2	2	1	2	4	2	1	5	10	Buffer	Cosmopolitan	LC
26	White Wagtail	<i>Motacilla alba</i>	Sighted	Line transects	7	8	9	4	4	1	1	6	2	1	8	9	Cosmopolitan	Riverbank	LC
27	Eastern Yellow Wagtail	<i>Motacilla tschutschensis</i>	Sighted	Line transects	-	7	8	-	3	2	1	-	4	1	7	8	Buffer	Riverbank	LC
28	Paddyfield Pipit	<i>Anthus rufulus</i>	Sighted	Line transects	2	6	4	2	1	2	1	1	2	1	6	4	Buffer	Agriculture	LC
29	Rosy Pipit	<i>Anthus roseatus</i>	Sighted	Line transects	-	5	1	-	1	-	-	-	1	-	5	1	Buffer	Swampy area	LC
30	Sand Lark	<i>Alaudala raytal</i>	Sighted	Line transects	-	4	2	-	2	-	-	-	-	2	4	2	Buffer	Sand bar	LC

o z s	Common Name	Scientific Name	Reported	Study Method	Sonitpur		Biswanath		Lakhimpur						Study area	Habitat	IUCN Red list	WPA-72		
					Zahajghat (T1)	Jaroni (T2)	Rangchali Dalani (T3)	Paken (T4)	Bonpuroi Jamuguri (T5, T6, T7)			Bandana Check Bund to Matmara (T8, T9, T10)							Baligaon to Papung (T11, T12)	
31	Baya Weaver	<i>Ploceus philippinus</i>	Sighted	Line transects	-	4	3	-	-	-	4	-	2	3	4	3	Buffer	Forested area	LC	
32	Eurasian Hoopoe	<i>Upupa epops</i>	Sighted	Line transects	1	4	3	-	2	-	1	-	1	1	4	3	Buffer	Agriculture	LC	
33	Black-hooded Oriole	<i>Oriolus xanthornus</i>	Sighted	Line transects	4	3	2	1	-	1	-	-	2	1	3	2	Buffer	Forested area	LC	
34	Spotted Dove	<i>Spilopelia chinensis</i>	Sighted	Line transects	9	7	4	3	2	4	1	2	-	1	7	4	Buffer	Cosmopolitan	LC	
35	Red-collared Dove	<i>Streptopelia tranquebari</i>	Sighted	Line transects	-	2	3	-	-	2	-	2	2	-	2	3	Buffer	Cosmopolitan	LC	
36	Eurasian Collared Dove	<i>Streptopelia decaocto</i>	Sighted	Line transects	-	2	2	-	-	1	1	2	1	1	2	2	Buffer	Cosmopolitan	LC	

o z s	Common Name	Scientific Name	Reported	Study Method	Sonitpur		Biswanath		Lakhimpur						Study area	Habitat	IUCN Red list	WPA-72	
					Zahajghat (T1)	Jaroni (T2)	Rangchali Dalani (T3)	Paken (T4)	Bonpuroi Jamuguri (T5, T6, T7)			Bandana Check Bund to Matmara (T8, T9, T10)							Baligaon to Papung (T11, T12)
37	Long legged buzzard	<i>Buteo rufinus</i>	Sighted	Line transects	-	1	-	-	-	-	-	-	-	-	-	Buffer	Forested area	LC	
38	Black-winged Kite	<i>Elanus caeruleus</i>	Sighted	Line transects	-	1	3	-	1	-	-	2	1	1	1	3	Buffer	Agriculture	LC
39	Black Kite	<i>Milvus migrans</i>	Sighted	Line transects	12	5	4	4	1	2	3	1	2	4	5	4	Cosmopolitan	Cosmopolitan	LC
40	Eurasian Kestrel	<i>Falco tinnunculus</i>	Sighted	Line transects	-	1	2	-	-	1	1	-	2	1	1	2	Buffer	Agriculture	LC
41	Spotted Owlet	<i>Athene brama</i>	Sighted	Line transects	7	2	4	2	-	4	-	2	4	-	2	4	Buffer	Forested area	LC
42	Collared Scops Owl	<i>Otus bakkamoena</i>	Sighted	Line transects	-	1	2	-	-	-	1	1	-	1	1	2	Buffer	Forested area	LC

o z s	Common Name	Scientific Name	Reported	Study Method	Sonitpur		Biswanath		Lakhimpur						Study area	Habitat	IUCN Red list	WPA-72	
					Zahajghat (T1)	Jaroni (T2)	Rangchali Dalani (T3)	Paken (T4)	Bonpuroi Jamuguri (T5, T6, T7)			Bandana Check Bund to Matmara (T8, T9, T10)							Baligaon to Papung (T11, T12)
43	Barn Owl	<i>Tyto alba</i>	Sighted	Line transects	2	2	1	1	1	1	-	2	1	2	2	3	Buffer	Forested area	LC
44	Asian Barred Owlet	<i>Glaucidium cuculoides</i>	Sighted	Line transects	-	1	1	-	1	-	-	1	2	-	1	1	Buffer	Forested area	LC
45	Brown Boobook	<i>Ninox scutulata</i>	Sighted	Line transects	-	2	1	-	-	-	1	-	-	1	2	1	Buffer	Forested area	LC
46	Asian Palm Swift	<i>Cypsiurus balasensis</i>	Sighted	Line transects	-	4	8	-	4	1	3	4	1	2	5	8	Core	Agriculture	LC
47	Greater Coucal	<i>Centropus sinensis</i>	Sighted	Line transects	4	3	1	1	1	-	1	1	2	1	3	1	Core	Swampy area	LC
48	Lesser Coucal	<i>Centropus bengalensis</i>	Sighted	Line transects	-	1	1	-	-	1	-	-	1	2	2	1	Core	Swampy area	LC

o z s	Common Name	Scientific Name	Reported	Study Method	Sonitpur		Biswanath		Lakhimpur						Study area	Habitat	IUCN Red list	WPA-72	
					Zahajghat (T1)	Jaroni (T2)	Rangchali Dalani (T3)	Paken (T4)	Bonpuroi Jamuguri (T5, T6, T7)			Bandana Check Bund to Matmara (T8, T9, T10)							Baligaon to Papung (T11, T12)
49	Asian Koel	<i>Eudynamys scolopacea</i>	Sighted	Line transects	2	1	1	1	2	-	-	2	1	2	1	1	Buffer	Forested area	LC
50	Common Hawk-Cuckoo	<i>Hierococcyx varius</i>	Sighted	Line transects	1	1	1	1	1	-	1	1	2	1	1	1	Buffer	Forested area	LC
51	Rose-ringed Parakeet	<i>Psittacula kramera</i>	Sighted	Line transects	7	4	12	4	8	2	4	8	12	4	4	11	Buffer	Forested area	LC
52	White-throated Kingfisher	<i>Halcyon smyrnensis</i>	Sighted	Line transects	4	4	2	1	1	1	-	1	1	-	4	2	Core	Riverbank	LC
53	Pied Kingfisher	<i>Ceryle rudis</i>	Sighted	Point Count	2	6	6	2	1	2	1	1	2	1	6	6	Core	Riverbank	LC
54	Asian Green Bee-eater	<i>Merops orientalis</i>	Sighted	Point Count	3	12	4	2	2	4	1	2	9	1	4	4	Buffer	Agriculture	LC

o z o	Common Name	Scientific Name	Reported	Study Method	Sonitpur		Biswanath		Lakhimpur						Study area	Habitat	IUCN Red list	WPA-72		
					Zahajghat (T1)	Jaroni (T2)	Rangchali Dalani (T3)	Paken (T4)	Bonpuroi Jamuguri (T5, T6, T7)			Bandana Check Bund to Matmara (T8, T9, T10)							Baligaon to Papung (T11, T12)	
55	Indochinese Roller	<i>Coracias affinis</i>	Sighted	Point Count	1	4	4	1	1	-	1	1	2	1	4	4	Buffer	Agriculture	LC	
56	Blue-throated Barbet	<i>Psilopogon asiaticus</i>	Sighted	Point Count	2	5	6	2	4	1	-	4	1	-	5	6	Buffer	Forested area	LC	
57	Coppersmith Barbet	<i>Psilopogon haemacephalus</i>	Sighted	Point Count	2	4	3	1	1	2	1	1	1	2	4	3	Buffer	Forested area	LC	
58	Black-rumped Flameback	<i>Dinopium benghalense</i>	Sighted	Line transects	-	1	4	-	2	-	1	2	-	1	1	4	Buffer	Forested area	LC	
59	Rufous Treepie	<i>Dendrocitta vagabunda</i>	Sighted	Line transects	2	3	5	1	2	1	-	2	2	-	3	2	Buffer	Agriculture	LC	
60	Siberian Stonechat	<i>Saxicola maurus</i>	Sighted	Point Count	4	2	9	4	-	2	4	-	1	2	2	9	Buffer	Riverbank	LC	

o z s	Common Name	Scientific Name	Reported	Study Method	Sonitpur		Biswanath		Lakhimpur						Study area	Habitat	IUCN Red list	WPA-72	
					Zahajghat (T1)	Jaroni (T2)	Rangchali Dalani (T3)	Paken (T4)	Bonpuroi Jamuguri (T5, T6, T7)			Bandana Check Bund to Matmara (T8, T9, T10)							Baligaon to Papung (T11, T12)
61	Grey-backed Shrike	<i>Lanius tephronus</i>	Sighted	Point Count	1	2	2	1	1	1	-	1	1	-	2	2	Buffer	Agriculture	LC
62	Red-vented Bulbul	<i>Pycnonotus cafer</i>	Sighted	Point Count	6	8	12	5	2	6	5	2	6	8	8	11	Cosmopolitan	Cosmopolitan	LC
63	Dusky Warbler	<i>Phylloscopus fuscatus</i>	Sighted	Point Count	-	4	6	2	2	4	4	2	4	4	4	6	Buffer	Riverbank	LC
64	Common Tailorbird	<i>Orthotomus sutorius</i>	Sighted	Point Count	-	3	5	1	-	1	1	-	1	1	3	4	Buffer	Forested area	LC
65	Common Iora	<i>Aegithina tiphia</i>	Sighted	Point Count	-	7	12	2	-	4	3	-	4	4	6	11	Buffer	Forested area	LC
66	Swamp Francolin	<i>Francolinus gularis</i>	Sighted	Call detection	-	1	-	-	-	-	-	-	-	-	-	-	Buffer	Grassland	VU

BUTTERFLIES

Project area harbour's rich floral diversity. This result in large varieties of butterflies. During primary survey butterflies were reported from core zone and buffer zone. Point count, Line transect methods and walk through were adopted to record the butterflies in study. About 12 species off butterflies were reported in the core and buffer zones of the project sites. The most commonly reported butterfly is small grass yellow, common grass yellow and lemon pansy. Table 13 below gives the list of butterflies reported in study area.

Table 13: Butterfly species reported in the study areas.

S. No.	Family	Scientific Name	Common Name	IUCN Category	IWPA 1972	Study Area
1	Lycaenidae	<i>Chilades lajus</i>	Lime Blue	LC	Not listed	Core+Buffer
2	Lycaenidae	<i>Acrocnemis violacea</i>	Lesser Glass Blue	LC	Not listed	Core+Buffer
3	Nymphalidae	<i>Junonia lemonias</i>	Lemon Pansy	LC	Not listed	Core+Buffer
4	Nymphalidae	<i>Junonia atlites</i>	Grey Pansy	LC	Not listed	Core
5	Pieridae	<i>Eurema hecabe</i>	Common Grass Yellow	LC	Not listed	Core+Buffer
6	Nymphalidae	<i>Mycalesis perseus</i>	Common Brush Brown	LC	Schedule I	Core+Buffer
7	Nymphalidae	<i>Danaus chrysippus</i>	Plain Tiger	LC	Not listed	Core
8	Nymphalidae	<i>Athyma perius</i>	Common Sergeant	LC	Not listed	Core+Buffer
9	Papilionidae	<i>Papilio demoleus</i>	Lime Butterfly	DD	Not listed	Core+Buffer
10	Pieridae	<i>Pieris canidia</i>	Indian Cabbage White	LC	Schedule I	Core+Buffer
11	Pieridae	<i>Eurema brigitta</i>	Small Grass Yellow	LC	Not listed	Core+Buffer
12	Nymphalidae	<i>Cepora nadina</i>	Lesser Gull	LC	Not listed	Core+Buffer

HERPETOFAUNA DIVERSITY

AMPHIBIANS

Seven amphibian species were recorded from the buffer areas of the project locations. The species of amphibian reported from the study areas are *Duttaphrynus melanostictus*, *Polypedates teraiensis*, *Hoplobatrachus tigerinus*, *Euphlyctis cyanophlyctis*, *Hylarana leptoglossa*, and *Microhyla ornata*. None of the Amphibian species reported falls under any threatened category in the IUCN Red List.

REPTILES

No reptilian species were noticed during primary survey. Based on interaction with locals 13 reptilian species were reported from during survey (Table14). All the reptiles reported in the study area are rated Least Concern by IUCN.

Table 14: List of reptiles recorded in the project area

S. No.	Scientific Name	Common Name	Area	IUCN Status*	Schedule (WPA, 1972)
1	<i>Ptyas mucosa</i>	Indian Rat Snake	Matmora, Jamuguri, Paken, Rangchali Dalani, Zahajghat, Jaroni	LC	Schedule II
2	<i>Ptyas korros</i>	Chinese Rat Snake	Matmora, Jamuguri, Paken, Rangchali Dalani, Zahajghat, Jaroni	LC	Not Listed
3	<i>Naja kaouthia</i>	Monocled Cobra	Matmora, Jamuguri, Rangchali Dalani, Jaroni	LC	Schedule II
4	<i>Fowlea piscator</i>	Checkered Keelback	Matmora, Jamuguri, Paken, Rangchali Dalani, Zahajghat, Jaroni	LC	Not Listed
5	<i>Rhabdophis subminiatus</i>	Red-necked Keelback	Matmora, Jamuguri, Paken, Rangchali Dalani, Zahajghat, Jaroni	LC	Not Listed
6	<i>Coelognathus radiatus</i>	Copper-headed Trinket	Matmora, Jamuguri, Paken, Rangchali Dalani, Zahajghat, Jaroni	Not Evaluated	Not Listed
7	<i>Lycodon aulicus</i>	Common Wolf Snake	Matmora, Jamuguri, Paken, Rangchali Dalani, Zahajghat, Jaroni	LC	Not Listed
8	<i>Xenochrophis vittatus</i>	Buff-striped Keelback	Matmora, Rangchali Dalani, Jaroni	LC	Not Listed
9	<i>Dendrelaphis tristis</i>	Painted Bronzeback	Matmora, Jamuguri, Rangchali Dalani, Jaroni	LC	Not Listed
10	<i>Varanus bengalensis</i>	Bengal Monitor Lizard	Matmora, Rangchali Dalani, Jaroni	NT	Schedule I
11	<i>Hemidactylus frenatus</i>	Common House Gecko	Matmora, Jamuguri, Paken, Rangchali Dalani, Zahajghat, Jaroni	Not Evaluated	Not Listed
12	<i>Calotes versicolor</i>	Garden Lizard	Matmora, Jamuguri, Paken, Rangchali Dalani, Zahajghat, Jaroni	LC	Not Listed
13	<i>Eutropis multifasciata</i>	Many-lined Grass Skink	Matmora, Jamuguri, Rangchali Dalani, Jaroni	LC	Not Listed

*IUCN status: LC: Least Concern, NT: Near Threatened

FISHES

To record the distribution of fish species in a 1 km study area, all fishing points near settlements were surveyed. About 9 fishing points were visited, and the details of these locations are presented in Table 14. A total of 23 fish species (Table 16) were reported from the study area in the Brahmaputra River. Based on primary surveys, the species recorded included *Labeo gonius*, *Wallago attu*, *Cirrhinus cirrhosus*, *Cirrhinus reba*, *Labeo bata*, *Labeo calbasu*, *Labeo rohita*, *Mystus vittatus*, *Rita rita*, *Chitala chitala*, and others. Secondary sources confirmed additional species such as *Amblypharyngodon mola*, *Aspidoparia morar*, and *Clupisoma garua*, which are sold in local markets. Notably, *Wallago attu* is listed under the Vulnerable category of the IUCN Red Data Book, but it is a commonly and commercially available fish in the fish markets of Assam. Based on the desktop review, it is anticipated that species like *Tor putitora* (LC), *Anguilla bengalensis* (LC), and others may also be present in the study area. These findings highlight the diversity and conservation significance of the Brahmaputra River's aquatic biodiversity.

Table15: Fishing points surveyed

SI No.	Name of location	Location Code	Co-ordinates	
			LATITUDE	LONGITUDE
1.	U/S of Bandana Check Bund to Matmara	F1	27°14'22.03"N	94°33'10.83"E
2.	Baligaon to Papung	F2	27°11'14.65"N	94°31'21.08"E
3.	Bonpuroi Jamuguri	F3	26.857429°N	93.815014°E
4.	Bonpuroi Jamuguri	F4	26.850334° N	93.808962° E
5.	Bonpuroi Jamuguri	F5	26.846926° N	93.799465° E
6.	Paken	F6	26°47'56.66"N	93°38'3.28"E
7.	Rangchali Dalani	F7	26°46'35.78"N	93°21'59.68"E
8.	Zahaz Ghat	F8	26°36'57.29"N	92°47'34.65"E
9.	Jarani	F9	26°37'55.27"N	92°40'41.46"E

Table16: List of fishes reported from the fishing points

SI no	Local name	Common name	Scientific name	IUCN status
1	Aarhi	Giant river Catfish	<i>Sperata seenghala</i>	LC
2	Rou	Rohu	<i>Labeo rohita</i>	LC
3	Borali	Sareng catfish	<i>Wallago attu</i>	VU
4	Bhokua	Catla	<i>Catla catla</i>	LC
5	Mirika	Mrigal/white carp	<i>Cirrhinus cirrhosus</i>	LC
6	Mali	Black rohu	<i>Labeo calbasu</i>	LC
7	Pithiya	Golden Mahseer	<i>Tor putitora</i>	LC
8	Chital	Humped feather back	<i>Chitala chitala</i>	LC
9	Kurhi	Kuria labeo	<i>Labeo gonius</i>	LC
10	Ilish	Ilish	<i>Tenualosa ilisha</i>	LC
11	Pabho	Pabda	<i>Ompok pabo</i>	LC
12	Boriyola	Aspidoparia	<i>Aspidoparia morar</i>	LC
13	Lachim	Lachim Bhangon	<i>Cirrhinus reba</i>	LC
14	Bhangon	Bata labeo	<i>Labeo bata</i>	LC
15	Puthi	Rosy Barb	<i>Puntius conchoniis</i>	LC
16	Selkona	Boopis razorbelly	<i>Salmostoma boopis</i>	LC
17	Pani mutura	Tang gobi	<i>Glossogobius giuris</i>	LC
18	Litha	Ritha catfish	<i>Rita rita</i>	LC
19	Xingora	Tengra	<i>Mystus vitatus</i>	LC
20	Bami	Freshwater eel	<i>Anguilla bengalensis</i>	LC
21	Koroti	Indian river Shad	<i>Gudusia charpa</i>	LC
22	Muwa	Mola	<i>Amblypharyngodon mola</i>	LC
23	Neria	Garua Bachcha	<i>Clupisoma garua</i>	LC

*IUCN Category: LC: Least Concern, VU: Vulnerable

AQUATIC MAMMALIAN SPECIES:

The Brahmaputra River supports significant aquatic biodiversity, including the Ganges River Dolphin (*Platanista gangetica*), a Schedule I species under the Wildlife Protection Act, 1972, and the National Aquatic Animal of India. These dolphins are typically found in areas with sufficient water depth and counter currents that facilitate prey availability. The river system is a significant stronghold for the Ganges River Dolphin (*Platanista gangetica*), currently harboring approximately 30% of the global population. Unlike the fragmented habitats of the Ganges River, the Brahmaputra system remains relatively free from barriers, supporting a continuous

dolphin range from the Assam border in the east to the Assam-Bangladesh border in the west. Tributaries such as the Kulsī and Subansiri also sustain dolphin populations, though these exhibit seasonal fluctuations linked to the flood cycles.

As per the Field guide “Monitoring Ganges and Indus River Dolphins, Associated Aquatic Fauna and Habitat” by Qureshi et al. 2022, there are approximately 877 individuals of Ganges River dolphins inhabit the Brahmaputra River system. Key natural habitats within the Brahmaputra basin include Dibru-Saikhowa National Park, Kaziranga National Park, and Orang National Park, which function as critical refuges for biodiversity. Identified dolphin hotspots include stretches near Sivasagar, Kaziranga-Tezpur, Guwahati, and Goalpara-Dhubri. These regions are characterized by high population densities and frequent sightings of calves, indicating breeding success. Other important areas include the confluences of the Brahmaputra with tributaries such as Lohit, Manas, and Subansiri, where habitat conditions are conducive to dolphin survival.

During the field survey conducted to assess dolphin distribution within the project’s influence area (1 km radius), consultations with local communities and fishermen were undertaken. The primary survey revealed that in several stretches, the main river course was far from the bank, and several riverbeds were dry and exposed. However, dolphin activity was recorded in areas with favourable habitat characteristics, including mid-Channel Islands and meanders. No individuals were sighted within 100 meters from the riverbank. These findings are summarized in Table 17.

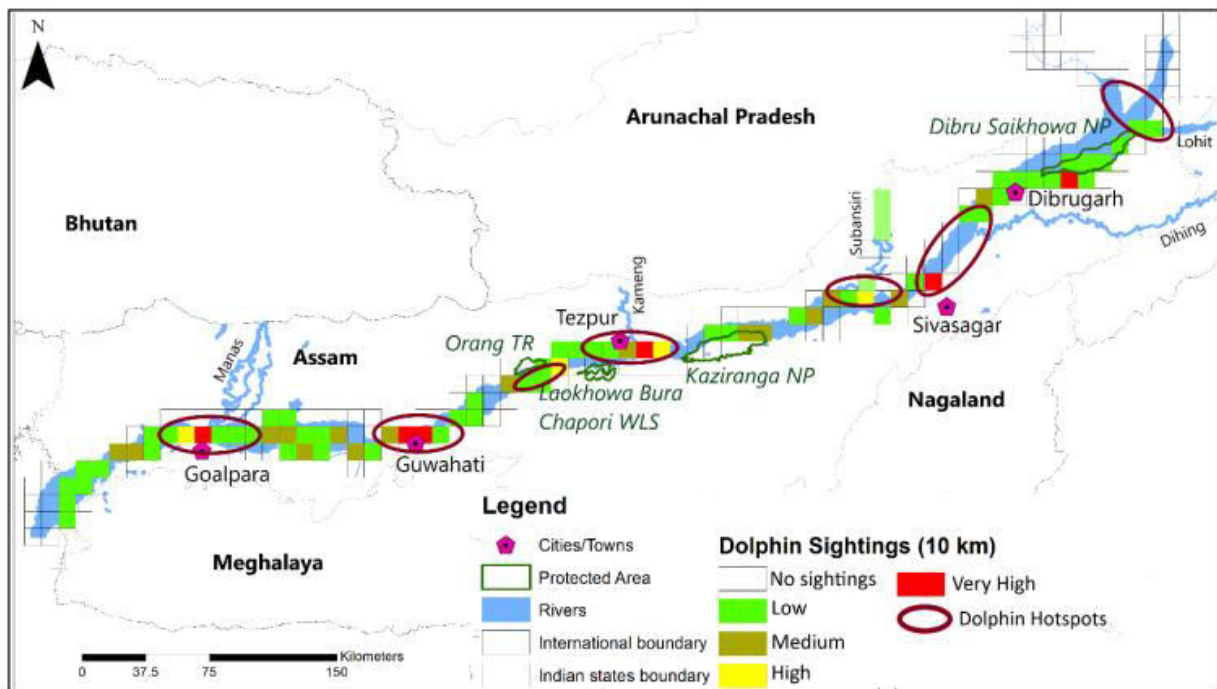


Figure 8: Dolphin hotspots in Brahmaputra, based on population encounters at every 10km (Map courtesy: Qureshi et al.2022).

Table 17: Dolphin distribution throughout the project sites.

S.No.	Project area	Subdivision	Dolphin Distribution	
			Within 100 m	100m-1km
1	U/S of Bandana Check Bund to Matmara	Dhakuakhona	-	+
2	Baligaon to Papung	Dhakuakhona	-	+
3	Bonpuroi Jamuguri	North Lakhimpur	-	+
4	Bonpuroi Jamuguri	North Lakhimpur	-	-
5	Bonpuroi Jamuguri	North Lakhimpur	-	+
6	Paken	Biswanath	-	-
7	Rangchali Dalani	Biswanath	-	+
8	Zahaz Ghat	Sonitpur	-	+
9	Jarani	Sonitpur	-	+

Appendix 8: Environmental Monitoring Results

Photographs



Air quality sampling at Matmora



Air quality sampling at Jamuguri



Noise sampling at Baligaon



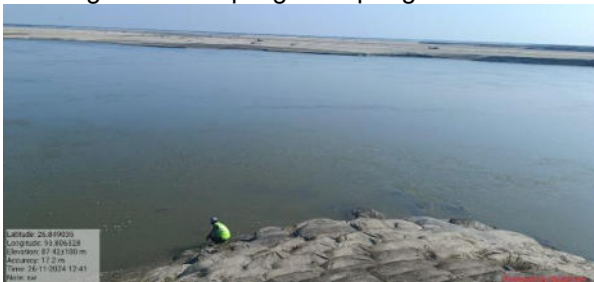
Noise sampling at Bonpuroi



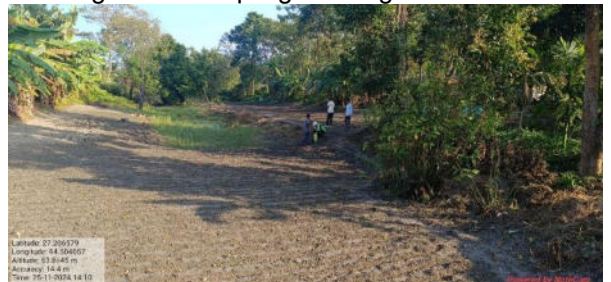
Drinking water sampling at Papung



Drinking water sampling at Rangchali Doloni



Surface water sampling at Bandana



Soil sampling at Jaroni

LABORATORY NABL CERTIFICATE



National Accreditation Board for
Testing and Calibration Laboratories

CERTIFICATE OF ACCREDITATION

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"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

SANKAR DEV PATH, HOUSE NO.-6, PUB SARANIA, CHANDMARI, GUWAHATI, KAMRUP METRO,
ASSAM, INDIA

in the field of

TESTING

Certificate Number: TC-7669

Issue Date: 28/02/2023

Valid Until:

27/02/2025

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL.
(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)


Name of Legal Identity : ENVISION ENVIRO TECHNOLOGIES NORTH EAST

Signed for and on behalf of NABL




N. Venkateswaran
Chief Executive Officer

Ambient Air and Noise Monitoring Result



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TC-7669

Recognized by Pollution Control Board, Assam

TEST REPORT

AMBIENT AIR ANALYSIS REPORT
 Rep.No. AAAR_15011336_0_944(A)
 Sample ID No.: EETNE/NOV/21(A)/24

Date: 30/11/2024
 ULR NO.: TC7669240000232(A)F

Issued To : M/s. M2M Consulting Consortium Pvt. Ltd., New Delhi.


Sample Drawn By : UTPAL BEZBARUAH
 Sampling Plan & Procedure : EETNE/SOP/01
 Analysis Duration : 25/11/2024 TO 30/11/2024
 Sampling Instrument Used : AIR SAMPLER/RDS
 Pollution Control Device, if any : NO
 Ambient Temperature : 26°C


SL. NO.	DATE OF SAMPLING	LOCATION/SOURCE (Latitude and Longitude) (Dhakuakhana)	WEATHER	PARAMETERS			
				PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)	NO ₂ (µg/m ³)	SO ₂ (µg/m ³)
i)	25-11-2024	(Bandana Check Bund To Matmara) Lat N 27°29'43.62 Long E 94°59'56.16	clear	57.3	37.1	14.4	10.1
ii)		Near Deorigaon Lat N 27°12'23.03 Long E 94°31'51.35		55.8	32.9	13.8	9.5

Remarks: - a) Parameters are within the permissible limit.
 b) Sampling done within 24 hours only.

NATIONAL AMBIENT AIR QUALITY STANDARDS:

Sl. No.	Pollutant	Test Method	Time Weighted Average	Concentration in Ambient Air Industrial, Residential, Rural and Other Area
1	Sulphur Dioxide (SO ₂), µg/m ³	IS-5182 Part-II/ CPCB	Annual 24 hours	50 80
2	Nitrogen Dioxide (NO ₂), µg/m ³	IS-5182 Part-VI/ CPCB	Annual 24 hours	40 80
3	Particulate (PM ₁₀), µg/m ³	IS-5182 Part-XXIII/ CPCB	Annual 24 hours	60 100
4	Particulate (PM _{2.5}), µg/m ³	EETNE/SOP/01/2017	Annual 24 hours	40 60



 Khairul Islam Sheikh
(Environmental Chemist)


 Utpal Bezbaruah
(Technical Manager)
 Authorized /Reviewed by


Note: i) The results relate only to the parameters tested item sampled.
 ii) The this report shall not be reproduced except in full, without written approval of laboratory

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TEST REPORT

AMBIENT NOISE LEVEL MEASUREMENT REPORT
 Rep.No. 241130_15011336_06A_944(B)
 Sample ID: EETNE/NOV/21(A)/24

Date: 30/11/24
 ULR NO.: TC7669240000232(A)F


Issued to : M/s. M2M Consulting Consortium Pvt. Ltd., New Delhi.


SL. NO.	DATE OF SAMPLING	LOCATION /SOURCE (Latitude and Longitude) (Dhakuakhana)	NOISE LEVEL in dB(A)	
			Day (6:00 am to 10:00 pm)	
i)	25-11-2024	(Bandana Check Bund To Matmara) Lat N 27°29'45.07 Long E 94°55'03.17	45.3	
ii)		Near School Road Lat N 27°12'24.61" Long E 94°30'51.34"	43.1	

Ambient Noise Standards:

Area Code	Category of area	Limits in dB(A)	
		Day (6:00 am to 10:00 pm)	Night (10:00 pm to 6:00 am)
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone	50	40

Remarks: Noise level is carried out during 75% of the Day Time.
 Method of analysis : IS 9889 : 1981 RA : 2014
 Sampling Instrument Used : SLM100 SL.NO.484-I-22, SLM 100 (213 DTC-2013)


 Khairul Islam Sheikh
(Environmental Chemist)


 Utpal Bezbaruah
(Technical Manager)
 Authorized /Reviewed by

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TESTREPORT

AMBIENT AIR ANALYSIS REPORT

Rep.No. AAAR_15011336_0_944(C)
Sample ID No.: EETNE/NOV/21(B)/24

Date: 30/11/2024
ULR NO.: TC7669240000232(B)F

Issued to : M/s. M2M Consulting Consortium Pvt. Ltd., New Delhi.

Sample Drawn By : UTPAL BEZBARUAH
Sampling Plan & Procedure : EETNE/SOP/01
Analysis Duration : 25/11/2024 TO 30/11/2024
Sampling Instrument Used : AIR SAMPLER/RDS
Pollution Control Device, if any : NO
Ambient Temperature : 26°C

SL. NO.	DATE OF SAMPLING	LOCATION/SOURCE (Latitude and Longitude) (North Lakhimpur)	WEATHER	PARAMETERS			
				PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)	NO ₂ (µg/m ³)	SO ₂ (µg/m ³)
i)	26-11-2024	(Bonpuroi Jamuguri) Lat N 26°849218 Long E 93°805034	clear	61.6	31.8	13.6	11.1
ii)		Near Pakilchuk LP School Lat N 26°846926 Long E 93°799464		59.2	30.6	14.1	10.8

Remarks: - a) Parameters are within the permissible limit.
b) Sampling done within 24 hours only.

NATIONAL AMBIENT AIR QUALITY STANDARDS:

Sl. No.	Pollutant	Test Method	Time Weighted Average	Concentration in Ambient Air (Industrial, Residential, Rural and Other Area)
1	Sulphur Dioxide (SO ₂), µg/m ³	IS:5182 Part-II/ CPCB	Annual 24 hours	50 80
2	Nitrogen Dioxide (NO ₂), µg/m ³	IS:5182 Part-VI/ CPCB	Annual 24 hours	40 80
3	Particulate (PM ₁₀), µg/m ³	IS:5182 Part-XXIII/ CPCB	Annual 24 hours	60 100
4	Particulate (PM _{2.5}), µg/m ³	EETNE/SOP/01/2017	Annual 24 hours	40 60

For Envision Enviro Technologies North East, Guwahati

Khairul Islam Sheikh
(Environmental Chemist)

Utpal Bezbaruah
(Technical Manager)
Authorized /Reviewed by

Note: i) The results relate only to the parameters tested item sampled.
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TEST REPORT

AMBIENT NOISE LEVEL MEASUREMENT REPORT

Rep.No. 241130_15011336_06A_944(D)
Sample ID: EETNE/NOV/21(B)/24

Date-30/11/24
ULR NO.: TC7669240000232(B)F

Issued to : M/s. M2M Consulting Consortium Pvt. Ltd., New Delhi.

SL. NO.	DATE OF SAMPLING	LOCATION /SOURCE (Latitude and Longitude) (North Lakhimpur)	NOISE LEVEL in dB(A)
			Day (6:00 am to 10:00 pm)
i)		(Bonpuroi Jamuguri) Lat N 27°294507 Long E 94°550317	49.1
ii)	26-11-2024	Near Village Area Lat N 26°850334 Long E 93°808962	47.6

Ambient Noise Standards:

Area Code	Category of area	Limits in dB(A)	
		Day (6:00 am to 10:00 pm)	Night (10:00 pm to 6:00 am)
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone	50	40

Remarks: Noise level is carried out during 75% of the Day Time.
Method of analysis : IS 9989 : 1981 RA : 2014
Sampling Instrument Used : SLM100 SL.NO.484-I-22, SLN 100 (213 DTC-2013)

FOR ENVISION ENVIRO TECHNOLOGIES NORTH EAST, GUWAHATI

Khairul Islam Sheikh
(Environmental Chemist)

Utpal Bezbaruah
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Authorized /Reviewed by

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TESTREPORT

AMBIENT AIR ANALYSIS REPORT

Rep.No. AAR_15011336_0_944(E)
Sample ID No.: EETNE/NOV/21(C)/24

Date: 30/11/2024
ULR NO.: TC7669240000232(C)F

Issued to : M/s. M2M Consulting Consortium Pvt. Ltd. , New Delhi.

Sample Drawn By : UTPAL BEZBARUAH
Sampling Plan & Procedure : EETNE/SOP/01
Analysis Duration : 25/11/2024 TO 30/11/2024
Sampling Instrument Used : AIR SAMPLER/RDS
Pollution Control Device, if any : NO
Ambient Temperature : 26°C

SL. NO.	DATE OF SAMPLING	LOCATION/SOURCE (Latitude Longitude) (Biswanath)	WEATHER	PARAMETERS			
				PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)	NO ₂ (µg/m ³)	SO ₂ (µg/m ³)
i)	27-11-2024	(Rangchali Dalani) Lat N 26°780808 Long E 93°362729	clear	58.6	30.5	13.6	11.5
ii)		Near Tea Garden Lat N 26°4201001 Long E 93°2103728		57.6	32.6	14.6	9.5

Remarks: - a) Parameters are within the permissible limit.
b) Sampling done within 24 hours only.

NATIONAL AMBIENT AIR QUALITY STANDARDS:

Sl. No.	Pollutant	Test Method	Time Weighted Average	Concentration in Ambient Air Industrial, Residential, Rural and Other Area
1	Sulphur Dioxide (SO ₂), µg/m ³	IS:5182 Part-II/ CPCB	Annual	50
			24 hours	80
2	Nitrogen Dioxide (NO ₂), µg/m ³	IS:5182 Part-VI/ CPCB	Annual	40
			24 hours	80
3	Particulate (PM ₁₀), µg/m ³	IS:5182 Part-XXIII/ CPCB	Annual	60
			24 hours	100
4	Particulate (PM _{2.5}), µg/m ³	EETNE/SOP/01/2017	Annual	40
			24 hours	60

For Envision Enviro Technologies North East, Guwahati

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TEST REPORT

AMBIENT NOISE LEVEL MEASUREMENT REPORT

Rep.No. 241130_15011336_06A_944(F)
Sample ID: EETNE/NOV/21(C)/24

Date-30/11/24
ULR NO.: TC7669240000232(C)F

Issued to : M/s. M2M Consulting Consortium Pvt. Ltd. , New Delhi.

SL. NO.	DATE OF SAMPLING	LOCATION /SOURCE (Latitude and Longitude) (Biswanath)	NOISE LEVEL in dB(A)
			Day (6:00 am to 10:00 pm)
i)	27-11-2024	(Rangchali Dalani) Lat N 26°776559 Long E 93°364777	46.8
ii)		Near Tea Garden Lat N 26°471571 Long E 93°213.82	46.6

Ambient Noise Standards:

Area Code	Category of area	Limits in dB(A)	
		Day (6:00 am to 10:00 pm)	Night (10:00 pm to 6:00 am)
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone	50	40

Remarks: Noise level is carried out during 75% of the Day Time.
Method of analysis : . IS 9989 : 1981 RA : 2014
Sampling Instrument Used : SLM100 SL.NO.484-I-22, SLM 100 (213 DTC-2013)

FOR ENVISION ENVIRO TECHNOLOGIES NORTH EAST, GUWAHATI

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TESTREPORT

AMBIENT AIR ANALYSIS REPORT

Rep.No. AAAR_15011336_0_944(G)
Sample ID No.: EETNE/NOV/21(D)/24

Date: 30/11/2024
ULR NO.: TC7669240000232(D)F

Issued to : M/s. M2M Consulting Consortium Pvt. Ltd., New Delhi.

Sample Drawn By : UTPAL BEZBARUAH
Sampling Plan & Procedure : EETNE/SOP/01
Analysis Duration : 25/11/2024 TO 30/11/2024
Sampling Instrument Used : AIR SAMPLER/RDS
Pollution Control Device, if any : NO
Ambient Temperature : 26°C

SL. NO.	DATE SAMPLING	LOCATION/SOURCE (Latitude and Longitude) (SONITPUR)	WEATHER	PARAMETERS			
				PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)	NO ₂ (µg/m ³)	SO ₂ (µg/m ³)
i)	28-11-2024	(Zahaz Ghat) Lat N 26°6'17.93 Long E 92°7'86.839	clear	58.3	31.6	13.7	11.7
ii)		(Near Gandhi Ashram School) Lat N 26°36'38.78 Long E 92°46.2.4		57.6	30.7	14.8	12.8

Remarks: - a) Parameters are within the permissible limit.
b) Sampling done within 24 hours only.

NATIONAL AMBIENT AIR QUALITY STANDARDS:

Sl. No.	Pollutant	Test Method	Time Weighted Average	Concentration in Ambient Air Industrial, Residential, Rural and Other Area
1	Sulphur Dioxide (SO ₂), µg/m ³	IS:5182 Part-II/ CPCB	Annual 24 hours	50 80
2	Nitrogen Dioxide (NO ₂), µg/m ³	IS:5182 Part-VI/ CPCB	Annual 24 hours	40 80
3	Particulate (PM ₁₀), µg/m ³ Matter	IS:5182 Part-XXIII/ CPCB	Annual 24 hours	60 100
4	Particulate (PM _{2.5}), µg/m ³ Matter	EETNE/SOP/01/2017	Annual 24 hours	40 60

For Enviro Enviro Technologies North East, Guwahati

Khairul Islam Sheikh
(Environmental Chemist)

Utpal Bezbaruah
(Technical Manager)
Authorized /Reviewed by

Note: i) The results relate only to the parameters tested item sampled.
ii) The test report shall not be reproduced except in full, without written approval of laboratory.

-----END OF REPORT-----

Recognized by Pollution Control Board, Assam

TEST REPORT

AMBIENT NOISE LEVEL MEASUREMENT REPORT

Rep.No. 241130_15011336_06A_944(H)
Sample ID: EETNE/NOV/21(D)/24

Date-30/11/24
ULR NO.: TC7669240000232(D)F

Issued to : M/s. M2M Consulting Consortium Pvt. Ltd., New Delhi.

SL. NO.	DATE OF SAMPLING	LOCATION /SOURCE (Latitude and Longitude) (Sonitpur)	NOISE LEVEL in dB(A)
			Day (6:00 am to 10:00 pm)
i)		(Zahaz Ghat) Lat N 26°6'17.93 Long E 92°7'86.839	48.5
ii)	28-11-2024	Near Industrial Training Institute, Tezpur Lat N 26°37'57.26 Long E 92°47'35.68	47.2

Ambient Noise Standards:

Area Code	Category of area	Limits in dB(A)	
		Day (6:00 am to 10:00 pm)	Night (10:00 pm to 6:00 am)
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone	50	40

Remarks: Noise level is carried out during 75% of the Day Time.
Method of analysis : IS 9989 : 1981 RA : 2014
Sampling Instrument Used : SLM100 SL.NO.484-I-22, SLM 100 (213 DTC-2013)

Khairul Islam Sheikh
(Environmental Chemist)


Utpal Bezbaruah
(Technical Manager)
Authorized /Reviewed by

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ii) The test report shall not be reproduced except in full, without written approval of laboratory.

-----END OF REPORT-----


Surface Water Monitoring Result

Recognized by Pollution Control Board, Assam



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TEST REPORT:
Report No: 241206_15011336_0
ULR No: TC76692400000536F
Sample ID No: EETNE/NOV/39/24
Test Starting Date: 30/11/2024



Date of Report: 06/12/2024 TC-7669
Date of sample receipt: 29/11/2024
Test completion Date: 06/12/2024

Name & Address of Client						M/s. M2M Consulting Consortium Pvt. Ltd., New Delhi.					
Sample Description		Type- Surface Water	Source - Brahmaputra river Location: U/S Of Bandana Check Bund to Hatmara, Dhakuakhana.			Latitude- 27°293866 Longitude- 94°589341					
Sample collected by						M/s. En-vision Enviro Technologies North East					
Sample Collection Particulars		Date 25/11/2024	Time 11:30 A.M	Temperature 30°C	Quantity Drawn:4L	Sampling Method: EETNE/SOP/02					


Sl No.	Parameters	Unit	Result	Reference Method
1	pH	---	6.91	IS:3025(Part II)-1983 (Reaffirmed 1995)
2	Turbidity	NTU	3.7	IS:3025(Part 10)
3	TDS	mg/L	217.8	IS:3025(Part 16)
4	Total hardness	mg/L	189.6	IS:3025(Part 21)
5	Calcium	mg/L	42.1	IS:3025(Part 40)
6	Magnesium	mg/L	17.7	IS:3025(Part 46)
7	Total Alkalinity	mg/L	199.2	IS:3025(Part 23)
8	Chloride	mg/L	33.6	APHA 23 rd Edition,4500-Cl B,Page:4-75
9	Sulphate	mg/L	20.4	APHA 23 rd Edition,4500-SO ₄ ²⁻ F,Page:4-199
10	Nitrate	mg/L	3.1	APHA 23 rd Edition,4500-NO ₃ ⁻ B,Page:4-127
11	Residual Chlorine	mg/L	BDL	APHA 23 rd Edition,4500-Cl B,Page:4-63

Page 1 of 2

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Report No: 241106_15011336_0
Sample ID No: EETNE/NOV/39/24




TC-7669


Date of Report: 06/12/2024
Date of sample receipt: 29/11/2024

Sl No.	Parameters	Unit	Result	Reference Method
12	Fluoride	mg/L	0.12	APHA 23 rd Edition,4500-F D,Page:4-90
13	Copper	mg/L	0.19	APHA 23 rd Edition,3111 B,Page:3-20
14	Iron(as Fe)	mg/L	0.15	APHA 23 rd Edition,3111 B,Page:3-20
15	Cadmium	mg/L	0.22	APHA 23 rd Edition,3111 B,Page:3-20
16	Lead(as Pb)	mg/L	0.18	APHA 23 rd Edition,3111 B,Page:3-20
17	Zinc	mg/L	0.015	APHA 23 rd Edition,3111 B,Page:3-20
18	Chromium Total	mg/L	0.03	APHA 23 rd Edition,3111 B,Page:3-20
19	Manganese	mg/L	0.042	APHA 23 rd Edition,3111 B,Page:3-20
20	Selenium	mg/L	<0.001	APHA 23 rd Edition,3114A,Page:3-36
21	BOD	mg/L	2.9	IS 3025(Part 44)
22	COD	mg/l	6.4	APHA 23 rd Edition 2017,5220-B,Page:5-18

NOTE: (BOD) Biochemical Oxygen Demand, (COD) Chemical Oxygen Demand, (TDS) Total Dissolved Solids, (BDL) Below Detection Limit.



Khairul Islam Sheikh
Environmental Chemist
Test Done By



Utpal Bezbaruah
Technical Manager
Authorized Signatory/ Reviewed by

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End of report

Page 2 of 2

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TC-7669

TEST REPORT:

Report No: 241206_15011336_01
 ULR No:TC766924000000537F
 Sample ID No: EETNE/NOV/40/24
 Test Starting Date: 30/11/2024

Date of Report: 06/12/2024
 Date of sample receipt: 29/11/2024
 Test completion Date: 06/12/2024

Name & Address of Client	M/s. M2M Consulting Consortium Pvt. Ltd., New Delhi.				
Sample Description	Type- Surface Water	Source -Brahmaputra river Location: Bonpuroi Jamuguri(North Lakhimpur)	Latitude- 26°849035 Longitude- 93°806328		
Sample collected by	M/s. En-vision Enviro Technologies North East				
Sample Collection Particulars	Date 26/11/2024	Time 12:30 P.M	Temperature 30°C	Quantity Drawn:4L	Sampling Method: EETNE/SOP/02

Sl No.	Parameters	Unit	Result	Reference Method
1	pH	---	7.13	IS:3025(Part II)-1983 (Reaffirmed 1996)
2	Turbidity	NTU	3.5	IS:3025(Part 10)
3	TDS	mg/L	220.5	IS:3025(Part 16)
4	Total hardness	mg/L	191.6	IS:3025(Part 21)
5	Calcium	mg/L	43	IS:3025(Part 40)
6	Magnesium	mg/L	18.9	IS:3025(Part 46)
7	Total Alkalinity	mg/L	201.2	IS:3025(Part 23)
8	Chloride	mg/L	32.2	APHA 23 rd Edition,4500-Cl B,Page:4-75
9	Sulphate	mg/L	22.7	APHA 23 rd Edition,4500-SO ₄ ²⁻ E,Page:4-199
10	Nitrate	mg/L	2.5	APHA 23 rd Edition,4500-NO ₃ B,Page:4-127
11	Residual Chlorine	mg/L	BDL	APHA 23 rd Edition,4500-Cl B,Page:4-63



TC-7669

Report No: 241206_15011336_01
 Sample ID No: EETNE/NOV/40/24

Date of Report: 06/12/2024
 Date of sample receipt: 29/11/2024

Sl No.	Parameters	Unit	Result	Reference Method
12	Fluoride	mg/L	0.18	APHA 23 rd Edition,4500-F D,Page:4-90
13	Copper	mg/L	0.1	APHA 23 rd Edition,3111 B,Page:3-20
14	Iron(as Fe)	mg/L	0.11	APHA 23 rd Edition,3111 B,Page:3-20
15	Cadmium	mg/L	0.29	APHA 23 rd Edition,3111 B,Page:3-20
16	Lead(as Pb)	mg/L	0.12	APHA 23 rd Edition,3111 B,Page:3-20
17	Zinc	mg/L	0.011	APHA 23 rd Edition,3111 B,Page:3-20
18	Chromium Total	mg/L	0.09	APHA 23 rd Edition,3111 B,Page:3-20
19	Manganese	mg/L	0.031	APHA 23 rd Edition,3111 B,Page:3-20
20	Selenium	mg/L	<0.001	APHA 23 rd Edition,3114A,Page:3-36
21	BOD	mg/L	3.1	IS 3025(Part 44)
22	COD	mg/l	7	APHA 23 rd Edition 2017,5220-BPage:5-18

NOTE:(BOD)Biochemical Oxygen Demand,(COD)Chemical Oxygen Demand, (TDS) Total Dissolved Solids, (BDL) Below Detection Limit.

For Envision Enviro Technologies North East


 KhairulIslam Sheikh
 Environmental Chemist
 Test Done By


 Utpal Bezbaruah
 Technical Manager
 Authorized Signatory/ Reviewed by

Note: i) The results relate only to the parameters tested & item sampled.
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End of report



TC-7669

TEST REPORT:

Report No: 241206_15011336_02
ULR No:TC76692400000538F
Sample ID No: EETNE/NOV/41/24
Test Starting Date: 30/11/2024

Date of Report: 06/12/2024
Date of sample receipt: 29/11/2024
Test completion Date: 06/12/2024

Name & Address of Client	M/s. M2M Consulting Consortium Pvt. Ltd., New Delhi.				
Sample Description	Type- Surface Water	Source - Brahmaputra river Location: Rangchali Dalani, Biswanath.	Latitude- 26°776671 Longitude- 93°365307		
Sample collected by	M/s. En-vision Enviro Technologies North East				
Sample Collection Particulars	Date 27/11/2024	Time 12:30 P.M	Temperature 30°C	Quantity Drawn:4L	Sampling Method: EETNE/SOP/02

Sl No.	Parameters	Unit	Result	Reference Method
1	pH	---	7.24	IS:3025(Part II)-1983 (Reaffirmed 1996)
2	Turbidity	NTU	3.1	IS:3025(Part 10)
3	TDS	mg/L	222.4	IS:3025(Part 16)
4	Total hardness	mg/L	190.4	IS:3025(Part 21)
5	Calcium	mg/L	42.8	IS:3025(Part 40)
6	Magnesium	mg/L	17.6	IS:3025(Part 46)
7	Total Alkalinity	mg/L	207.3	IS:3025(Part 23)
8	Chloride	mg/L	30.3	APHA 23 rd Edition,4500-CF,Page:4-75
9	Sulphate	mg/L	23.4	APHA 23 rd Edition,4500-SO ₄ ²⁻ E,Page:4-199
10	Nitrate	mg/L	2	APHA 23 rd Edition,4500-NO ₃ B,Page:4-127
11	Residual Chlorine	mg/L	BDL	APHA 23 rd Edition,4500-Cl B,Page:4-63



TC-7669

Report No: 241206_15011336_02
Sample ID No: EETNE/NOV/41/24

Date of Report: 06/12/2024
Date of sample receipt: 29/11/2024

Sl No.	Parameters	Unit	Result	Reference Method
12	Fluoride	mg/L	0.12	APHA 23 rd Edition,4500-F D,Page:4-90
13	Copper	mg/L	0.14	APHA 23 rd Edition,3111 B,Page:3-20
14	Iron(as Fe)	mg/L	0.19	APHA 23 rd Edition,3111 B,Page:3-20
15	Cadmium	mg/L	0.31	APHA 23 rd Edition,3111 B,Page:3-20
16	Lead(as Pb)	mg/L	0.11	APHA 23 rd Edition,3111 B,Page:3-20
17	Zinc	mg/L	0.016	APHA 23 rd Edition,3111 B,Page:3-20
18	Chromium Total	mg/L	0.05	APHA 23 rd Edition,3111 B,Page:3-20
19	Manganese	mg/L	0.025	APHA 23 rd Edition,3111 B,Page:3-20
20	Selenium	mg/L	<0.001	APHA 23 rd Edition,3114A,Page:3-36
21	BOD	mg/L	3.7	IS 3025(Part 44)
22	COD	mg/l	7.8	APHA 23 rd Edition 2017,5220-B,Page:5-18

NOTE:(BOD)Biochemical Oxygen Demand,(COD)Chemical Oxygen Demand, (TDS) Total Dissolved Solids, (BDL) Below Detection Limit.

For Envision Enviro Technologies North East


KhairulIslam Sheikh
Environmental Chemist
Test Done By


Utpal Barbaruah
Technical Manager
Authorized Signatory/ Reviewed by

Note: i) The results relate only to the parameters tested & item sampled.
ii) The test report shall not be reproduced except in full, without written approval of laboratory
End of report



TEST REPORT:
Report No: 241206_15011336_03
ULR No:TC76692400000539F
Sample ID No: EETNE/NOV/42/24
Test Starting Date: 30/11/2024

Date of Report: 06/12/2024
Date of sample receipt: 29/11/2024
Test completion Date: 06/12/2024

Name & Address of Client	M/s. M2M Consulting Consortium Pvt. Ltd., New Delhi.				
Sample Description	Type- Surface Water	Source -Brahmaputra river Location: Zahaz Ghat (Sonitpur)	Latitude- 26°6'15724 Longitude- 92°6'47269		
Sample collected by	M/s. En-vision Enviro Technologies North East				
Sample Collection Particulars	Date 28/11/2024	Time 12:10 P.M	Temperature 30°C	Quantity Drawn:4L	Sampling Method: EETNE/SOP/02

Sl No.	Parameters	Unit	Result	Reference Method
1	pH	---	7.31	IS:3025(Part II)-1983 (Reaffirmed 1996)
2	Turbidity	NTU	3.7	IS:3025(Part 10)
3	TDS	mg/L	218.8	IS:3025(Part 16)
4	Total hardness	mg/L	186.2	IS:3025(Part 21)
5	Calcium	mg/L	40.4	IS:3025(Part 40)
6	Magnesium	mg/L	15.2	IS:3025(Part 46)
7	Total Alkalinity	mg/L	201.1	IS:3025(Part 23)
8	Chloride	mg/L	28.4	APHA 23 rd Edition,4500-ClB,Page:4-75
9	Sulphate	mg/L	21.2	APHA 23 rd Edition,4500-SO ₄ ²⁻ E,Page:4-195
10	Nitrate	mg/L	2.4	APHA 23 rd Edition,4500-NO ₃ B,Page:4-127
11	Residual Chlorine	mg/L	BDL	APHA 23 rd Edition,4500-Cl B,Page:4-63



Report No: 241206_15011336_03
Sample ID No: EETNE/NOV/42/24

Date of Report: 06/12/2024
Date of sample receipt: 29/11/2024

Sl No.	Parameters	Unit	Result	Reference Method
12	Fluoride	mg/L	0.16	APHA 23 rd Edition,4500-F D,Page:4-90
13	Copper	mg/L	0.17	APHA 23 rd Edition,3111 B,Page:3-20
14	Iron(as Fe)	mg/L	0.2	APHA 23 rd Edition,3111 B,Page:3-20
15	Cadmium	mg/L	0.22	APHA 23 rd Edition,3111 B,Page:3-20
16	Lead(as Pb)	mg/L	0.18	APHA 23 rd Edition,3111 B,Page:3-20
17	Zinc	mg/L	0.012	APHA 23 rd Edition,3111 B,Page:3-20
18	Chromium Total	mg/L	0.04	APHA 23 rd Edition,3111 B,Page:3-20
19	Manganese	mg/L	0.029	APHA 23 rd Edition,3111 B,Page:3-20
20	Selenium	mg/L	<0.001	APHA 23 rd Edition,3114A,Page:3-36
21	BOD	mg/L	3.3	IS 3025(Part 44)
22	COD	mg/l	7.2	APHA 23 rd Edition 2017,5220-BPage:5-18

NOTE:(BOD)Biochemical Oxygen Demand,(COD)Chemical Oxygen Demand, (TDS) Total Dissolved Solids, (BDL) Below Detection Limit.


For Envision Enviro Technologies North East

Khairul Islam Sheikh
Environmental Chemist
Test Done By


Utpal Bezbaruah
Technical Manager
Authorized Signatory/ Reviewed by

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End of report

Ground Water Monitoring Result



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TC-7669

TEST REPORT:
 Report No: 241206_15011336_04
 ULR No: TC76692400000541F
 Sample ID No: EETNE/NOV/43/24
 Test Starting Date: 30/11/2024
 Date of Report: 06/12/2024
 Date of sample receipt: 29/11/2024
 Test completion Date: 06/12/2024


Name & Address of Client		M/s. M2M Consulting Consortium Pvt. Ltd., New Delhi.					
Sample Description		Type: Drinking Water	Source: Borewell (Location: Bandana Check Bund to Matmara, Dhakuakhana)				
Sample collected by		M/s. En-vision Enviro Technologies North East					
Sample Collection Particulars		Date 25/11/2024	Time 12:10 P.M	Temperature 30°C	Quantity Drawn:4L	Sampling Method: EETNE/SOP/02	

Sl No.	Parameters	Unit	Result	Reference Method	IS 10500: 2012	
					Acceptable limit	Permissible limit
1	pH	---	7.28	IS 3025 (Part 11) Electrometric Method	6.5-8.5	No relaxation
2	Turbidity	NTU	1.3	IS 3025 (Part 4) Nephelometric Method	1.0	5.0
3	TDS	mg/L	128	IS 3025 (Part 16)	500	2000
4	Total hardness	mg/L	103.2	IS 3025 (Part 21)	200	600
5	Calcium	mg/L	28.9	IS 3025 (Part 40) EDTA Titrimetric Method	75	200
6	Magnesium	mg/L	9.3	IS 3025 (Part 46)	30	100
7	Total Alkalinity	mg/L	126.7	IS 3025 (Part 23)	200	600
8	Dissolved Oxygen	mg/L	4.8	APHA 23 rd Edition 2017,4500-D C,Page:4-146	--	--


Page 1 of 2

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TC-7669


Report No: 241206_15011336_04
 Sample ID No: EETNE/NOV/43/24
 Date of Report: 06/12/2024
 Date of sample receipt: 29/11/2024

Sl No.	Parameters	Unit	Result	Reference Method	IS 10500: 2012	
					Acceptable limit	Permissible limit
9	Chloride	mg/L	16.5	APHA 23 rd Edition 2017,4500-CI B,Page:4-75	250	1000
10	Sulphate	mg/L	10.2	APHA 23 rd Edition 2017,4500-SO4 ²⁻ E,Page:4-199	200	400
11	Nitrate	mg/L	1.1	APHA 23 rd Edition 2017,4500-NO3 ⁻ B,Page:4-127	45	No relaxation
12	Fluoride	mg/L	0.31	APHA 23 rd Edition 2017,4500-F O,Page:4-90	1.0	1.5
13	Copper	mg/L	0.01	APHA 23 rd Edition 2017,3111 B,Page:3-20	0.05	1.5
14	Iron(as Fe)	mg/L	0.24	APHA 23 rd Edition 2017,3500-Fe B,Page:3-80	0.3	No relaxation
15	Cadmium	mg/L	BDL	APHA 23 rd Edition 2017, 3111 B,Page:3-20	0.003	No relaxation
16	Lead	mg/L	BDL	APHA 23 rd Edition 2017, 3111 B,Page:3-20	0.01	No relaxation
17	Zinc	mg/L	0.12	APHA 23 rd Edition 2017, 3111 B,Page:3-20	5	15
18	Total Chromium	mg/L	BDL	APHA 23 rd Edition 2017, 3111 B,Page:3-20	0.05	No relaxation
19	Manganese	mg/L	0.012	APHA 23 rd Edition 2017, 3111 B,Page:3-20	0.1	0.3
20	Selenium	mg/L	BDL	APHA 23 rd Edition 2017, 3114 B,Page:3-36	0.01	No relaxation
21	Arsenic	mg/L	BDL	APHA 23 rd Edition 2017,3114 B,Page:3-36	0.01	0.05

NOTE: TDS (Total Dissolved Solids), BDL (Below Detection Limit)



KHAIRUL ISLAM SHEIKH
Environmental Chemist
Test done by



UTPAL BEZBARUAH
Technical Manager
Authorized Signatory / Reviewed By

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TC-7669

TEST REPORT:

Report No: 241206_15011336_05
ULR No:TC76692400000542F
Sample ID No: EETNE/NOV/44/24
Test Starting Date: 30/11/2024

Date of Report: 06/12/2024
Date of sample receipt: 29/11/2024
Test completion Date: 06/12/2024

Name & Address of Client	M/s. M2M Consulting Consortium Pvt. Ltd., New Delhi.				
Sample Description	Type: Drinking Water	Source: Hand Pump (Location: Bonpuroi Jamuguri, North Lakhimpur)			
Sample collected by	M/s. En-vision Enviro Technologies North East				
Sample Collection Particulars	Date 26/11/2024	Time 12:30 P.M	Temperature 30°C	Quantity Drawn:4L	Sampling Method: EETNE/SOP/02

Sl No.	Parameters	Unit	Result	Reference Method	IS 10500: 2012	
					Acceptable limit	Permissible limit
1	pH	---	7.16	IS 3025 (Part 11) Electrometric Method	6.5-8.5	No relaxation
2	Turbidity	NTU	1.5	IS 3025 (Part 4) Nephelometric Method	1.0	5.0
3	TDS	mg/L	125.6	IS 3025 (Part 16)	500	2000
4	Total hardness	mg/L	105.4	IS 3025 (Part 21)	200	600
5	Calcium	mg/L	29.4	IS 3025 (Part 40) EDTA Titrimetric Method	75	200
6	Magnesium	mg/L	10.1	IS 3025 (Part 46)	30	100
7	Total Alkalinity	mg/L	123.5	IS 3025 (Part 23)	200	600
8	Dissolved Oxygen	mg/L	4.6	APHA 23 rd Edition 2017, 4500-O C, Page:4-146	--	--

Page 1 of 2

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TC-7669


Report No: 241206_15011336_05
Sample ID No: EETNE/NOV/44/24

Date of Report: 06/12/2024
Date of sample receipt: 29/11/2024

Sl No.	Parameters	Unit	Result	Reference Method	IS 10500: 2012	
					Acceptable limit	Permissible limit
9	Chloride	mg/L	14.3	APHA 23 rd Edition 2017, 4500-CI B, Page:4-75	250	1000
10	Sulphate	mg/L	9.4	APHA 23 rd Edition 2017, 4500-SO ₄ ²⁻ E, Page:4-199	200	400
11	Nitrate	mg/L	1.24	APHA 23 rd Edition 2017, 4500-NO ₃ -B, Page:4-127	45	No relaxation
12	Fluoride	mg/L	0.33	APHA 23 rd Edition 2017, 4500-F D, Page:4-90	1.0	1.5
13	Copper	mg/L	0.014	APHA 23 rd Edition 2017, 3111 B, Page:3-20	0.05	1.5
14	Iron(as Fe)	mg/L	0.2	APHA 23 rd Edition 2017, 3500-Fe B, Page:3-80	0.3	No relaxation
15	Cadmium	mg/L	BDL	APHA 23 rd Edition 2017, 3111 B, Page:3-20	0.003	No relaxation
16	Lead	mg/L	BDL	APHA 23 rd Edition 2017, 3111 B, Page:3-20	0.01	No relaxation
17	Zinc	mg/L	0.1	APHA 23 rd Edition 2017, 3111 B, Page:3-20	5	15
18	Total Chromium	mg/L	BDL	APHA 23 rd Edition 2017, 3111 B, Page:3-20	0.05	No relaxation
19	Manganese	mg/L	0.018	APHA 23 rd Edition 2017, 3111 B, Page:3-20	0.1	0.3
20	Selenium	mg/L	BDL	APHA 23 rd Edition 2017, 3114 B, Page:3-36	0.01	No relaxation
21	Arsenic	mg/L	BDL	APHA 23 rd Edition 2017, 3114 B, Page:3-36	0.01	0.05

NOTE: TDS (Total Dissolved Solids), BDL (Below Detection Limit)

For Envision Enviro Technologies North East, Guwahati


KHAIRUL ISLAM SHEIKH
Environmental Chemist
Test done by


UTPAL BEZBARUAH
Technical Manager
Authorized Signatory / Reviewed By

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End of report

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TC-7669

TEST REPORT:

Report No: 241206_15011336_06
ULR No: TC76692400000543F
Sample ID No: EETNE/NOV/45/24
Test Starting Date: 30/11/2024

Date of Report: 06/12/2024
Date of sample receipt: 29/11/2024
Test completion Date: 06/12/2024

Name & Address of Client	M/s. M2M Consulting Consortium Pvt. Ltd., New Delhi.				
Sample Description	Type: Drinking Water	Source: Hand Pump (Location: Rangchali Dalani, Biswanath)			
Sample collected by	M/s. En-vision Enviro Technologies North East				
Sample Collection Particulars	Date 27/11/2024	Time 1:20 P.M	Temperature 30°C	Quantity Drawn:4L	Sampling Method: EETNE/SOP/02

Sl No.	Parameters	Unit	Result	Reference Method	IS 10500: 2012	
					Acceptable limit	Permissible limit
1	pH	---	7.22	IS 3025 (Part 11) Electrometric Method	6.5-8.5	No relaxation
2	Turbidity	NTU	1.7	IS 3025 (Part 4) Nephelometric Method	1.0	5.0
3	TDS	mg/L	121.1	IS 3025 (Part 16)	500	2000
4	Total hardness	mg/L	101.3	IS 3025 (Part 21)	200	600
5	Calcium	mg/L	22.1	IS 3025 (Part 40) EDTA Titrimetric Method	75	200
6	Magnesium	mg/L	7.6	IS 3025 (Part 46)	30	100
7	Total Alkalinity	mg/L	119.4	IS 3025 (Part 23)	200	600
8	Dissolved Oxygen	mg/L	4.4	APHA 23 rd Edition 2017,4500-O C,Page:4-146	--	--

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TC-7669

Report No: 241206_15011336_06
Sample ID No: EETNE/NOV/45/24

Date of Report: 06/12/2024
Date of sample receipt: 29/11/2024

Sl No.	Parameters	Unit	Result	Reference Method	IS 10500: 2012	
					Acceptable limit	Permissible limit
9	Chloride	mg/L	13.2	APHA 23 rd Edition 2017,4500-Cl B,Page:4-75	250	1000
10	Sulphate	mg/L	6.9	APHA 23 rd Edition 2017,4500-SO ₄ ²⁻ E,Page:4-199	200	400
11	Nitrate	mg/L	1.11	APHA 23 rd Edition 2017,4500-NO ₃ ⁻ B,Page:4-127	45	No relaxation
12	Fluoride	mg/L	0.29	APHA 23 rd Edition 2017,4500-F D,Page:4-90	1.0	1.5
13	Copper	mg/L	0.017	APHA 23 rd Edition 2017,3111 B,Page:3-20	0.05	1.5
14	Iron(as Fe)	mg/L	0.26	APHA 23 rd Edition 2017,3500-Fe B,Page:3-80	0.3	No relaxation
15	Cadmium	mg/L	BDL	APHA 23 rd Edition 2017, 3111 B,Page:3-20	0.003	No relaxation
16	Lead	mg/L	BDL	APHA 23 rd Edition 2017, 3111 B,Page:3-20	0.01	No relaxation
17	Zinc	mg/L	0.172	APHA 23 rd Edition 2017, 3111 B,Page:3-20	5	15
18	Total Chromium	mg/L	BDL	APHA 23 rd Edition 2017, 3111 B,Page:3-20	0.05	No relaxation
19	Manganese	mg/L	0.012	APHA 23 rd Edition 2017, 3111 B,Page:3-20	0.1	0.3
20	Selenium	mg/L	BDL	APHA 23 rd Edition 2017, 3114 B,Page:3-36	0.01	No relaxation
21	Arsenic	mg/L	BDL	APHA 23 rd Edition 2017,3114 B,Page:3-36	0.01	0.05

NOTE: TDS (Total Dissolved Solids), BDL (Below Detection Limit)

For Envision Enviro Technologies North East, Guwahati

Khairul Islam Shekh
KHAIRUL ISLAM SHEKH
Environmental Chemist
Test done by

Utpal Bezbaruah
UTPAL BEZBARUAH
Technical Manager
Authorized Signatory / Reviewed By

Note: i) The results relate only to the parameters tested & item sampled.
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TC-7669

TEST REPORT:

Report No: 241206_15011336_07
 ULR No:TC76692400000544F
 Sample ID No: EETNE/NOV/46/24
 Test Starting Date: 30/11/2024

Date of Report: 06/12/2024
 Date of sample receipt: 29/11/2024
 Test completion Date: 06/12/2024

Name & Address of Client	M/s. M2M Consulting Consortium Pvt. Ltd., New Delhi.				
Sample Description	Type: Drinking Water	Source: Hand Pump (Location: Zahaz Ghat, Sonitpur)			
Sample collected by	M/s. En-vision Enviro Technologies North East				
Sample Collection Particulars	Date 28/11/2024	Time 12:55 P.M	Temperature 30°C	Quantity Drawn:4L	Sampling Method: EETNE/SOP/02

Sl No.	Parameters	Unit	Result	Reference Method	IS 10500: 2012	
					Acceptable limit	Permissible limit
1	pH	---	7.47	IS 3025 (Part 11) Electrometric Method	6.5-8.5	No relaxation
2	Turbidity	NTU	1.1	IS 3025 (Part 4) Nephelometric Method	1.0	5.0
3	TDS	mg/L	132.4	IS 3025 (Part 16)	500	2000
4	Total hardness	mg/L	106.4	IS 3025 (Part 21)	200	600
5	Calcium	mg/L	24.3	IS 3025 (Part 40) EDTA Titrimetric Method	75	200
6	Magnesium	mg/L	8.2	IS 3025 (Part 46)	30	100
7	Total Alkalinity	mg/L	116.7	IS 3025 (Part 23)	200	600
8	Dissolved Oxygen	mg/L	4.3	APHA 23 rd Edition 2017, 4500-C, Page:4-146	--	--



TC-7669

Report No: 241206_15011336_07
 Sample ID No: EETNE/NOV/46/24

Date of Report: 06/12/2024
 Date of sample receipt: 29/11/2024

Sl No.	Parameters	Unit	Result	Reference Method	IS 10500: 2012	
					Acceptable limit	Permissible limit
9	Chloride	mg/L	12.4	APHA 23 rd Edition 2017, 4500-CI B, Page:4-75	250	1000
10	Sulphate	mg/L	5.1	APHA 23 rd Edition 2017, 4500-SO ₄ ²⁻ E, Page:4-199	200	400
11	Nitrate	mg/L	1.18	APHA 23 rd Edition 2017, 4500-NO ₃ B, Page:4-127	45	No relaxation
12	Fluoride	mg/L	0.26	APHA 23 rd Edition 2017, 4500-F D, Page:4-90	1.0	1.5
13	Copper	mg/L	0.019	APHA 23 rd Edition 2017, 3111 B, Page:3-20	0.05	1.5
14	Iron(as Fe)	mg/L	0.27	APHA 23 rd Edition 2017, 3500-Fe B, Page:3-80	0.3	No relaxation
15	Cadmium	mg/L	BDL	APHA 23 rd Edition 2017, 3111 B, Page:3-20	0.003	No relaxation
16	Lead	mg/L	BDL	APHA 23 rd Edition 2017, 3111 B, Page:3-20	0.01	No relaxation
17	Zinc	mg/L	0.158	APHA 23 rd Edition 2017, 3111 B, Page:3-20	5	15
18	Total Chromium	mg/L	BDL	APHA 23 rd Edition 2017, 3111 B, Page:3-20	0.05	No relaxation
19	Manganese	mg/L	0.013	APHA 23 rd Edition 2017, 3111 B, Page:3-20	0.1	0.3
20	Selenium	mg/L	BDL	APHA 23 rd Edition 2017, 3114 B, Page:3-36	0.01	No relaxation
21	Arsenic	mg/L	BDL	APHA 23 rd Edition 2017, 3114 B, Page:3-36	0.01	0.05

NOTE: TDS (Total Dissolved Solids), BDL (Below Detection Limit)

For Envision Enviro Technologies North East, Guwahati


Khairul Islam Sheikh
 Environmental Chemist
 Test done by

Utpal Bezbaruah
 Technical Manager
 Authorized Signatory / Reviewed By

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Soil Water Monitoring Result



Enviro Technologies North East
(Recognized by Pollution Control Board, Assam)

Technologies for better tomorrow

SOIL ANALYSIS REPORT

Report No: 241207_15011336_03 Date: 07/12/24


Name & Address of Client	M/s. M2M Consulting Consortium Pvt. Ltd., New Delhi.
Sample Description	Soil collected from Project Site (Location: Zahaz Ghat, Sonitpur)
Date of Sampling	28/11/2024
Sample collected by	M/s. En-vision Enviro Technologies North East

Sl No.	Soil Parameters	Unit	Result	Reference Method
1	pH	---	7.7	Potentiometric
2	Soil type	----	Sandy Clay Loam	Hydrometer
	Sand	%	68	Hydrometer
	Clay	%	19.1	Hydrometer
	Silt	%	7.5	Hydrometer
3	Nitrogen	kg/ha	0.08	Alkaline KMnO ₄
4	Phosphorus	mg/kg	19.6	Olsen method
5	Potassium	mg/kg	8.8	NH ₄ -acetate extraction
6	Electrical conductivity	mS/cm	0.296	Conductivity meter
7	Water holding capacity	%	48	Standard method

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Sl No.	Parameters	Unit	Result	Reference Method
8	Organic matter	%	1	Titrimetric
9	Salinity	mS/cm	2.06	Conductometric
10	Iron	g/100g	1.1	Flame AAS (mg/kg)
11	Copper	mg/kg	7.12	Flame AAS
12	Nickel	mg/kg	8.17	Flame AAS
13	Manganese	g/kg	53.1	Flame AAS (mg/kg)
14	Zinc	mg/kg	28.9	Flame AAS
15	Chloride	mg/kg	77	Argentometric

For En-vision Enviro Technologies North East, Guwahati



UTPAL BEZBARUAH
(Technical Manager)
Authorised Signatory

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SOIL ANALYSIS REPORT

Report No: 241207_15011336_02

Date: 07/12/24

Name & Address of Client	M/s. M2M Consulting Consortium Pvt. Ltd., New Delhi.
Sample Description	Soil collected from Project Site (Location: Rangchali Dalani, Biswanath)
Date of Sampling	27/11/2024
Sample collected by	M/s. En-vision Enviro Technologies North East

Sl No.	Soil Parameters	Unit	Result	Reference Method
1	pH	---	7.5	Potentiometric
2	Soil type	----	Sandy Clay Loam	Hydrometer
	Sand	%	70	Hydrometer
	Clay	%	18.4	Hydrometer
	Silt	%	6.9	Hydrometer
3	Nitrogen	kg/ha	0.05	Alkaline KMnO ₄
4	Phosphorus	mg/kg	19	Olsen method
5	Potassium	mg/kg	9.54	NH ₄ -acetate extraction
6	Electrical conductivity	mS/cm	0.375	Conductivity meter
7	Water holding capacity	%	47.8	Standard method

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Sl No.	Parameters	Unit	Result	Reference Method
8	Organic matter	%	1.8	Titrimetric
9	Salinity	mS/cm	2.87	Conductometric
10	Iron	g/100g	1.26	Flame AAS (mg/kg)
11	Copper	mg/kg	7.7	Flame AAS
12	Nickel	mg/kg	8.9	Flame AAS
13	Manganese	g/kg	50.4	Flame AAS (mg/kg)
14	Zinc	mg/kg	30.3	Flame AAS
15	Chloride	mg/kg	75.5	Argentometric

For En-vision Enviro Technologies North East, Guwahati


UTPAL BEZBARUAH
(Technical Manager)
Authorised Signatory

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SOIL ANALYSIS REPORT

Report No: 241207_15011336_01

Date: 07/12/24

Name & Address of Client	M/s. M2M Consulting Consortium Pvt. Ltd., New Delhi.
Sample Description	Soil collected from Project Site(Location: Bonpuroi to Jamuguri, North Lakhimpur)
Date of Sampling	26/11/2024
Sample collected by	M/s. En-vision Enviro Technologies North East

SI No.	Soil Parameters	Unit	Result	Reference Method
1	pH	---	8.2	Potentiometric
2	Soil type	----	Sandy Clay Loam	Hydrometer
	Sand	%	73	Hydrometer
	Clay	%	16.7	Hydrometer
	Silt	%	8.2	Hydrometer
3	Nitrogen	kg/ha	0.09	Alkaline KMnO ₄
4	Phosphorus	mg/kg	17.7	Olsen method
5	Potassium	mg/kg	8.46	NH ₄ -acetate extraction
6	Electrical conductivity	mS/cm	0.438	Conductivity meter
7	Water holding capacity	%	49.5	Standard method

SI No.	Parameters	Unit	Result	Reference Method
8	Organic matter	%	1.1	Titrimetric
9	Salinity	mS/cm	2.31	Conductometric
10	Iron	g/100g	1.96	Flame AAS (mg/kg)
11	Copper	mg/kg	6.7	Flame AAS
12	Nickel	mg/kg	8.2	Flame AAS
13	Manganese	g/kg	48.3	Flame AAS (mg/kg)
14	Zinc	mg/kg	31.2	Flame AAS
15	Chloride	mg/kg	78.6	Argentometric

For En-vision Enviro Technologies North East, Guwahati


UTPAL BEZBARUAH
 (Technical Manager)
 Authorised Signatory

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SOIL ANALYSIS REPORT

Report No: 241207_15011336_0

Date: 07/12/24

Name & Address of Client	M/s. M2M Consulting Consortium Pvt. Ltd., New Delhi.
Sample Description	Soil collected from Project Site(Location: U/S of Bandana Check Bund to Matmara, Dhakuakhana)
Date of Sampling	25/11/2024
Sample collected by	M/s. En-vision Enviro Technologies North East

Sl No.	Soil Parameters	Unit	Result	Reference Method
1	pH	---	7.9	Potentiometric
2	Soil type	----	Sandy Clay Loam	Hydrometer
	Sand	%	70	Hydrometer
	Clay	%	18.7	Hydrometer
	Silt	%	7.4	Hydrometer
3	Nitrogen	kg/ha	0.07	Alkaline KMnO ₄
4	Phosphorus	mg/kg	19.8	Olsen method
5	Potassium	mg/kg	8.1	NH ₄ -acetate extraction
6	Electrical conductivity	mS/cm	0.568	Conductivity meter
7	Water holding capacity	%	44.5	Standard method

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Sl No.	Parameters	Unit	Result	Reference Method
8	Organic matter	%	1.6	Titrimetric
9	Salinity	mS/cm	1.92	Conductometric
10	Iron	g/100g	2.36	Flame AAS (mg/kg)
11	Copper	mg/kg	5.1	Flame AAS
12	Nickel	mg/kg	7.8	Flame AAS
13	Manganese	g/kg	50.8	Flame AAS (mg/kg)
14	Zinc	mg/kg	33.4	Flame AAS
15	Chloride	mg/kg	80.4	Argentometric

For En-vision Enviro Technologies North East, Guwahati


UTPAL BEZBARUAH
(Technical Manager)
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Appendix 9: Summary of Stakeholder Consultations including Attendance Sheets

Sl. N.	Name of Village	FGD Type	Date of Consultation	Participants		
				Male	Female	Total
1	Amlokhi Bandana (Bahir Bandana)	General	21/11/2024	3	3	6
2	Papung	General	22/11/2024	9	0	9
3	Baghchuk(Kolbari)	Gender	22/11/2024	0	5	5
4	Sonitpur	General	25/11/2024	7	0	7
5	Jarony	General	25/11/2024	12	0	12
6	Jarony	Gender	12/12/2024	0	10	10
7	Paken	General	27/12/2024	14	0	14
8	Rangchali Dalani	General	27/12/2024	11	4	15
9	Jamuguri	General	13/12/2024	8	5	13
10	Jamuguri	Gender	13/12/2024	0	10	10
Total				64	37	101

Issue	Discussion/Suggestion
Loss of Structure/ Loss of Land	The level of vulnerability remains very high in the flood or erosion prone communities and during the consultation with various community groups many hindrances were highlighted that come along with loss of land or shelter and relocation. The inhabitants of these villages are dependent on agriculture as a source of livelihood. But relocation always comes with its own disadvantages affecting income, lifestyle, culture etc. People have already lost huge land and shelter due to erosion and flood over the years Highlighting the response on recent major soil erosion which was in 2020-22 and 2023-24 in which they have lost most of their land and shelter. One statement also came repeatedly that the embankment protection measures are not sustainable.
Environmental impact	While speaking about the impact people have spoken about both positive and negative impact. In terms of negative impact People are anticipating that the construction might leave an impact on the environment as it might create noise and air pollution in that area during the construction period
Gender responsive and Inclusiveness	Women are taking up activities through Self Help Group model where they have access to credit. It eventually supports the holistic development of the family. Women's participation in village/panchayat level politics is also reflected to be limited which came in the responses from the communities.
Educational status and importance of education	There is lack of awareness overall in the community on importance of education and during the consultation respondents stated the poor condition of educational activities in the area which is eventually also leading to high rate of drop out among children. Though in certain places they stated that education is accessible for them and the children goes to

Issue	Discussion/Suggestion
	school on a regular basis. According to them, despite knowing the benefits of education they are unable to access the services due to poverty engagement of children in other activities
Discrimination on the basis of gender	According to the women, they are not entitled to equal pay like man, and the reason stated by the respondent is women do not give much time to work compare to the opposite gender. Some of them also stated that women are physically less capable than men to do certain works which is why women are paid less in those jobs.
Dependency on Water resources	People are dependent on the water resources to some extent. These activities might get limited or restricted due to the construction work. Hence, people have lack of confidence on any kind of interventions, as flood periodically impacts their lifestyle and dependency on other external resources
Rate of compensation	Compensation at replacement cost.
Compensation preference	Willingness for self-relocation but also people prefer compensation and assistance in cash.
Communication and accountability	People prefer to have direct communication with the reliable sources associated to the project. They are also very positive about participating in all the construction activities. A direct and reliable communication between affected people and department would help to ease the communication and avoid any muddle.
Skill based livelihood pattern	The communities are lacking in terms of traditional skill set and on above that no NGOs or institutions are able to reach out to them in order to provide vocational training. It is found that under Assam state rural livelihood mission (ASRLM) the women are engaged in income generating activities though they denied the fact of getting any training on value addition or any other areas or activities.

CONSULTATION ATTENDANCE

Dhakuakhan

List of Participants Vill - Amloki Bandana (Bahir Bandana)					
S.L.	Name	Profession	Age	Sex	Signature
1	Sunil Pegu	Agriculture	45	M	
2	Purba Pegu	" "	40	F	
3	Jummai Doley	" "	25	F	
4	Jyoti Pegu	" "	40	F	
5	Biraban Pegu	Student	18	M	Biraban Pegu
6	Tudra Pegu	Student	20	M	Tudra Pegu
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

List of Participants Vill - Papung					
S.L.	Name	Profession	Age	Sex	Signature
1	Mrigendra Pegu	Agriculture	24	M	Mrigendra Pegu
2	Maidral			M	
3	Nityanand	Student	17		Nityananda Kundu
4	Lakshinath Doley	Business	45	M	Lakshinath Doley
5	Mahamanda Pegu	Business	23	M	
6	Ganesh Malg	Business	34	M	GANESH MALG
7	Rubul	Labour	32	M	
8	Surentra Doley	Agriculture	70	M	
9	Biswanath Doley	Student	19	M	Biswanath Doley
10	Priyanath Doley		26	M	Ghy
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

Lakhimpur

List of Participants Vill - Jamuzuri					
S.L.	Name	Profession	Age	Sex	Signature
1	Nivedita Doley	Govt Pradhan	46	F	Nivedita Doley
2	Malu Patir	Ex Pradhan	50	M	Malu Patir
3	Shivram	Student	23	M	Shivram Pegu
4	Mananati Pegu	Housewife	30	F	Mananati Pegu
5	Manaram Pegu	Labour	51	M	Manaram Pegu
6	Chunamuni Pegu	Housewife	29	F	Chunamuni Pegu
7	Dalim Pegu	Housewife	40	F	Dalim Pegu
8	Robby Pegu	Housewife	46	F	Robby Pegu
9	Ramen Pegu	Labour	30	M	Ramen Pegu
10	Dinach Doley	Agriculture	36	M	Dinach Doley
11	Vijay Doley	Student	27	M	Vijay Doley
12	Krishna Pegu	Business	28	M	Krishna Pegu
13	Bolo Pegu	Labour	20	M	Bolo Pegu
14					
15					
16					
17					
18					
19					
20					

3

List of Participants Vill - Jarony					
S.L.	Name	Profession	Age	Sex	Signature
1	Sri Januki Devi	Student	27	Female	Sri Januki Devi
2	Sri Anu Devi	House wife	22	Female	Anu Devi
3	Sri Pujya Thakur	House wife	28	Female	Anu Pujya Thakur
4	Sri Rabitka Devi	House wife	58	Female	Rabitka Devi
5	Sri Butumaya Devi	House wife	60	Female	Butumaya Devi
6	Sri Bhadrakamaya Devi	House wife	45	Female	Bhadrakamaya Devi
7	Sri Sita Devi	House wife	30	Female	Sita Devi
8	Sri Sangita Devi	Student	23	Female	Sangita Devi
9	Sri Hita Devi	Student	14	Female	Sri Hita Devi
10	Sri Sabita Devi	House wife	36	Female	Sobita DEVI
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

3

Biswanath

List of Participants					
S.L	Name	Profession	Age	Sex	Signature
1	Sri Ajit Kaman	Farmer	35	M	Ajit kaman
2	Sri Melikanta Patra	Farmer	30	M	Melikanta Patra
3	Sri Rajy Kaman	"	35	M	Ajay kaman
4	Ayodhya Patra	"	35	M	Ayodhya
5	Madhab "	"	30	M	Madhab
6	Bali Pegu	"	36	M	Bali Pegu
7	Rabin Patra	"	38	M	Rabin patra
8	Nabam Das	"	36	M	Nabam Das
9	Sabyir Das	Business	20	M	Sabyir Das
10	Santosh Kr.	"	37	M	S. Kumar
11	Ryanikutay	Farmer	45	M	S. Rajorikta
12	Apole Mili	"	40	M	A. M
13	Dev Pegu	"	30	M	Dev Pegu
14	Kaju Das	"	35	M	Kaju Das
15					
16					
17					
18					
19					
20					

List of Participants					
S.L	Name	Profession	Age	Sex	Signature
1	Krishna homa Jain	Agriculture	68	M	Krishna Jain
2	Bhanu Bhakta Upadhyay	Agriculture	46	M	Bhanu Bhakta Upadhyay
3	Punya Upadhyay	Agriculture	73	M	Punya Upadhyay
4	Madhav homa Jain	Agriculture	55	M	Madhav Jain
5	Archana Jwala	Agriculture	40	F	Archana Jwala
6	Nayan Muni Das	Agriculture	30	M	Nayan Muni Das
7	Meena Devi	Agriculture	50	F	Meena Devi
8	Buddhi Upadhyay	Agriculture	40	M	Buddhi Upadhyay
9	Sabya Das	Agriculture	35	M	Sabya Das
10	Dadhi Khatiyara	Agriculture	66	M	Dadhi Khatiyara
11	Uma Khatiyara	Agriculture	46	M	Uma Khatiyara
12	Santanam Das	Agriculture/ Sheepkeeper	48	M	Santanam Das
13	Bhimesh Mala	Agriculture	26	M	Bhimesh Mala
14	Tulumoni Mala	Agriculture	45	F	Tulumoni Mala
15	Hemlata Devi	Agriculture	59	F	Hemlata Devi
16					
17					
18					
19					
20					

Sonitpur

them

List of Participants Vill - Jarony					
S.L.	Name	Profession	Age	Sex	Signature
1	Sri Januki Devi	Student	27	Female	Sri Januki Devi
2	Sri Anu Devi	House wife	22	Female	Anu Devi
3	Sri Pujā Thakur	House wife	28	Female	Anu Pujā Thakur
4	Sri Tabitka Devi	House wife	58	Female	Tabitka Devi
5	Sri Bulumaya Devi	House wife	60	Female	Bulumaya Devi
6	Sri Bhadrakamaya Devi	House wife	45	Female	Bhadrakamaya Devi
7	Sri Sita Devi	House wife	30	Female	Sita Devi
8	Sri Sangita Devi	Student	23	Female	Sangita Devi
9	Sri Hita Devi	Student	14	Female	Hita Devi
10	Sri Sabita Devi	House wife	36	Female	Sobita DEVI
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

3

List of Participants Vill - Jarony					
S.L.	Name	Profession	Age	Sex	Signature
1	Dipak Mohanta	Gram Pradhan		M	Dipak Mohanta
2	Keshav Chhetri	Gram Pradhan	43	M	Keshav Chhetri
3	Guna Bahadur	Agriculture	57	M	Guna Bahadur
4	Kiran Chhetri	Agriculture	60	M	Kiran Chhetri
5	Karna Newar	Agriculture	69	M	Karna Newar
6	Mohini Khatu	Agriculture	76	M	Mohini Khatu
7	Dilip Newar	Driver	23	M	Dilip Newar
8	Ankur Nath	Agriculture	55	M	Ankur Nath
9	Rasanta Nath	Agriculture	38	M	Rasanta Nath
10	Dhan Bahadur Chhetri	Agriculture	49	M	Dhan Bahadur Chhetri
11	Ram Lal Chhetri	Agriculture	60	M	Ram Lal Chhetri
12					
13					
14					
15					
16					
17					
18					
19					
20					

3

Consultation Photographs
Dhakuakhana



Lakhimpur



Biswanath



Sonitpur



INSTITUTIONAL CONSULTATION PHOTOGRAPHS



Consultation with Field Director Kaziranag at FREMAA office



Consultation with DFO, wildlife, and DFO territorial at Biswanath



Consultation with DFO, Sonitpur



Consultation with DFP, Lakhimpur



Consultation with District Commissioner, Sonitpur



Consultation with District Commissioner, Lakhimpur



Consultation with, ADC, Biswanath

Appendix 10: Annual Environmental Monitoring Report Format

I. INTRODUCTION

- Overall project description and objectives
- Environmental category as per ADB Safeguard Policy Statement, 2009
- Environmental category of each project as per national laws and regulations
- Project Safeguards Team

Name	Designation/Office	Email Address	Contact Number
1. PMU			
2. PIUs			
3. Consultants			

- Overall project and subproject progress and status
- Description of projects (package-wise) and status of implementation (preliminary, detailed design, on-going construction, completed, and/or O&M stage)

Package Number	Components/ List of Works	Status of Implementation (Preliminary Design/Detailed Design/On-going Construction/Completed/O&M) ^a	Contract Status (specify if under bidding or contract awarded)	If On-going Construction	
				%Physical Progress	Expected Completion Date

a- If on-going construction, include %physical progress and expected date of completion.

II. COMPLIANCE STATUS WITH NATIONAL, STATE OR LOCAL STATUTORY ENVIRONMENTAL REQUIREMENTS

Package No.	project Name	Environmental Requirements	Status of Compliance	Validity if obtained	Action Required	Specific Conditions that will require environmental monitoring as per Environment Clearance, Consent/Permit to Established

- a- All statutory clearance/s, no-objection certificates, permit/s, etc. should be obtained prior to award of contract/s. Attach as appendix all clearance obtained during the reporting period.
- b- Specify status of compliance (e.g. environmental clearance? Permit/consent to establish? Forest clearance? etc.)
- c- Specify if obtained, submitted and awaiting approval, application not yet submitted.
- d- Example: Environmental Clearance requires ambient air quality monitoring, Forest Clearance/Tree- cutting Permit requires 2 trees for every tree, etc.

III. COMPLIANCE STATUS WITH ENVIRONMENTAL LOAN COVENANTS

No. (List schedule and paragraph number of Loan Agreement)	Covenant	Status of Compliance	Action Required

IV. COMPLIANCE STATUS WITH THE ENVIRONMENTAL MANAGEMENT PLAN (REFER TO EMP TABLES IN APPROVED IEE/s)

- Confirm if IEE/s require contractors to submit site-specific EMP/construction EMPs. If not, describe the methodology of monitoring each package under implementation.
- Identify the role/s of Safeguards Team including schedule of on-site verification of reports submitted by consultants and contractors.
- For each package, provide name/s and contact details of contractor/s' nodal person/s for environmental safeguards.
- Include as appendix all supporting documents including **signed** monthly environmental site inspection reports prepared by consultants and/or contractors.
- With reference to approved EMP/site-specific EMP/construction EMP, complete the table below

Package-wise Implementation Status

Package Number	Component	Design Status (Preliminary Design Stage/ Detailed Design Completed)	Final IEE based on Detailed Design				Site-specific EMP (or Construction EMP) Approved by Project Director? (Yes/No)	Remarks
			Not yet due (detailed design not yet completed)	Submitted to ADB (Provide Date of Submission)	Disclosed on project website (Provide Link)	Final IEE provided to Contractor/s (Yes/No)		

- Provide the monitoring results as per the parameters outlined in the approved EMP (or site-specific EMP/construction EMP when applicable).
- In addition to the table on EMP implementation, the main text of the report should discuss in detail the following items (but not limited to):
 - a. Confirm if any dust was noted to escape the site boundaries and identify dust suppression techniques followed for site/s.
 - b. Identify muddy water was escaping site boundaries or muddy tracks were seen on adjacent roads.
 - c. Identify type of erosion and sediment control measures installed on site/s, condition of erosion and sediment control measures including if these were intact following heavy rain.
 - d. Identify designated areas for concrete works, chemical storage, construction materials, and refueling. Attach photographs of each area.
 - e. Confirm spill kits on site and site procedure for handling emergencies.
 - f. Identify any chemical stored on site and provide information on storage condition. Attach photograph.
 - g. Describe management of stockpiles (construction materials, excavated soils, spoils, etc.). Provide photographs.
 - h. Describe management of solid and liquid wastes on-site (quantity generated, transport, storage and disposal). Provide photographs.

- i. Provide information on barricades, signages, and on-site boards. Provide photographs.
- j. Provide information on checking if there are any activities being under taken out of working hours and how that is being managed.

Overall Compliance with CEMP/EMP

No.	Subproject Name	EMP/ CEMP Part of Contract Documents (Y/N)	CEMP/ EMP Being Implemented (Y/N)	Status of Implementation (Excellent/ Satisfactory/ Partially Satisfactory/ Below Satisfactory)	Action Proposed and Additional Measures Required

V. APPROACH AND METHODOLOGY FOR ENVIRONMENTAL MONITORING OF THE PROJECT

- ⌞ Brief description on the approach and methodology used for environmental monitoring of each project

VI. MONITORING OF ENVIRONMENTAL IMPACTS ON PROJECT SURROUNDINGS (ambient air, water quality and noise levels)

- ⌞ Brief discussion on the basis for monitoring
- ⌞ Indicate type and location of environmental parameters to be monitored
- ⌞ Indicate the method of monitoring and equipment to be used
- ⌞ Provide monitoring results and an analysis of results in relation to baseline data and statutory requirements

As a minimum the results should be presented as per the tables below.

Air Quality Results

Site No.	Date of Testing	Site Location	Parameters (Government Standards)		
			PM10 $\mu\text{g}/\text{m}_3$	SO2 $\mu\text{g}/\text{m}_3$	NO2 $\mu\text{g}/\text{m}_3$

Water Quality Results

Site No.	Date of Sampling	Site Location	Parameters (Government Standards)					
			pH	Conductivity $\mu\text{S}/\text{cm}$	BOD mg/L	TSS mg/L	TN mg/L	TP mg/L

Noise Quality Results

Site No.	Date of Testing	Site Location	LA _{eq} (dBA) (Government Standard)	
			Day Time	Night Time

*Note: add more tables to show results of other monitoring activities.

Summary of Environmental Monitoring Activities (for the Reporting Period)

Impacts (List from IEE)	Mitigation Measures (List from IEE)	Parameters Monitored (As a minimum those identified in the IEE should be monitored)	Method of Monitoring	Location of Monitoring	Date of Monitoring Conducted	Name of Person Who Conducted the Monitoring
Design Phase						
Pre-Construction Phase						
Construction Phase						
Operational Phase						

^{an} Attach Laboratory Results and Sampling Map/Locations

VII. GRIEVANCE REDRESS MECHANISM

Provide information on establishment of grievance redress mechanism and capacity of grievance redress committee to address project-related issues/complaints. Include as appendix Notification of the GRM (town-wise if applicable).

Complaints Received during the Reporting Period. Provide information on number, nature, and resolution of complaints received during reporting period. Attach records as per GRM in the approved IEE. Identify safeguards team member/s involved in the GRM process. Attach minutes of meetings (ensure English translation is provided).

VIII. SUMMARY OF KEY ISSUES AND REMEDIAL ACTIONS

- Summary of follow up time-bound actions to be taken within a set timeframe.

APPENDIXES

- Photos
- Summary of consultations
- Copies of environmental clearances and permits
- Sample of environmental site inspection report
- Other

Appendix 11: Sample Contractor’s Monthly Environmental Monitoring Report Format

(Note: The format may be adjusted as needed based on the actual situation.)

Project Name:

Contract Agreement No:

{Project Name, Contract Package/Lot}

Reporting Period {Month Year}

Submission Date: {Day Month Year}

Executing Agency:

Submitted by: Contractor’s Name

Red text serves as guide for report preparation, please delete it when the report is finalized}

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ANNEXURES

ABBREVIATIONS

Abbreviations

Full Form

Abbreviations

Full Form

Introduction

{Please provide a brief in 2-3 paragraphs.}

{Succinctly convey the details of the contract package, details of construction camps and other temporary facilities}

{Highlight any unanticipated impacts in relation to change in the project scope, locations or alignments of components no matter how minor the contractor considers they may be, construction methods, and/or implementation schedule during the reporting period, if none confirm this.}

{Describe the implementation stage reached (design, pre-construction, construction, commissioning) and the % progress, main project activities and milestones achieved during the reporting period. Report on updates to IEE/EMP that were required during the reporting period, status of delivery of documents, permissions received, required amendments, consultation and disclosure undertaken etc.}

{Include table and/or organogram of environmental safeguards staffing at contractors/subcontractors and relationships between subcontractors, etc. Highlight any changes in the project organization and environmental safeguards staffing during the reporting period, if none confirm this}

Table: Details of Contract

Sl. No.	Contract	Details of Work	District	Contract Amount	Appointed Date	Expected Date of Completion
1						

Source: Contract Agreement

Figure : Location Map

Table: Proposed Interventions/Summary of Construction Work Package X

Particulars	Details	Progress Status
		-
		-
		-
		-
		-
		-

Source:

Project Progress

The contract for was signed on xxx and the xx% physical progress achieved. Details of current progress of works are presented in table below:

Table: Progress of Work Up to Month Year

Sl. No.	Description	Contract Package xxxx
1	Financial progress	
a	Mobilization Advance	Rs. xxx Crores up to date payment Certified
b	Mobilization Advance Recovery	Up to date recovered till end of xxx is xxx, as it is a stage payment of xx%
c	Stage Payment	Up to date Amount certified up to xxx is Rs. xxx Crores out of xxx Crores (xxx %)
2	Pre-Construction Activities	
a	Tree Cutting (if required)	
b	Electric Pole Erection/Shifting (if	

Sl. No.	Description	Contract Package xxxx
	involved)	
c	Applicable Insurances	<ul style="list-style-type: none"> Submitted by as per provision of contract Employee Compensation Insurance valid till xxx Contractor's All Risk Insurance Policy (CAR) valid till xxx Professional Indemnity Insurance policy valid till xxx
3	Design Review	
a	Plan and Profile drawings for xxx	<ul style="list-style-type: none"> Submitted by vide letter no. xxx dated xxx Finalized for: xxx Approved vide letter no. xxx dated xxx
b	Plan and Profile drawings for xxx	<ul style="list-style-type: none"> Submitted by vide letter no. xxx dated xxx Finalized for: xxx Approved vide letter no. xxx dated xxx
c	Plan and Profile drawings for xxx	<ul style="list-style-type: none"> Submitted by vide letter no. xxx dated xxx Finalized for: xxx Approved vide letter no. xxx dated xxx
5	EMP	<ul style="list-style-type: none"> Site specific EMP submitted vide letter no. xxx dated xxx Approved vide letter no. xxx dated xxx
6	QAP and Work Programme	<ul style="list-style-type: none"> QAP submitted by vide letter no. xxx dated xxx Reviewed and approved vide letter no. xxx dated xxx
7	Plant Status	
a	xxx Plant (Hot mix, batching, crusher etc.)	<ul style="list-style-type: none"> Intimation of plant submitted vide letter no. xxx dated xxx Installation and calibration completed, and production started on xxx
b	xxx Plant (Hot mix, batching, crusher etc.)	<ul style="list-style-type: none"> Intimation of plant submitted vide letter no. xxx dated xxx Installation and calibration completed, and production started on xxx
8	Civil work	
A	Survey Work	
a	NGL	<ul style="list-style-type: none"> xxx % completed
b	OGL	<ul style="list-style-type: none"> xxx % completed
c	TBM Fixing	<ul style="list-style-type: none"> xxx % completed
9	Milestone I	<ul style="list-style-type: none"> Milestone date is to be achieved on xxx xxx Works xxx% Completed
10	Milestone II	<ul style="list-style-type: none"> Milestone date is to be achieved on xxx xxx Works xxx % Completed
11	Milestone III	<ul style="list-style-type: none"> Milestone date is to be achieved on xxx xxx % Completed
12	Milestone IV	<ul style="list-style-type: none"> Milestone date is to be achieved on xxx
13	Milestone xxx	<ul style="list-style-type: none"> Milestone date is to be achieved on xxx
14	Physical Progress (%)	<ul style="list-style-type: none"> xxx %

Source:

Site Visits and Review Meetings by Client

{Please provide a brief in one – two paragraphs}

EHS Setup/Organization Chart

{Please provide a brief in one – two paragraphs}

Figure: Organization Chart of EHS Team

Table: Environmental, Health and Safety Staff

Name	Designation	Location	Mobile	Email address	Mobilization Date	Demobilization Date	Total Days Absent in last month	Total present (Months)

Compliance on Environment, Health and Safety Safeguards

Camp Details

{xxx camps, xxx separate labor/operator’s camps besides xxx temporary labor camps for the project have been established. The details of the plants in the camps are given below:}

Table: Details of Camps Established as on Month and Year

Sl. No.	Camp No.	Camp Location	Plants	Unit	Capacity	Clearance	Remarks
1							
2							

Source:

Table: Details of Labor Camps Established as on Month Year

Sl. No.	Camp No.	Camp Location	Occupant (No.)	Grade	Facilities
1					<ul style="list-style-type: none"> Toilets: XX No. Lodging: XX No. Kitchen XX No.
2					<ul style="list-style-type: none"> Toilets: XX No. Lodging: XX No. Kitchen XX No.
3					<ul style="list-style-type: none"> Toilets: XX No. Lodging: XX No. Kitchen XX No.
4					<ul style="list-style-type: none"> Toilets: XX No. Lodging: XX No. Kitchen XX No.
5					<ul style="list-style-type: none"> Toilets: XX No. Lodging: XX No. Kitchen XX No.

Source:

Compliance to Environmental Management Plan

{With reference to the EMP of the project, include a table following sample table below with the compliance status during the reporting period, with sufficient details (evidence) to show how compliance was achieved, or corrective action to be taken if there was non-compliance including timeline and budget}

{Flag if previous environmental monitoring report(s) included corrective action plan, if it did details of that corrective action plan should be incorporated into the EMP table and compliance status reported}

{Provide explanations of any instances where performance standards were temporarily exceeded during the reporting period, along with details of any response taken to rectify the exceedance once identified, even if at the end of the reporting period the project is deemed as being compliant}

{Copies of clearances, CEMP, construction method statements, and other documentation produced in accordance with EMP during the reporting period should be included as an appendix}

Table: Status of EMP as of Month Year

Item #	Requirement	Prior Corrective Action	Remarks {provide sufficient details (evidence) to show how compliance was achieved; or explain the corrective action to be taken if there was noncompliance including timeline and budget}
		Compliance Status {complied; partially complied; not complied; still ongoing or n/a at current stage of the project}	

Status of National/State/ Local Statutory Environmental Requirements

{Status of compliance and further action to ensure ongoing compliance; if there is partial or no compliance recommendations for corrective action are required. Provide explanations of any instances where the requirements of regulations or agreements were breached along with details of responses taken to rectify the breach once identified. Include all the applicable National Regulations and International Agreements following the sample table below attaching copy of the consents/license in the period they were obtained}

Table: Status of Legal Compliance as of Month Year

Sl. No.	Activities	Statutory Authority	Status (Yes, No or Partial only)		Expiry Date	Remarks
			Applied	Obtained		
1	Camp Layout Plan	Engineer			-	
2	NOC letter	District Commissioner			-	
3	Storage, Handling, and Transport of Hazardous Materials	State Pollution Control Board				Consent No. xxx dated xxx
4	Labor License	Labor Commissioner				Consent No. xxx dated xxx
5	Withdrawal of Ground Water for Construction	Ground Water Board				Consent No. xxx dated xxx
6	Registration of Vehicles and PUC	Motor Vehicle Department				-
7	Debris Disposal Sites	Gram Panchayat				Consent No. xxx dated xxx
8	Any other					

Sl. No.	Activities	Statutory Authority	Status (Yes, No or Partial only)		Expiry Date	Remarks
			Applied	Obtained		
	clearances/permits/NOCs					

Source: EPC Contractor

Spoil Disposal Sites and Utilization of Construction Wastes

{Please provide a brief in 2-3 paragraphs. Provide not more than 4 photographs showing before and after scenario}

Figure: Some Photographs of Spoil Disposal Sites

Environmental Supervision and Monitoring Results

{With reference to the contract budget earmarked for EMP (if any) summarize details of budget allocated and the current spend profile}

Table: Status of Budget allocated for EMP and spent as of Month Year

Activity	Allocated Budget (INR)	Budget Spent (INR)	% Spent	Remarks
Total				

Environmental Pollution Monitoring

{Please provide a brief in one – two paragraphs. Provide not more than 1 photograph at each site for each activity}

{Environmental monitoring results – summarize in a table the reporting period’s quantitative monitoring activities and data obtained in accordance with the Environmental Monitoring Plan (EMoP) of the project. Provide explanations of any instances where performance standards were exceeded along with details of responses taken to rectify the exceedance once identified. Attach survey reports}

Typically, this section will include the results of:

- Flora and fauna surveys
- Air quality surveys
- Noise and vibration surveys
- Water quality surveys

{Indicate monitoring locations using a map or plan with grid coordinates, dates, times, duration of samples as applicable, weather conditions as applicable, parameters measured, equipment used, standards, tests, and limits used etc.}

{Corrective actions with timeline and budget are required to ensure any exceedances will be prevented in the future}

{Calibration and QA certifications of monitoring equipment and laboratories analyzing samples should be included as an appendix}

Figure: Photographs Environmental Monitoring

Table: Ambient Air Quality Monitoring Results

Name of sampling site	Geo-Coordinates	Parameters					
		PM ₁₀	PM _{2.5}	SO ₂	NO ₂	CO	Lead
Location xx							
Location xx							
Location xx							
Location xx							
Stack emission of DG Location xx (xx KVA)							
Stack emission of DG Location xx (xx KVA)							
National Ambient Air Quality Standards ⁵⁶		100	60	80	80	4	1
Emission Limits for Diesel generator set up to 800 kW ⁵⁷		0.2		-	4	3.5	-

Source:

Table: Ambient Noise Quality Monitoring Results

Name of sampling site	Geo Coordinates	Parameters		National Standards		Remarks
		Leq (Day)	Leq (Night)	Day time	Nighttime	
Location xx						
Location xx						
Location xx						
Location xx						
DG at Location xx						
DG at Location xx						

Source:

Table: Drinking Water Quality Monitoring Results

Parameters	Location					National Standards (IS 10500:2012)	
	Location xx	Location xx	Location xx	Location xx	Location xx	Acceptable Limit	Permissible Limit
Color						5 max.	15 max.
Odor						Agreeable	Agreeable
Turbidity						1 max.	5 max.
pH						6.5 – 8.5	No Relaxation
Total Dissolved Solids						500 max.	2000 max.
Total Hardness (CaCO ₃)						200 max.	600 max.
Total Alkalinity (CaCO ₃)						200 max.	600 max.

⁵⁶ National Ambient Air Quality Standards, Notification dated 16th November 2009

⁵⁷ Environment (Protection) (Third Amendment) Rules, 2013 dated 11th December 2013, G.S.R. 771(E)

Parameters	Location					National Standards (IS 10500:2012)	
	Location xx	Location xx	Location xx	Location xx	Location xx	Acceptable Limit	Permissible Limit
Chloride (Cl)						250 max.	1000 max.
Fluoride (F)						1.0 max.	1.5 max.
Sulphate (SO ₄)						200 max.	400 max.
Nitrate (NO ₃)						45 max.	No Relaxation
Iron (Fe)						0.3 max.	No Relaxation
Lead (Pb)						0.01 max.	No Relaxation
Zinc (Zn)						5 max.	15 max.
Total Chromium (Cr)						0.05 max.	No Relaxation
Copper (Cu)						0.05 max.	1.5 max.
Calcium (Ca)						75 max.	200 max.
Magnesium (Mg)						30 max.	100 max.
Manganese (Mn)						0.1 max.	0.3 max.
Total Arsenic (As)						0.01 max.	0.05 max.
Total Coliform						Should be absent	No Relaxation
E. Coli						Should be absent	No Relaxation

Source:

Supply and Status of PPE

The details of the PPEs are given in table below:

Table: Status of PPEs on Month Year

SI. No	PPE	Opening Stock	Distributed	Closing Stock	Ordered
	Helmets – Laborers (Yellow)				
	Helmets – Supervisors (color)				
	Helmets – Engineers (color)				
	Helmets – EHS (Green)				
	Helmets – Visitors (color)				
	Helmets – Others (color)				
	Gloves				
	Masks				
	Goggles				
	Safety Shoes				
	Gum boots				
	Safety Tackles				
	Safety Jacket – Laborers (color)				
	Safety Jacket - Engineers (color)				
	Safety Jacket – Others (color)				
	Others, please specify				

Source:

Medical Facilities

Please provide details of the medical facilities including first aid and hospitals in one – two paragraphs.

Table : Details of First Aid/Medical Room on Month Year

Sl. No	Camp	Size (m ²)	No. of First Aider	No. of Beds	Capacity to Treat (No. of Laborers that can be treated)	Compliant with Labor laws
						Yes/No

Table: Details of First Aider as on Month Year

Sl. No	Camp	Name	Qualification	Years of Experience	Deployment Date	Employment Status

Table: Details of Hospitals and Doctors tied up with as on Month Year

Sl. No	Name	Location	Distance from Site	MoU Number	Date of MoU	Facilities offered	Expiry Date

Table: Details of First Aid Boxes in Project Site as on Month Year

Sl. No	Location	Size of Box	Date of last Inspection	Inspected by (Name and Designation)	Status of Inspection

Table: Details of Ambulances in Project Site as on Month Year

Sl. No	Location	Vehicle Type	Vehicle Number	Date of last Inspection	Inspected by (Name and Designation)	Status of Inspection	Fitness Certificate Status

Figure: Photographs of Medical Facilities in camp sites

Not more than 6 photographs

Figure: Photographs of Ambulances in Camp Sites

Not more than 4 photographs

EHS Trainings

Please provide a table/para showing the details of the trainings that are to be conducted as per EPC contract. Details shall include name of training and frequency. The list of attendees to be provided in the annex.

The following programs were conducted during the reporting period:

Table: Training Programs Conducted during Reporting Period

Sl. No	Date	Program Name	Type of Program	Location	No. of Attendees	Faculty/Trainer

Figure: Some Photographs of EHS Training Programs

AIDS and COVID 19 Awareness Camps

The following programs on COVID, 19 HIV/AIDS were conducted during the reporting period:

Table: AIDS and COVID 19 Awareness Programs Conducted during Reporting Period

SI. No	Date	Program Name	Type of Program	Location	No. of Attendees	Faculty/Trainer

Figure: Some Photographs of Awareness Programs

COVID 19 Response and Mitigation (if Relevant during reporting period)

Single Paragraph on steps taken, Any Cases of COVID amongst workers etc.

Compliance on Labor

The details on the compliance of labor are given in sections below

Labor Details

Table : Labor Details as on Month Year

SI. No	Type	Number			Camp Location	Employment Type		
		Local	Outsider	Total		Casual	Outsourced	Permanent
	Unskilled							
	Semi-skilled							
	Skilled							
	Total							

Accident Record

{If there was any near-miss or accident, illness, or other occupational or community health and safety related incident during the reporting period (or a previously reported incident with ongoing rectification) report following the sample table below. Include as appendices work safety checklists, incident reports, and other relevant supporting documents. If no incidents, please confirm}

- Total Man hours preceding month: **xx**
- Total Man hours in reporting month: **xx**
- Total Man hours in project till the end of present month: **xx**
- Total Safe Man hours preceding month: **xx**
- Total Safe Man hours in reporting month: **xx**
- Total Safe Man hours in project till the end of present month: **xx**
- No. of accidents in reporting month: **xx**
- Total Accidents in project: **xx**
- No. of incidents in reporting month: **xx**
- Total Accidents in project: **xx**
- Total near misses in reporting month: **xx**
- Total near misses in Project: **xx**
- Any other points: **xx**

Table: Safety Details on Month Year

Frequency Rate	Severity Rate	Risk Index	Risk Index Factor	Accident Rate	Incident Potential Rate	Frequency of First Aid Case

Table: Accident Details as on Month Year

First Aid Cases	Accidents	Fatality	Incidents	Near Miss	Dangerous Occurrences	Unsafe Acts Observed	Compliance %	Man-hours worked	Man-day lost	Safe Man hours

Table: Safety Details on Month Year

Frequency Rate	Severity Rate	Risk Index	Risk Index Factor	Accident Rate	Incident Potential Rate	Frequency of First Aid Case

Table: Accident Details as on Month Year

First Aid Cases	Accidents	Fatality	Incidents	Near Miss	Dangerous Occurrences	Unsafe Acts Observed	Compliance %	Man-hours worked	Man-day lost	Safe Man hours

Meaningful Consultation

{Meaningful consultation – report on any ongoing consultation undertaken, and main issues raised by consultees; detailed consultation records should be included as an appendix. If no ongoing consultation, please confirm}

Table: Consultations in Month Year

Date	Format/Venue	Participants (Occupation, M/F)	Main Issues Raised

Grievance Redressal

{If there was any grievance or complaint, regardless informal or minor, during the reporting period (or previously reported complaint with ongoing rectification) provide the corrective action taken following the sample table below. Detailed grievance records and response reports should be included as an appendix}

{A paragraph on:

- Procedure for redressal
- No. of grievances received and type
- Status of grievances}

Table : Grievances details as on Month Year

Grievances Received		Grievances Status of last Month		Total till Date Grievances Status	
Last Month	Total till Date	Open	Closed	Open	Closed

Table : Status of Grievances on Month Year

Complainant/s or Affected Persons	Location/s and Date/s of Complaint	Description of Grievance/Complaint	Timeline*	Time-bound Corrective Action

* To be solved within 2 weeks

Follow up Actions and Conclusions

{Summarize the contract's environmental performance during the reporting period based on the previous sections and, if any non-compliance identified, provide detailed recommendations including responsibilities, timeliness and budget for the preparation and completion of corrective action}

{If non-compliance is major or not readily addressed then a separate corrective action plan may need to be prepared. For minor and readily addressed non-compliances the corrective action plan can be incorporated into this final section of the environmental monitoring report following the sample table below}

Table : Follow up actions as on Month Year

Non-compliance	Corrective Action to be Taken	Responsibility	Timeline	Budget

APPENDICES

Photographs {Include relevant photographs of the project site and project area of influence taken during the reporting period to provide evidence of compliance and/or non-compliance. For each photo, provide a caption with description of what it illustrates, accurate location, and date taken}

Supporting Documents {E.g.,

- Maps and plans
- Checklists and reports
- Permits/Clearances/NOCs obtained in Last Month and documentation
- Training records
- Detailed monitoring data, laboratory results etc.
- Calibration and QA certificates
- Consultation records
- Meeting agendas and attendance records
- Grievance records
- Environment, health and safety reports
- EHS Correspondences in Last Month

Appendix 12: Sample Chance find Protocol

Introduction

1. There are possibility of any chance finds (artefacts) recovery during excavations. Contractors working must take additional care not to destroy or damage historic features during excavations. There may be many buried historic features in heritage towns such as – idols, toys, wells, ancient drains, remains of buildings, other walls, grain pits, etc. Every care must be made not to destroy these during excavations.
2. Excavator drivers need to be instructed to be aware of hitting buried features and that they must be investigated before continuing work. When features are encountered during mechanical excavation, work should stop, and the PIU/Consultants engineers must be informed immediately so that they can be inspected at the first opportunity.
3. When historic features such as walls, brick constructions and other features are encountered during excavation the excavation must be stopped immediately, and the PIU/Consultants must be informed immediately.
4. **Contractors' instruction:** As soon as contractor recovers any chance find during any excavation works for pipe laying, they should immediately inform PIU/Consultant present in town about the chance find recovery. Immediately stop the excavation activity near point of recovery. After PIU/consultants engineers come at site, contractor should follow cleaning and photography in supervision of PIU/Consultant engineers.
5. **Cleaning** - When a feature/chance find is discovered it must be defined by careful cleaning. Roots must be removed, and dirt must be carefully cleaned away. The section or trench base should also be cleaned back for a little distance around the feature.
6. **Record photography** – When the feature is clean good photography should be taken – vertical and face-on shots and a few general shots of the feature, also showing its position in relation to surrounding features, buildings, etc. The photographed should be catalogued (date, location, direction of shot)
7. **Drawn record** - When features/chance finds are revealed a drawn record should also be made.
 - a. General location record – measuring its position and orientation within the protected site/in relation to surrounding structures
 - b. Record drawings – detail drawings made in plan and section/profile. The extent (edges) of the feature should be drawn and the level of the existing ground surface and the top and base of the feature should be recorded. These levels should be marked on the drawings. The drawings should include detail of the construction of the feature. Perspective sketches could also be made if necessary. Explanatory notes can also be put on the drawings.
8. **Reporting finds** - When finds are made these should be reported to PIU/Consultants. Photographs and record drawings should be sent.
9. **Discovery of historic objects** - When clearance and excavation takes place artifacts and historic objects are sometimes found. These should be recovered and kept in a safe place. The place of discovery should be recorded, and each find given a number and tag tied to the find with the same number on it. A list of the finds should be kept (with the find No. And place of discovery and date of discovery recorded).
10. **PIU/Consultants responsibility-** PIU/Consultants should inform in written to the State Archaeological Department at the earliest with photographs and request to Archaeology Department to visit the site and hand over the chance finds to them

Appendix 13: Environmental and Social risk analysis

- The process of environmental and social Impact Assessment was accomplished through the review of available documents viz. Detailed Project Reports (DPR), literatures available related project site, site selections etc. Detailed Site visits and field surveys were carried out engaging key experts. The expert during visit interacted with key stakeholders and consultations with host communities.
- The finding of site was used to identify and assess the anticipated environmental and social impacts associated with the proposed project.
- Environmental risk is a function 1- Magnitude of potential consequences (i.e. levels of magnitudes) and likelihood of these consequences to occur (i.e. levels of probability of occurrence). To quantify the environmental risks, the formula is:

Likelihood x Consequence

- First, ratings have been assigned for different levels of likelihood and consequence to determine the level of environmental risks. Each risk has been given as ratings for likelihood and consequence. Examples of ratings are presented below; however, they can be modified by the executive agency as appropriate.

Table1: Likelihood or level of probability

Likelihood		Rating
Likely	Potential to occur more than twice during construction and/or operations	3
Unlikely	May occur once or twice during construction and/or operations	2
Rare	Highly unlikely to occur during construction and/or operations	1

Table 2: Consequence or level of magnitude

Consequences	Consequence or levels of magnitude Consequence	Rating
Major	Significant damage or impact on the natural environment or communities.	3
Moderate	Limited adverse impact on natural environment or communities	2
Minor	No or minimal adverse impact on natural environment or communities.	1

- When all environmental risks are assigned with likelihood and consequence ratings, then the formula is to be applied, and results stated. The E&S ratings show the quantifiable environmental risks. These risks are then to be classified based on the levels of risk. The table below shows the categories of environmental risk based on the formula above.

Table 3: Quantifiable Environmental risk matrix

Likelihood	Likely	3	3	6	9
	Unlikely	2	2	4	6
	Rare	1	1	2	3
Higher 6 and above			1	2	3
Medium 3-5			Minor	Moderate	major
Low 0-2			consequences		

- Definition of Environmental Risk level pertains to High, medium and moderate has been presented below,

Table 4: Definition of Environmental Risk level

High	Significant damage or impact on natural environment or communities For example: <ul style="list-style-type: none"> ✓ Major loss of soil, water resources and water quality due to storm water runoff
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	<ul style="list-style-type: none"> ✓ Significant pollution of soil and water resources including major contamination from hazardous materials ✓ Significant effects on eco systems with isolated deaths of non-vulnerable fauna ✓ Major nuisance or annoyance to communities ✓ Major damage to archaeological or historical sites.
Medium	<p>Limited adverse impact on the natural environment or communities. For example.</p> <ul style="list-style-type: none"> ✓ Localized short-term noticeable changes in storm water quality ✓ Localized and contained pollution of soil resources Short-term minor changes in ecosystem (no death of fauna) ✓ Isolated or partial damage to archaeological or historical sites
Low	<p>No or minimal adverse impact on natural environment or communities. For example.</p> <ul style="list-style-type: none"> ✓ No measurable or noticeable change in storm water runoff and quality remains within tolerable limits ✓ Undetectable effects on soil resources from material storage Minimal effects on modified habitat ✓ No or only isolated few complaints from the community ✓ No or minimal damage to archaeological or historical site

7. Based on the above criteria, the level of risk and their respective rating has been estimated. The level of risk on ambient air, water, soil, noise, land range between minor to moderate level. The risk would mainly during construction stage, though the construction activity area majorly manual in nature. The embankment protection at reach is stacking of sandbags/ geo bags with no machinery interference. Excavator/ Digger machines shall be used for the preparation of site would be major construction equipment in the project. The carriage of material is majorly through boat/ local vendors, vehicles. Based on the Table 5 criteria following table shows the analysis of level of environmental risk and rating.

Table 5. Computation of Environmental risks.

Environmental Risks	Likelihood	Consequence	Rating
Air and Noise Environment			
Increase of dust generation at construction sites	2	2	4
Disruption of livelihood activities along affected reaches	2	2	4
Effect on Air quality due to construction phases- emission	2	2	4
Effect on Noise and vibrations during construction activity	1	2	2
Effect on Air quality due to operation phases- emission	1	1	2
Impact on land			
Acquisition of private land in some patches	2	2	4
and Use Change due to Project Activities and, material Sourcing	1	1	2
Borrow Areas	2	2	4
Soil Compaction and Contamination	2	2	4

Environmental Risks	Likelihood	Consequence	Rating
Wastes from construction activity	2	2	4
Impact on Water			
Effects on River Morphology - Upstream and Downstream Effect	1	1	2
Impact on Silt Deposition and Bed Level Change	1	1	2
Impact on surface/river water quality	2	2	4
Effect on Drainage System	2	1	2
Effect on Wetlands/ Beels	2	1	2
Accidental spillage of fuel and hazardous chemicals	2	1	2
Ecology and biodiversity			
Damage on wildlife habitats due to removal of natural riverbanks	1	1	2
Impact of Dolphins Habitat	1	1	2
Effect on ecology and habitat on long run	1	1	2
Impact on Migratory Route of Fishes	1	1	2
Effect on fishing activity /productivity	2	2	4
Impact of tree felling	2	2	4
Community/occupational health and safety			
Occupational health and hazard to worker/Labour camp	2	2	4
Impact on flood and local community	1	1	1
Socio Economic impact/sourcing of labour-construction and operation stage	2	1	2
Socio Economic impact on livelihood and agriculture on flood plains in long run	2	1	2

Appendix 14. Critical Habitat Assessment

This report summarizes the findings of the Critical Habitat Assessment process for the Project. It identifies the species and habitats with high biodiversity value that both regularly occur in the Project Area of Influence (AoI) and potentially trigger Critical Habitat thresholds. The assessment has been desk-based and involved a review of data from the Integrated Biodiversity Assessment tool (IBAT), the field visits and other reliable data sources. The AoI for this project with 1 km buffer around the project with surrounding protected areas, KBAs, IBAs, natural and modified habitats and proposed emergency intervention works under the project is shown in Figure 1.

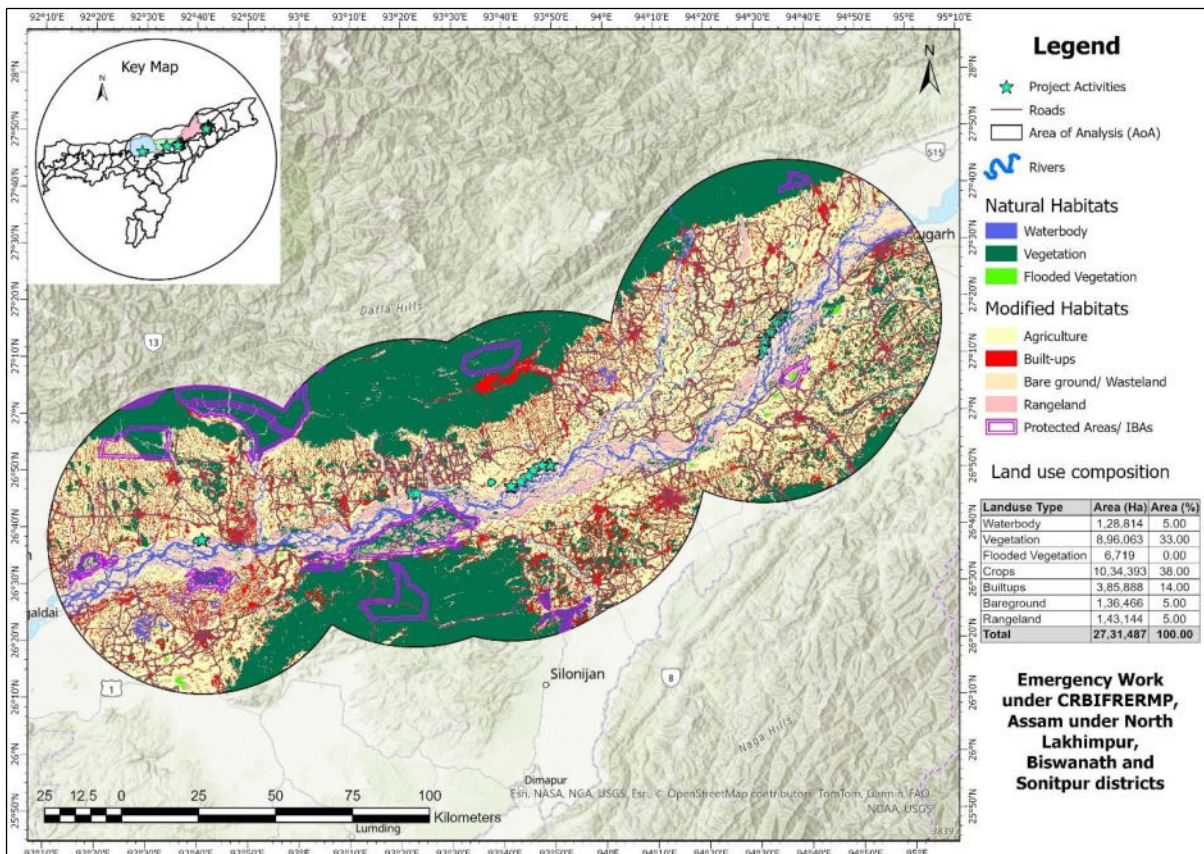


Figure1: Map showing locations of the Area of Analysis, Protected Areas/ Important Bird Area and land use/land cover

Critical Habitat Assessment process

Critical Habitats as defined in the ADB Safeguard Policy Statement (SPS) (2009) is a subset of modified or natural habitats containing high biodiversity values based on specific criteria like threatened species presence, endemism, migratory species concentrations, or unique ecosystems. The process of Critical Habitat Assessment involves scoping of potential biodiversity and ecosystem services issues, utilizing desktop analysis, literature review, stakeholder engagement, and field reconnaissance followed by proposing mitigation hierarchy approach of avoidance, minimize, restore and compensatory offset measures to address potential impacts on biodiversity and ecosystem services. The ADB SPS and IFC PS6 recommends a No Net Loss (NNL) and a Net Positive Impact (NPI) for the Project for which the Critical Habitat was designated. For operating in critical habitat, the project shall ensure that no viable alternatives exist, no measurable adverse impacts on biodiversity values, no net reduction in global or national/ regional populations of Critically Endangered or Endangered species followed by and long-term biodiversity monitoring and evaluation program is implemented.

Critical Habitat assessment is fundamentally based on the following criteria:

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

In order to assess the presence of Critical Habitat, International Finance Corporation (IFC) Guidance Note 6 (GN6) has been adopted throughout this process. IFC GN6 gives specific numerical thresholds that can be applied to the Critical Habitat Requirements set by the ADB SPS. These thresholds are broadly based upon globally standardised numerical thresholds published in IUCN's A Global Standard for the Identification of Key Biodiversity Areas and Red List Categories and Criteria. The thresholds are indicative and serve as a guideline for decision-making only. There is no universally accepted or automatic formula for making determinations on critical habitat.

The first stage of Critical Habitat assessment involves initial screening to examine and identify species and protected sites Project Aol. The 1 km Aol has been considered encompassing project direct and indirect impacts and to characterize the ecological patterns, processes, and functions occurring in the project area. The Integrated Biodiversity Assessment Tool (IBAT) provides much of the foundation data along with recent and reliable field baseline data and additional desk-based study. This data is supplemented with initial review of published and grey literature e.g. Important Bird Areas (IBAs), IUCN Red List of Threatened Species, IFC PS6 GN6 (IFC, 2012, 2019), Biodiversity Conservation and Sustainable Management of Living Natural Resources Guidance Note (EBRD, 2022) and World Database of Key Biodiversity Areas. This initial assessment is made to determine if each species identified regularly occurs (as per IFC GN6) in the Project Aol. The likelihood of regular occurrence is derived by species characteristics including typical geographic range, size, habitat requirements, movement, migratory routes, breeding sites and population distribution etc.

All species that are likely to regularly occur within the project Aol are further assessed to determine the potential to meet ADB SPS critical habitat criteria and are subject to more detailed analysis to confirm if they trigger Critical Habitat.

For certain species an ecologically scaled appropriate area of analysis (AoA) may be required to determine the presence of critical habitat for each species with regular occurrence in the Project's Area of Influence (Aol), or ecosystem by taking into account the distribution of species or ecosystems (within and sometimes extending beyond the project's Aol and the ecological patterns, processes, features, and functions that are necessary for maintaining them). This approach ensures that all important biodiversity within the project footprint and linked surrounding habitats are taken into consideration.

Assam boasts rich biodiversity, with forest cover accounting for 36.09% of its geographical area. The studied districts showcase a diverse range of forest types and contribute significantly to the state's ecological health.

Sonitpur: Contains significant forested areas, including parts of the Nameri National Park and Sonai Rupai Wildlife Sanctuary. Forest cover constitutes 20.59% of the district's area, facing challenges like deforestation and habitat degradation.

Biswanath: Features a mix of forest types, including areas linked to the Kaziranga National Park. It plays a vital role in Assam's biodiversity by providing critical wildlife corridors.

Lakhimpur: Has a smaller proportion of forest cover (13.64% of its total area), primarily open and moderately dense forests. The district holds significance for water catchment and flood control, impacting the Brahmaputra River basin's ecological health.

Assam's protected area network comprises seven national parks and eighteen wildlife sanctuaries, spanning approximately 0.39 million hectares. The project area is located a discrete location along North bank of Brahmaputra River characterised by highly braided riverine network with large flood/ alluvial plain of Brahmaputra River, forest, foothill agricultural and settlements. A significant part of the project influence area is within the transition zone or the land water interface area in the bank of river Brahmaputra. Some part of the project influence area where forest ecosystem is either degraded or modified and natural habitats severely affected by agricultural and other activities. The proposed discrete structures are located in three districts of North Lakhimpur, Biswanath and Sonitpur. Considering the AoI predominantly land use with around 38% of the area falls under agricultural/ fallow land, 33% of the area falls under vegetated and forest land, 14% of built-up areas and 5% area each for waterbodies, hilly/ rangeland and bare ground.

The proposed emergency sites are not falling under any legally Protected Areas (PAs) in India or by any international conservation agencies. As the project does not require forest land diversion and the project is not falling within any protected areas (National Parks, Tiger Reserve and Wildlife Sanctuaries), thus no clearance is required from Forest Department of Assam and from National Wildlife Board, MoEF&CC, Government of India.

There are 15 notified areas within 50 km of the subproject locations: 3 Important Bird Areas (IBAs) and 12 protected areas as shown in Table 1 and in Figure 2.

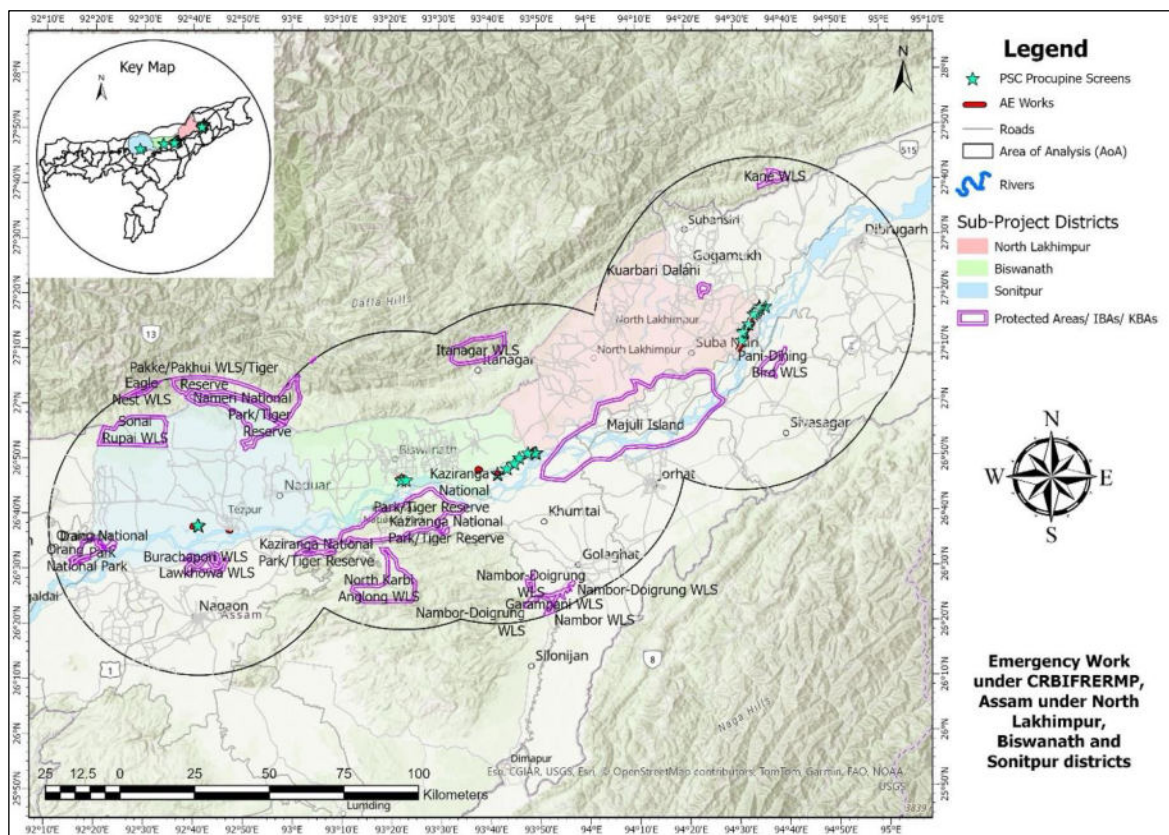


Figure 2: Map showing the Protected Areas/ IBAs/ KBAs within the Project AoA

Table 1: Protected areas within 50 km Buffer of project components

S. No.	Name	Designation	Distance/ Direction	Important Faunal Species
1.	Kaziranga National Park	Protected	6 km South, from Biswanath district	Kaziranga National Park is virtually home to great Indian one horned rhinoceros. Besides, wild buffaloes, swamp deer, hog deer, sambar, elephant, tiger and leopard are also found in KNP. The faunal population of KNP has 35 species of mammals, 42 species of fishes, and 254 species of birds including Bengal florican. Kaziranga National Park is also a "World heritage site" and a "Tiger reserve"
2.	Itanagar WLS	Protected	34 km North, from Sonitpur district	Itanagar Wildlife Sanctuary is a protected area in the Papum Pare. It's a 140.30 square kilometer area that's home to a variety of wildlife, including Sambar, Barking Deer, Antelopes, Langur, Porcupines, Himalayan black bear, Elephant, Tiger, and leopards.
3.	Sonai-Rupai Wildlife Sanctuary	Protected	28 km North, from Sonitpur district	The sanctuary is 45 km from Salonibari Tezpur airport, and it harbours the big four, i.e. Asian Elephant, Tiger, Leopard, and Gaur. The smaller carnivores are Jungle Cat (<i>Felis chaus</i>), Leopard Cat (<i>Prionailurus bengalensis</i>), Golden Jackal (<i>Canis aureus</i>), Large Indian Civet (<i>Viverra zibetha</i>) and Small Indian Civet (<i>Viverricula indica</i>), Sambar (<i>Cervus unicolor</i>), Hog Deer (<i>Axis porcinus</i>) and Barking Deer (<i>Muntiacus muntjak</i>) are found in the sanctuary. Besides, various bird species like White-winged Duck (<i>Cairina scutulata</i>), Bengal Florican (<i>Houbaropsis bengalensis</i>), Swamp Francolin (<i>Francolinus gularis</i>) and the occasional Rufous-necked Hornbill (<i>Aceros nipalensis</i>) etc. Reptilian species like Python, Russell's Viper etc are also found in the sanctuary.
4.	Nameri National Park	Protected	27 km North Sonitpur district	Located in the district of Sonitpur, 40 km from Tezpur town in northern Assam, Nameri National Park is also a tiger reserve under Project Tiger. Nameri is home to a number of globally threatened birds and mammals. Asian Elephant (<i>Elephas maximus</i>) and Tiger (<i>Panthera tigris</i>), Sambar (<i>Cervus unicolor</i>), Hog Deer (<i>Axis porcinus</i>), Barking Deer (<i>Muntiacus muntjak</i>) and Gaur (<i>Bos frontalis</i>). Small mammals like Jungle Cat (<i>Felis chaus</i>), Leopard Cat (<i>Prionailurus bengalensis</i>), Golden

S. No.	Name	Designation	Distance/ Direction	Important Faunal Species
				Jackal (<i>Canis aureus</i>), Large Indian Civet (<i>Viverra zibetha</i>) and Small Indian Civet (<i>Viverricula indica</i>) are some of the smaller predators reported from Nameri. Among the bird species White-winged Duck (<i>Cairina scutulata</i>), Crow-billed Drongo (<i>Dicrurus annectans</i>), Black-backed Forktail (<i>Enicurus immaculatus</i>), Sultan Tit (<i>Melanochlora sultanea</i>), Lesser Necklaced Laughingthrush (<i>Garrulax moniliger</i>), Greater Necklaced Laughingthrush (<i>G. pectoralis</i>), Rufous-necked Laughingthrush (<i>G. ruficollis</i>), Grey Peacock Pheasant (<i>Polyplectron bicalcaratum</i>) and Himalayan Flameblack (<i>Dinopium shorii</i>), Masked Finfoot (<i>Heliopais personata</i>) etc.
5.	Laokhowa and Burhachapori Sanctuaries	Protected	9 km South, from Sonitpur district	Both Laokhowa and Burhachapori are located on the floodplains of the Brahmaputra River. Laokhowa-Burhachapori continues to be one of the important habitats of Indian One-horned Rhinoceros, a globally endangered animal. Other mammals are Elephants (<i>Elephas maximus</i>), Wild Water Buffalo (<i>Bubalus arnee</i>), Tiger (<i>Panthera tigris</i>), Hog Deer (<i>Axis porcinus</i>), Wild Boar (<i>Sus scrofa</i>), Porcupine (<i>Hystrix brachyura</i>), Large Indian Civet (<i>Viverra zibetha</i>), Indian Grey Mongoose (<i>Herpestes edwardsii</i>), Jungle Cat (<i>Felis chaus</i>), Common Otter (<i>Lutra lutra</i>), Clawless Otter (<i>Amblonyx cinereus</i>) and Golden Jackal (<i>Canis aureus</i>).
6.	Pani-Dihing Bird Sanctuary	Protected	8 km South-East from Dhakuakhan sub division	Situated 17 km North of Sibsagar town, the district headquarters, this large wetland complex lies on the south bank of River Brahmaputra, near its confluence with the tributary Disang. Among the avi-faunal species Cattle Egret (<i>Bubulcus ibis</i>), Pond Heron (<i>Ardeola grayii</i>), Chinese Pond Heron (<i>Ardeola bacchus</i>), Little Egret (<i>Egretta garzetta</i>), Purple Heron (<i>Ardea purpurea</i>), Grey Heron (<i>A. cinerea</i>), Little Cormorant (<i>Phalacrocorax niger</i>) and Glossy Ibis (<i>Plegadis falcinellus</i>). Among the mammals Asian Elephants (<i>Elephas maximus</i>), One-horned Rhinoceros (<i>Rhinoceros unicornis</i>) and Tiger (<i>Panthera tigris</i>) are also reported. Common Otters (<i>Lutra lutra</i>) and Hog deer (<i>Axis porcinus</i>), Gangetic dolphin

S. No.	Name	Designation	Distance/ Direction	Important Faunal Species
				(<i>Plantanista gangetica</i>) are occasionally seen.
7.	Kane Wildlife Sanctuary	Protected	39 km North from Sonitpur district	Kane Wildlife Sanctuary lies close to the Assam-Arunachal border. The area is known for the presence of threatened mammals such as Asian Elephant (<i>Elephas maximus</i>), Tiger (<i>Panthera tigris</i>), Asiatic Black Bear (<i>Ursus thibetanus</i>), Wild Dog (<i>Cuon alpinus</i>), and Gaur (<i>Bos frontalis</i>). Avi fauna like White-winged Duck (<i>Cairina scutulata</i>), Rufous-necked Hornbill (<i>Aceros nipalensis</i>) are also reported in few pools deep inside the sanctuary.
8.	Dibru - Saikhowa Complex	Protected	50 km North-East from Dhakuakhana sub division	This is home to many important faunal species including white wing wood duck, hoolock gibbon, wild buffalo, several species of turtles, Gangetic dolphin, golden mahaseer etc. The documented faunal population includes 3 species of amphibians, 22 species of reptiles, 25 species of birds, 25 species of mammals, 62 species of fishes etc. This biosphere reserve is also home to a number of feral horses.
9.	Orang National Park	Protected	25 km Wdistrict est from Sonitpur project sites	Orang National Park is well known as an important habitat the Indian One-horned Rhinoceros (<i>Rhinoceros unicornis</i>) and is situated on the northern bank of the Brahmaputra River. Other mammals are Asiatic Elephant (<i>Elephas maximus</i>), Chinese Pangolin (<i>Manis pentadactyla</i>), Chinese Porcupine (<i>Hystrix brachyura</i>), Small Civet (<i>Viverricula indica</i>), Jungle Cat (<i>Felis chaus</i>), Smooth Indian Otter (<i>Lutrogale perspicillata</i>) and Rufous-tailed Hare (<i>Lepus nigricollis ruficaudatus</i>). Important avifaunal species are Baer's Pochard (<i>Aythya baeri</i>), Blyth's Kingfisher (<i>Alcedo Hercules</i>) and Finn's Weaver or Yellow Weaver (<i>Ploceus megarhynchus</i>), Manipur Bush Quail (<i>Perdicula manipurensis</i>), Black-breasted Parrotbill (<i>Paradoxornis flavirostris</i>) and Marsh Babbler (<i>Pellorneum palustre</i>). Some of the reptiles reported are Indian Tent Turtle (<i>Kachuga tentoria</i>), Brown Roof Turtle (<i>K. smithi</i>), Malayan Box Turtle (<i>Cuora amboinensis</i>), Eastern Hill Terrapin (<i>Melanochelys tricarinata</i>), Spotted Black Terrapin (<i>Geoclemys</i>

S. No.	Name	Designation	Distance/ Direction	Important Faunal Species
				<i>hamiltonii</i> , Indian Softshelled Turtle (<i>Aspideretes gangetica</i>).
10.	Gibbon (Hollongapar) Sanctuary	Protected	50 km South-East from Sonitpur district	Hollongapar Gibbon Sanctuary is located in Jorhat district of eastern Assam. Sanctuary is known for its populations of Hoolock Gibbon (<i>Hylobates hoolock</i>) and Stump-tailed Macaque (<i>Macaca arctoides</i>). Sight records of White-winged Duck (<i>Cairina scutulata</i>) is also reported. Other fauna of the Sanctuary includes Asian Elephant (<i>Elephas maximus</i>), Tiger (<i>Panthera tigris</i>), Leopard (<i>P. pardus</i>), Leopard Cat (<i>Prionailurus bengalensis</i>), Sambar (<i>Cervus unicolor</i>), Barking Deer (<i>Muntiacus muntjak</i>), Wild Boar (<i>Sus scrofa</i>), Chinese Porcupine (<i>Hystrix brachyura</i>), Chinese Pangolin (<i>Manis pentadactyla</i>) and Malayan Giant Squirrel (<i>Ratufa bicolor</i>), Slow Loris (<i>Nycticebus coucang</i>), Assamese Macaque (<i>M. assamensis</i>), Rhesus Macaque (<i>M. mulatta</i>), Pig-tailed Macaque (<i>M. nemestrina</i>), Stump-tailed Macaque, Capped Langur (<i>Trachypithecus pileatus</i>) etc. Indian Rock Python (<i>Python molurus</i>) and a variety of other snakes are also found.
11.	Pakhui or Pakke Wildlife Sanctuary	Protected	26 km North from Sonitpur district	Pakhui Wildlife Sanctuary is bounded to the north and west by the River Bhareli (known as Kameng), to the east by the River Pakke and to the south by the Nameri National Park of Assam. Globally threatened species such as the Rufous-necked Hornbill (<i>Aceros nipalensis</i>), White-winged duck (<i>Cairina scutulata</i>), Pallas's Fish-Eagle (<i>Haliaeetus leucoryphus</i>) and Marsh Babbler (<i>Pellorneum palustre</i>). Besides a good number of Asian Elephant (<i>Elephas maximus</i>), Tiger (<i>Panthera tigris</i>) and Leopard (<i>P. pardus</i>), there is also evidence of presence of Clouded Leopard (<i>Neofelis nebulosa</i>) in the area. Among the reptile Keeled Box Turtle (<i>Pyxedia mouhotii</i>) is also found.
12.	Nambor-Doigrung WLS	Protected	33 km South from Biswanath district	Located in Golaghat district and is well known for elephant, hoolock gibbon, stumped tailed macaque, pig tailed macaque, slow loris, Assamese macaque, rhesus macaque, tiger, leopard, fishing cat, barking deer, sambar, wild pigs, gaur, etc

S. No.	Name	Designation	Distance/ Direction	Important Faunal Species
13.	Majuli Island	IBA	1 km South from Dhakukahan sub district	Majuli Island in the Brahmaputra River is located about 15 km from the district headquarters at Jorhat in eastern Assam. Majuli is known not only for its cultural richness but also for its ecological diversity. The island's wetlands, riverine forests, and water bodies provide a haven for a variety of wildlife, particularly migratory birds like Black-breasted or Black-throated Parrotbill (<i>Paradoxornis nipalensis</i>), Marsh Spotted Babbler (<i>Pellorneum palustre</i>), Jerdon's Babbler (<i>Chrysomma altirostre</i>), Spot-billed Pelican (<i>Pelecanus philippensis</i>),
14.	Jhanjimukh - Kokilamukh	IBA	20 km South-East From Lakhimpur district	This site includes the riverine tracts of the Brahmaputra River near its confluence with one of its tributaries, the Jhanji. Situated 30 km northeast of Jorhat, the district headquarters, this wetland complex is an important site for waterbirds. This IBA is particularly noteworthy for the records of Baer's Pochard (<i>Aythya baeri</i>), which has been listed as Vulnerable. Gangetic Dolphin (<i>Plantanista gangetica</i>) inhabits the rivers, and various turtles are also found
15.	Kuarbari Dalani	IBA	2 km North from Dhakuakhan sub-district	Kuarbari or Koabari is a small marshy area near Dhakuakhana township in Lakhimpur district, eastern Assam. This site attracts a large number of waterfowl including Spot-billed Pelican (<i>Pelecanus philippensis</i>), Greater <i>Leptoptilos dubius</i> and Lesser <i>L. javanicus</i> Adjutants and Asian Openbill (<i>Anastomus oscitans</i>). Critically Endangered Oriental White-backed Vultures (<i>Gyps benghalensis</i>) and Slender-billed vultures (<i>G. tenuirostris</i>) are also seen, but they are widespread, move around a lot and are found in numerous other areas.

The data shows 1,575 species that have the potential to be present within 50 km of the IBAT report. These species by their taxonomic groups and IUCN global threat status are presented in **Table 2**.

Table 2: Species present or potentially present within 50 km IBAT report

Group	Critically Endangered	Endangered	Vulnerable	Near Threatened, Least Concern, Data Deficient	Total
Reptiles	6	9	8	105	128
Birds	8	8	24	636	676
Mammals	1	14	19	100	134

Group	Critically Endangered	Endangered	Vulnerable	Near Threatened, Least Concern, Data Deficient	Total
Amphibians	0	0	4	70	74
Fish	0	2	7	96	105
Invertebrates	3	1	2	227	233
Plants	8	4	9	202	223
Fungi	0	0	1	1	2
Total	26	38	74	1,437	1,575

Critical Habitat

Of the total 1,575 species found within 50 km of the IBAT report, 138 species are recorded to be in critically endangered, endangered and vulnerable category of IUCN red listed of threatened species. Further analysis substantiating with primary survey and desktop review with an Aol confirmed that only 138 potentially regularly occurred species is assessed in the Project Aol that may met the ADB SPS critical habitat criterion. The likelihood of a species regularly occurring in the Aol was informed by its typical range, habitat requirements, movement and migratory routes, breeding sites, populations distributions and so forth.

The results of the assessment for each of the ADB SPS criterion are summarized below. Several species were found to meet more than one ADB SPS critical habitat criterion and have been assessed against each accordingly.

Critical Habitat requirement 1 – Critically Endangered and Endangered Species

ADB requirement for critical habitat criterion 1 is the areas required for the survival of critically endangered or endangered species. The corresponding IFC GN6 guidance for this requirement adds further detail to allow more accurate assessment, and is as follows:

- Areas that support globally important concentrations of an IUCN Red-listed EN or CR species ($\geq 0.5\%$ of the global population AND ≥ 5 reproductive units GN16 of a CR or EN species)
- Areas that support globally important concentrations of an IUCN Red-listed Vulnerable (VU) species, the loss of which would result in the change of the IUCN Red List status to EN or CR and meet the thresholds in GN72(a)
- As appropriate, areas containing important concentrations of a nationally or regionally listed EN or CR species.

Critically Endangered, Endangered, and Vulnerable species and relevant subspecies were included in an initial screening if they were found during surveys, or there is indication of their presence near the project site from literature. Threat status is taken from the global IUCN Red List (IUCN 2020). Comparison with IUCN Red List Extent of Occurrence maps identified the potential for 16 Critically Endangered, 30 Endangered, and 9 Vulnerable species to occur in the Project AoA. This total of 55 candidate species was further reduced to 39 after a quick screening of IUCN distribution maps and marginal occurrence against quantitative thresholds for Critical Habitat (IFC 2019) based on the extremely limited extent of their global distribution known or likely to be within the AoA, it was implausible that they would meet these thresholds. Thus, the 16 discounted species are listed in Table 3 and detailed in Table 5. The remaining 39 are considered in more detail as in Annexure-1.

Table 3: Species with very marginal occurrence, if present at all, in Project AoA

S. No.	Biodiversity type	Scientific name	Common name	IUCN Category
1.	Reptile	<i>Oligodon erythrorhachis</i>	Namsang Kukri Snake	VU
2.	Mammals	<i>Manis pentadactyla</i>	Chinese Pangolin	CR
3.	Mammals	<i>Cuon alpinus</i>	Dhole	EN

S. No.	Biodiversity type	Scientific name	Common name	IUCN Category
4.	Mammals	<i>Manis crassicaudata</i>	Indian Pangolin	EN
5.	Amphibian	<i>Minervarya chilapata</i>	Chilapata Rainpool Frog	VU
6.	Aves	<i>Sarcogyps calvus</i>	Red-headed Vulture	CR
7.	Aves	<i>Gyps tenuirostris</i>	Slender billed Vulture	CR
8.	Aves	<i>Heliopais personatus</i>	Masked Finfoot	CR
9.	Aves	<i>Emberiza aureola</i>	Yellow breasted Bunting	CR
10.	Aves	<i>Perdicula manipurensis</i>	Manipur Bush-quail	EN
11.	Aves	<i>Aquila nipalensis</i>	Steppe Eagle	EN
12.	Aves	<i>Ploceus megarhynchus</i>	Finn's Weaver	EN
13.	Fishes	<i>Amblyceps arunchalensis</i>	-	EN
14.	Fishes	<i>Aborichthys tikaderi</i>	-	VU
15.	Fishes	<i>Aborichthys garoensis</i>	-	VU
16.	Fishes	<i>Devario acuticephala</i>	-	VU

Critical Habitat requirement 2 – Restricted Range Species

ADB requirement two for critical habitat criterion 2 is areas *having special significance for endemic or restricted-range species*. The IFC GN6 defines a terrestrial restricted range species as having an Extent of Occurrence (EOO) less than 50,000 km². The Critical habitat threshold for this requirement is defined as *'areas that regularly hold ≥ 10% of the global population size AND ≥ 10 reproductive units of a species*.

The IBAT tool was used to identify any species potentially present within 50 km that was listed by the IUCN as having an EOO of less than 50,000 km².

The screening process for Criterion 1 and Criterion 2 concluded that five 5 species have the potential to meet the ADB SPS Critical Habitat criteria and either regularly occur in the Project Area or, in accordance with the precautionary approach, were assumed to regularly occur (See Annexure-1).

Out of the all species, 5 species were subject to further analysis. Critical habitat thresholds are potentially triggered for 3 species involving Assam Roofed Turtle (*Pangshura sylhetensis*) as critically endangered species whereas Hog Deer (*Axis porcinus*) and Wild Water Buffalo (*Bubalus arnee*) are in the endangered category as shown in Table 4. The Asiatic Elephant (*Elephas maximus*) and Dolphin (*Platanista gangetica*) are also Endangered and regularly present in the Aol, but its population is not sufficient to trigger Critical Habitat. Further detail and justification for all 39 species analysis are see Annexure-1.

Table 4: Results of the Criterion 1 and Criterion 2 scoping assessment

Scientific name	Common Name	Population Sizes	Assessment Results	CH Conclusion
<i>Pangshura sylhetensis</i>	Assam Roofed Turtle (CR)	Around 10-17 individuals are observed in Kaziranga National Park and 2 species in Nameri National Park only. However it is unlikely that this critically endangered species within project sites to regularly holds ≥ 10% of global population and ≥ 10 reproductive units of the species to qualify as Critical Habitat. No sightings of this species at the project sites.	Unlikely to meet criterion 1 and 2, however requires further survey during works.	Low probability to trigger Critical Habitat
<i>Axis porcinus</i>	Hog Deer (EN)	14,000 -16,000 individuals out of maximum of 16,650 population are reported in Kaziranga National Park which	Unlikely to meet criterion 1, however	Low probability to trigger

Scientific name	Common Name	Population Sizes	Assessment Results	CH Conclusion
		is a stronghold of the species located around 6 km South from the project intervention area. It is very unlikely that project sites will hold population $\geq 0.5\%$ of the global population and ≥ 5 reproductive units to qualify the project area as Critical Habitat. No sightings of this species at the project sites.	requires further survey during works.	Critical Habitat
<i>Bubalus arnee</i>	Wild Water Buffalo (EN)	The global population is almost 4,000 individuals whereas Kaziranga National Park strongholds the species and has reported 2,600 individuals as per the departmental counts in 2011. It is unlikely, that project sites will hold population above 0.5% (with 20 individuals) of the global population to qualify as critical habitat. No sightings of this species at the project sites.	Unlikely to meet criterion 1, requires further survey during works.	Low probability to trigger Critical Habitat
<i>Elephas maximus</i>	Asiatic Elephant (EN)	The global population is estimated to exceed 41,000 individuals, however, based on the baseline data collected through stakeholder consultation residents in the project area at Jaroni of Sonitpur district reported that the area harbour herd of 100-150 individuals of elephant species.	100-150 individuals are not adequate to trigger critical habitat thresholds for this species under Criterion 1	Not Critical Habitat under criterion 1
<i>Platanista gangetica</i>	Dolphin	500 individuals globally known. The population present in the AoA is estimated to be between 9-10 individuals altogether.	9-10 individuals are not adequate to trigger critical habitat thresholds of 25 individuals for this species under Criterion 1	Not Critical Habitat under criterion 1

Avoidance and minimization measures are required, and details must be presented in the IEE to reduce the risk to this species. A Biodiversity Action Plan (BAP) is required to deliver net gain, as required by ADB SPS requirement. The BAP would outline monitoring and adaptive management measures.

Critical Habitat Requirements 3 and 4 – Migratory and Congregatory species

ADB requirements 3 and 4 is relevant to areas *‘that are critical for the survival of migratory species and areas supporting globally significant concentrations or numbers of individuals of congregatory species.*

The relevant IFC Thresholds are as follows:

- Areas known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species at any point of the species’ lifecycle.*
- Areas that predictably support ≥ 10 percent of the global population of a species during periods of environmental stress.*

Although Assam is endowed with many wetlands and important bird areas (IBA) the subproject areas are not in IBAs. Kuarbari Dalani IBA is located near to Dhakuwakhana town in North Lakhimpur district which is located 2 km North of the project intervention work area. Similarly, Majuli island IBA is located 1 km South of the project

intervention work area (PIs refer Table 2). These IBA supports many bird species migrating from breeding grounds further north to overwintering sites in Siberia, Africa, the Middle East, Pakistan etc. There are no ecological or topographical features in the project area that constitute an important stop-off or bottleneck for migrating birds after reviewing the nature of migrating species from available literature that are present near the Project Bengal However, few species viz; Florican (*Houbaropsis bengalensis*), Pallas's Fish eagle (*Haliaeetus leucoryphus*) and Swamp Grass babbler (*Laticilla cinerascens*) needs further assessment of the fly path to establish that individuals pass over the project in passage infrequency.

From all the available data, it can be concluded therefore that the Area of Analysis does not contain any major bottlenecking points for migratory birds, nor is it a key stop-off point, and thus the **Project does not constitute Critical Habitat under Criterion 3 or 4**. See Annexure-1 for a detailed assessment of Criterion 3 and 4.

Critical Habitat Requirement 5 – Evolutionary processes and Ecosystem services

ADB Critical Habitat Requirement 5 is that Critical habitat includes '*areas with unique assemblages of species or that are associated with key evolutionary processes or provide key ecosystem services*'. The IFC GN6 gives some guidance on this, stating that areas associated with Key evolutionary processes tend to have high spatial heterogeneity, which can lead to speciation via isolation or divergent evolution or environmental gradients, also known as ecotones, which produce transitional habitat and are associated with the process of speciation. The study area does not fit these criteria and is the landscape is predominantly modified habitat land followed by natural habitats of a similar type.

The area is also not thought to provide key ecosystem services. **The project area does not contain Critical Habitat under Criterion 5.**

Critical Habitat Requirement 6 – Community importance

ADB Critical Habitat Requirement 6 is that Critical habitat includes '*areas having biodiversity of significant social, economic, or cultural importance to local communities*'.

No Species of significant social, economic or cultural importance have been identified. **Therefore, the project area does not contain Critical Habitat under Criterion 6.**

Critical Habitat Requirement 7 – Protected or designated areas

ADB Critical Habitat Requirement 7 is defined as '*areas either legally protected or officially proposed for protection, such as areas that meet the criteria of the World Conservation Union classification, the Ramsar List of Wetlands of International Importance, and the United Nations Educational, Scientific, and Cultural Organization's world natural heritage sites*'.

There are 2 Important Bird Areas (IBAs), 2 Key Biodiversity Areas (KBAs) and 2 protected areas, within 50km of the Alignment. The closest of these is the Majuli island IBA and Kuarbari Dalani IBA which is some 1 km and 2 km away from project intervention at its closest point respectively. Whilst IBAs are not strictly Critical Habitat Criteria under the ADB SPS (2009) guidance. However, Majuli island IBA and Kuarbari Dalani IBA is globally recognised and in close to the Project careful attention should be given in the IEE to avoid any negative direct or indirect effects.

No protected or designated areas occur within the Area of Impact for this project, and thus **the project area does not contain Critical Habitat under Criterion 7.**

Conclusions

The proposed subprojects may have low probability to trigger critical habitat under ADB SPS requirements for the Assam Roofed Turtle, Hog Deer and Wild Water Buffalo. A number of other vulnerable, endangered and critically endangered species have been identified as present, and whilst they do not trigger critical habitat, will need consideration in project design and monitoring to avoid, reduce, minimize and potentially offset any potential adverse impacts.

The project area is likely to have a much broader migratory flyway with no major nearby wetlands thus no recognized ecological or topographical features that constitute significant stop-off points or bottlenecks in, or in close proximity to, the project area that would result in regular or consistent interaction with the project for any

of these species. The project is therefore not anticipated to lead to significant impacts to these species.

The Assam Roofed Turtle, Hog Deer and Wild Water Buffalo are thought to be at low risk from the project. To avoid and minimize potential adverse impacts during construction (e.g. poaching by workers) the IEE will include that the contractor's environmental officer (EO) includes during toolbox talks and training at contractor camps and on-site awareness raising of the threatened species present and the potential risks to them. There will also be a hunting ban for all workers.

A Biodiversity Action Plan (enclosed as Appendix – 2 of Critical Habitat Assessment) has been prepared to mitigate the potential impact during the execution of project

Table 5: Results of the Criteria initial screening assessment

S. No.	Scientific name	Common name	IUCN Category	Comments/ Justifications	CH Likelihood
Reptiles					
1.	<i>Oligodon erythrorhachis</i>	Namsang Kukri Snake	VU	This Namsang Kukri Snake (<i>Oligodon erythrorhachis</i>) is currently known from only three localities in India. It has been found in Namsang, Jeypore District, Assam (now eastern part of Tirap - A. Captain pers. comm.); Chessa, Papum Pare District (Captain 1997, Bhatt et al. 1998), and from Manas Tiger Reserve in Assam (taken in 2013 - A. Das pers. comm. 2019). Extent of occurrence of 5,354 km ² . Due to restricted range of the species in the forest of another state and Manas Tiger Reserve it is unlikely that the project AoA regularly hold this species.	<i>Discounted</i>
Mammals					
2.	<i>Manis pentadactyla</i>	Chinese Pangolin	CR	Chinese Pangolin (<i>Manis pentadactyla</i>) globally Critically Endangered (Challender et al. 2019; Mahmood et al. 2019) due to its declining trend resulting from treats from hunting for its meat (delicacy) and scales trade or other medicinal importance. This species was reported in the 1980s as common in the undisturbed hill forests, however, little is known about the total population in India (Tikader 1983, Zoological Survey of India 1994). However, trafficking figures suggest this species is under severe hunting pressure in Northeast India (Misra and Hanfee 2000, Mohapatra et al. 2015, D'Cruze et al. 2018). Considering the limited hunting pressure inadequate information on its presence or reported sightings during primary survey within the AoA, it is very unlikely that project AoA to regularly host this species.	<i>Discounted</i>
3.	<i>Cuon alpinus</i>	Dhole	EN	Dhole (<i>Cuon alpinus</i>) is found in Bangladesh; Bhutan; Cambodia; India; Indonesia; Lao People's Democratic Republic; Malaysia; Myanmar; Nepal; Thailand. Estimating the number of "mature individuals" is challenging for Dholes, because they are obligate cooperative breeders (Johnsingh 1982, Venkataraman 1998). Consequently, within a pack the alpha male and female are the parents of the majority of surviving pups (Venkataraman 1998). Although there is relatively high uncertainty with this population estimate, it has a large range, and we feel that it adequately represents the possible population size of Dholes. Global population of 4,500-10,500 individuals, of which only 949-2,215 are mature individuals. In Assam, it is only reported in Manas National Park, so it is unlikely that AoA to regularly host this species.	<i>Discounted</i>
4.	<i>Manis crassicaudata</i>	Indian Pangolin	EN	Indian Pangolin (<i>Manis crassicaudata</i>) is considered globally Endangered, (Challender et al. 2019; Mahmood et al. 2019) due to its declining trend resulting from treats from hunting for its meat (delicacy) and scales trade or other medicinal importance. There is very limited information or data on population of this species at	<i>Discounted</i>

S. No.	Scientific name	Common name	IUCN Category	Comments/ Justifications	CH Likelihood
				project or any level, and generally there is a lack of research on abundance ⁵⁸ . Considering the limited hunting pressure inadequate information on its presence or reported sightings during primary survey within the AoA, it is very unlikely that project AoA to regularly host this species.	
Amphibian					
5.	<i>Minervarya chilapata</i>	Chilapata Rainpool Frog	VU	The species has been recorded in the forest of the Kodalbasti Range of Jaldapara National Park in Alipurduar and Jalpaiguri districts of West Bengal State (Deuti et al. 2017), the Manas Tiger Reserve (on the border with Bhutan), and Orang National Park in Assam State (M.F. Ahmed pers. comm. September 2020). Its elevational range is 50-100 m asl (A. Ohler and K. Deuti pers. comm. January 2012) and occurs in five to ten threat-defined locations and its extent of occurrence (EOO) is 7,488 km ² . Thus, due to its geographic distribution and restricted altitude range between 50m to 100m of the species, it is unlikely that the project AoA to regularly host the species.	<i>Discounted</i>
Aves					
6.	<i>Sarcogyps calvus</i>	Red-headed Vulture	CR	Red-headed Vulture (<i>Sarcogyps calvus</i>) is not reported in Assam and sparsely distributed and declining, now rare or absent from some areas, e.g. parts of Gujarat and the north-eastern states, but still fairly common in the west Himalayan foothills and reported in the Western Ghats between 2006 and 2010 [Ramesh et al. 2011]). Thus, it is unlikely that the project AoA to regularly host the species.	<i>Discounted</i>
7.	<i>Gyps tenuirostris</i>	Slender billed Vulture	CR	Slender billed Vulture (<i>Gyps tenuirostris</i>) is found in India north of, and including, the Gangetic plain, west to at least Himachal Pradesh and Haryana, south to southern West Bengal (and possibly northern Orissa), east through the plains of Assam, and through southern Nepal, and north and central Bangladesh. The total population is therefore thought to be c.1,100-1,300 individuals, roughly equating to 730-870 mature individuals and there is no reporting of the species in the project AoA, so it is unlikely that the project AoA to regularly host the species.	<i>Discounted</i>
8.	<i>Heliopais personatus</i>	Masked Finfoot	CR	Masked Finfoot (<i>Heliopais personatus</i>) is patchily distributed across South-East Asia. The species's stronghold is assumed to be the Sundarbans in Bangladesh (80-160 mature individuals), Myanmar (12-40 mature individuals) and presumably migratory in Cambodia, Vietnam and Laos. There are no recent records from its historical range in Assam and in north-eastern India; however large parts of the area are not well studied (Chowdhury et al. 2020). Total population is estimated to number 108-304 mature individuals in total (Chowdhury et al. 2020 and references therein). The species is not reported in the project area during the primary survey and is not likely to regularly host in the project AoA.	<i>Discounted</i>
9.	<i>Emberiza</i>	Yellow	CR	Yellow breasted Bunting (<i>Emberiza aureola</i>) is widely distributed in Europe and	<i>Discounted</i>

⁵⁸ *A socio-economic survey of pangolin hunting in Assam, Northeast India*

S. No.	Scientific name	Common name	IUCN Category	Comments/ Justifications	CH Likelihood
	<i>aureola</i>	breasted Bunting		South-East Asia and is not reported to regularly host in the project AoA.	
10.	<i>Perdica manipurensis</i>	Manipur Bush-quail	EN	Manipur Bush-quail (<i>Perdica manipurensis</i>) is globally Endangered species is extremely poorly known. It is known from now much-fragmented grasslands in West Bengal, Assam and Manipur (BirdLife International 2020h). The only recent records are from Dibru-Saikhowa WLS in March 1998 and Manas National Park in 2006 Assam. Given no further information on this sighting in the project area, it would not be appropriate at present to not consider the project AoA as Critical Habitat for this species.	<i>Discounted</i>
11.	<i>Aquila nipalensis</i>	Steppe Eagle	EN	Steppe Eagle (<i>Aquila nipalensis</i>) is widely distributed Russia, across Kazakhstan into Kyrgyzstan, and Mongolia. Combined totals from across the whole range estimate the number of pairs at 31,372 (26,014-36,731), which equates to 62,744 (52,028-73,462) mature individuals or 94,116 (78,042-110,193) individuals (I. Karyakin in litt. 2015). The global population is hence below 37,000 pairs (Karyakin et al. 2016). There is no reported occurrence in project AoA so is discounted for further analysis.	<i>Discounted</i>
12.	<i>Ploceus megarhynchus</i>	Finn's Weaver	EN	Finn's Weaver (<i>Ploceus megarhynchus</i>) is endemic to the Terai of the northern Indian subcontinent, where it is known from three disjunct populations: The western population occurs in Delhi, northern Uttar Pradesh and Uttarakhand states, India, and adjacent extreme western Nepal where it is a rare breeding resident and summer visitor. The eastern population occurs from eastern Nepal to Assam in India and the southern population in West-Bengal. It has been recorded in very small numbers from Kaziranga, Orang, Dibru-Saikhowa and Manas National Parks (Assam), Jaldapara Wildlife Sanctuary and Buxa Tiger Reserve (West Bengal), Corbett National Park (Uttar Pradesh), and Suklaphanta National Park and Koshi Tappu Wildlife Reserves (Nepal) (H. Baral and C. Inskipp in litt. 2016) thus do not need assessment due to marginal occurrence.	<i>Discounted</i>
Fishes					
13.	<i>Amblyceps arunchalensis</i>		EN	<i>Amblyceps arunchalensis</i> is reported to be found in the rivers draining to Dikrong River and are not reported in the project AoA so discounted.	<i>Discounted</i>
14.	<i>Aborichthys tikaderi</i>		VU	<i>Aborichthys tikaderi</i> is endemic to Namdapha Wildlife Sanctuary and has also been recorded from 4-5 other locations in northeastern state (Bagra et al. 2009) and Brahmaputra drainage system. However, no adequate information to determine the species current range, and it may be present in other Indian states, including Assam so is discounted.	<i>Discounted</i>
15.	<i>Aborichthys garoensis</i>		VU	<i>Aborichthys garoensis</i> is considered to be Vulnerable since the extent of occurrence < 20,000 km ² accompanied by habitat destruction (due to siltation caused by deforestation and agricultural development) is known from the Garo Hills, Meghalaya (southern tributary of the Brahmaputra) and Dikrong River (northern tributary) (W.	<i>Discounted</i>

S. No.	Scientific name	Common name	IUCN Category	Comments/ Justifications	CH Likelihood
				Vishwanath pers. comm.) Thus, no adequate information to determine the species to present in the project AoA so is discounted.	
16.	<i>Devario acuticephala</i>		VU	<i>Devario acuticephala</i> is restricted to less than 15,000 km ² in range where there is continuing habitat degradation and potential threats to the area of occupancy due to the upcoming dam. It is endemic in the state of Manipur and reported from Dikhu River in Nagaland (Ao <i>et al.</i> 2008) Thus, no adequate information to determine the species to present in the project AoA so is discounted.	<i>Discounted</i>

Appendix 14. Annexure-1: Results of the Criterion 1 and Criterion 2 assessments

S. No.	Scientific name	Common name	IUCN Category	Comments/ Justifications	CH Likelihood
Reptiles					
1.	<i>Nilssonia nigricans</i>	Black Softshell Turtle	CR	Black Softshell Turtle (<i>Nilssonia nigricans</i>) is found in wild along much of the main channel of the Brahmaputra, and its distribution range is currently understood to include the Brahmaputra River and its tributaries. Isolated subpopulations have also been found recently in several temple ponds in Assam and Tripura of Northeast India (Baruah et al. 2010). The species was thought to be restricted to the Bostami tank of Bangladesh until wild individuals were recorded at Bishwanath Ghat, Dibrugarh, Tinsukia and Nameri National Park and also found that <i>N. nigricans</i> were the most common temple turtle species of Assam which were previously misidentified as <i>N. hurum</i> (Anuja Mital, 2020). Small stable populations seem to exist in the protected areas of Kaziranga and Orang in Assam along the Brahmaputra River. There is no population information for this critically endangered species in wild in Brahmaputra River habitats based on the baseline information collected and due to its restricted or endemic range to identified ponds in temples it is unlikely that the project AoA to regularly holds $\geq 10\%$ of global population and ≥ 10 reproductive units of the species to qualify as Critical Habitat.	Not Critical Habitat
2.	<i>Gavialis gangeticus</i>	Gharial	CR	Gharial (<i>Gavialis gangeticus</i>) were common and abundant in the main rivers and tributaries of the Indus, Gangetic and Brahmaputra drainages with extent of occurrence of 3,000 km ² . Saikia et al. (2010) sighted gharial at natural lake localities on the Brahmaputra drainage, with presence confirmed by local inhabitants. National Chambal Sanctuary in north India, spans 625 river km, and contains population comprises 77% (500/650) of the total global gharial population, with >410 nests in 2017, or ~86% of the global nest total (>410/475 nests). Thus, it is unlikely that the project area will hold over 4 individuals of this species to supports $\geq 0.5\%$ of the global population and ≥ 5 reproductive units to qualify the project area as Critical Habitat.	Not Critical Habitat under criterion 1 and assessment under criterion 3
3.	<i>Pangshura sylhetensis</i>	Assam Roofed Turtle	CR	Assam Roofed Turtle (<i>Pangshura sylhetensis</i>) is a small, cryptic species with specialised habitat requirements for clear flowing streams and occurs at a few small localities (associated with forest patches), and adding the area of all of these habitat patches together suggests an area of occupancy of presumably less than 500 km ² and is restricted in distribution to the Brahmaputra and Meghana River systems. In northeast India the species appears to be more widespread in different habitats than traditionally understood and may have larger populations in more locations than historically known whereas a single population survives in Bangladesh in an approximately 15 km stretch of a river in the Southeast. Around 10-17 individuals are observed in Kaziranga National Park and 2 species in Nameri National Park as per Anuja Mital (2020) Freshwater Turtles and Tortoises Foundation.	Low probability to be Critical Habitat under criterion 1 and 2, however requires further survey during works

S. No.	Scientific name	Common name	IUCN Category	Comments/ Justifications	CH Likelihood
4.	<i>Batagur dhongoka</i>	Three striped Roofed Turtle	CR	Three-striped roofed turtle (<i>Batagur dhongoka</i>) is a semi-aquatic species that is native to the Ganges and Brahmaputra River system. Few stable subpopulations are present in protected areas of Chambal and Kaziranga (Anuja Mital, 2020 Freshwater Turtles and Tortoises Foundation). Apparently, there is only a single unconfirmed record from the Brahmaputra basin. The species is now mostly restricted to the National Chambal Sanctuary (India) and Ganga Farakka (India). In the Chambal River, the species is now restricted to a ~100 km stretch, with ~500 nests recorded recently (S. Singh pers. comm. 2018). Based on the distribution of this species it is very unlikely that the project AoA will hold sufficient individuals of this species to supports $\geq 0.5\%$ of the global population and ≥ 5 reproductive units to qualify the project area as Critical Habitat.	Not Critical Habitat
5.	<i>Indotestudo elongata</i>	Elongated Tortoise	CR	Elongated Tortoise (<i>Indotestudo elongata</i>) is widely distributed across South and Southeast Asia. The western most limit of the species range is in in Kaleshar Wildlife Sanctuary in the foothills of Himalayas in the Arravali Range. Global occurrences are in northern and eastern India, Nepal and Bangladesh, Bhutan and much of Myanmar, Thailand and Cambodia, and scattered occurrences in Lao and Vietnam, and extreme northwestern Peninsular Malaysia (Iverson 1992). Local distribution is reported throughout Northeast region, Uttarakhand to North Bengal, Bihar, Odisha; Dhubri and Dima Hasao districts (Dr. Chandra Barooah and Lani Sarma, 2016 Assam Science Technology and Environment Council). Occurrence of single individual is observed in Brahmaputra near protected area of Amchang WLS (Anuja Mital and Sneha Dharwadkar, 2020 Freshwater Turtles and Tortoises Foundation). No adequate information on its presence in project AoA or reported sightings during primary surveys. Based on the distribution of this species it is very unlikely that the project AoA will hold sufficient individuals of this species to supports $\geq 0.5\%$ of the global population and ≥ 5 reproductive units to qualify the project area as Critical Habitat.	Not Critical Habitat
6.	<i>Manouria emys</i>	Asian Giant Tortoise	CR	Global distribution of Asian Giant Tortoise (<i>Manouria emys</i>) occurs from Bangladesh and northeastern India through mid-elevation hilly areas of Myanmar, and western and southern Thailand through Malaysia and Indonesia (including Sumatra and Borneo) (Iverson 1992, Platt et al. 2018) within altitude range from 600m to 1,500m. Locally found in India Assam, Meghalaya, Mizoram, and Nagaland. Only three records of wild individuals have been reported in Assam since 2010, which have all been relocated to the zoo; and ten records from Manipur (S. Singh pers. comm 2018). No adequate information on its presence in project AoA or reported sightings during primary survey. Based on the geographic distribution of this species and the high-altitude range of the species is very unlikely that the project AoA will hold sufficient individuals of this species to supports $\geq 0.5\%$ of the global population and ≥ 5 reproductive units to qualify the project area as Critical Habitat.	Not Critical Habitat

S. No.	Scientific name	Common name	IUCN Category	Comments/ Justifications	CH Likelihood
7.	<i>Cuora amboinensis</i>	Southeast Asian Box Turtle	EN	Southeast Asian Box Turtle (<i>Cuora amboinensis</i>) has a wide distribution, it is found in the Nicobar Islands, eastern India (Assam), Bangladesh, Myanmar, Thailand, Cambodia, Laos, central and southern Vietnam, west Malaysia, Singapore, Philippines, Indonesia and possibly Sri Lanka. Locally distributed in Nagaland, northeastern state of India, Nicobar Islands and throughout Assam. The species was considered not rare in northeast India and the Nicobars by Das (1991), while Choudhury et al. (2000) considered that substantial populations occurred in several northeastern protected areas. The species has been recorded from Galathea National Park (Great Nicobar), D'Ering Wildlife Sanctuary, Kaziranga National Park, Manas Tiger Reserve and Orang Wildlife Sanctuary (Assam). No adequate information on its presence in project AoA or reported sightings during field surveys. Considering the wide geographic distribution in protected areas of this species it is very unlikely that the project AoA supports $\geq 0.5\%$ of the global population and ≥ 5 reproductive units to qualify the project area as Critical Habitat.	Not Critical Habitat
8.	<i>Geoclemys hamiltonii</i>	Spotted Pond Turtle	EN	Spotted Pond Turtle (<i>Geoclemys hamiltonii</i>) inhabits the lowlands of the Indus, Ganga and Brahmaputra River basins of Pakistan; Assam, Bihar, Jammu, Meghalaya, Punjab, Rajasthan, Uttar Pradesh, West Bengal in India; Bangladesh; and Nepal. The species has been recorded from Kaziranga National Park, Orang National Park and Dibru Saikhowa National Park (Assam), Harike Lake (Punjab), and Keoladeo National Park (Rajasthan) in India (Das 1991, Hanfee 1999, Das and Bhupathy 2010); its populations are apparently quite secure at Harike Lake and other lakes in Punjab. Choudhury et al. (2000) considered the species common in the Brahmaputra floodplains and rare elsewhere and rated its population as apparently stable in India. The protected river valley in Assam's Kaziranga-Orang Riverine Landscape (KURL) is an important area for the species future (Ahmed and Das 2010). No adequate information on its presence in project AoA or reported sightings during primary survey. Considering the wide geographic distribution in protected areas of this species it is very unlikely that the project AoA supports $\geq 0.5\%$ of the global population and ≥ 5 reproductive units to qualify the project area as Critical Habitat.	Not Critical Habitat
9.	<i>Hardella thurjii</i>	Crowned River Turtle	EN	Crowned River Turtle (<i>Hardella thurjii</i>) inhabits the Ganga-Brahmaputra basin of northern India and Bangladesh, and the Indus basin of Pakistan and northern India (Iverson 1992; P. Praschag pers. comm. Sept 2005). This species is much rarer in Assam than previously understood; it is highly localized, and possibly now restricted to protected areas (M. Ahmed pers. comm. 2017). The species has been recorded from Kaziranga National Park (Assam), Kanha National Park (MP), Dudhwa National Park, Katarniaghat Wildlife Sanctuary (UP), Keoladeo National Park (Rajasthan) and Harike Lake Wildlife Sanctuary (Punjab) in India (Hanfee 1999, Das and Bhupathy 2009); a record from the Chambal Wildlife Sanctuary has recently been confirmed. Occurrence of single individual is observed in Brahmaputra near protected area of	Not Critical Habitat

S. No.	Scientific name	Common name	IUCN Category	Comments/ Justifications	CH Likelihood
				Kaziranga National Park near Tezpur (Anuja Mital, 2020) Freshwater Turtles and Tortoises Foundation). No adequate information on its presence in project AoA or reported sightings during primary survey. Considering the wide geographic distribution in protected areas of this species it is very unlikely that the project AoA supports $\geq 0.5\%$ of the global population and ≥ 5 reproductive units to qualify the project area as Critical Habitat.	
10.	<i>Morenia petersi</i>	Indian Eyed Turtle	EN	The distribution of Indian Eyed Turtle (<i>Morenia petersi</i>) is restricted to the drainages of the Ganga and the western Brahmaputra rivers at elevations of between 10 to 100 m above sea level. The species has been recorded from Dudhwa Tiger Reserve in Uttar Pradesh, India (Hanfee 1999) and Deepor Beel Ramsar Site, Kaziranga National Park and Pobitora Wildlife Sanctuary in Assam, and may occur in additional protected sites (Das and Sengupta 2010). No adequate information on its presence in project AoA or reported sightings during primary survey. Considering the low altitude range of the species between 10-100 m it is unlikely the project AoA (with elevation above 100 m) will hold $\geq 0.5\%$ of the global population and ≥ 5 reproductive units to qualify the project area as Critical Habitat.	Not Critical Habitat
11.	<i>Nilssonina gangetica</i>	Indian Softshell Turtle	EN	Indian Softshell Turtle (<i>Nilssonina gangetica</i>) is considered one of the most widespread and common turtle species in India occurs throughout the northern plains of the Indian Subcontinent, in the Indus, Ganga, Narmada and Mahanadi basins and most tributaries and intervening drainages of Bangladesh, India, Nepal, Pakistan and Afghanistan (Schneider and Djalal 1970), and the Brahmaputra basin (Das 1995, Iverson 1992, Praschag and Gemel 2002). Participants at the 2005 Red List Workshop considered that the species remained fairly widespread and common in Northeastern India and in Bangladesh but had declined severely elsewhere over the previous 12 years and in places was nearly gone. Currently, <i>Nilssonina gangetica</i> remains widespread and stable in temple ponds. No adequate information on its presence in project AoA or reported sightings during primary survey. There is no population information for this endangered species and considering its wide geographic distribution of this species it is very unlikely that the project AoA supports $\geq 0.5\%$ of the global population and ≥ 5 reproductive units to qualify the project area as Critical Habitat.	Not Critical Habitat
12.	<i>Nilssonina hurum</i>	Indian Peacock Softshell Turtle	EN	Indian Peacock Softshell Turtle (<i>Nilssonina hurum</i>) occurs throughout the Indus, Ganga and Brahmaputra basins of Bangladesh, northern India, southern Nepal and Pakistan (Iverson 1992, Das 1995, Praschag and Gemel 2002, Das et al. 2010). <i>Nilssonina hurum</i> inhabits rivers, lakes and ponds (Das 1991, 1995) and is most commonly traded in Assam and Tripura for consumption. No adequate information on its presence in project AoA or reported sightings during primary survey. There is no population information for this endangered species and considering its wide geographic distribution of this species it is very unlikely that the project AoA supports	Not Critical Habitat

S. No.	Scientific name	Common name	IUCN Category	Comments/ Justifications	CH Likelihood
				≥ 0.5% of the global population and ≥ 5 reproductive units to qualify the project area as Critical Habitat.	
13.	<i>Cuora mouhotii</i>	Keeled Box Turtle	EN	Keeled Box Turtle (<i>Cuora mouhotii</i>) occurs in scattered, disjunct occurrences in northeast India, and northern Myanmar. Very limited population data are available, suggesting that the species is locally uncommon to moderately common in suitable habitat. Choudhury et al. (2000) noted the species as apparently common in the north Cachar Hills, Assam, and Namdapha Tiger Reserve, though Praschag (pers. comm. 2005). The species is geographically restricted within altitude range from 350m to 1,200 m. No adequate information on its presence in project AoA or reported sightings during primary survey. Due to restricted altitude range of the species 350m to 1,200m, it is unlikely that the project AoA to supports significant population ≥ 0.5% of the global population and ≥ 5 reproductive units to qualify the project area as Critical Habitat.	Not Critical Habitat
14.	<i>Manouria impressa</i>	Impressed Tortoise	EN	This Impressed Tortoise (<i>Manouria impressa</i>) is known to inhabit forests and mountainous areas, in dense undergrowths at an altitude of 700 to 2,000 feet. <i>Manouria impressa</i> is generally distributed over southeast Asia, including Myanmar, Cambodia, Thailand, the Langbian Plateau of Vietnam, and Peninsular Malaysia. Regional distribution of this species is only in northeastern state of India. No adequate information on its presence in project AoA or reported sightings during primary survey. Considering the high-altitude range of the species between 700-2000 feet it is unlikely the project AoA (with elevation below 700 feet) to supports significant population ≥ 0.5% of the global population and ≥ 5 reproductive units to qualify the project area as the project area as Critical Habitat.	Not Critical Habitat
15.	<i>Melanochelys tricarinata</i>	Tricarinate Hill Turtle	EN	Tricarinate Hill Turtle (<i>Melanochelys tricarinata</i>) inhabits the Himalayan foothill from western Uttar Pradesh to northern and northeastern India (with an isolated occurrence in southern Bihar/western West Bengal) and southern Nepal (Iverson 1992, Das 1995, Choudhury et al. 2000). The species appears to be rare and is poorly known to occur in Assam and reported in Pobitora Wildlife Sanctuary, Orang NP, Kaziranga NP, Manas Tiger Reserve, Sonapur and Biswanath plain (Dr. Chandra Barooah and Lani Sarma (2016) Assam Science Technology and Environment Council). No adequate information on its presence in project AoA or reported sightings during primary survey and considering its wide geographic distribution of this species it is very unlikely that the project AoA supports ≥ 0.5% of the global population and ≥ 5 reproductive units to qualify the project area as Critical Habitat.	Not Critical Habitat
Mammals					
16.	<i>Platanista gangetica</i>	Ganges River Dolphin	EN	Ganges River Dolphin (<i>Platanista gangetica</i>) potentially occurs in the Zahajghat area of Brahmaputra River of Sonitpur district. Two (2) Dolphins were directly sighted in the Zahajghat area at a distance of 100 meters from the riverbank during the biodiversity survey. Consultation with locals also confirms that 3-4 individuals are regularly sighted in the Zahajghat area. Findings by Qureshi et al. (2022), also aligns	Not Critical Habitat under criterion 1 but need further survey during

S. No.	Scientific name	Common name	IUCN Category	Comments/ Justifications	CH Likelihood
				<p>with the region designated as moderate sighting area for the species in Sonitpur district.</p> <p>On the other hand, there was no direct sighting during surveys, however extremely rare sighting by local residents with 1-2 individuals during peak monsoon at Jaroni area in Sonitpur district.</p> <p>Similarly, there was no direct sighting during survey, however rare sighting by local residents with 4-5 individuals during peak monsoon at Bandana to Matmora and Baligaon to Papung stretch of the Brahmaputra River of North Lakhimpur district. Findings by findings by Qureshi et al. (2022), which categorize the region as a low-sighting zone for the species in North Lakhimpur district.</p> <p>Similarly, no direct sighting during survey, however rare sighting by local residents with 1-2 individuals during peak monsoon at Bonpuroi Jamuguri stretch of the Brahmaputra River of North Lakhimpur district. Findings by findings by Qureshi et al. (2022), which categorize the region as a low-sighting zone for the species in North Lakhimpur district. No direct sighting during survey however extremely rare sighting by local residents with 1-2 individuals during peak monsoon at Paken and Rangchali Dalani area in Bishwanath district.</p> <p>Thus, considering all together 9-10 individuals is reported in the project area, and it is unlikely that the project AoA supports more than 25 individuals $\geq 0.5\%$ of the global population and ≥ 5 reproductive units to qualify the project area as Critical Habitat.</p>	works
17.	<i>Axis porcinus</i>	Hog Deer	EN	<p>Hog Deer (<i>Axis porcinus</i>) is found mainly in the Terai grasslands along the Himalayan foothills and the floodplains of the Rivers Ganges and Brahmaputra, from Punjab in the west to northeastern state of India (Tandon 1989, Johnsingh et al. 2004, Biswas 2004)</p> <p>A recent assessment of Northeast India, one of the species' have major strongholds, revealed that substantial local subpopulations persist in Assam, with notable numbers in northern West Bengal (Choudhury, 2013). However, in Assam, sharp declines have been observed outside protected areas, particularly in the Lakhimpur and Dhemaji districts (Choudhury, 2007). A small but stable subpopulation exists in Manipur, alongside scattered individuals in other states of the region.</p> <p>Assessments conducted specifically for Hog Deer by Biswas et al. (2002; see also Biswas 2004) with 20–50 in Dibru-saikhowa, over 14,000 -16,000 in Kaziranga National park, 20–50 in Nameri, 200–500 in Orang, 20–50 in Burachapori shows that</p>	Low probability to be Critical Habitat under criterion 1

S. No.	Scientific name	Common name	IUCN Category	Comments/ Justifications	CH Likelihood
				a maximum of 16,650 population are reported in the protected area falling within the project AoA and Kaziranga National park major strongholds with at ecological densities of 38.6 (with SE 3.45) animals per km ² (Karanth and Nicholls 2000, N.S. Kumar pers. comm. 2008).	
18.	<i>Ailurus fulgens</i>	Red Panda	EN	Red Panda (<i>Ailurus fulgens</i>) distribution is along Nepal (2010), Myanmar (2012), and India and Bhutan (2013). In Nepal Red Panda has been reported from 23 districts. In Myanmar it is known only from the northernmost state, Kachin, and is locally distributed even there (Than Zaw et al. 2008). It is found in three provinces, Sichuan, and Yunnan. In India it is found in only three states: Sikkim, West Bengal and northeastern state of India. Red Panda occurs in a narrow altitude band between 2,300 to 4,000 m (Roberts and Gittleman). Due to restricted altitude range between 2,300m to 4,000m of the species, it is unlikely that the project AoA will hold population ≥ 0.5% of the global population and ≥ 5 reproductive units to qualify the project area as Critical Habitat.	Not Critical Habitat
19.	<i>Caprolagus hispidus</i>	Hispid Hare	EN	The current distribution Hispid Hare (<i>Caprolagus hispidus</i>) includes the countries of Bangladesh, India, Nepal, and Bhutan (Jordan et al. 2005, Yadav et al. 2008, Aryal et al. 2012, Tandan et al. 2013, Nath and Machary 2015, Nidup et al. 2015, Khadka et al. 2017). The area of occupancy for the Hispid Hare has been estimated to be <500 km ² , in highly fragmented populations in widely disparate localities (Jordan et al. 2005). During the mid-1960s there was speculation that the Hispid Hare had gone extinct, however, the capture of a live specimen in 1971 in the Barnadi Wildlife Sanctuary, northwest Assam, confirmed that the species was persisting (Maheswaran 2002). Due to the limited geographic less than 500 km ² and altitude range of the species between 100m to 250m, it is unlikely that AoA regularly holds population ≥ 0.5% of the global population and ≥ 5 reproductive units to qualify the project area as Critical Habitat.	Not Critical Habitat
20.	<i>Elephas maximus</i>	Asian Elephant	EN	Asian Elephant (<i>Elephas maximus</i>) is considered globally Endangered. The elephants in north-eastern India together with those of Bhutan, Bangladesh, Nepal and Myanmar had an almost continuous distribution with estimated population of 11,000 elephants in north-eastern states of India ⁵⁹ . In eastern Assam, the range also covers part of the floodplains of the Brahmaputra and the Lohit rivers. This long range (about 750 km) is almost continuous; the few gaps are crossed easily by the elephants. This population is, however, not entirely restricted to the north bank; in the easternmost part, the pachyderms regularly cross over to the Dibru-Saikhowa Sanctuary and widely travelling in Assam, northeastern state of India, Meghalaya and Manipur, visits were made to Nagaland, Mizoram, Tripura, north Bengal and parts of	Not Critical Habitat under criterion 1 but need further survey during works.

⁵⁹ Status and conservation of the Asian Elephant *Elephas maximus* in north-eastern India

S. No.	Scientific name	Common name	IUCN Category	Comments/ Justifications	CH Likelihood
				Bhutan and Myanmar, as well as the borders of Sikkim and Bangladesh. The global population is estimated to exceed 41,000 individuals, and its distribution in the project area is limited by habitat loss, degradation and poaching. Based on the baseline data collected through stakeholder consultation residents in project area at Jarani of Sonitpur district reported that the area harbour herd of 100-150 individuals of elephant species. It is therefore unlikely that the project AoA holds may more than 200 individuals, as would be necessary to meet Critical Habitat thresholds (IFC 2019).	
21.	<i>Panthera tigris</i>	Tiger	EN	The species is found in Bangladesh; Bhutan; India, Indonesia, Malaysia Myanmar; Nepal; Russian Federation Thailand. The Global Tiger population estimate of between 3,726 and 5,578 individuals with the number of mature individuals between 2,608 and 3,905 with the best estimate of 3,140. India has a minimum of 3,167 tigers which accounts for more than 70% of the world's wild tiger population (International Tiger Day 2024 Report). Total number of 227 Tigers is reported as of 2022 ⁶⁰ mainly reported in Manas National Park, Orang National Park and Northeastern Hills and Brahmaputra Plains Landscape. Thus, it is unlikely that project AoA holds >28 individuals, as would be necessary to meet Critical Habitat thresholds (IFC 2019). As such, this species does not qualify the Project area as Critical Habitat.	Not Critical Habitat
22.	<i>Nycticebus bengalensis</i>	Bengal Slow Loris	EN	Bengal Slow Loris (<i>Nycticebus bengalensis</i>) occurs in Bangladesh, Cambodia West of the Mekong River, north-eastern India, Lao PDR, Myanmar, Thailand north of the Isthmus of Kra, and Vietnam. In India, the encounter rates vary from 0.1 to 0.77/km (Radhakrishna <i>et al.</i> 2006). In 2014, densities of <i>N. bengalensis</i> had declined to a range of 0.06-0.20 individuals/km (Das <i>et al.</i> 2015). This species is reported in variety of habitats like Amsang WLS, Barnadi WLS, Basistha RF, Bherjan Borajan Podumani WLS, Borlander RF, Borail RF, Borajan WS, Burachapori WLS, Chakrasila WLS, Chirrang RF, Dehing Patkai WS, Dhansiri RF, Dibru Saikhuwa NP, Garampani WLS, Gibbon WLS, Goalpara, Innerline RF, Jeypore RF, Kaziranga NP, Langting Mupa RF, Laokhowa WLS, Manas NP, Nameri NP, Nambor-Doigurung WLS, Sonai Rupai WLS, Ranni RF, Pobitora WLS. No adequate information on its presence in project AoA or reported sightings during primary survey and considering the wide distribution of the species it is unlikely that the project AoA will hold $\geq 0.5\%$ of the global population and ≥ 5 reproductive units to qualify the project area as Critical Habitat.	Not Critical Habitat
23.	<i>Trachypithecus pileatus ssp. Brahma</i>	Capped Langur	EN	Capped Langur (<i>Trachypithecus pileatus</i>) occurs in Bangladesh, Bhutan and northwestern Myanmar. In India, capped langurs are found in Assam, northeastern state of India, Manipur, Meghalaya, Mizoram, Nagaland and Tripura. Widely distributed in the highlands south and east of the Brahmaputra and west of the Chindwin; in Myanmar found in the Chin Hills south to Mount Victoria; in India, the	Not Critical Habitat

⁶⁰ *Tiger Census 2022 Report - Tiger Population in 2022 - Big Cats India - Customised Tiger Safari in India*

S. No.	Scientific name	Common name	IUCN Category	Comments/ Justifications	CH Likelihood
				<p>Karbi Anglong, Khasi, Garo, Naga, and Jaintia Hills, Lakhimpur, Golaghat, Cachar Hills, Samaguting, and Sibsagar (Groves 2001) along with the Karbi Plateau and the Barail Range in Assam (Groves 2001, Das and Chetry pers. comm.).</p> <p>The species is reported in the Manas region to the north of the Brahmaputra River and between river Jia-Bhoreli in the west and Manas river in the east in the state of Assam and northeastern state in India and Bhutan (Choudhury 2014, Das and Chetry pers. comm., Groves 2001).</p> <p>An exercise between 2008 and 2014 in Assam indicated 18,600 species (range: 17,500–20,000) of langurs⁶¹. The subspecies brahma and tenebricus, both found north of Brahmaputra, have features in common but which differ from the langurs south of Brahmaputra. The key feature distinguishing tenebricus from brahma is the cap. Considering the wide distribution of the species it is unlikely that the project AoA will hold $\geq 0.5\%$ of the global population and ≥ 5 reproductive units to qualify the project area as Critical Habitat.</p>	
24.	<i>Hoolock hoolock</i>	Western Hoolock Gibbon	EN	<p>This globally endangered species is restricted to North-East India, Bangladesh and Myanmar (Brockelman <i>et al.</i> 2019). It is known that 125 individuals of Hoolock Gibbon is recorded from the Hollongapar Gibbon Wildlife Sanctuary as of Nov 2023 (Anand, Ashvita 25 November 2023). The distribution in India is restricted to points south of the Brahmaputra and east of the Dibang (Dingba Qu) Rivers (Choudhury 2001). The total population in northeastern India is now estimated to be over 12,000, of which about 2,000 occur in the state of Assam (Molur <i>et al.</i> 2005). There are estimated to be about 200-280 hoolocks in Bangladesh (Islam <i>et al.</i> 2006, Molur <i>et al.</i> 2005). Namdapha National Park in the Changlang District of northeastern state of India which would yield projections of the total population in the park of over 15,000. Using those figures, the total population of this species globally would exceed 27,000. It seems unlikely that the population of this species in the Project AoA would meet thresholds to qualify the area as Critical Habitat (0.5% of the global population would be at least 135 individuals).</p>	<i>Not Critical Habitat</i>
25.	<i>Bubalus arnee</i>	Wild Water Buffalo	EN	<p>Wild Water Buffalo (<i>Bubalus arnee</i>) occur at single sites in each of southern Nepal, southern Bhutan, western Thailand, eastern Cambodia, and northern Myanmar, and at several sites in India: in the Central India and the North-east, predominantly in Assam. The global population of Wild Water Buffalo is almost certainly less than 4,000 animals, occupying an area of less than 20,000 km². The majority of the Wild Buffalo assemblage in India is restricted to the north-eastern states of India, with Assam</p>	<i>Low probability to be Critical Habitat 1, requires further survey during works</i>

⁶¹ The Capped Monkeys Of India's Northeast by Dr. Anwaruddin Choudhury

S. No.	Scientific name	Common name	IUCN Category	Comments/ Justifications	CH Likelihood
				accounting for most of the population spread across several protected areas of the state. Kaziranga National Park has 2,600 individuals as per the departmental counts in 2011. Manas National Park has 250 individuals reported during the 2008 census. Dibru-Saikhowa National Park has more than 400 Wild Buffaloes, as per the 2008 census (Choudhury 2010). The other states like Meghalaya have not more than 50 individuals Choudhury (2010), Chhattisgarh with an attempt made by the Forest Department in the year 1986-87 accounted for 240 individuals.	
Amphibian					
26.	<i>Uperodon assamensis</i>	Assamese Balloon Frog	VU	Assamese Balloon Frog (<i>Uperodon assamensis</i>) is known from several localities in the state of Assam, two in the northeastern state of India, and one in West Bengal, India. In Assam, it was found in Majbat, Nameri National Park, Orang National Park and vicinity (all in Sonitpur District); and in Bongaigaon, western Assam (Nath et al. 2011). In northeastern state of India, it has been found in Pakhui Wildlife Sanctuary in Kamlang District, and Itanagar (Ohler et al. 2018). The species is Listed as Vulnerable because its extent of occurrence (EOO) of 18,611 km ² . There is no information on the population size. Although the species is restricted range within a limited EOO it is unlikely that project AoA regularly holds ≥ 10% of global population AND ≥ 10 reproductive units of the species to qualify as critical habitat.	Not Critical Habitat
27.	<i>Amolops assamensis</i>	Assamese Cascade Frog	VU	This species was previously only known from Mayeng Hill Reserve Forest and Kolaghat Reserve Forest in the Kamrup District of Assam State in northeastern India (Sengupta et al. 2008). It is now also known to occur in Burhapahar Forest in Nagaon District (M.M. Borah pers. comm. September 2020), and Amchang and Garbhanga-Rani Reserve Forest in Assam State. Listed as Vulnerable, as this species has an extent of occurrence (EOO) of 10,666 km ² . There is no information on the population size. Although the species is restricted range within a limited EOO it is unlikely that project AoA regularly holds ≥ 10% of global population AND ≥ 10 reproductive units of the species to qualify as critical habitat.	Not Critical Habitat
Aves					
28.	<i>Houbaropsis bengalensis</i>	Bengal Florican	CR	A handful of recorded sightings of Bengal Florican (<i>Houbaropsis bengalensis</i>) within 50 km of this project, generally at IBAs. No evidence of this species breeding in the region and the low number of observations suggests it is unlikely to occur regularly in the AoA. Migratory data indicates this species is more appropriately assessed under criterion 3.	Not Critical Habitat under criterion 1 but need further survey during works
29.	<i>Gyps bengalensis</i>	White rumped Vulture	CR	White rumped Vulture (<i>Gyps bengalensis</i>) is widely distributed in Pakistan, India, Bangladesh, Nepal, Bhutan, Myanmar, Thailand, Laos, Cambodia and southern Viet Nam, and Malaysia (BirdLife International 2001). Since the mid-1990s, it has suffered a catastrophic decline (over 99%) across the Indian Subcontinent due to the usage of non-steroidal anti-inflammatory drug (NSAID), diclofenac, behind this rapid population	Not Critical Habitat

S. No.	Scientific name	Common name	IUCN Category	Comments/ Justifications	CH Likelihood
				collapse (Green et al. 2004, Oaks et al. 2004a, Shultz et al. 2004). The total population is therefore estimated to be c. 6,000-9,000 individuals, equating to 4,000-6,000 mature individuals. In Assam 6-8 observations are reported in Kaziranga National Park, 1 in Nameri National Park, 2 at Pani-Dhing Bird WLS. Given no further information on this sighting in the project area, it seems unlikely that the population of this species in the project AoA would meet thresholds (0.5% of the global population would need at least 50 individuals) to qualify the area as Critical Habitat it would not be appropriate at present to not consider the project AoA as Critical Habitat for this species.	
30.	<i>Aythya baeri</i>	Baer's Pochard	CR	Baer's Pochard (<i>Aythya baeri</i>) is classified as Critically Endangered distributed in Russia, Bangladesh, Myanmar, Thailand, India, Japan, South Korea, Hong Kong, Mongolia, Philippines, North Korea, Nepal, Bhutan, Lao, Vietnam with occasional occurrence of wintering and is fully migrant. It is now absent or occurs in extremely reduced numbers over the majority of its former breeding and wintering grounds and is common nowhere. The global population is with 150-700 mature individuals with extent of occurrence of 2,270,000 km ² . The species migratory and is native non-breeding in India and reported to visit in wintering at Deepor Beel Bird Sanctuary, Dibru-Saikhowa Complex, Jhanjimukh – Kokilamukh, Kaziranga National Park, Laokhowa and Burhachapori Sanctuaries, Majuli, Pani-Dihing Bird Sanctuary, Orang National Park, Tamaranga - Dalani - Bhairab Complex etc. Thus, it is unlikely that the project AoA predictably supports ≥10 percent of global population during periods of environmental stress.	Not Critical Habitat
31.	<i>Ardea insignis</i>	White-bellied Heron	CR	<i>Ardea insignis</i> is known from the eastern Himalayan foothills in Bhutan and north-east India to the hills of Bangladesh, north Myanmar and, historically at least, across west and central Myanmar. Birds may visit the Brahmaputra lowlands in winter. Most of the few recent records come from sites in Assam and Namdapaha in northeastern state of India (Maheswaran 2007, A. Choudhury <i>in litt.</i> 2016), a few sites in Bhutan, and parts of Myanmar. The current population size is thought to be best placed in the band 50-249 mature individuals (D. Wilson and J. Eames <i>in litt.</i> 2006). This equates to 75-374 individuals in total, rounded here to 70-400 individuals. No recent sightings from a number of former sites including Jamjing Reserved Forest, Dibru-Saikhowa National Park, Kaziranga National Park, Nameri National Park and Pabitora Wildlife Sanctuary (A. Choudhury <i>in litt.</i> 2012, 2016). The most recent sightings in Assam were a lone immature bird in Kanamakra area of the western buffer of Manas Tiger Reserve in 2007, two birds from Subankhata Reserved Forest, Baksa district of the eastern buffer of Manas Tiger Reserve in 2010 and an immature individual near Dibru-Saikhowa National Park in 2015 (A. Choudhury <i>in litt.</i> 2012, 2016, G. Maheswaran <i>in litt.</i> 2016). Considering the large extent of occurrence (non-breeding) of 290,000 km ² it is unlikely that the project AoA will encompass hold > 0.5% of the	Not Critical Habitat

S. No.	Scientific name	Common name	IUCN Category	Comments/ Justifications	CH Likelihood
				population.	
32.	<i>Asarcornis scutulata</i>	White winged Duck	CR	This waterbird White winged Duck (<i>Asarcornis scutulata</i>) is resident over large range that extended through much of eastern South Asia but now mostly occurs in Assam and northeastern state of India, and marginal visitor to Bhutan (Choudhury 2007). Habitat type is slow-flowing natural and artificial wetlands, within or adjacent to evergreen, deciduous or swamp forests, on which it depends for roosting and nesting, usually in tree-holes and feeds on pondweed, small fish, aquatic snails, spiders and insects etc and live in small groups of 2-12. There are now likely only 150-450 mature individuals left, widely scattered in populations across its once vast range, many of which are probably now too small to be viable. Recent surveys found only a total of 24 individual ducks from three forest areas (Ahmed et al. 2023). Strong hold of this species is in Dibru-Saikhowa National Park, Doomdooma Dangori Reserve Forests, Nameri Forest and Dihing–Patkai where large population is expected (Talukdar and Bhattacharjee 1994, Choudhury 1996). However, this species has never been observed around the project area and it is unlikely that project AoA will encompass > 0.5% of the population.	Not Critical Habitat
33.	<i>Rynchops albicollis</i>	Indian Skimmer	EN	Indian Skimmer (<i>Rynchops albicollis</i>) is now almost completely restricted to India as a breeding bird, with only occasional breeding in western Bangladesh (Kabir et al. 2016) however distributed in Indian Subcontinent. The global population is estimated at 2,450-2,900 mature individuals (Chowdhury et al. 2020). Present breeding records are from National Chambal Sanctuary, around 500 adults (Shaikh and Mendis 2019, Singh and Sharma 2018), River Mahanadi, 188-224 adults (Debata et al. 2019), Son Gharial Sanctuary, 50 adults (P. Shaikh in litt 2019), River Ganga, 450 adults (A. Kumar. in litt 2019) and Turtle Wildlife Sanctuary, 13 adults (five pairs) (Mital et al. 2019). Given no further information on this sighting in the project area, it seems unlikely that the population of this species in the project AoA would meet thresholds (0.5% of the global population would be at least 15 individuals) to qualify the area as Critical Habitat.	Not Critical Habitat
34.	<i>Sterna acuticauda</i>	Black-bellied Tern	EN	Black-bellied Tern (<i>Sterna acuticauda</i>) now has the majority of its range in India where it remains widespread but in decline. The species is native to Bangladesh; India; Myanmar; Nepal; Pakistan. Despite its large range the global population is now estimated to number only 800-1,600 mature individuals with the vast majority (>90%) with 1000 mature individuals is now confined to India with critical strongholds (containing more than 30 birds) in the National Chambal Sanctuary, Madhya Pradesh, Uttar Pradesh and Rajasthan Morena (150 individuals); Yamuna Khadar, Delhi (44 individuals); River Godavari, Andhra Pradesh (approximately 25 individuals), Walayar Lake, Coimbatore, Tamil Nadu (35 individuals); Talab Shahi, Dhaulpur (30 individuals); Haiderpur and Narora on River Ganga (likely to be more than 30) and River Mahanadi, Odisha (likely more than 40) [P. Shaikh in litt. 2021].	Not Critical Habitat

S. No.	Scientific name	Common name	IUCN Category	Comments/ Justifications	CH Likelihood
				Given no further information on this sighting in the project area, it seems unlikely that the population of this species in the project AoA would meet thresholds (0.5% of the global population would be at least 8 individuals) to qualify the area as Critical Habitat.	
35.	<i>Haliaeetus leucoryphus</i>	Pallas's Fish eagle	EN	Pallas's Fish eagle (<i>Haliaeetus leucoryphus</i>) may breed only in northern India (apparent strongholds in Assam and Uttarakhand), Bangladesh and Myanmar, with very small numbers in Bhutan, dispersing north of the Himalayas to Kazakhstan, Russia and Mongolia in its non-breeding season (May to September). Based on surveys and available data on the population is estimated to fall well below 2,500 mature individuals (M. Steele and M. Gilbert in litt. 2016). Tend to be restricted to wetland sites when not on migration. Sightings are reported in Kaziranga National Park, Burhachapori Wildlife Sanctuary, Dibru-Saikhowa National Park, Nameri National Park, Laokhowa Wildlife Sanctuary Including Kadam and Pabho Reserve Forests, South of Koliabhomora Bridge are potentially suitable habitat for this species, and is also observed sometimes, implying it is not resident in the region.	Not Critical Habitat under Criterion 1. Need survey during works
36.	<i>Laticilla cinerascens</i>	Swamp Grass Babbler	EN	Swamp Grass babbler (<i>Laticilla cinerascens</i>) is found in the plains of the Brahmaputra River, Assam and western Bihar in north-east India and adjacent northern Bangladesh. It now appears to be very localised or present at very low densities along the Brahmaputra River, perhaps owing to specialised habitat requirements (J. Eaton in litt. 2010, R, Kumar Das in litt. 2011). There are very few recent records (J. Eaton in litt. 2016) and based on an assessment of known records, range size and descriptions of abundance this species may have a population size in the band 250-2,499 mature individuals, with <250 mature individuals per possible subpopulation. Monitored birds near Dibru-Saikhowa National Park suffered almost total habitat loss in 2010 when local villagers cleared grassland for agriculture, and birds have since been seen in open grassland nearby (R. K. Das in litt. 2011). It is probably also threatened by the impacts of livestock grazing in reserves such as Dibru Saikhowa (J. Eaton in litt. 2011), and grasslands within Protected Areas are managed for large mammals, so grass burning may occur at times of year that could impact upon this species (A. Rahmani in litt. 2016). This species is non-migratory from its nest site, so it has the potential to occur regularly in the AoA.	Not Critical Habitat under Criterion 1. Need survey
37.	<i>Chrysomma altirostre</i>	Jerdon's Babbler	VU	Jerdon's Babbler (<i>Chrysomma altirostre</i>) is widely distributed in Pakistan, Nepal, north-east India, Myanmar the population is estimated to number 2,500-9,999 mature individuals based on an assessment of known records, descriptions of abundance and range size. This estimate is equivalent to 3,750-14,999 individuals in total, rounded here to 3,500-15,000 individuals. Surveys in Assam and northeastern state of India in 2015-2016 found the species in Kaziranga, Orang, Manas, and Dibru-Saikhowa National Parks, Pani-Dihing Bird Sanctuary, and Majuli and Maguri <i>bee!</i> in Assam, and D'Ering Memorial Wildlife Sanctuary and Dibang Reserved Forest in	Not Critical Habitat

S. No.	Scientific name	Common name	IUCN Category	Comments/ Justifications	CH Likelihood
				northeastern state of India (A. Rahmani <i>in litt.</i> 2016; A. Choudhury <i>in litt.</i> 2020). Considering the lack of information on the population and wide distribution of the species it is unlikely that the project AoA will hold significant population to qualify as critical habitat.	
38.	<i>Paradoxornis flavirostris</i>	Black breasted Parrotbill	VU	Black breasted Parrotbill (<i>Paradoxornis flavirostris</i>) is now very probably endemic to India, where there are recent records from only five scattered localities in the country's north-east (from west to east): Manas National Park and environs; Kaziranga National Park and environs (where apparently rather scarce) (Assam); Loktak Lake and surrounding marshes (Manipur); and the species stronghold, the marshes north of Tinsukia (mostly contained within Dibru-Saikhowa National Park, Assam), north into northeastern state of India, mostly in D'Ering Memorial Wildlife Sanctuary, an area north of it 'East Siang' in Choudhury (2021), and grasslands west of Roing in the Lower Dibang Valley (Choudhury 2021, Rahmani <i>et al.</i> 2022, Krishnan 2023, eBird 2023, SoIB 2023). It may also persist in the <i>chapories</i> of the Lohit River, with unchecked suitable habitat covering a relatively large area that Choudhury (2021) concluded probably still hosted the species. Considering the lack of information on the population and endemic or restricted nature of the species to protected areas it is unlikely that the project AoA will hold significant population to qualify as critical habitat.	<i>Not Critical Habitat</i>
Fishes					
39.	<i>Tor putitora</i>		EN	<i>Tor putitora</i> fish species is considered globally Endangered (Jha <i>et al.</i> 2018). It occurs in montane and submontane streams and rivers throughout the Himalayan region, but is under severe threat from overfishing, loss and degradation of habitat, and dam development. It is not mapped for the Project area by Jha <i>et al.</i> (2018). Given the wide range of the species, and high rates of fishing in the area, it is highly unlikely that a sufficiently large population of the species uses the Project AoA to qualify it as Critical Habitat (per IFC 2019).	<i>Not Critical Habitat</i>

Appendix 14. Annexure–2 Biodiversity Action Plan

Biodiversity Action Plan (BAP)

This section presents the Biodiversity Action Plan (BAP), which outlines the mitigation actions and monitoring activities to ensure that the proposed projects have no long-term net loss in biodiversity.

Conservation actions were developed for concerns on biodiversity features as result of the proposed project implementation and ensure the application of the mitigation hierarchy (i.e. avoid, minimize, mitigate/remediation and compensate/offset). The concept of the mitigation hierarchy is outlined below. This will allow for the careful management of risk and the best possible outcomes for the project without compromising the health, function and integrity of the ecological system and biodiversity features.

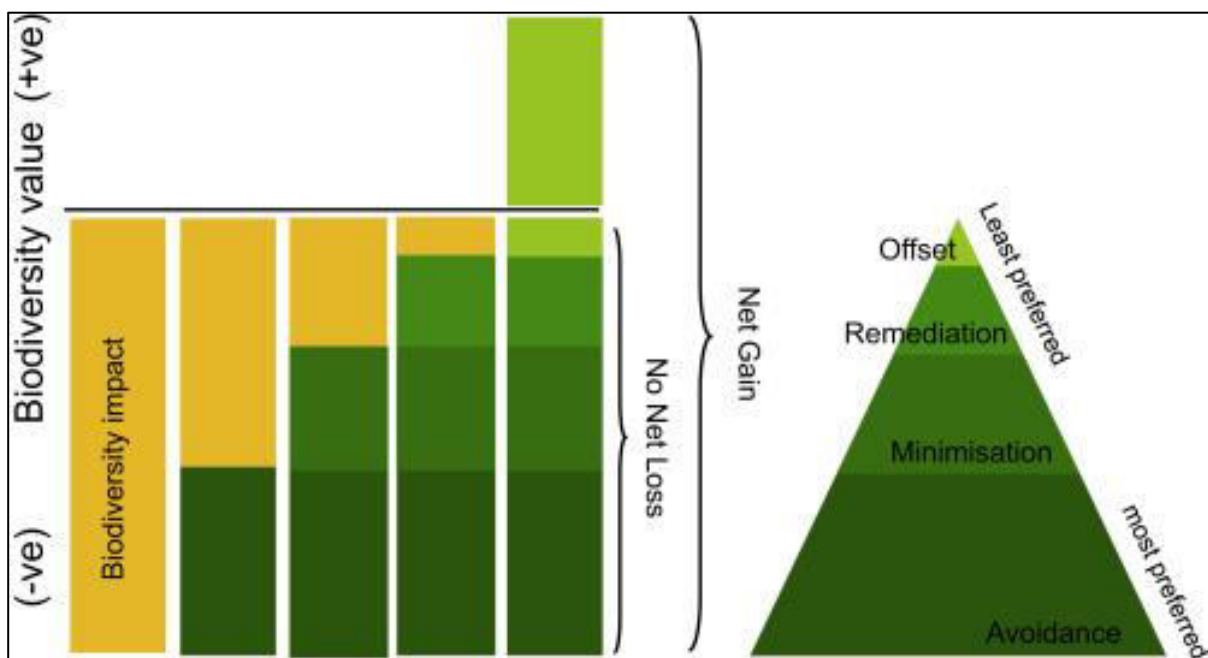


Figure 1: Diagram showing concept of mitigation hierarchy to achieve no net loss⁶²

The actions to conserve habitats and wildlife population along the project areas aimed of achieving 'no net loss' to biodiversity in accordance with ADB's safeguards requirements. The requirements need evidence that the mitigation hierarchy will be applied, that avoidance is prioritized, and that offsets are only applied as a last resort where residual impacts are un-avoidable. This biodiversity action plan will be integrated with the EMPs for each project.

⁶² Figure is sourced from "Net Gain: Seeking Better Outcomes for Local People when Mitigating Biodiversity Loss from Development. One Earth, Volume 1, Issue 2. 195-20" by Jones, J. P. G. and et. al. (2019).

Table 1 Biodiversity Action Plan (BAP)

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
<p>Widening of existing embankment</p> <p>Operation of labour camps</p>	<p>Water resources</p>	<p><u>Water quality decline</u> due to contamination of water flowing in wetlands or beels and Brahmaputra River.</p>	<p><i>Avoidance:</i></p> <ul style="list-style-type: none"> • No borrow soil should be dumped in streams. • No labour should be allowed to do open defecate on river. This would result in increase in total coliform and faecal coliform in wetlands or beels. • No material storage camps labours camps, borrow earth be allowed within 500 meters from riverbed and 1 km from the forest and Eco-sensitive Zone. <p><i>Minimization:</i></p> <ul style="list-style-type: none"> • Carry out construction works in non-monsoon season. • During Monsoon spawning of fishes take place. The schedule of embankment work should be planned in manner that it is over before arrival of monsoon. • As barge to carry construction materials, old boats should not be utilized and overloading the capacity is not allowed. <p><i>Remediation:</i></p> <ul style="list-style-type: none"> • Provision of silt traps should be available. • Embankment soil should be stabilized regularly. • The slopes of embankments should be stabilized adopting bioengineering measures. • Grassing, seeding and mulching are biological measures to stabilize riverbanks. • The soil used in embankment should be tested for pollutants like heavy metals. • There should be provision of mobile toilets at all construction sites. 	<p>Contractor</p>	<p>PISC, PIU and PMU</p>

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
Sourcing of materials for filling-up geo-bags Earthworks and slope stabilization along riverbanks	Soil stability	<u>Increase in soil erosion</u> results from construction works that disrupts bank slopes, sandbars and existing embankments	<p><i>Avoidance:</i></p> <ul style="list-style-type: none"> Construction shall be scheduled during non-monsoon season. <p><i>Minimization:</i></p> <ul style="list-style-type: none"> Obtain materials from aggregate and sand quarries/crusher sites which has necessary permissions from the Department of Mines and Geology, Prior EC from SEIAA/MoEF&CC and CTO from PCBA <p><i>Remediation:</i></p> <ul style="list-style-type: none"> Afforestation shall be undertaken with community participation. Soil erosion shall be visually checked on potential erosion zones during construction phase. The slopes of embankments should be stabilized adopting bioengineering measures. Grassing, seeding and mulching are biological measures to stabilize riverbanks. Exposed surface shall be resurfaced and stabilized as soon as possible and covered by straw or mulch to avoid soil loss in the intervening period. 	Contractor	PISC, PIU and PMU
Construction of embankment, anti-erosion works and activities within construction camps	Ambient air quality	<u>Air quality decline</u> results from implementation of projects and related construction works.	<p><i>Avoidance:</i></p> <ul style="list-style-type: none"> No sand mining or any form construction works will be done in Notified area of Kaziranga for project sites under Biswanath districts. <p><i>Minimization:</i></p> <ul style="list-style-type: none"> The emission shall meet Pollution Control Board standards. The batching plants must be sited at least 1 km in the downwind direction from 	Contractor	PISC, PIU and PMU

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
			<p>wildlife habitats with high biodiversity value.</p> <ul style="list-style-type: none"> All slopes and embankments will be turfed as per best engineering practices to help minimize the dust generation during operation. <p><i>Remediation:</i></p> <ul style="list-style-type: none"> Vehicles delivering loose and fine materials like earth/sand shall be covered to reduce spills on existing road. Water may be sprayed on earthworks, on a regular basis. During and after compaction, water will be sprayed at regular intervals to prevent dust generation. Regular maintenance of machinery and equipment will be carried out Ambient air quality monitoring shall be carried out during construction and the first year of operation phase as per the Environmental Monitoring Plan (EMoP) Plantation along the embankment shall be maintained. 		
Construction of embankment, anti-erosion works and activities within construction camps	Acoustic environment	<u>Noise level increase</u> results from implementation of projects and related construction works.	<p><i>Avoidance:</i></p> <ul style="list-style-type: none"> Stationary equipment shall be placed along low biodiversity value areas. No sand mining or any form construction works will be done in notified boundary of Kaziranga national park for sites under Biswanath districts. <p><i>Minimization:</i></p> <ul style="list-style-type: none"> use of appropriate temporary noise barriers especially near noise sensitive receptors identified near the construction zone Construction activities shall be prohibited between 9.00 pm and 6.00 am near high 	Contractor	PISC, PIU and PMU

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
			<p>biodiversity value areas throughout the project stretch</p> <p><i>Remediation:</i></p> <ul style="list-style-type: none"> • Construction equipment and machinery shall be fitted with silencers and regularly maintained • Regular noise monitoring measurements shall be carried out as per the EMoP during the construction period and 1st year of the operation period 		
<p>Construction of embankment, anti-erosion works and activities within construction camps</p>	<p>Biodiversity values</p>	<p>Disruption of migratory animals in the Brahmaputra River.</p> <p>Decline of population of Ganges River Dolphins and other species (EN, CR and VU).</p> <p>Disruption of breeding and spawning section of the river.</p>	<p><i>Avoidance:</i></p> <ul style="list-style-type: none"> ▪ The construction activity in the riverbed shall be prohibited during the breeding period of April to August. ▪ Poaching, hunting and fishing by the construction workers shall be strictly prohibited. <p><i>Minimization:</i></p> <ul style="list-style-type: none"> ▪ Channels are not permanently obstructed during the construction period in any way nearby the work zone. ▪ If Ganges River Dolphins are sighted near to the riverbanks during the construction period, works shall be temporarily suspended till it move out into the main channel. The same action will be taken for terrestrial and aquatic mammals. <p><i>Remediation:</i></p> <ul style="list-style-type: none"> ▪ Capacity building and workshops for the laborers shall be conducted about biodiversity and managing risks to wildlife. ▪ In case of accidental trappings due to construction works, wildlife department shall be immediately contacted for necessary actions. ▪ Biodiversity and ecology assessment 	<p>Contractor</p> <p>FREMAA to get clearance</p>	<p>PISC, PIU and PMU</p>

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
			including surveys/census of IUCN Red listed species shall be carried out prior to start of construction period and in the operation period for all the 4 high priority project areas		
Construction of embankment and anti-erosion works	Areas having biodiversity of significant social, economic, or cultural importance to local communities	Reduction on local fishing activities	<p><i>Avoidance:</i></p> <ul style="list-style-type: none"> Construction shall be scheduled during non-monsoon season. <p><i>Minimization:</i></p> <ul style="list-style-type: none"> Passage of local people to the river will not be blocked and ensure access to the temporary ghats. <p><i>Remediation:</i></p> <ul style="list-style-type: none"> Any local facilities affected shall be restored or maintained for undisturbed movement of the fisherman. During the construction, provide a clear signages to guide which areas that local fishing boat should not pass. During construction phase, contractors will provide alternate landing sites (ghats) with berthing facilities, access, and other common infrastructure Regular consultation with local people in view of construction works. In places the riverbank protection will provide steps to facilitate landing of local boats in support of trade and river crossings 	Contractor	PISC, PIU and PMU
Offsetting measures against impacts to biodiversity	Biodiversity	Disturbance to wildlife, and habitat loss and fragmentation	<ul style="list-style-type: none"> Establish and enforce conservation zones around habitats, particularly in Kaziranga National Park. Conduct pre-construction monitoring and analysis to assess population trends and habitat conditions. Raise awareness among local communities and implement measures to prevent poaching and habitat 	PIU and PISC	PMU

Construction/ project activity	Environmental Aspect	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Responsible for Supervision
			degradation. <ul style="list-style-type: none"> • Undertake habitat restoration and reforestation programs in degraded areas around the project site. • Collaborate with park authorities for wildlife-friendly planning and conservation programs. • Support afforestation efforts with elephant-friendly native tree species to expand habitats. • Monitor river flow and sedimentation patterns to ensure minimal disruption to the species' habitat. 		

Appendix 15. Lessons Learned from Assam Integrated Flood and Riverbank Erosion Risk Management Investment Program (AIFRERMIP)

Introduction: Out of India's total land area of 329 million hectares (ha), more than 40 million ha are prone to floods. Flooding is a recurrent hazard and has been increasingly severe in recent years. Riverbank erosion is one of the most prominent causes of disasters in Assam due to highly dynamic morphology of the Brahmaputra River and its tributaries. About 40% of the state (i.e., about 9.4% of the national flood prone area) is inundated on average annually during the monsoon by the Brahmaputra River and its tributaries, resulting in damages and loss of assets and crops.

The Assam government's development plans reflect the critical need for effective, sustainable flood risk management since most urban and agriculture areas are prone to floods and have suffered devastation from flooding for years. As part of the boarded plan to address and manage the flood hazard in the state of Assam, the multitranche financing facility (MFF) between the Government of India and the Asian Development Bank (ADB) for the Assam Integrated Flood and Riverbank Erosion Risk Management Investment Program (AIFRERMIP) was approved by ADB in 2010 with two tranches.⁶³

The program used a phased approach and focused on three selected and appraised subprojects—Palasbari-Gumi, Kaziranga, and Dibrugarh—that have flood embankment systems protecting critical urban and productive rural areas along the Brahmaputra River, and capacity- building initiatives.⁶⁴ The program introduced international best practices of riverbank protection technologies and community participation. A major initiative was state-level institutional capacity strengthening for flood and erosion risk management. Resilience against the possible impacts of climate change which may increase the frequency and magnitude of flood disasters was to be strengthened through the investment program, thereby contributing to the efforts of climate change adaptation.

Project 1 (Tranche I) became effective on 4 August 2011 and was completed on 31 July 2017. Project 1 successfully executed immediately required protection works in the three subprojects areas and laid the foundations for institutional strengthening for flood and riverbank erosion risk management (FRERM) and community participation. Project 2 (Tranche II) was approved by ADB on 30 November 2018 with completion date of 18th October 2020. Project 2 aimed to complete the remaining protection works in the same three subproject areas, and continue institutional strengthening activities, to accomplish the appraised investments with necessary refinement.

The MFF and projects 1 and 2 are rated *likely sustainable*. The design and technology adopted in the subprojects are innovative and appropriate given (i) the huge advantages of non-structural and innovative structural solutions and technology (geotextile bags, pro-siltation, and heightened embankments), which have addressed climate resilience and morphological changes; and (ii) the involvement of communities in flood management and their provision with better opportunities for income generation and tourism⁶⁵. The project was nonrevenue-generating and so the financial internal rate of return was not calculated. Instead, financial sustainability was assessed based on guidelines of the ADB.⁶⁶ The analysis shows that the program is likely to be financially sustainable since, historically, WRD has received on average 85% of the operation and maintenance (O&M) budget from the Assam government, and the agency has been utilizing on average 94% of its budget in the last few years.

Environmental Safeguards ADB approved environment category of project 1 was A, per ADB's Environment Policy 2002; and category B for project 2, per ADB's Safeguard Policy Statement (SPS) 2009. The environmental impact assessment (EIA) report was prepared in June 2009 and disclosed on the ADB website. The EIA was carried out in the three subproject areas covered by Projects 1 and 2. While no significant negative environmental impacts were anticipated, ADB classified project 1 as environmental category A in consideration of the diverse riverine environment. An environmental assessment and review framework (EARF) was prepared

⁶³ ADB. 2010. *Report and Recommendation of the President to the Board of Directors: Proposed Multitranche Financing Facility to India for the Assam Integrated Flood and Riverbank Erosion Risk Management Investment Program*. Manila.

⁶⁴ Built during 1950–1960, the area's flood embankments are among the most critical reaches of the Brahmaputra River, spanning 90 kilometres (km). They are at risk of being breached because of river erosion and overtopping during extreme floods.

⁶⁵ Besides tourism, livelihood activities were weaving and spinning, agro-diversification, and vegetable production.

⁶⁶ ADB. 2019. *Financial Analysis and Evaluation: Technical Guidance Note*. Manila.

and disclosed on ADB website to guide the subprojects selection, screening and categorization, environmental assessment, preparation, and implementation of the safeguards plans and documentation. Three initial environmental examination (IEE) reports were prepared for subprojects under project 2 from March to August 2018 and disclosed on ADB website. The EARF was also updated and disclosed to reflect the requirements for small community works proposed under project 2. An addendum to the IEE report—covering the Health and Safety Plan (in response to the coronavirus disease COVID-19 pandemic)—was prepared and disclosed on ADB website in June 2020 under project 2.

Positive environmental impacts included preservation of flora and fauna from the impacts of river erosion and flooding, including wetlands, pond fisheries, and agricultural lands. Interventions near Kaziranga helped preserve wildlife habitat by preventing the impacts of sudden flooding (from embankment breach). No damage was anticipated to the endangered species and to Kaziranga National Park. The anticipated impacts on hydrology and morphology were also deemed insignificant. This is because the program supported the proper functioning of the existing flood embankment systems, and riverbank protection works were carried out taking an adaptive approach, i.e., providing protection along the naturally developed bank lines where and when necessary. Nevertheless, close monitoring was undertaken to detect any unforeseen impacts and that mitigation measures were provided. Possible negative impacts included those associated with construction, which were temporary, site-specific, and reversible and could be mitigated through prescribed mitigation measures under the environmental monitoring and management plan that was operationalized under the projects, with the necessary capacity building of the executing agency.

Statutory environmental compliance the regulatory permissions required under the then prevailing environmental and labor-related laws of India at the national, state, and local levels were reported to have been obtained—with significant delays for both projects 1 and 2. Given the nature of activities undertaken under both projects, regulatory compliances were commonly required. During project 1, the regulatory permission to undertake works in the Kaziranga National Park area was significantly delayed. As a result, the works proposed in this protected area were shifted to project 2 for implementation. The level of regulatory compliance during project 1 was observed to be limited. During the initial stages of project 2 implementation, regulatory compliance continued to be limited and needed persistent efforts to obtain them. The state's Forest Department had imposed penal sanctions for the regulatory lapses for which the civil works contractors paid fines imposed by the regulatory agency. The applicable forest and tree-cutting permissions were obtained. Initially, during project 2 implementation, regulatory shortcomings were observed: the earth used were obtained from borrow areas, construction materials were procured from quarries and mines, construction water was sourced from wells and bore wells, and construction plants were utilized for the projects. With sustained follow-ups, these shortcomings were addressed to achieve regulatory compliance. Labor licenses, as required under the labor laws of India, were also obtained and renewed with some lapses during project 2 implementation. With regular follow-up, it was ensured that the project personnel were adequately insured by the contractors and their subcontractors during the implementation of the projects. By the project closure, all regulatory permissions were reported to have been obtained and were valid.

Institutional arrangements. During the implementation of project 1, the project management unit (PMU) designated one of its contractual staff as the environmental officer with the additional responsibility of managing the tasks related to environmental safeguards. The PMU-designated environmental officer did not possess the requisite academic background or professional experience in the subject area. This officer participated in ADB-organized capacity- building programs on safeguards for enhanced understanding. The same environmental officer continued to provide inputs for project 2. The executive officer of the PMU was ably supported by the environmental expert engaged within the consultancy firm. The civil works contractors designated their existing site engineers and/or engaged environment, health, and safety officers to implement the environmental management and monitoring plans. During project 2, the executive officer of the PMU held regular review meetings for environmental safeguards with the staff from the consulting firm and the contractors, which was helpful in identifying the areas requiring attention. Overall, the institutional arrangements during implementation were assessed to be just adequate. Towards the closure of the MFF program, the PMU was staffed with two full-time environmental practitioners on a long-term contractual basis who both have the requisite academic training and professional experience.

Implementation of environmental management, monitoring, and reporting. The civil works contracts included the environmental management and monitoring plans (EMMP). The consultant's and contractors' staff were provided training by the environmental expert from the consulting firm to understand the requirements in the EMMPs. The overall implementation of the EMMPs could have been better if the corrective actions were

systematically executed. The concern areas—such as safety measures at the sites, the provision of basic amenities to laborers, housekeeping practices, and others—continued throughout the implementation of both projects 1 and 2. This is due to the adequate institutional set up to manage environmental safeguards. The testing of parameters for ambient air quality and noise levels was very limited during the initial stage of the project, which improved with regular follow-ups by the PMU and by the project management consultant. The environmental performance of the MFF improved over the period with increased monitoring and coordination by ADB with the project staff. During project 2 implementation, time-bound corrective action plans to address shortcomings were prepared but implemented with some delays. Semi-annual environmental monitoring reports (EMR) since project commencement to its operation period were submitted with some delays. The testing of parameters for ambient air quality, water qualities, and noise levels and the submission of semi-annual EMRs improved over the period with regular guidance from ADB. A total of 20 EMRs (during July 2014 to September 2022), capturing the implementation of environmental safeguards during construction and operation stages, were prepared. The EMRs captured the status of regulatory compliances, the implementation of EMMPs, and the public consultations held during the implementation of the program, and these were disclosed on ADB website.

Public consultation and grievance management system the project staff from the PMU, project implementing units (PIUs), consultants, and contractors conducted consultations with the local residents and other government agencies including regulatory agencies regarding project-related activities. The project staff increased the frequency of informal consultations with the locals to disseminate project benefits, identify issues, and address problems encountered by the public during implementation. Copies of environmental planning documents were made available at site offices. The grievance redress committees were established at PMU and PIU levels and continued to be functional till closure of the project. The routine grievances registered at site offices on environmental aspects were mainly on issues such as dust, removal of debris, and borrowing earth from authorized areas. The project staff responded to these grievances within a reasonable time and obtained feedback from the complainants about their resolution prior to closing the grievance log.

The project engaged women in FRERM decision-making by increasing their participation in public consultations and representation in community-based village DMCs. Project 2 included lessons learned on gender in the draft FRERM plan document, which emphasized building the gender-mainstreaming capacities of FREMAA staff. The institutional environment and gender-mainstreaming capacity building will have long-term impact. The enabling factors will contribute to the likely sustainability of GAP achievements.

Conclusion The environmental implementation performance of the program was initially lacking due to limited institutional arrangements under the project, however, it improved over the period with increased monitoring and coordination by ADB with the project staff during project 2 implementation. Better environmental performance could have been achieved by deploying appropriate safeguards experts at the PMU and among contractors. To improve the environmental performance of the project, the envisaged institutional arrangements for environmental safeguards should be fully functional from commencement to closure of the project. The PMU and PIUs were unfamiliar with ADB's procedures and policies on environmental safeguards during the initial stages of the project and needed regular handholding by ADB through training at frequent intervals during the implementation of the project.

Appendix 16. No Objection Letter from territorial DFOs and Field Director Kaziranga National Park and Tiger Reseserve

Letter from Field Director Kaziranga



GOVERNMENT OF ASSAM
OFFICE OF THE FIELD DIRECTOR: KAZIRANGA NATIONAL PARK & TIGER RESERVE
BOKAKHAT: ASSAM-785612

(E-mail ID: dir.kaziranganp@gmail.com)

Letter No. KNP/FG.827/PPEP of KNP

Dated: 06/12/2024

To

The Executive Engineer,
Biswanath W.R. Division, Biswanath Chariali
(Email: wrdbiswanath@gmail.com).

Sub: Regarding NOC for Schemes under Water Resource Department.

Ref: i) Your letter No. BWRD/Tech-27/2023-23/1443, dtd. 06-12-2024,
ii) DFO, Biswanath Wildlife Division letter No. A/WBC/NOC/2024/2547-48,
dtd. 06-12-2024.

Sir,

With reference to the subject cited above, this is to inform you that based on the survey report submitted by the DFO, Biswanath Wildlife Division vide his letter mentioned under reference (ii) No Objection Certificate (NOC) has been granted for the proposed bank protection works near the boundary of the 6th addition to Kaziranga National Park.

This is for your information and further necessary action.

Yours sincerely,

Field Director,
Kaziranga National Park & Tiger Reserve
Bokakhat: Assam: 785612

Copy for information to:

1. Principal Chief Conservator of Forests & Head of Forest Force, Assam, Aranya Bhawan, Panjabari, Guwahati – 781037 (Email: hoff-assam@gov.in).
2. Principal Chief Conservator of Forests (WL) & Chief Wildlife Warden, Assam, Aranya Bhawan, Panjabari, Guwahati – 781037 (Email: pccf.wl.assam@gmail.com).
3. The DFO, Biswanath Wildlife Division, Biswanath Chariali (Email: dfowildlifebnc@gmail.com).

Field Director,
Kaziranga National Park & Tiger Reserve
Bokakhat: Assam: 785612

Letter from DFO, Wildlife , Biswanath



Govt. Of Assam
Environment and Forest Department
Office of the Divisional Forest Officer, Biswanath Wildlife Division,
cum Deputy Director, Kaziranga Tiger Reserve
Biswanath Chariali
Pin: 784176



Phone:6000500218

Email: dfo.wl.bnc@gmail.com

Letter No: A/WBC/NOC/2024/ **2547-48**

Date: **06/12/2024**

To,

Director,
Kaziranga National Park & Tiger Reserve
Bokakhat, Assam

Sub: NOC for Schemes under water resources Department

Ref: Letter from Executive Engineer, Biswanath W.R Division letter No. BWRD/Tech-27/2023-24/1443 dated 06/12/2024

Sir,

With respect to the subject cited above, I would like to forward herewith letters from the office of the Executive Engineer, Biswanath W. R. Division, Biswanath Chariali seeking NOC for proposed bank protection works near the boundary of the 6th addition to Kaziranga National Park.

As per letter from WR department, a joint survey was conducted by officials of Biswanath Wildlife Division and Biswanath Water Resources Division at the site of the proposed schemes. The details of the proposed scheme is given in the annexure of the letter from WR Department and comments of the undersigned is given below

I. Name of Proposed Scheme: - Climate Resilient Brahmaputra Integrated Flood and River Erosion Risk Management Project in Assam (Additional high priority works at Paken Area under Biswanath W.R. Division)

Sl. No.	Name of Location	Co-Ordinates		Type of Work
		Latitude	Longitude	
I	Paken	1. 26°47'57.21"N	1. 93°38'3.86"E	Works of GeoBag along the bank through the given GPS coordinates with 40m apron towards the river from point no 1 to Point no 6.
		2. 26°47'58.93"N	2. 93°38'1.75"E	
		3. 26°48'1.57"N	3. 93°37'50.78"E	
		4. 26°48'4.55"N	4. 93°37'42.95"E	
		5. 26°47'58.44"N	5. 93°37'29.29"E	
		6. 26°47'46.69"N	6. 93°37'32.47"E	
II	Amguri Pichala, Aliguri	26°50'14.00"N	93°45'58.32"E	Proposed PSC Porcupine Screens
III	Kharoiati	26°49'11.09"N	93°45'0.67"E	Proposed PSC Porcupine Screens
IV	Bhalukaguri	26°48'5.58"N	93°43'29.52"E	Proposed PSC Porcupine
V	Gospuria	26°47'14.61"N	93°41'34.82"E	Proposed PSC Porcupine

The northern boundary of 6th addition to Kaziranga National Park as per Department of Environment & Forest notification no. FRS.89/2002/13 dated 22, December, 2008 is the North High bank of river Brahmaputra.

The locations of the proposed scheme at Sl no I i.e Paken are at the present bank of the river Brahmaputra. There has been some amount of erosion at the site of proposed location in the last few years. As per nearest temporal satellite imagery available from google earth, the proposed locations are at least 40 metres away from the northern boundary of the 6th addition of

Kaziranga National Park is the High bank of River Brahmaputra during the time of notification of the 6th addition of the Kaziranga National Park. As all works will be limited to 40 meters from the given GPS points, the works will be done outside the boundary of the park at the time of notification.

Proposed PSC porcupine at SI no II in approximately 13 KM away from the boundary of the park.

Proposed PSC porcupine at SI no III in approximately 11 KM away from the boundary of the park.

Proposed PSC porcupine at SI no IV in approximately 8 KM away from the boundary of the park.

Proposed PSC porcupine at SI no V in approximately 4.4 KM away from the boundary of the park.

Therefore, on the grounds of the above reasoning, no objection certificate may be given for the proposed works.

2. Name of Proposed Scheme: - Climate Resilient Brahmaputra Integrated Flood and River Erosion Risk Management Project in Assam(Additional high priority works at Rangchali Dalani Area under Biswanath W.R. Division)

Sl. No.	Name of Location	Co-Ordinates		Type of Work
		Latitude	Longitude	
I	Rangchali Dalani	1. 26°46'35.78"N	1. 93°21'59.68"E	Works of GeoBag along the bank through the given GPS coordinates with 40m apron towards the river from point no 1 to Point no 4
		2. 26°46'34.03"N	2. 93°21'48.48"E	
		3. 26°46'29.23"N	3. 93°21'35.75"E	
		4. 26°46'23.76"N	4. 93°21'25.69"E	
II	Gai Tapu	26°46'36.03"N	93°22'6.89"E	PSC Porcupine Screens

The northern boundary of 6th addition to Kaziranga National Park as per Department of Environment & Forest notification no. FRS.89/2002/13 dated 22, December, 2008 is the North High bank of river Brahmaputra.


The locations of the proposed scheme at both SI no I & SI no II are at the present bank of the river Brahmaputra. There has been considerable amount of erosion at the site of proposed location in the last few years. As per available satellite imagery from google earth, the proposed locations are at least 40 metres away from the northern boundary of the 6th addition of Kaziranga National Park is the High bank of River Brahmaputra during the time of notification of the 6th addition of the Kaziranga National Park. As all works will be confined to 40 meters from the given GPS points, the works will be done outside the boundary of the park at the time of notification.

Therefore, on the grounds of the above reasoning, no objection certificate for the proposed works may be given.


I request you to kindly look into the matter and take necessary action at the earliest.

Yours faithfully

Encl: As stated above.


(Khagesh Pegu, IFS)
Divisional Forest Officer
Biswanath Wildlife Division cum
Deputy Director, Kaziranga Tiger Reserve
Biswanath Chariali.


Copy to the Principal Chief Conservator of Forests (Wildlife) & Chief Wildlife Warden, Assam, Panjabari, Guwahati-37 for favour of his kind information.


(Khagesh Pegu, IFS)
Divisional Forest Officer
Biswanath Wildlife Division cum
Deputy Director, Kaziranga Tiger Reserve
Biswanath Chariali.

Memo No.: B/WBC/NOC/2024/ 2184

Date: 06/12/2024

Copy to the Executive Engineer, Biswanath Water Resources Division, Nabapur, Biswanath Chariali for information.


(Khagesh Pegu, IFS)
Divisional Forest Officer
Biswanath Wildlife Division cum
Deputy Director, Kaziranga Tiger Reserve
Biswanath Chariali.

Letter from DFO, Dhakuakhana



LIFE
Landscape for
Incentive and Forest
Enhancement

(112)



GOVERNMENT OF ASSAM
OFFICE OF THE DIVISIONAL FOREST OFFICER :LAKHIMPUR DIVISION;
NORTH LAKHIMPUR.

E-mail ID: dfo.t.lakhimpur@gmail.com

Letter No. FLKT/B/NOC/2024/ 5600 - 601

Date. 5/9/2024

To,

✓ The Executive Engineer,
Dhakuakhana W.R. Division
Dhakuakhana.

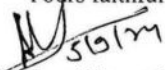
Sub:- Regarding NOC for proposed work site.

Ref:- Your letter No. F-I/DK/08/543 dtd.02-07-2024.

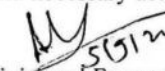
Sir,

With reference to the subject and letter cited above and also the field verification report submitted by the I/c North Lakhimpur Range vide his letter No.NL/27(E)/NOC/2024/1402 dtd.02-09-2024, I would like to inform you that the proposed work namely "Anti Erosion and protection works at different reaches of the river Brahmaputra from Bamuni Chapari to Tekeliphuta" (GPS Co-ordinates N 27.279572° E94.583325° to N27.14352° E94.501348°) under Lakhimpur Revenue Circle as stated in your letter does not fall inside Reserved Forest area. So, this office has no objection regarding execution of the proposed work as stated in your letter cited above on the condition that no tree felling in this connection is to be allowed.

Yours faithfully,


Divisional Forest Officer
Lakhimpur Division
North Lakhimpur.

Copy to the I/c North Lakhimpur Range for his information and necessary action.


Divisional Forest Officer
Lakhimpur Division
North Lakhimpur.

Letter from DFO North Lakhimpur



GOVERNMENT OF ASSAM
OFFICE OF THE DIVISIONAL FOREST OFFICER :LAKHIMPUR DIVISION;
NORTH LAKHIMPUR.

E-mail ID: dfo.t.lakhimpur@gmail.com

Letter No. FLKT/B/NOC/2024/ 6640 -41

Date., 20/11/24

To,
The Executive Engineer,
North Lakhimpur W.R. Division
North Lakhimpur


Sub:- Regarding NOC for the proposed work site.

Ref:- Your letter No. NLWRD/C/321/2008-09/3332 dtd.11-11-2024.


Sir,

With reference to the subject and letter cited above and the field verification report submitted by the I/c Harmutty Range vide his letter No.H/154/NOC/2024/1162 dtd.16-11-2024, I would like to inform you that the proposed work "Climate Resilient Brahmaputra Integrated Flood and Riverbank Erosion Risk Management Project in Assam (Additional high priority works at Bonpuroi-Jamuguri under North Lakhimpur W.R. Division)" as stated in your letter does not fall inside the Reserved Forest area. Therefore, this office has no objection regarding the execution of the proposed work as indicated in your letter on the condition that no tree felling is allowed and there is no adverse effect on flora and fauna.

Yours faithfully,


Divisional Forest Officer
Lakhimpur Division
North Lakhimpur.

Copy to the I/c Harmutty Range for his information and necessary action.


Divisional Forest Officer
Lakhimpur Division
North Lakhimpur.

Letter from DFO Sonitpur



K. Suman
5/12/2024

GOVERNMENT OF ASSAM
ENVIRONMENT AND FOREST DEPARTMENT
OFFICE OF THE DIVISIONAL FOREST OFFICER
SONITPUR WEST DIVISION, TEZPUR

Email: dfo.t.sonitwest@gmail.com

No.FSWT/B/NOC/2024-25/ 8140

Date: 04/12/2024

To

The Executive Engineer
Sonitpur Water Resources Division,
Tezpur

Sub: Regarding NOC to take- up Anti Erosion works under ADB funded work
"Climate Resilient Brahmaputra integrated flood and river bank erosion
management project in Assam (Additional high priority works at Jarani and
Zahazghat area under Sonitpur W R Division)"

Ref: Your letter No. TWRD/C/357/2022/72, dated 26-11-2024

Sir,

With reference to your above quoted letter, I would like to inform you that, as per the GPS Coordinates submitted by you pertaining to implementation of the work "Climate Resilient Brahmaputra integrated flood and river bank erosion management project in Assam (Additional high priority works at Jarani and Zahazghat area under Sonitpur W R Division)" and from the below mentioned GPS coordinates of the proposed project area, it is clear that the above mentioned project will be implemented outside the Reserve Forest area of this division and will be no impact on flora & fauna as well as tree covers around the project area in implementing the above project. Hence, you may start the works as per the detailed plan & estimate of the scheme. Further, please ensure that during execution of the works, Forest permit for procurement of Forest materials may kindly be obtained from the Forest department as per rule in force.

Sl. No.	Name	GPS Coordinates
1	Zahaz Ghat	26° 36' 57.29" 92° 47' 34.65" to 26° 37' 2.55" 92° 47' 13.82"
2	Jarani	26° 37' 55.27" 92° 40' 41.46" to 26° 37' 39.78" 92° 40' 2.34"
3	Borchalla	26° 37' 47.57" 92° 41' 11.59" to 26° 37' 54.66" 92° 40' 59.70"

This is for your kind information and necessary action.

Yours faithfully,

K. Suman
Divisional Forest Officer
Sonitpur West Division, Tezpur

Photo Documentation



Latitude: 27.343184
Longitude: 94.546653
Elevation: 115.1858 m
Accuracy: 7.0 m
Time: 28-11-2024 08:03

Vegetation Survey Bandana Area, Lakhimpur



Latitude: 27.229772
Longitude: 94.545975
Altitude: 67.6349 m
Accuracy: 9.9 m
Time: 28-11-2024 08:20

Personal Interview with local residents in Bandana Area, Lakhimpur



Latitude: 27.22487
Longitude: 94.54875
Altitude: 57.18510 m
Accuracy: 10.6 m
Time: 28-11-2024 08:50

Dolphin Survey at Matmara, Lakhimpur



Latitude: 27.181573
Longitude: 94.520455
Elevation: 104.7938 m
Accuracy: 3.8 m
Time: 28-11-2024 09:49

Avian survey in Matmara



Latitude: 26.850418
Longitude: 93.625664
Elevation: 73.6787 m
Accuracy: 8.1 m
Time: 27-11-2024 14:25

FGD at Paken area, Biswanath



Latitude: 26.830433
Longitude: 93.625918
Altitude: 38.77816 m
Accuracy: 12.5 m
Time: 27-11-2024 14:10

Sesamum indicum plant in Paken



Latitude: 26.849156
Longitude: 93.806301
Elevation: 76.27818 m
Accuracy: 13.4 m
Time: 28-11-2024 15:12

Dolphin survey at Bonpuroi Jamuguri



Latitude: 26.849423
Longitude: 93.805498
Elevation: 73.5287 m
Accuracy: 4.1 m
Time: 28-11-2024 15:40

FGD at Bonpuroi Jamuguri



Dolphin sighted at Zahajghat, Sonitpur



Black Kite sighted at Zahajghat



Long legged buzzard sighted at Jaroni



Cinerous tit sighted at Rangchali Dalani



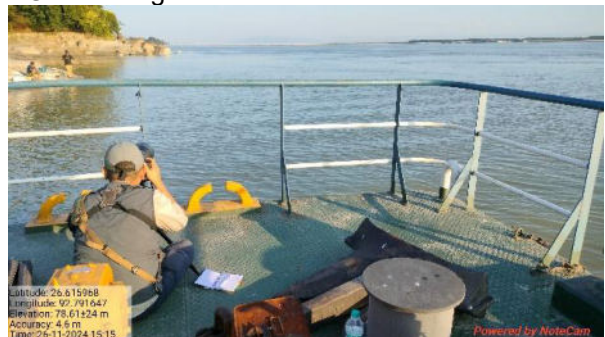
Elephant footprints at Rangchali Dalani



FGD at Rangchali Dalani



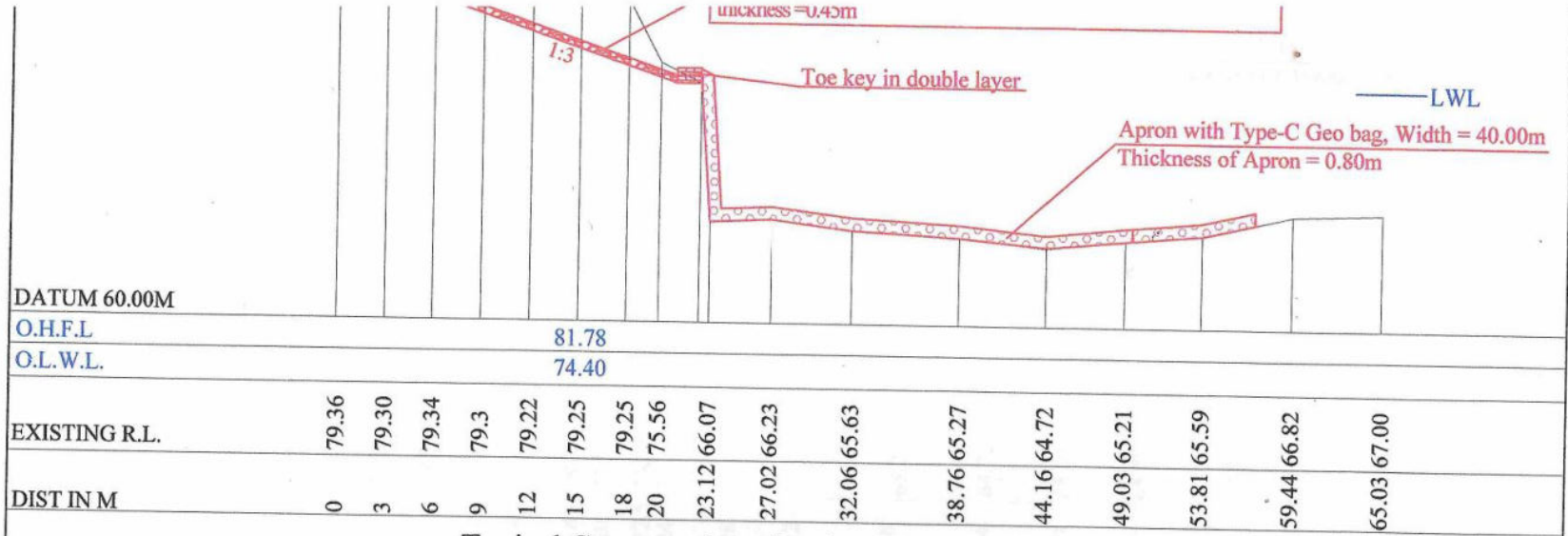
Personal interview at Rangchali Dalani



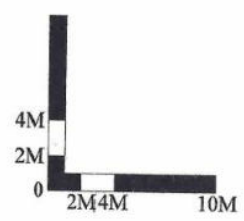
Boat survey for dolphin at Zahajghat, Sonitpur




Engineering drawing of proposed interventions

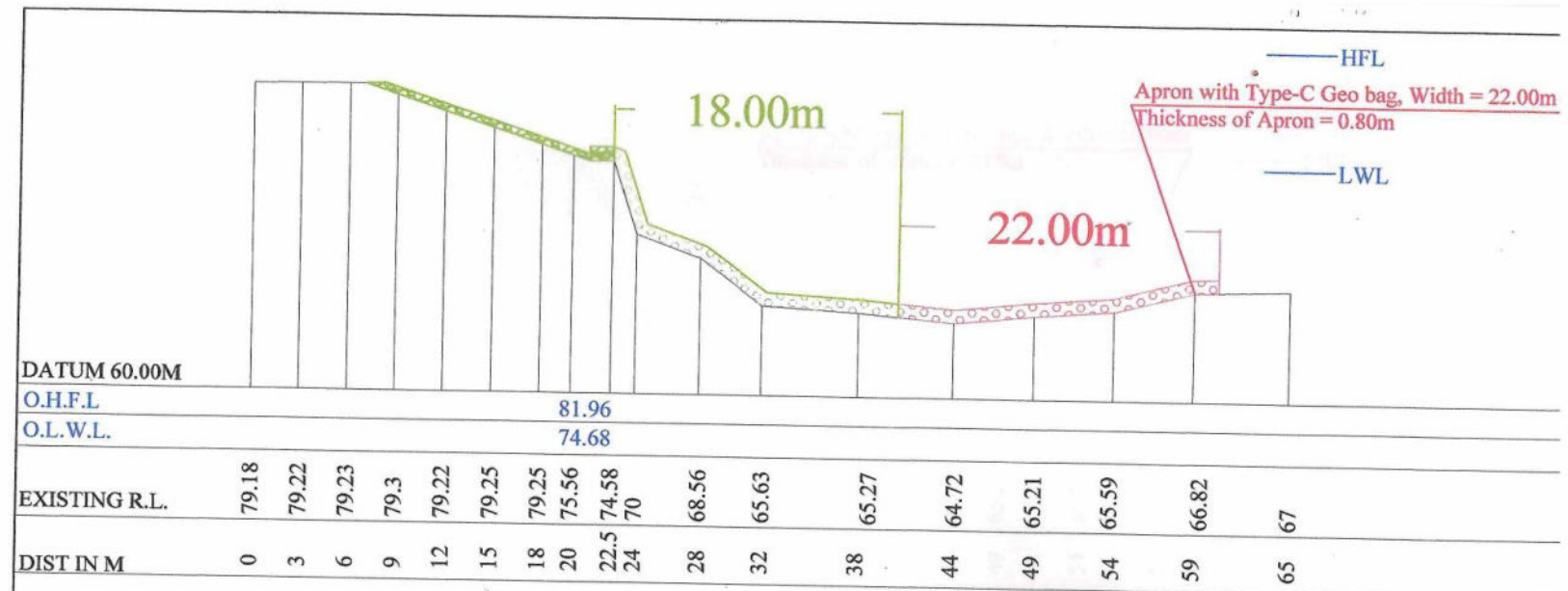
Lakhimpur



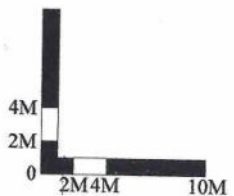
Typical Cross section of anti erosion works at CH:23200m



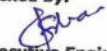


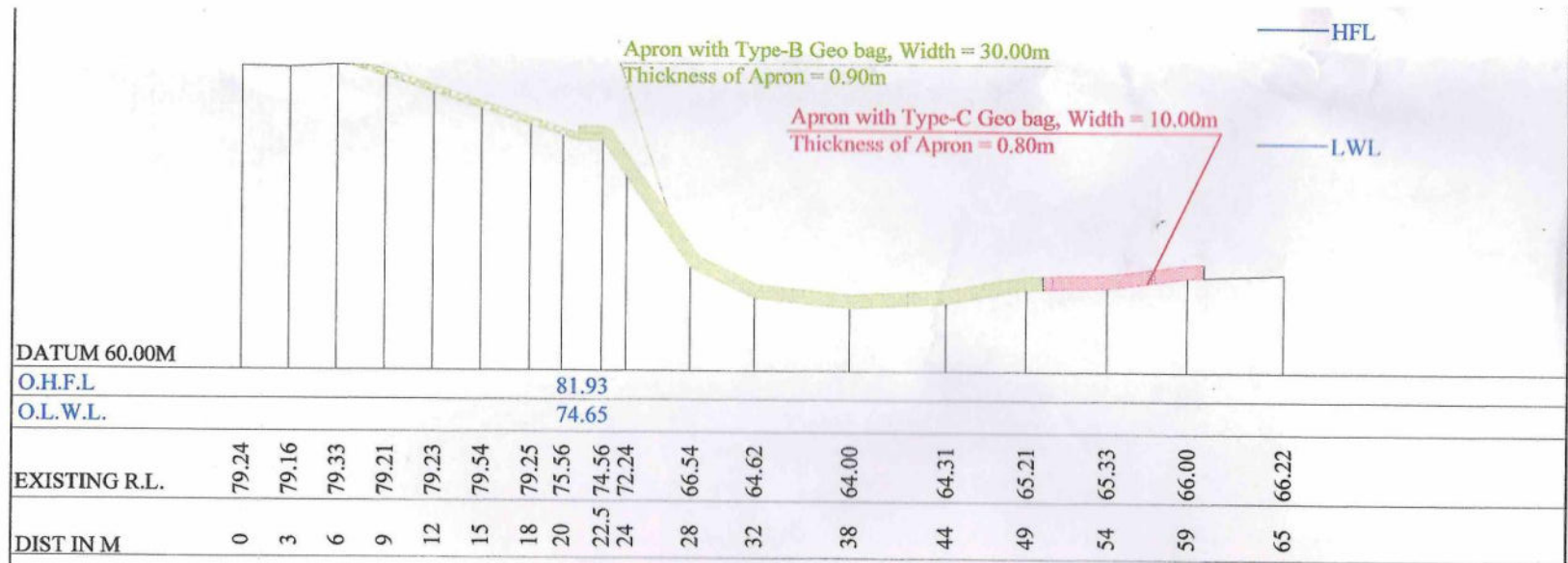
Govt. of Assam Water Resources Department	
Cross Section	
Name of Scheme:- Climate Resilient Brahmaputra Integrated Flood and Riverbank Erosion Risk Management Project in Assam (Additional high priority works at Bonpuroi-Jamuguri under North Lakhimpur W.R. Division.	
Survd & Prepared by:- 	Submitted by:- 
Checked by:-  Asstt. Executive Engineer Bihpuria W.R. Sub-District Bihpuria	Executive Engineer N. Lakhimpur W.R. Division N. Lakhimpur



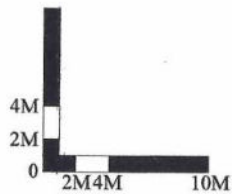
Typical Cross section of adaptation anti erosion works at CH:21900m



Govt. of Assam Water Resources Department	
Cross Section	
Name of Scheme:- Climate Resilient Brahmaputra Integrated Flood and Riverbank Erosion Risk Management Project in Assam (Additional high priority works at Bonpuroi-Jamuguri under North Lakhimpur W.R. Division.	
Survd & Prepared by:- 	Submitted by:- 
Checked by:-  Asstt. Executive Engineer Bihpuria W.R. Sub-District Bihpuria	Executive Engineer N. Lakhimpur W.R. Division N. Lakhimpur

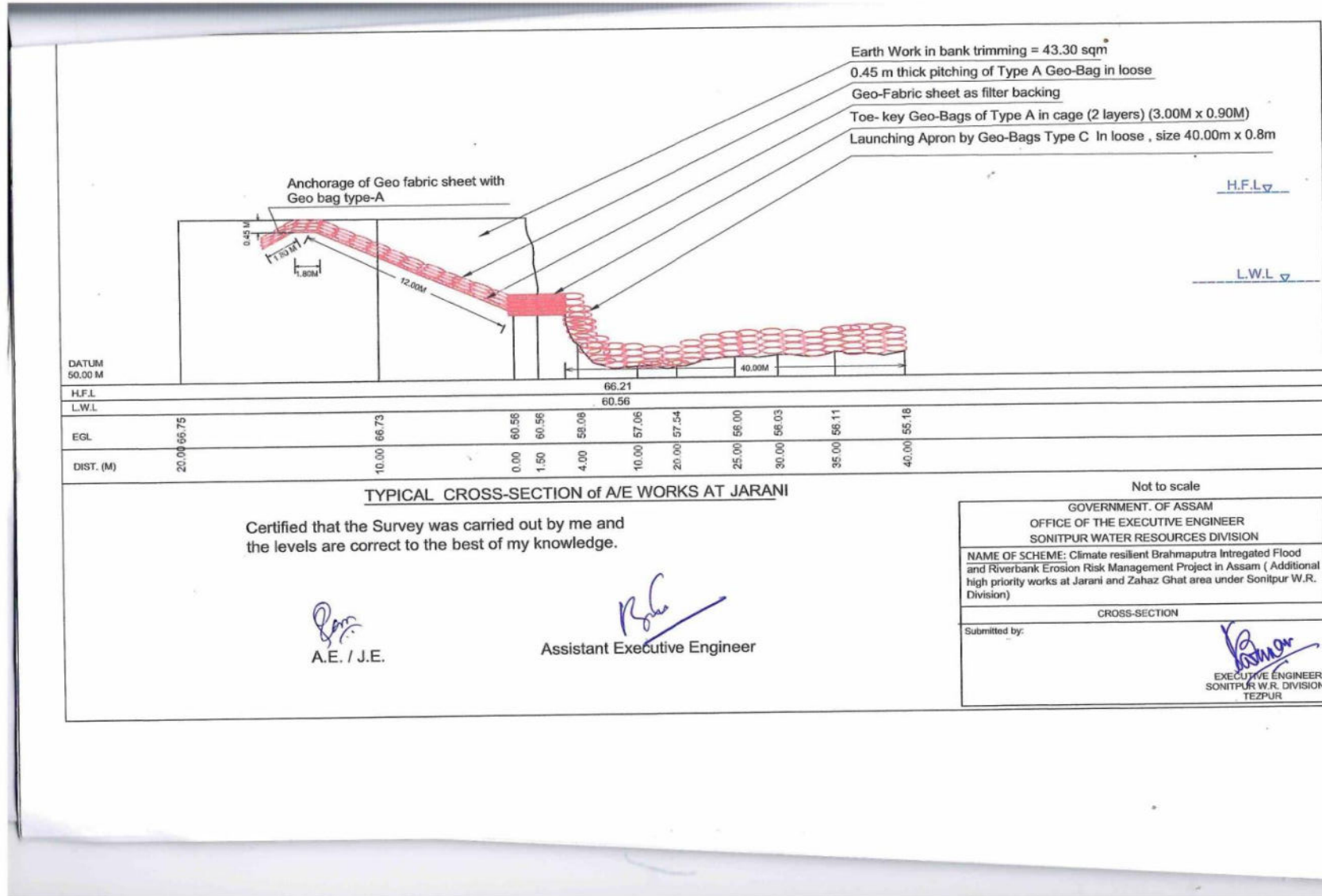


Typical Cross section of adaptation anti erosion works at CH:22150m



Govt. of Assam Water Resources Department	
Cross Section	
Name of Scheme:- Climate Resilient Brahmaputra Integrated Flood and Riverbank Erosion Risk Management Project in Assam (Additional high priority works at Bonpuroi-Jamuguri under North Lakhimpur W.R. Division.	
Survd & Prepared by:-	
 Checked by:- Asstt. Executive Engineer Bihpuria W.R. Sub-District Bihpuria	Submitted by:- Executive Engineer N. Lakhimpur W.R. Division N. Lakhimpur

Sonitpur



TYPICAL CROSS-SECTION of A/E WORKS AT JARANI

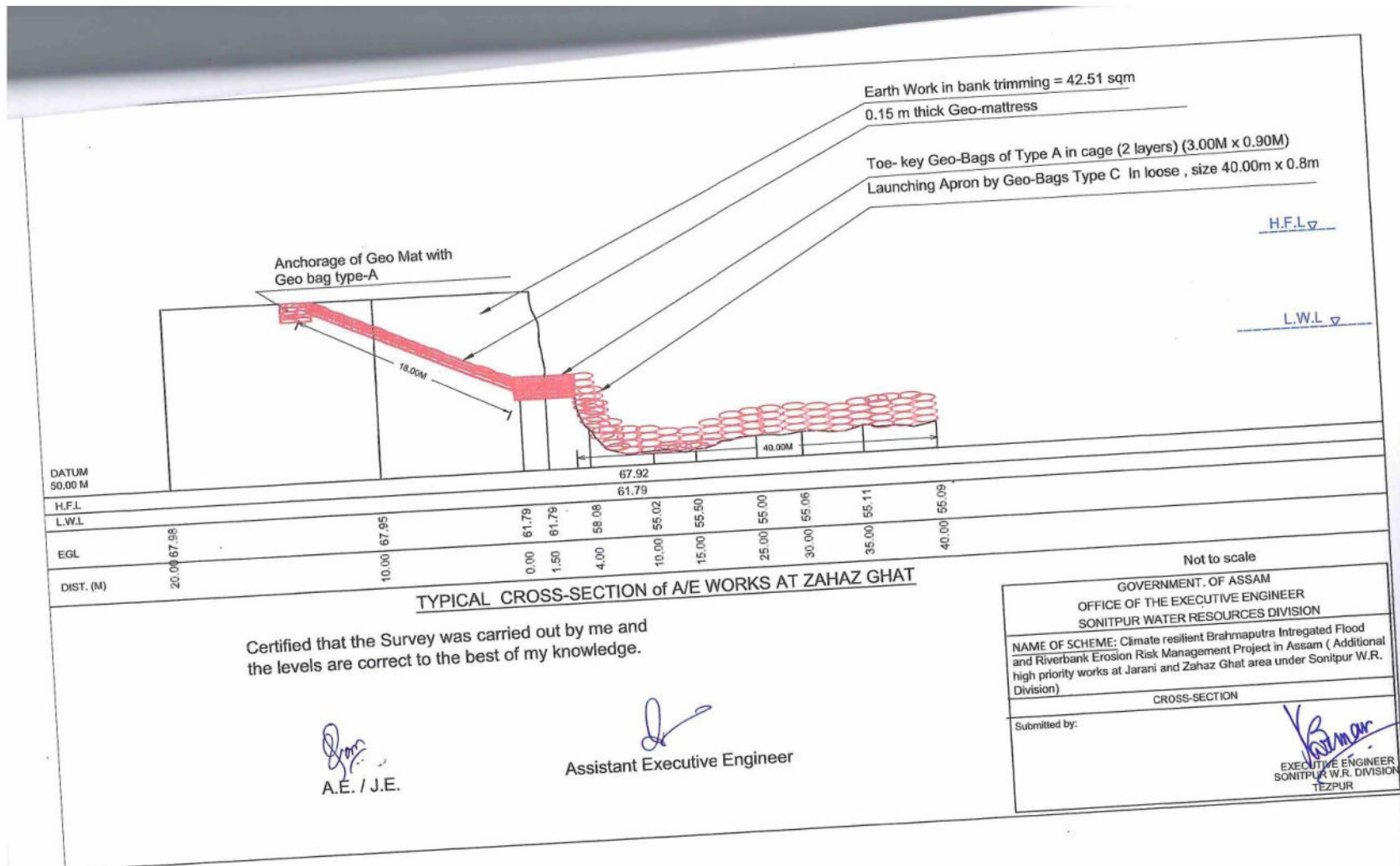
Certified that the Survey was carried out by me and the levels are correct to the best of my knowledge.

[Signature]
A.E. / J.E.

[Signature]
Assistant Executive Engineer

Not to scale

<p>GOVERNMENT OF ASSAM OFFICE OF THE EXECUTIVE ENGINEER SONITPUR WATER RESOURCES DIVISION</p>
<p>NAME OF SCHEME: Climate resilient Brahmaputra Integrated Flood and Riverbank Erosion Risk Management Project in Assam (Additional high priority works at Jarani and Zahaz Ghat area under Sonitpur W.R. Division)</p>
<p>CROSS-SECTION</p>
<p>Submitted by: <i>[Signature]</i> EXECUTIVE ENGINEER SONITPUR W.R. DIVISION TEZPUR</p>

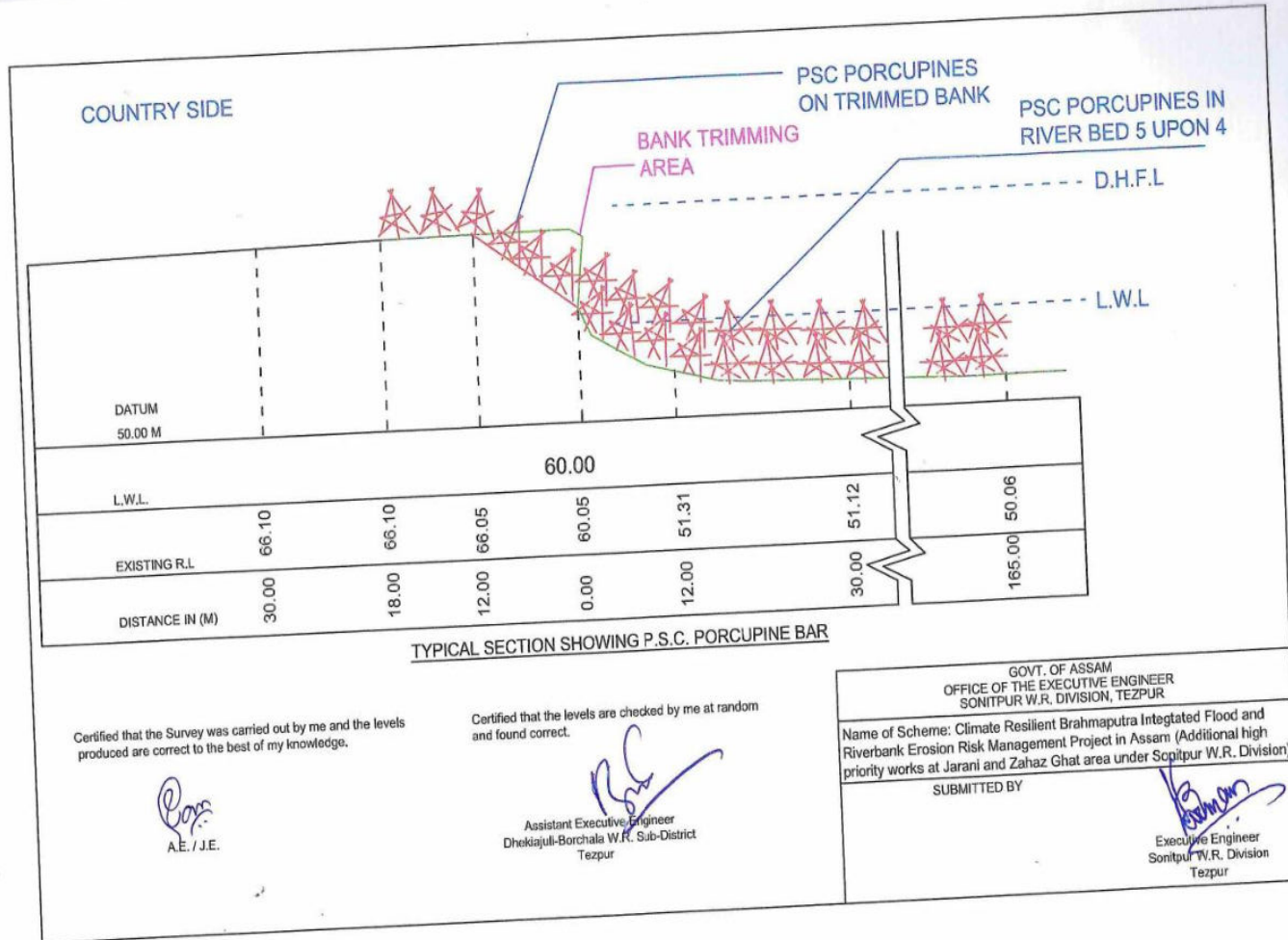


TYPICAL CROSS-SECTION of A/E WORKS AT ZAHAZ GHAT

Certified that the Survey was carried out by me and the levels are correct to the best of my knowledge.

[Signature]
 A.E. / J.E.

[Signature]
 Assistant Executive Engineer



Certified that the Survey was carried out by me and the levels produced are correct to the best of my knowledge.

[Signature]
A.E. / J.E.

Certified that the levels are checked by me at random and found correct.

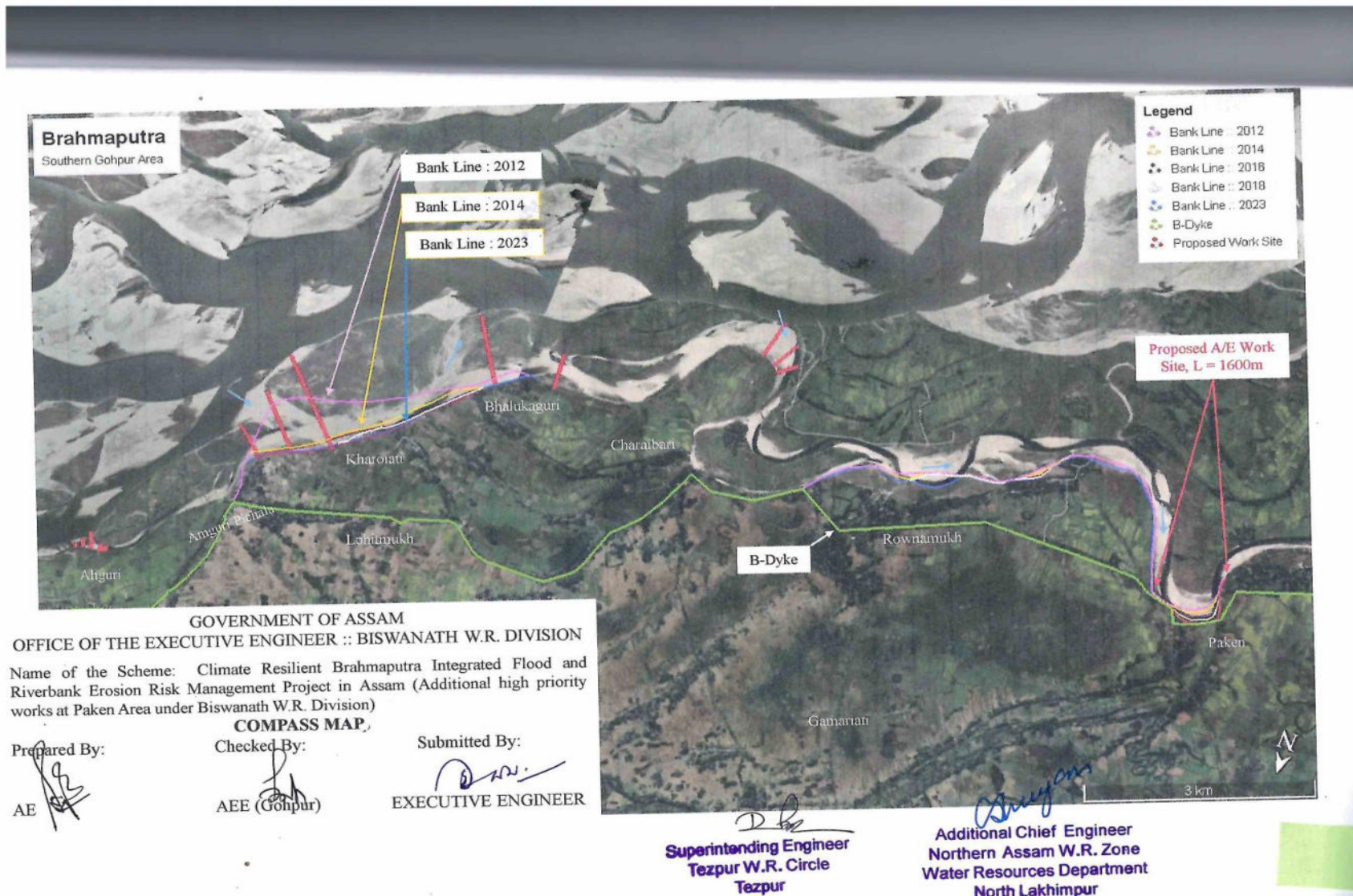
[Signature]
Assistant Executive Engineer
Dhekiajuli-Borchala W.R. Sub-District
Tezpur

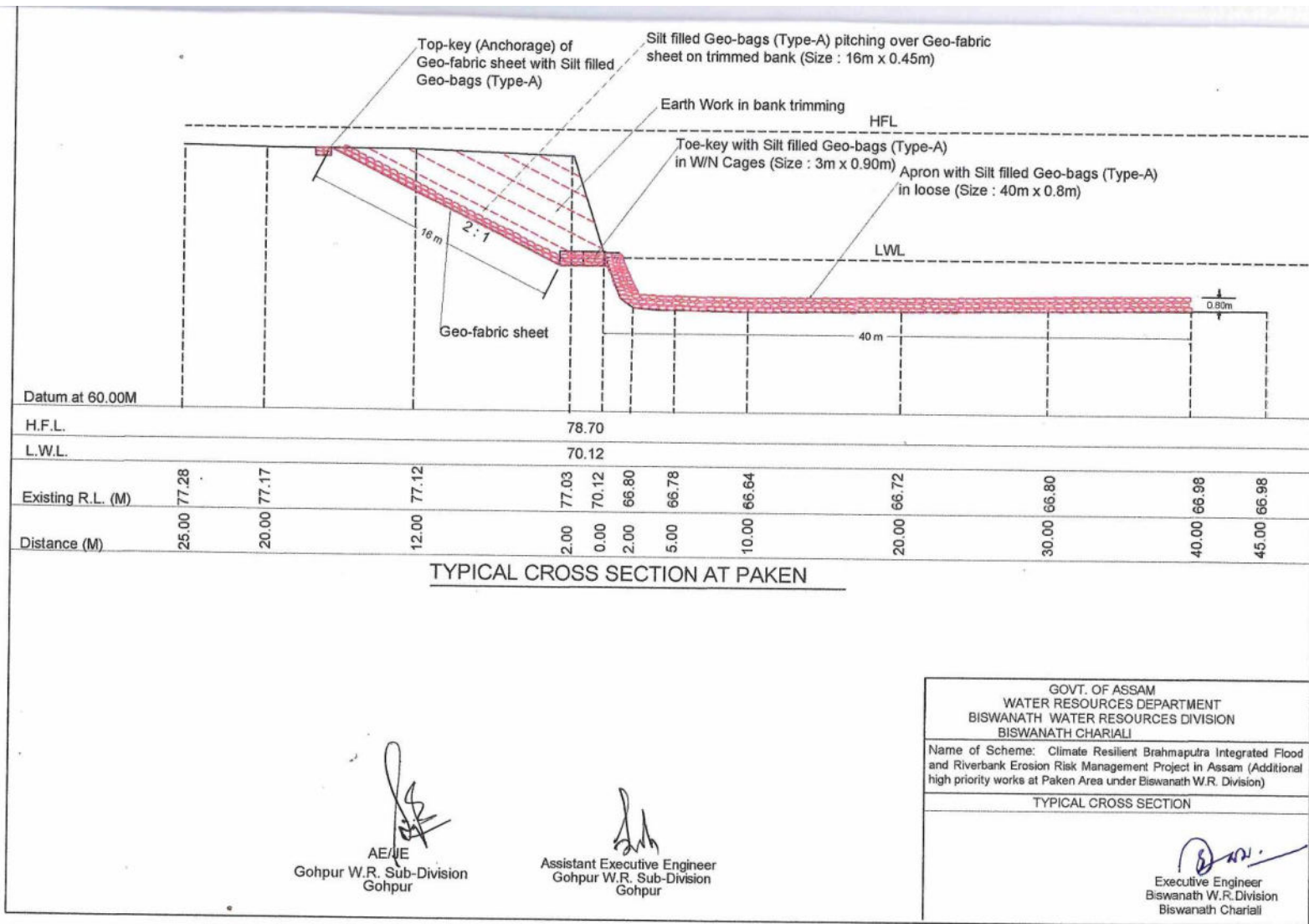
GOVT. OF ASSAM
OFFICE OF THE EXECUTIVE ENGINEER
SONITPUR W.R. DIVISION, TEZPUR

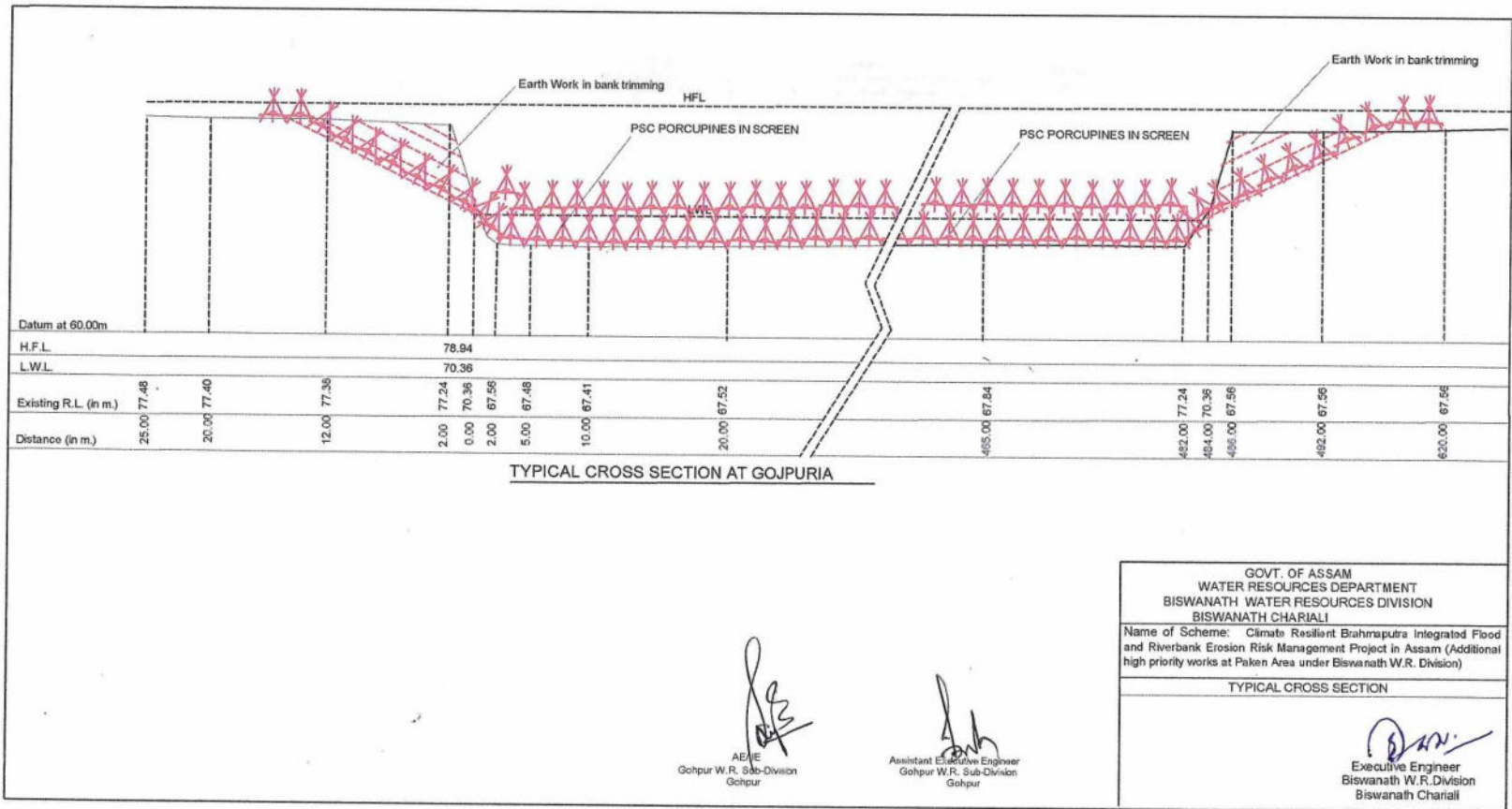
Name of Scheme: Climate Resilient Brahmaputra Integrated Flood and Riverbank Erosion Risk Management Project in Assam (Additional high priority works at Jarani and Zahaz Ghat area under Sonitpur W.R. Division)

SUBMITTED BY *[Signature]*
Executive Engineer
Sonitpur W.R. Division
Tezpur

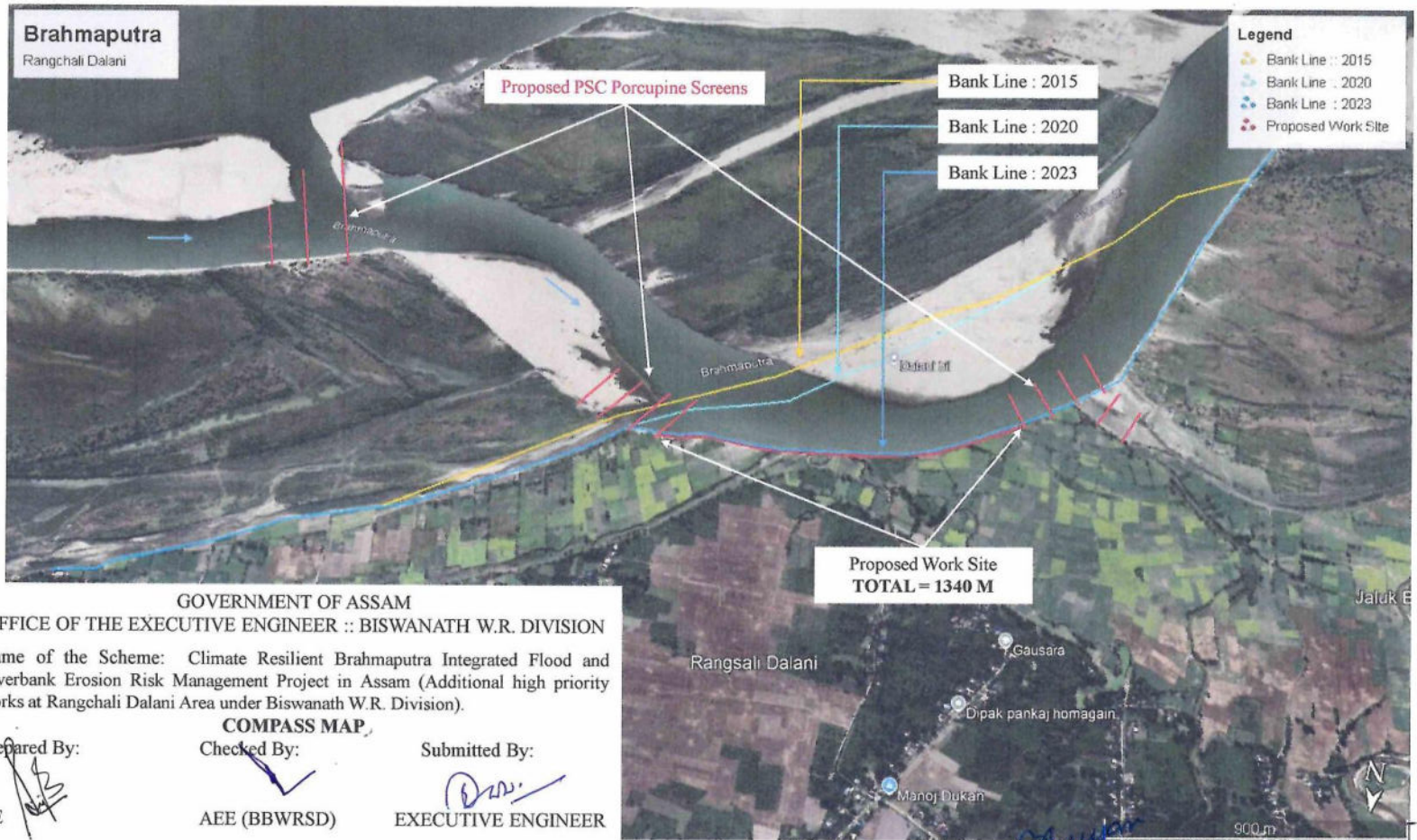
Biswanath – Paken







Biswanath – Rangachali Dalani



GOVERNMENT OF ASSAM
OFFICE OF THE EXECUTIVE ENGINEER :: BISWANATH W.R. DIVISION

Name of the Scheme: Climate Resilient Brahmaputra Integrated Flood and Riverbank Erosion Risk Management Project in Assam (Additional high priority works at Rangachali Dalani Area under Biswanath W.R. Division).

COMPASS MAP

Prepared By:

AE

Checked By:

AEE (BBWRSD)

Submitted By:

EXECUTIVE ENGINEER

[Signature]
Superintending Engineer
Tezpur W.R. Circle

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Additional Chief Engineer
Northern Assam W.R. Zone
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