Cumulative Impact Assessment (CIA) Report

Assam Inland Water Transport Project (AIWTP)

Prepared for:

ASSAM INLAND WATER TRANSPORT DEVELOPMENT SOCIETY
(An Autonomous Body under Govt. of Assam)

Prepared by:

Sustainability Intelligence India LLP

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EXECUTIVE SUMMARY

Assam has approximately 1980 km of navigable waterways of which the most important for transport purposes are the Brahmaputra and Barak rivers. The state Government of Assam (GoA), with financial assistance from the World Bank is implementing the "Assam Inland Water Transport (AIWT) Project" to improve the quality of inland water transport services and integrate high-quality passenger and vehicle ferry services in the Brahmaputra River. The Assam Inland Water Transport Development Society (AIWTDS) has been formed under the Transport Department to implement the AIWT projects for modernisation of Inland Water Transport (IWT) in Assam. Under this project, five have been planned in the first phase - these are located within the Central Group Terminals (three numbers) located at Guwahati and the North Group Terminals (two numbers) located at Jorhat.

Presently, there are a number of operating ferry-ghats in central and north cluster, mostly used for the transport of passengers, goods, and vehicles (two-wheelers, bicycles, and cars). There are also cargo operations in the NW-2, and cargo terminals are also located in both Central and North Group Terminals. Other developments, including construction and operation of bridges over the river, river-bank protection measures, construction roads associated with bridges and terminals or ferry ghats, urbanization, and tourism, can also be triggered as a result of inland navigation. All existing projects in Central and North Group Terminals are anticipated to cause impacts on Valued Environment Components (VECs) like water quality, aquatic ecology, community health and safety, socio-economic, etc. In view of the situation prevailing in these clusters, it is important to understand the cumulative impact of the existing terminals or ferry ghats, riverfront activities, and associated development activities that are in operation and those that have been planned in the future in these clusters on a set of key VECs. The overall approach for CIA study was developed in reference to the guidance issued by the International Finance Corporation (IFC) in form of the Good Practice Handbook for Cumulative Impact Assessment and Management.

A set of preliminary VECs were identified through review of the individual terminal specific ESIA's, outcomes of stakeholder consultations and site-based observations and reviews on the AIWT project's impact to environmental and social components, impacts that can potentially be caused other developmental projects and natural & anthropogenic drivers. The spatial boundary demarcation for the CIA has been delineated based on the location of projects and their likely impacts on potential VECs within their Area of Influence (AOI). The aerial distance between the Central and North Group Terminals is around 260 km. Temporal delineation for a CIA is a challenge due to the inherent uncertainty about potential future projects and activities. The temporal boundaries for the CIA study have been considered for 10 years, considering the foreseeable projects planned in both clusters.

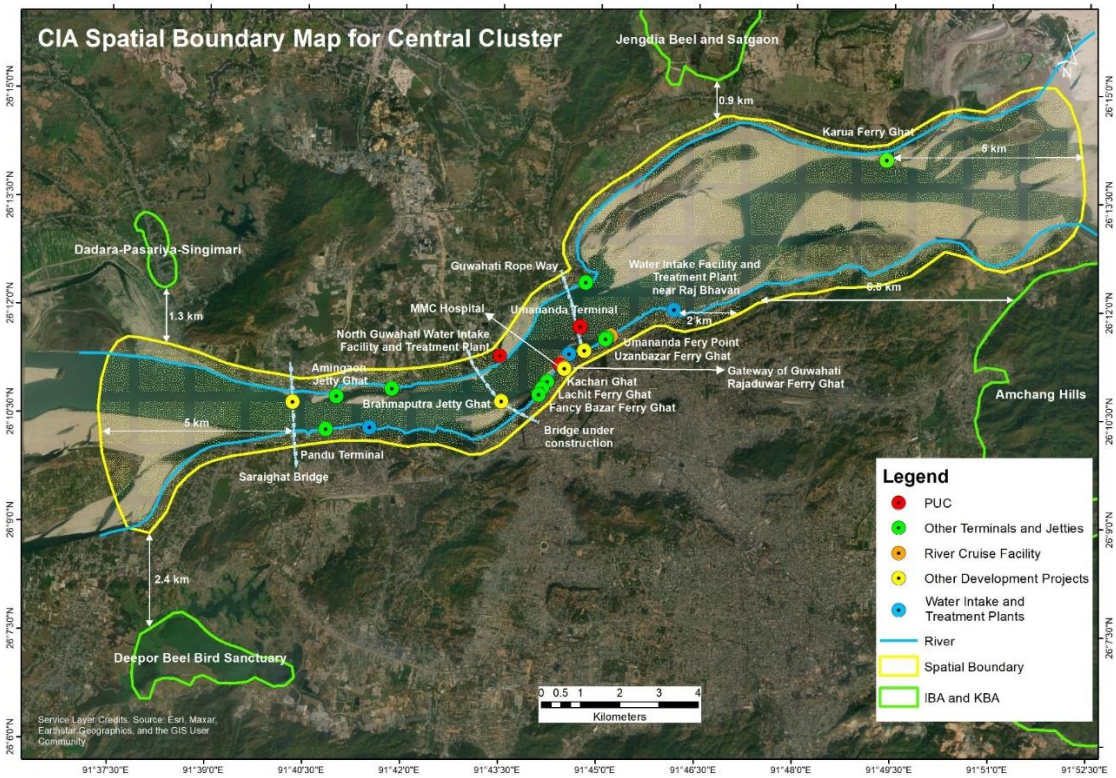

Figure 1 - CIA Spatial Boundary Map for Central Cluster

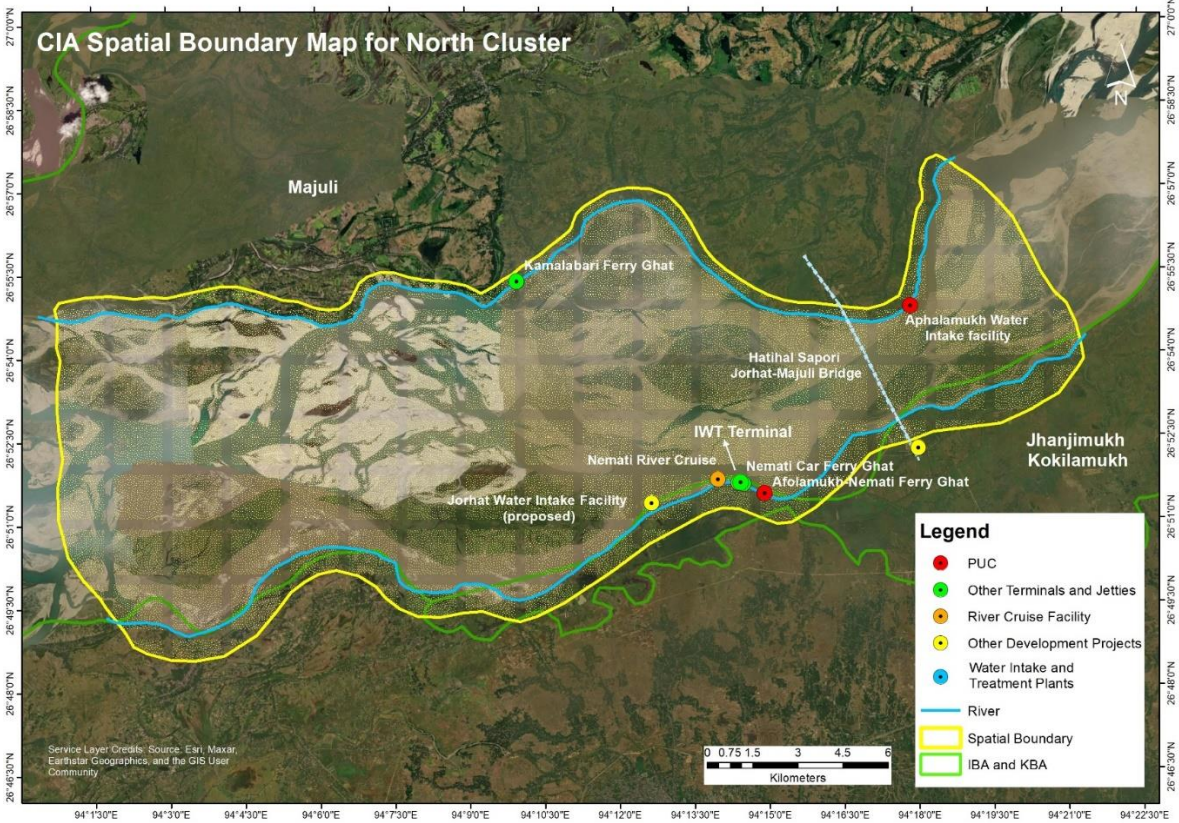

Figure 2 - CIA Spatial Boundary Map for North Cluster

AIWTDS presently proposes to develop and modernise terminal infrastructure initially at five (5) locations, i.e., Gateway Guwahati Ghat (GGG), North Guwahati, Umananda (Central Cluster), Aphalamukh, and Neamati (North Cluster). Out of five terminals, four are located on government

land, and the Neamati terminal will be constructed on private land. The location of the proposed terminals is presented in the **Figure 2** and **Figure 3** above. The scope of a CIA covers past, present and future developmental projects within the area of influence of the project under consideration to assess impacts on VECs. The following projects under the central and north clusters that has been for this study:

Central Cluster	North Cluster
▪ 12 operational ferry ghats/ terminals ▪ An operational cargo facility -Pandu Port/Terminal ▪ Two river cruise facilities ▪ Four Water intake facilities including water treatment plants for domestic and drinking water supply ▪ Construction of a six-lane bridge connecting Guwahati with North Guwahati ▪ Guwahati Ropeway ▪ Saraighat Road and Railway bridge ▪ Under construction MMC Hospital ▪ Under construction river-front development project ▪ Expansion of the Pandu port ▪ Elevated road along the south bank of the Brahmaputra River, from Panbazar Brahmaputra Bridge to Uzanbazar	▪ Three (3) operational ferry ghats ▪ A minor cargo facility at Neamati ▪ One river cruise facility ▪ Water intake facility including water treatment plant ▪ Under construction Hatihal Sapori Jorhat-Majuli Bridge ▪ Number of existing river sand mines ▪ IWAI ferry terminal at Neamati; ▪ Jorhat water supply project at Dainigaon village ▪ Expansion or new sand mines, ▪ River-bank protection work towards Neamati side

In addition, the study has considered the following external stressors or drivers has potential to have impact on selected VECs:

- **Urbanization:** The population of Guwahati is about 9.57 lakhs, with a decadal population growth rate of 20 percent. The water requirement of the city is in the range of 433 MLD. Approximately 154 MLD of sewage is generated from the city. Presently, there is no STP facility available in the city and untreated wastewater is directly or indirectly discharged into the Brahmaputra River.
- **Natural Stressors:** Natural influences and environmental drivers include those linked to climate change. This includes flood, erosion and accretion, drought etc. comprise major stressors that reportedly affect the surface water resource and aquatic biodiversity, livelihood, physical infrastructure, and properties in the river basin.

A VEC screening process was applied, using a logical analytical framework, to determine ones which of the preliminarily identified VECs can be reasonably expected to be affected by some combination of other projects and/or external stressors and the project. The key VECs selected for this CIA, either accounting for both the north and central cluster, or separately are land use along the river front, river geomorphology, air environment, underwater noise and vibration, surface water quality, key biodiversity areas for migratory birds, protected aquatic fauna like dolphins and turtles, community health and safety of people residing near the river terminals. The interactions of the project considered with the key VEC's, leading to cumulative impacts are summarised in the Figure below.

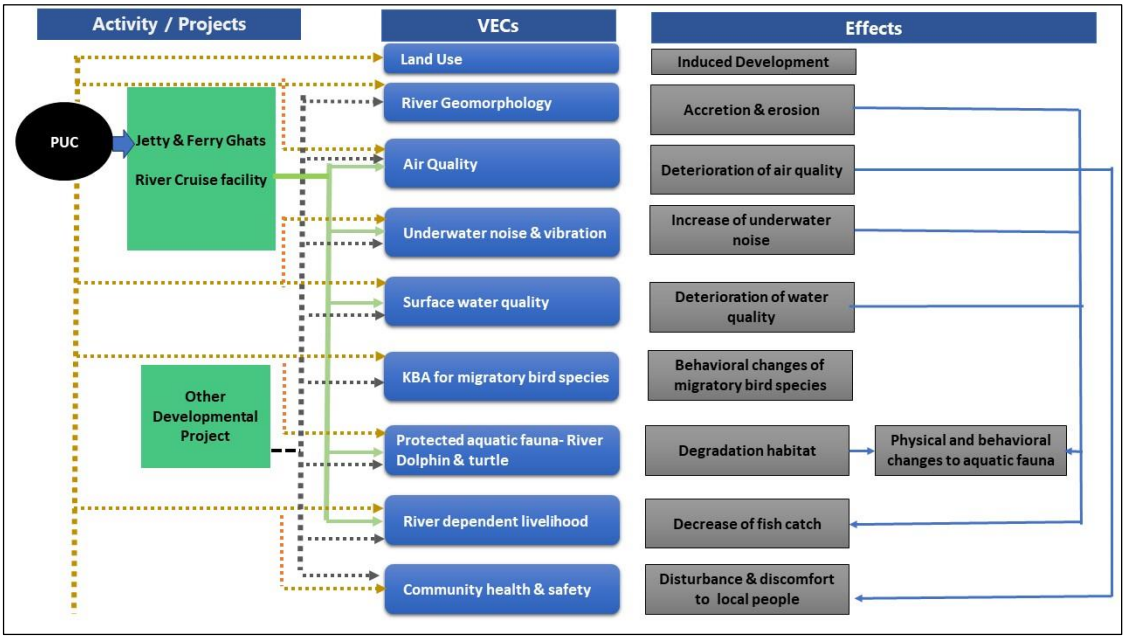

Figure 3 - Activity/Project – VEC Interactions and Effects

Key and relevant stakeholders were identified as a part of the CIA study process and consultations were undertaken with them to gather information on VECs, understanding past and present conditions, obtaining inputs on potential cumulative impacts identified by the study team and what stakeholders thought would be appropriate mitigations measures. The issues and concerns raised by the stakeholders are summarised, as follows:

- **River geomorphology**: in future, accretion and erosion of the Brahmaputra river channel may hamper ferry operations;
- **Community health and safety**: construction of terminals may cause inconvenience to some passengers, result in loss of business for boat operators and surface transporters;
- **Surface water quality**: surface water quality may be adversely impacted during the construction phase of the terminals;
- **Livelihood**: degradation of surface water quality and the operation of boats may adversely affect fish catch from the river;
- **Ganges River Dolphin**: construction and operation of terminals and ferry services may affect Ganges River dolphins due to degradation of surface water quality and underwater noise.

The cumulative impacts on the VECs accounting for the AIWT project, other past, present and future developmental projects as well as external drivers / stressors have been assessed and a summary of the impacts and recommended mitigation measured are summarised below.

VEC	Cumulative Impact	Indicator	Management measures
River geo-morphology	Medium level potential cumulative impacts on river geomorphology, erosion and accretion rates, with the project's contribution assessed as low.	Accretion and erosion rates	Ensure protection of riverbank in the Neamati terminal area and its impact zone, and major riverfront related construction activities are carried out in the dry season. During project operation

			stage, arrange for periodic de-siltation at the terminal area under guidance of IWT. Conduct geomorphological studies in the Brahmaputra river and undertake periodic assessments, in stretches where there are several river front related developmental projects planned.
Land use around the ferry terminals	Cumulative impact of both AIWT project and other developments are anticipated to be low.	Rate of land use change, unplanned developments	Zonal land use plans, especially for urban, commercial and industrial areas, along the riverbank, to be prepared.
Air Quality	Cumulative impact on ambient air quality in terms of concentration of PM (PM_{10} and $PM_{2.5}$) and NOx is assessed to be medium for central cluster, while contribution from AIWT project would be low.	Levels of PM and NOx concentration in ambient air	Adopt air pollution control measures like dust suppression, control of emissions from heavy equipment / vehicles and installation of stacks of appropriate height on DG sets during construction phase. During operation phase, ensure grid electricity connection for terminals, install back-up DG sets with proper stack height and procure battery operated vessels. Undertake periodic ambient air quality monitoring around terminals.
Underwater noise and vibration	Impacts that may lead to behavioural of aquatic mammals are assessed to be medium for central and low for northern cluster, with project's contribution expected to be low.	Underwater noise levels during piling. Behavioural changes in aquatic mammals.	Adopt preventive measures like low energy piling technology to ensure minimum noise propagation from on-river piling activities and ensure seasonal restrictions on piling activities, dolphin breeding season, in consultation with the wildlife wing of the forest department. Generate low intensity impulsive noise prior to start of pile driving activities, ensuring that any visible marine fauna moves away from the underwater noise source. Undertake periodic monitoring of underwater noise in the vicinity of on-river piling activity.
Surface water quality	Medium level cumulative impact in central cluster area and low level in northern cluster; contribution from project expected to be low.	Concentration of DO & BOD Turbidity & TSS.	During construction phase, consider use of silt or air bubble screens during construction activities, channelise surface water run-off to settling tank before discharge, have provision for treatment of sewage from labour camps before discharge. During operation of terminals, ensure domestic wastewater treatment system is installed to treat sewage from terminals and from vessels.

			Consider options for treatment of urban sewage /wastewater before discharge into Brahmaputra river and undertake regional level water quality monitoring on periodic basis.
KBA for endangered & migratory birds	Cumulative impact on KBA for endangered & migratory birds are assessed to be low, with the same being valid for the project.	Species diversity and count of birds near terminals.	Install low noise equipment's at terminals both at construction and operations phase, have proper maintenance schedules for equipment, consider lowering operation intensity during bird migration season in northern cluster. Formulate regionally focussed biodiversity management plans, awareness amongst workers and local communities, along with periodic monitoring of endangered bird species.
Protected aquatic fauna- Ganges River dolphin and turtles	Cumulative impact on protected aquatic fauna- Ganges River dolphin and turtles assessed to be medium for both clusters and PUC contribution expected to be low.	Dolphin population in vicinity of terminals.	Adopt underwater noise control measures for vessels, physical protection to prevent propeller collisions, terminal specific mitigation measures for sewage, and waste disposal and noise generation. Develop and implement a regional level dolphin conservation plan for Brahmaputra River.
River dependant livelihoods	Cumulative impact assessed to be low for both clusters, with project contribution also being low.	Fish catch at landing sites in the vicinity of project terminals.	Project specific control measures for erosion control and discharges to river (as discussed above).
Community health and safety	Low cumulative impacts.	Grievances from communities.	Ensure effective management of traffic on access roads to terminals

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ABBREVIATIONS

AIWTDS	Assam Inland Water Transport Development Society
AIWTP	Assam Inland Water Transport Project
AOI	Area of Influence
BOD	Biological Oxygen Demand
CIA	Cumulative Impact Assessment
CTC	Crew Training Centre
DO	Dissolved Oxygen
EMP	Environmental Management Plan
ESIA	Environment and social impact assessment
GGG	Guwahati Gateway Ghat
GMC	Guwahati Municipal Corporation
GoA	Government of Assam
IFC	International Finance Corporation
IWAI	Inland Waterways Authority of India
IWT	Inland Water Transport
KBA	Key biodiversity area
MLD	Million Litre per Day
NW2	National Waterway-2
NWMP	National Water Quality Monitoring Programme
PCBA	Pollution Control Board Assam
PDOs	Project Development Objectives
PUC	Projects under consideration PUC
RFFAs	Reasonably Foreseeable Future Actions
SI	Sustainability Intelligence
SIA	Social Impact Assessment
SPV	Solar Rooftop Photo Voltaic
STP	Sewage Treatment Plant
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
VECs	Valued environmental and social components

1 INTRODUCTION

1.1 PROJECT BACKGROUND

Worldwide, waterways are considered as a cost-efficient and an environment-friendly mode of transport. The development of the National Waterways as a supplementary mode of transport in India would enable the diversion of traffic from over-congested roads and railways. This is anticipated to result in significant gains in terms of economic growth, livelihood generation, and prosperity.

Assam has approximately 1980 km of navigable waterways of which the most important for transport purposes are the Brahmaputra and Barak rivers. The Brahmaputra River is navigable for most of its length in India. The Brahmaputra River, with a length of 891 km between the Bangladesh Border and Sadiya, was declared National Waterway No. 2 (NW-2) by the Government of India in 1988 (refer to **Figure 1.1**).

The Inland Waterways Authority of India (IWAI), and the Inland Water Transport Department, Assam (IWTDA), are both keen to realize NW-2's full potential for cargo and passenger transportation. River tourism is another key potential area that can hugely contribute to the economies of the north-eastern states.

The Directorate of Inland Water Transport, Assam (DIWTA), established in 1958 and part of the Assam Transport Department, is responsible for developing, maintaining, and regulating inland water transport services in the state. It also operates and maintains many of the passenger transport services, ferry terminals and navigation aids on both Brahmaputra and Barak Rivers.

The Brahmaputra River, running through the central part of the state of Assam, provides a vital link for both urban and rural ferry services, which are the single most important transport mode for many sections of the population, especially for rural households in Assam. These ferry services are provided by the DIWTA and by country boat operators, who are typically small, independent, and informal private ventures. In addition to the 106 ferry service routes designated by the DIWTA, there are numerous routes licensed by the local Panchayat, Zilla Parishads, and autonomous councils. The development of a modern ferry terminal with all the basic amenities is in long demand among the locals.

The state Government of Assam (GoA) has taken up a "Assam Inland Water Transport (AIWT) Project" to improve the quality of inland water transport services and integrate high-quality passenger and vehicle ferry services in the Brahmaputra River. The World Bank is financing the GoA to achieve this objective. The Assam Inland Water Transport Development Society (AIWTDS) has been formed by the GoA under the Transport Department to implement the AIWT projects to modernise Inland Water Transport (IWT) in Assam.

The IWAI maintains the navigational infrastructure on the Brahmaputra River. Under the AIWT Project, 13 terminals, classified into three Groups i.e., South Terminals, Central Terminals, and North Terminals, they have been planned all along the Brahmaputra River. The Grouping of these proposed terminals is based on geographical location: The South Group Terminals is located in the Jogoghppa area, the Central Group Terminals is in the Guwahati area, and the North Group Terminals is in the Jorhat area. Out of the 13 proposed terminals, five have been planned in the first phase; these are located within the Central Group Terminals (three numbers) and the North Group Terminals (two numbers) (refer to **Figure 1.1**). Presently, these five terminals are operational terminals.

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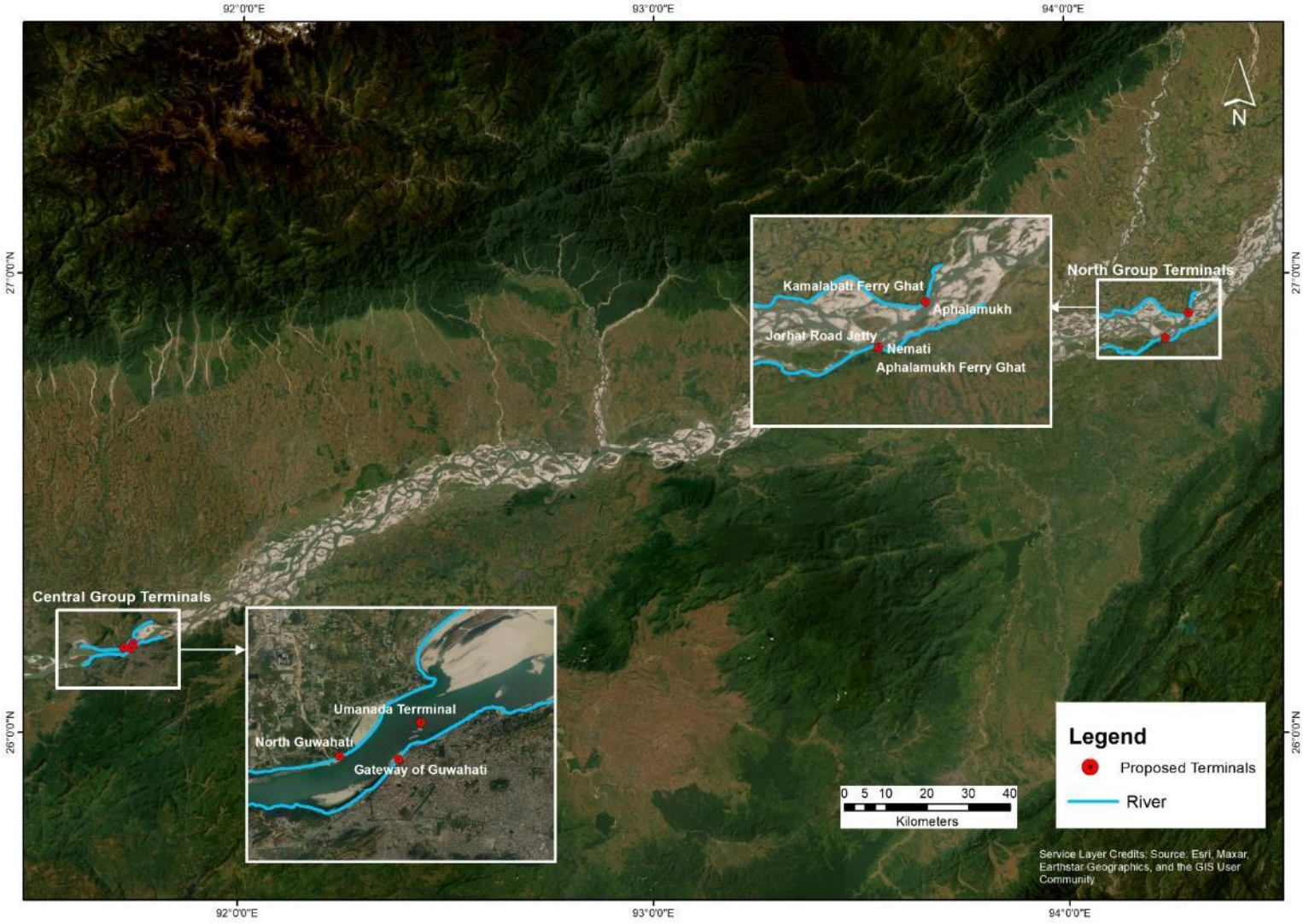
Figure 1.1 Brahmaputra River- National Waterway 2

Figure 1.2 Central and North Group of Terminals Location Map



1.2 NEED FOR THE PROJECT

The Brahmaputra River is a braided river system characterised by high sediment loads. This is caused by its very low gradients, making it sensitive to rapid geometry (boundary and channel) changes, channel baring, and flooding. In addition, the river course often changes significantly during and after floods. Most of the ferry terminals consist of moorings on the bank of the river, which often require relocation with changing river conditions.

The ferry terminals are a vital mode of transport in the northeast region along the banks of the Brahmaputra River due to the limited presence of river crossing bridges. The existing infrastructure at the terminals does not have passenger amenities, and the associated parking facilities also do not meet acceptable safety standards while operating. With the current infrastructure and considering the river dynamics, it is a significant challenge to maintain the terminal operational throughout the year. The development work requires improving the passenger ferry infrastructure and services, both for the current scenario and for the future.

As part of the project the scope is as follows:

- **Planning**: The planning includes assessing the existing traffic, future traffic, and related infrastructure requirements for these terminals. The planning phase also includes designing the terminals - riverside side and landside facilities.
- **Construction of Terminals**: All five terminals under this project will be constructed as per detailed design reports.
- **Operation of Terminals**: After the development of these terminals, they will be operated by AWITDS.

1.3 CUMULATIVE IMPACT ASSESSMENT

There are a number of operating ferry-ghats in Central and North Group Terminals, mostly used for the transport of passengers, goods, and vehicles (two-wheelers, bicycles, and cars). There are also cargo operations in the Brahmaputra River, and cargo terminals are also located in both Central and North Terminals Group. Other developments, including construction and operation of bridges over the river, river-bank protection measures, construction roads associated with bridges and terminals or ferry ghats, urbanization, and tourism, can also be triggered as a result of inland navigation.

In course of time, all the existing projects on the Brahmaputra River (Central and North Group Terminals) will contribute to environmental impacts on Valued Environment Components (VECs) like water quality, aquatic ecology, community health and safety, socio-economics, etc.

Over the years, project-level Environmental Impact Assessments (EIAs) studies have been carried out in the region before the development of industrial or infrastructural projects, confirming the regulatory requirements in India. These assessments have restricted themselves to the project being studied as standalone operations without any consideration for surrounding projects or developmental activities. However, an assessment of regional or cumulative impacts of all the river transportation and related riverfront development activities has not been previously documented.

Therefore, in view of the situation prevailing in these Group Terminals, it is important to understand the cumulative impact of the existing terminals or ferry ghats, riverfront activities, and associated development activities that are in operation and those that have been planned in the future in these Groups on a set of key VECs. Therefore, AIWTDS has commissioned this cumulative impact

assessment (CIA) study for the proposed Central and North Group Terminals located around Guwahati and Jorhat towns respectively in Assam.

AIWTDS has plans to redevelop five terminals—three in Central Terminals and two in North Terminals—which are termed "projects", and also termed" Project under Consideration (PUC)" for this CIA study. The World Bank is financing the GoA for the Assam Inland Water Transport Projects. The CIA study is being undertaken, aligning with the guidelines of the World Bank.

The CIA study was undertaken in two separate phases - scoping study and impact assessment. In the first stage a scoping study aims to identified the key VECs likely to be affected, identified associated projects and developments to be considered for the CIA study, delineated spatial and temporal boundaries, as well identified and engaged with relevant stakeholders and consider their views and opinions regarding perceived impacts on the identified VECs. The scoping study also provided key inputs towards understanding the critical information required for conduct of detailed CIA in the subsequent stage.

AIWTDS has engaged Sustainability Intelligence (SI) to carry out the afore-mentioned CIA study under the AIWT Project of the World Bank. The scoping report have been submitted to AIWTDS in the month of November 2023. The VEC, spatial and temporal boundaries, and stakeholder s have been finalized. This cumulative impact assessment was undertaken based on the scoping report, submitted earlier.

1.4 OBJECTIVES OF THE STUDY

Cumulative impacts refer to direct or indirect impacts on valued environmental components from a combination of past, present, and future human activities on a regional and long-term scale. The CIA for the proposed AIWT projects in accordance with the International Finance Corporation's (IFC; part of the World Bank) Good Practice Handbook on Cumulative Impact Assessment and Management (IFC, 2013)[1].

The CIA Good Practice Handbook provides a methodology for identifying the significant cumulative impacts, focusing on valued environmental and social components (VECs), which are: (1) rated as highly valued by potential project-affected communities and/or the scientific community; and (2) cumulatively impacted by the proposed AIWT projects, by other projects, and/or by natural environmental and social external stressors.

The broad objectives of the CIA study include the following:

1. Delineate the spatial and temporal boundaries for this CIA.
2. Identify the key VECs and determine their present conditions.
3. Mapping of major polluting industries and different sources of impacts, i.e., stressors affecting the VECs;

[1] The Good Practice Handbook for Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets (2013) of IFC presents a useful approach for developers in emerging markets the conduct of a rapid cumulative impact assessment (RCIA).

4. Undertake stakeholder consultations for identification of VEC and formulation of recommendations towards the management of cumulative impacts;
5. Assess cumulative impacts and evaluate their significance over VECs predicted future conditions;
6. Provide recommendations for the management of cumulative impacts and the development of an environmental and social management plan.

1.5 SCOPE OF THE STUDY

WAPCOS Ltd. (a Government of India undertaking) has prepared the environment and social impact assessment (ESIA) for the individual terminals. Under the ESIA study, primary environmental monitoring, baseline surveys as well as stakeholder consultations, were conducted. This CIA is based the information and data collected under ESIA study process, which is considered to be sufficient to inform the CIA process. No additional primary monitoring or supplementary studies have been considered for this CIA.

SI has conducted a Cumulative Impact Assessment (CIA) for Central and North Terminals within the Brahmaputra River Basin in accordance with the International Finance Corporation's (IFC; part of the World Bank) Good Practice Handbook on Cumulative Impact Assessment and Management (IFC, 2013).

1.6 LIMITATIONS

The CIA report was drafted in view of the following limitations and caveats:

- The CIA is desk-based and relies on information provided by AIWTDS and their E&S consultants as well as available information in the public domain;
- For each VEC that has been screened in, the CIA has attempted to document the baseline conditions within the identified spatial boundaries by relying on information from readily available environmental and social impact assessment (ESIA) studies. However, these assessments did not have complete and consistent information and SI has extrapolated certain findings documented in the SIA and Dolphin study reports;
- Detailed information about certain projects and activities
- Specific study reports, like geomorphological studies, river water quality, dolphins, etc., for other development projects are not available in the public domain.
- The specific study report on river dolphins due to underwater noise vibration is not available to refer to the present CIA project.
- Very little information is available on the influence of the river system on the hydrobiology and fisheries of the associated floodplain wetlands.
- Very little information is available on the influence of the river system on the water quality and fisheries and dolphin habitat.
- Consultation with local communities and other stakeholders conducted during the project screening stage and the ESIA study period has been referred to the CIA;
- To identify potential sources of impacts and likely stressors, SI has consulted stakeholders as identified in Section 6 of the report;
- Within the entire Terminal areas primary baseline data is only available for the PUC area;

- The spatial boundary for the CIA study is considered for the north and central of terminals; a basin-level study has not been scoped for this project.

1.7 LAYOUT OF THE REPORT

The report is structured as under:

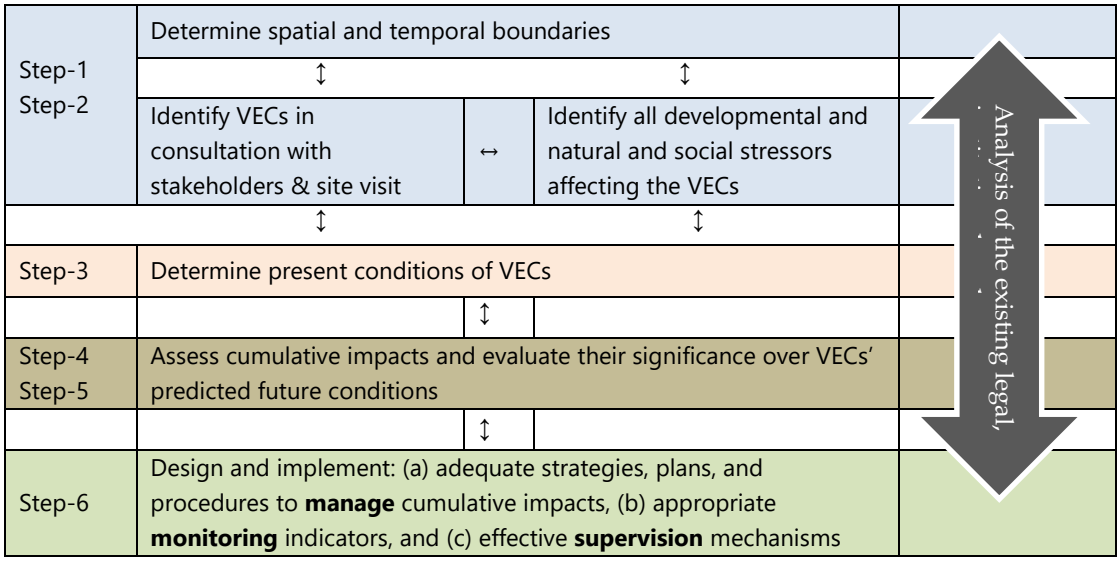
Chapter 1: Introduction (this Chapter)
Chapter 2: Approach and Methodology
Chapter 3: Administrative Framework
Chapter 4: Developments in Central and North Cluster
Chapter 5: Valued Environmental and Social Components
Chapter 6: Stakeholder Engagement
Chapter 7: Assessment of Cumulative Impacts
Chapter 8: Recommendations and Conclusion

2 APPROACH AND METHODOLOGY

2.1 APPROACH OF THE STUDY

The overall approach for CIA study was developed in reference to the guidance that has been issued by the International Finance Corporation (IFC) in form of the Good Practice Handbook for Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets (2013). The overall approach that has been adopted for the CIA study has been presented .in **Figure 2.1.**

Figure 2.1 Overall Approach for Cumulative Impact Assessment



2.2 METHODOLOGY OF THE STUDY

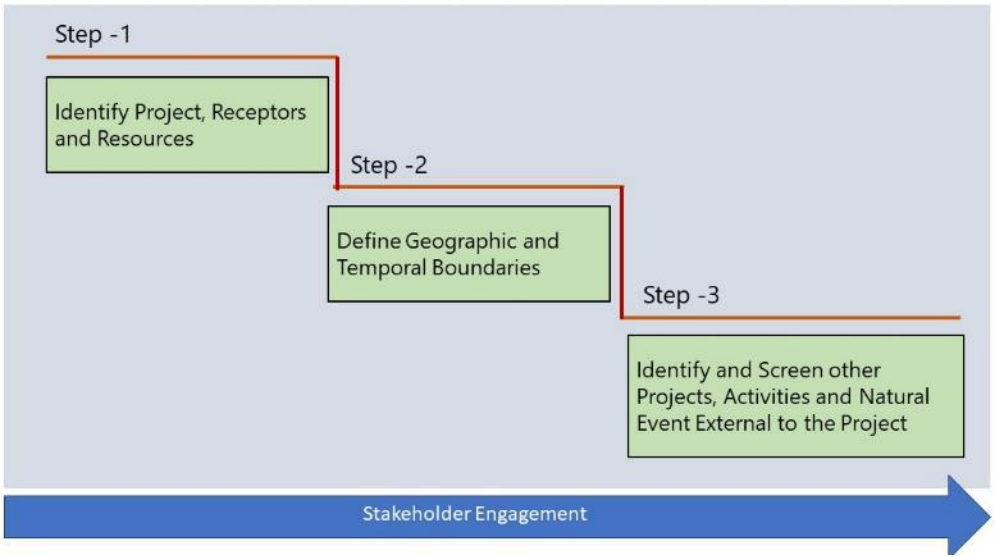
2.2.1 CIA Scoping

The overall approach that has been adopted for the scoping study has been presented in the following **Figure 2.2**. The scoping steps 1 and 2 comprise the identification of the VECs to be studied in the assessment and determination of the spatial and temporal boundaries of each VEC. VECs were identified by the CIA team with the participation of stakeholders.

Desk based Review

The present and proposed water-front development projects were identified from review of documents prepared by AIWTDS and a meeting was organised with the Planning department, GoA to validate the tentative list. External activities and natural and social stressors were identified by the CIA team through review of secondary data and from knowledge of the regional context gained through the site reconnaissance visit and consultation with AIWTDS team.

Figure 2.2 Overall Approach for CIA Scoping



Identification of VECs

Valued Environmental and Social Components (VECs) are defined as fundamental elements of the physical, biological or socio-economic environment that are likely to be the most sensitive receptors to cumulative impacts of PUC, other projects in combination with PUC and any other associated stressors. A set of preliminary VECs have been identified through review of the individual project level ESIA's, outcomes of stakeholder consultations and site-based observations and reviews on impacts to environmental and social components. that could be cumulatively impacted by the PUC, other developmental projects and natural & anthropogenic drivers. The VECs have been shortlisted such that they can be primarily linked to cumulative impacts that may be caused by the construction and operation phase of the projects, while also taking into account other past, present and future developments within the identified spatial boundary as also other stressors which would be at play. However, some residual construction related impacts viz. habitat loss, loss of livelihoods, if not mitigated, may also result in cumulative impacts on environmental and social components. The following candidate VECs were identified for the Central and North Group:

- Land environment
  - Land use
  - Soil and sediment quality
- River geomorphology (erosion and accretion)
- Air environment (Air quality)
- Acoustic environment (noise quality)
- Underwater Noise & Vibration
- Surface water
  - Water resources
  - Water quality
- Terrestrial biodiversity
  - Key Biodiversity Area for migratory bird species
- Aquatic Biodiversity
  - Protected aquatic fauna- Ganges River Dolphin and turtles

- Socio-economy
    - River dependent livelihoods
    - Land based livelihood
- Community Health & Safety

VEC screening process was conducted to determine which of the preliminary VECs would be included in the CIA. Findings from the VEC screening process are presented in **Table 5-1**.

Identification of Stakeholders

The stakeholder engagement process typically refers to the efforts made to understand and involve identified stakeholder s to find solutions to shared challenges within the wider socio-economic and ecological context. The potential stakeholders have been mapped as part of CIA scoping and are listed in **Table 4**.1 The identified stakeholder s that were found to be relevant to the CIA on the basis of information review undertaken and the guidance provided by IFC's expectations on identification, i.e., stakeholders that represent one or more entities that:

- Directly benefit from the PUCs;
- Are adversely affected by the PUCs;
- Directly interact with or oversee environmental and social components that overlap with the PUCs; and
- Indirectly influence or regulate the condition of environmental and social components.

Determining Spatial Boundaries

The spatial boundary demarcation for the CIA has been done based on the location of projects and their likely impacts on potential VECs within their Area of Influence (AOI). Special attention was given to the impacts caused by the PUC activities, viz., the construction of terminals and the operation of the terminals that could exacerbate the impacts of other projects in the vicinity. The CIA spatial boundary considers a combination of these impacts and extends beyond the PUC's area of influence, keeping the likely extent of cumulative impacts in mind.

AIWTDS is presently developing and modernising terminal infrastructure initially at five (5) locations, i.e., Gateway Guwahati Ghat, North Guwahati, Umananda (Central Group Terminal), Aphalamukh, and Nemati (North Group Terminal). The aerial distance between the Central Group and North Group Terminals is around 260 km. During the initial scoping phase, it was premised that existing river terminals, ferry ghats, and other river or riverside activities, as well as terminals likely to come up in the future, may have a cumulative impact on the water quality and aquatic biodiversity in the area of influence of the two Group Terminals. However, in course of further studies, it was understood that the water quality-related impacts, especially TSS and TDS from the operation of river terminals and other riverfront activities, can travel a maximum of 3-5 km downstream. Therefore, surface water pollutants released within a river terminal is unlikely to disperse to the other terminals, and the cumulative impacts of because of the two group terminals areas on the surface water quality and aquatic biodiversity of the regional water shed are not envisaged.

The dolphin migration and movement studies revealed that it is thought the upstream movement during the monsoon is because the increased water levels which create new suitable habitat patches in upstream areas, whereas low flows (i.e., in dry summer and winters) restrict available habitat and

dolphins concentrate in the remaining habitat patches in the main channels of larger rivers (Anderson et al., 1879; Shreshtha, 1989; Smith, 1993; Sinha et al., 2000; Sinha and Sharma, 2003; Kelkar, 2008; Mazumder et al., 2014). It is possible that seasonal shifts in distribution in relation to the annual flood may still occur in the Brahmaputra catchment, which is less fragmented. The dolphins move up and down in the river on a daily basis in search of good fishing and resting areas. Work by the Wildlife Institute of India in the Brahmaputra showed that discharge and velocity were the two main factors that influenced dolphin distribution, with depth alone showing a significant but less strong influence (Qureshi et al. 2019). The river turtle has a suitable riverine habitat for breeding and foraging; generally, their migration is localized only during lean periods, when water is not available at a particular location.

The aerial distance between the Central Group Terminal and the North Group Terminal is around 260 km. Due to the migration and movement factors discussed above, the movement of dolphins from one terminal to another is unlikely due to the discharge and velocity of the river and the availability of food. Considering the potential impacts on surface water quality and migration of river dolphins, two separate Groups have been considered for the CIA study. The Central Group Terminals and North Group Terminals are termed the Central Cluster and North Cluster, respectively, for the CIA study.

The delineation of spatial boundary was undertaken, taking into consideration the following attributes:

- Location of existing and future river terminals and jetties, river ports, and associated facilities such as roads and ancillary activities (e.g., transport of materials to the project site) that may result in cumulative impacts:
- Presence and connectivity to habitats in the basin (which may vary in terms of degradation status), thereby providing options for acting as source or sink habitats for ecological receptors of conservation significance.
- Assemblages of KBA such as Amchang Wildlife Sanctuary, Deepor Beel Bird Sanctuary, Dadara-Pasaria-Singimari, Jengdia Beel near Central Cluster, Majuli, and Janjimukh-Kalilamukh near the North Cluster may be impacted by project infrastructure.

Table 2.1 below provides a shortlisting of the identified VEC's along with the delineated spatial boundaries:

Table 2.1 VEC-wise Spatial Boundary for CIA Study

Candidate VEC 's	Consideration for spatial boundary	Spatial boundary
Land Environment	The VEC may be impacted by the construction and operation of PUCs and other associated activities, like the construction of access roads to the terminals. Potential land use change and soil contamination is localized- within the project site or its immediate vicinity.	Spatial boundary for this VEC is 1 km buffer towards land side.
River geomorphology (erosion and accretion)	The VEC may be impacted by the construction and operation of terminals and other jetties located upstream and downstream of the PUCs, the construction of bridges, elevated roads along the river-bank of South Guwahati (Central Cluster), sand mining operations at the North Cluster, and river bank protection works. The potential cumulative impact on the geomorphology of the river is likely to be impacted downstream of the river and immediately upstream of the river near the project intervention site. Geomorphological change can also occur towards the river-bank side.	Spatial boundary for this VEC is 2 km upstream and 5 km downstream) of the river and 0.50 km towards land side. The extent of potential cumulative impact
Air environment (& Acoustic environment	The VEC may be impacted by the construction of PUCs and other associated activities, like the construction of access roads to the terminals. Fugitive air emissions are due to construction-related activities and are localized. PUC, those are located in the urban area. i.e., the Central Cluster may have a potential cumulative impact on the air environment and the acoustic environment.	Spatial boundary for this VEC is 1 km buffer towards land side.
Underwater Noise & Vibration	The VEC may be impacted by the construction and operation of terminals and other jetties located upstream and downstream of the PUCs, the construction of bridges, and elevated road along the river-bank of the South Guwahati-Central Cluster.	Spatial boundary for this VEC is 2 km upstream and 5 km downstream of the river.
Surface water quality	The VEC may be impacted by the construction and operation of terminals and other jetties located upstream and downstream of the PUCs, the construction of bridges, elevated road along the river-bank of South Guwahati (Central Cluster), sand mining operations at North Cluster, river-bank protection works, and the discharge of treated or untreated sewage from nearby urban areas of Central Cluster.	Spatial boundary for this VEC is 2 km upstream and 5 km downstream.
Key Biodiversity area for migratory bird species	The KBA and protected & migratory species may be impacted due to noise, vibration, and artificial illumination from development activities.	Spatial boundary for this VEC is 1 km upstream and 1 km downstream) of the river and 1 km buffer towards land-side

Candidate VEC 's	Consideration for spatial boundary	Spatial boundary
	The VEC may be impacted by the construction and operation of terminals and other jetties located upstream and downstream of the PUCs, the construction of bridges, sand mining operations at North Cluster, and river-bank protection works. The noise and vibration related impact will be mostly localized; however, the artificial illumination may have impact up to 1 km buffer area.	
Protected aquatic fauna- Ganges River Dolphin and turtles	The Ganges River dolphins were reported throughout the entire Brahmaputra River, from the Assam-Arunachal border to the India-Bangladesh border, and in the downstream areas of the Lohit River and Siang River. The potential sources of impact on Ganges River dolphins are river water quality and underwater noise and vibration. The VEC may be impacted by the construction and operation of terminals and other jetties located upstream and downstream of the PUCs, the construction of bridges, elevated road along the river bank of South Guwahati (Central Cluster), sand mining operations at North Cluster, river bank protection works, and the discharge of treated or untreated sewage from nearby urban areas of Central Cluster.	Spatial boundary for this VEC is 2 km upstream and 5 km downstream of the river.
Land based livelihood	The VEC may be impacted by construction and operation of PUCs and other associated activities, like the construction of access roads to the terminals.	Spatial boundary for this VEC is 1 km radius area towards land side.
River dependent livelihoods	The potential source of impact on river use and river-dependent livelihoods is the movement of vessels.	The spatial boundary for river use and river-dependent livelihoods is also the same as that considered for surface water quality.
Community Health and Safety	Construction and operation of terminals, bridges, and associate facilities like roads and hospitals at the Central Cluster.	The spatial boundary for this VEC is 1 km radius area towards land side around- Central Cluster.

Determining Temporal Boundaries

Temporal delineation for a CIA is a challenge due to the inherent uncertainty about potential future projects and activities. The following are the basic assumptions to determine temporal boundaries for the assessment according to the IFC CIA Guidelines.

a) The time frame expected for the complete life cycle of the proposed development (including construction, operation, and decommissioning)
b) The expected time frame for the potential effects of the proposed development can extend beyond (a).
c) The most conservative time frame is between (a) and (b).
d) Use of professional judgement to balance between overestimating and underestimating, and make sure to document the justification or rationale.
e) Exclusion of future actions if (i) they are outside the geographical boundary, (ii) they do not affect VECs, or (iii) their inclusion cannot be supported by technical or scientific evidence.

Most of the projects identified within the spatial boundary are riverfront activities (terminals, jetties, port, and sand mining), construction bridges, and river-bank protection measures. The temporal boundaries for the current CIA have been established keeping in mind the following:

- **Life cycle of existing projects and foreseeable planned projects:** At least a 20-year period for the current project lifecycle, which includes 5 years in the foreseeable future for proposed terminals and other riverfront developments in the Clusters, the 10-year period represents a feasible and appropriate timeline for identifying projects to be considered for the CIA.
- **Climate change and anthropogenic factors:** anticipated timescales for selected other external factors (e.g., climate change) that may impact all selected VEC conditions beyond the project lifecycle and stretch to a 100-year period. These consider the contribution of the natural driving forces of long-term climate cycles and anthropological activities that may impact hydrological factors such as water availability, floods, etc.

The temporal boundaries for the CIA study have been considered for 10 years, considering the foreseeable projects planned in both Clusters.

Figure 2.3 CIA Spatial Boundary Map for Central Cluster

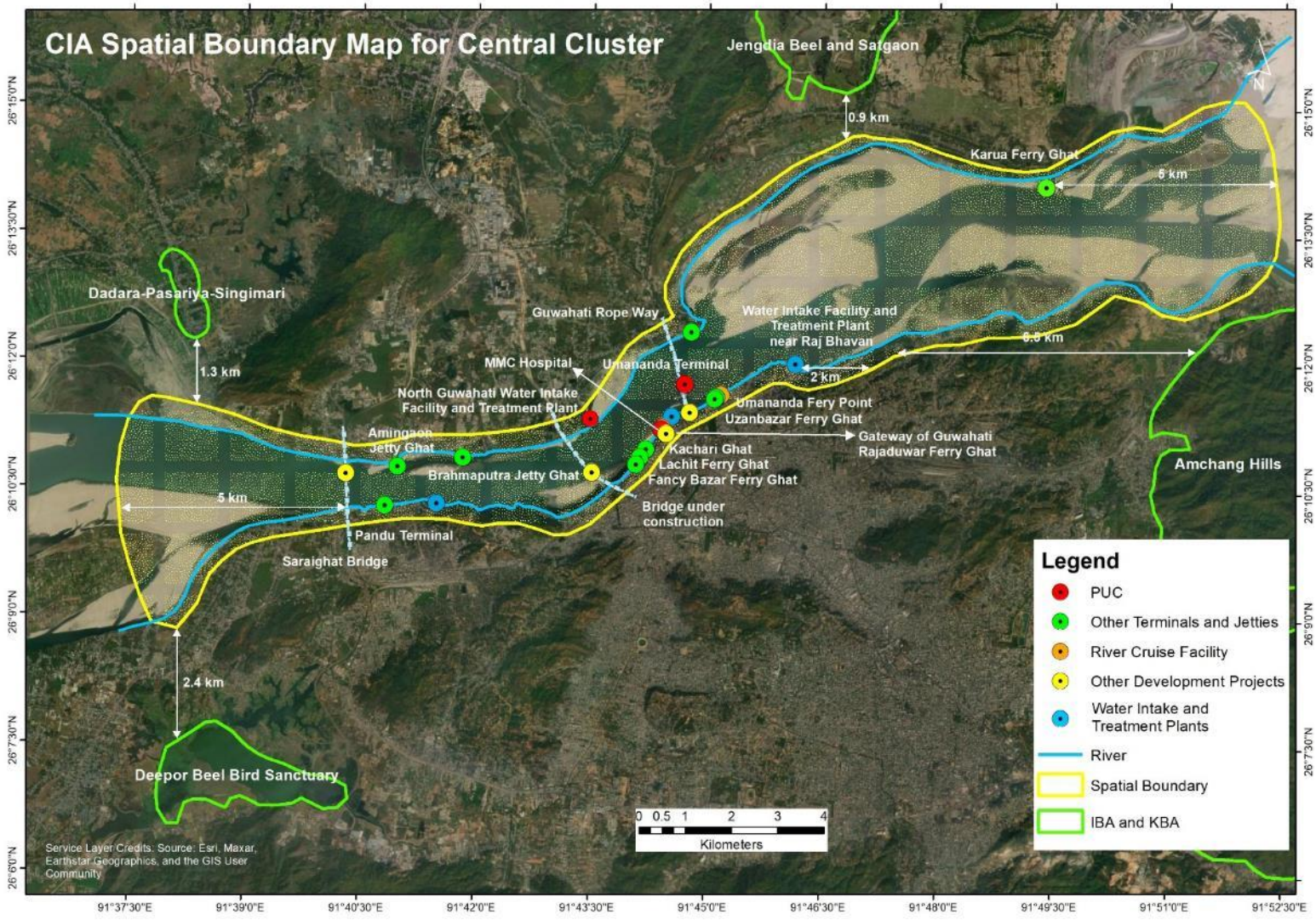
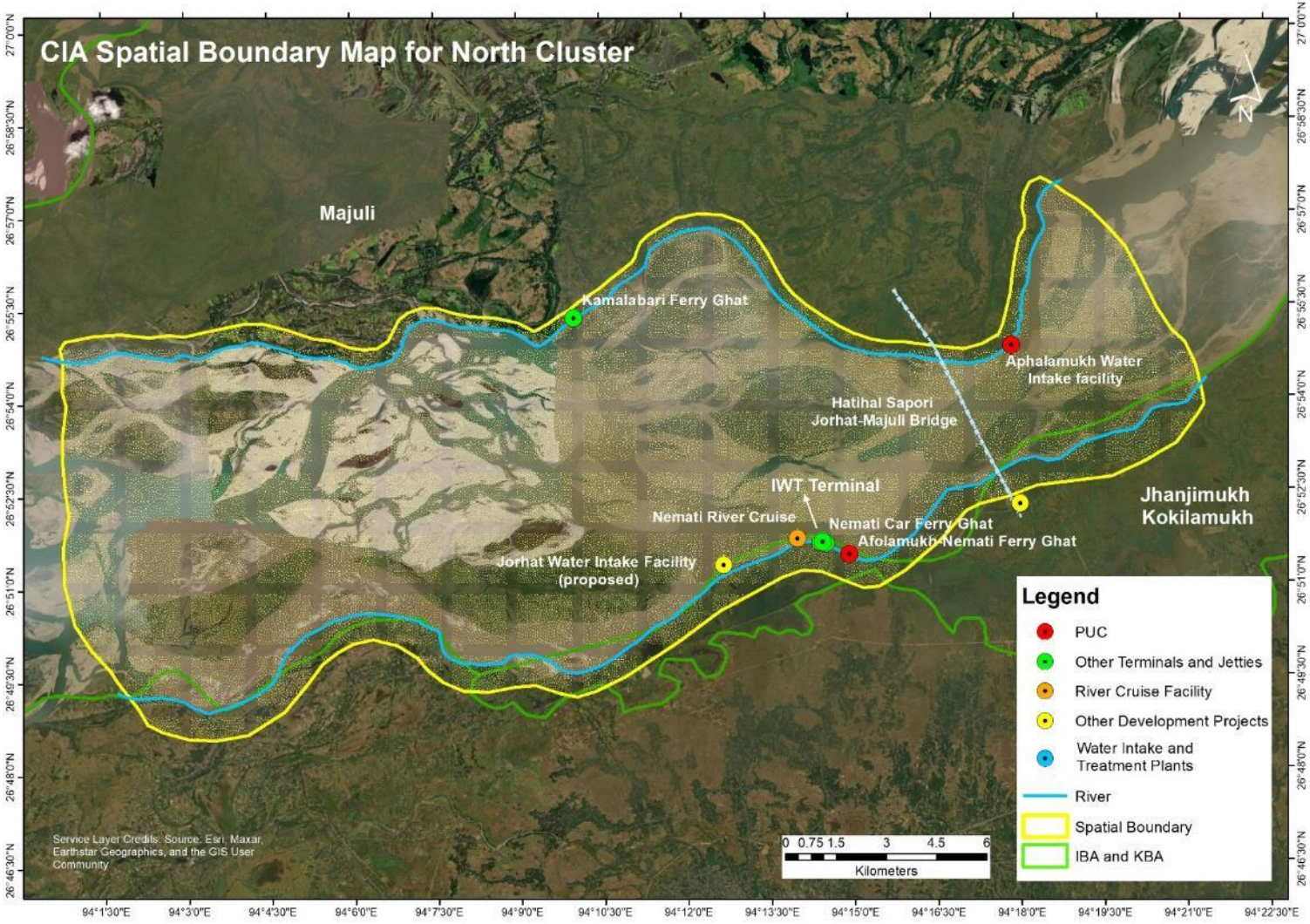


Figure 2.4 CIA Spatial Boundary Map for North Cluster



Identification of Sources of Impacts

SI has considered the following sources of cumulative impacts based on the IFC Good Practice Handbook Guidance:

Past and Present Projects in the CIA Spatial Area

The past and present projects or activities with a potential to cause cumulative impacts on VECs include the following:

- River front activities
    - Existing river terminals or ferry ghats: 12 in Central Cluster and 3 in the North Cluster
    - River cruise facility: 2 in Central Cluster and 1 in the North Cluster.
    - Existing river cargo terminal: one in Central Cluster and one in North Cluster.
    - Water intake facility & treatment plant: 4 in Central Cluster and 1 in the North Cluster.
- Other Developmental Projects in the area
    - Existing bridge over the Brahmaputra River- Saraighat Road and Railway bridge in Central Cluster.
    - Under construction bridge over the Brahmaputra River—a six-lane bridge connecting South Guwahati with North Guwahati at Central Cluster and a second one at North Cluster—Hatihal Sapori Jorhat-Majuli Bridge, connecting the world's largest river island, Majuli, with Jorhat.
    - River-bed sand mining- number of mines in North Cluster.
    - River-bank protection projects

Reasonably Foreseeable Future Actions (RFFAs)

Proposed projects including new future developments in the basin that have a potential to cause cumulative impacts on VECs include the following:

- River terminal/ jetties
    - River terminals either under construction and/or planned- three in Central Cluster and two in North Cluster;
    - IWAI proposed terminal at Neamati side;
    - Expansion of Pandu River Port.
- Other Developmental Projects in the area
    - River-bed sand mining- expansion or new riverbed sand mines in North Cluster;
    - River-bank project in the North Cluster;
    - Elevated road from Panbazar Brahmaputra Bridge to Uzanbazar along the river bank of Central Cluster.

External Stressors or Drivers

Human activities and natural drivers that exert an influence on VEC condition has been identified and characterized based on existing knowledge and secondary information available in the public domain. Any impacts or risks these identified drivers may have on the identified VECs has been linked and assessed.

Urbanization

Guwahati city is located on both side the Brahmaputra River. The population of Guwahati is about 9.57 lakh with the decadal population growth rate being in the range of 20 percent. The water requirement of the Guwahati City Corporation is 433 million liters per day. Approximately 154 million litres per day (MLD) of wastewater is generated from the city. Presently, there are no sewage treatment plants (STPs) available in the city and untreated wastewater is directly or indirectly discharged into the Brahmaputra River.

Natural Stressors

Natural influences and environmental drivers include those linked to climate change. These includes flood, erosion and accretion, drought etc. comprise major stressors that reportedly affect the surface water resource and aquatic biodiversity, livelihood, physical infrastructure and properties in in the river basin. The stressors are elucidated below:

Flood: Global studies suggest that climate change[1] could increase the risk of hydrological disasters in the future (Van Aalst, 2006; Lane and Kay, 2021). The fluvial processes of the Brahmaputra River and its tributaries continuously alter the floodplains, at times to an undesired magnitude (Sarma and Phukan, 2004; Kotoky et al., 2005, 2012; Das et al., 2012; Lahiri and Sinha, 2012). The river regularly inundates and erodes owing to high orographic precipitation on a narrow drainage basin (Shampa and Ali, 2019). The Brahmaputra flood plain (BFP) experienced high magnitude floods in 1954, 1962, 1972, 1977, 1984, 1988, 1998, 2002, 2004, 2012, and 2020 over the past half-a-century.

Erosion and Accretion: The Brahmaputra River is usually subjected to severe bank erosion leading to the widening of the river and adding more deposits forming permanent islands or chars (Sarker et al., 2003). The river is highly dynamic with erosion rates up to 1 km per year and the total erosion rate is 1.5–2 times higher than that of the Ganga River and much higher than the world average (Galy and France-Lanord, 2001). Erosion-deposition phenomenon is a typical characteristic feature of the Brahmaputra River leading to changes in the channel pattern and bank-line shifts that have a severe impact on the agrarian communities.

Sand bars: The Brahmaputra channel experiences major changes in response to variations in the flow and sediment load. During November to March, when the river discharge is low, the channel is highly braided with several bars and islands. After April and May, when discharge starts increasing, these islands and bars get submerged and the river looks straight. During the low water stage, the main channel in a braided river, which carries a portion of the discharge, is commonly situated near one of the riverbanks and is slightly curved, moving from one bank to the other. During the rising stage, when the flow increases rapidly, while the flow inclines to follow the deep channel, it is not able to develop rapidly to accommodate the increasing flow, and hence there is a tendency for bank cutting and sloughing.

[1] There is no specific climate change related action plan related to water resource management of the Brahmaputra River in the Assam State Action Plan on Climate Change 2015–20. The Draft Assam State Action Plan on Climate Change 2020-30 has not been disclosed yet.

The hydrological modelling study was conducted for the project to understand the erosion and accretion patterns of the rivers for the purpose of designing the ferry terminals. The aqua monitor images were analysed to understand the erosion and accretion changes from 2010 to 2020. The modelling results revealed that erosion was reported towards the southern bank, i.e., the Neamati side, and accretion towards the northern bank. The sand bar formation was also recorded towards the northern side. The central cluster modelling results revealed that accretion was reported towards the northern bank, i.e., the North Guwahati terminal side. Sand bar formation is also reported in this cluster. The formation of sand bars may hamper the operation of terminals and the movement of vessels.

2.2.2 Determining Present Conditions of VECS

The purpose of this task was to define the existing condition of VECs, understand potential interaction with development influences and stressors. During the initial stage of the study, secondary data from veritable sources was collected and reviewed. SI has utilized the existing data which includes information from the terminal level ESIA report, Dolphin study reports- conducted by Zoological Survey of India (ZSI), WWF India, periodical Dolphin monitoring reports, secondary literature and geospatial information, to define the existing condition of the VECs, their vulnerabilities and their potential reaction to stress, resilience and recovery times. Cause Effect (Network) diagrams were also developed to clearly understand the interactions between the key VECs and the developmental stressors.

2.2.3 Assessment of Cumulative Impacts on VECs

Assessing the cumulative impact on the screened-in VECs was done for the identification of indicators (linked to the baseline conditions of the VECs) and thresholds (indicating vulnerability that may lead to an adverse impact) and thereafter-assessing significance. The considerations for development of indicators was conducted keeping in mind:

a) representation of VECs;
b) measurable based on some temporal data availability; and
c) understood by the decision makers and other key stakeholders.

Threshold levels for the indicators have been developed to assess the significance of cumulative impacts on VECs. The threshold level for an indicator has considered any national regulatory standards of or comparison with previous studies as part of different ESIAs in the area. This approach is based on certain exemplar socio-economic indicators, discussed in **Section 5.4** of the IFC GPH on CIA (2013) to reflect cumulative impacts over selected VECs. These indicators and thresholds have estimated potential impact to the vulnerability, and/or risk to the sustainability, of the VECs assessed.

Assessing Significance of Cumulative Impacts

Significance of cumulative impact will be determined based on the criteria set below.

Table 2.2 Impact Significance Definition

High	VEC would experience changes that would likely exceed its range of tolerance / resilience within the spatial and temporal boundaries considered and the viability of the VEC would be threatened.
Substantial	VEC would experience changes beyond natural variation, but within its range of tolerance / resilience within the spatial and temporal boundaries considered; viability of VEC will not be threatened.
Moderate	VEC would experience noticeable changes, but within natural variations within the spatial and temporal boundaries considered.
Negligible	VEC would not experience noticeable changes within the spatial and temporal boundaries considered.

2.2.4 Cumulative Impact Management Plan

Practical measures for managing the PUCs contribution to cumulative impacts within the spatial boundary was identified. These include measures targeted for AIWT developers, other project sponsors in the basin, as well as measures that may require action from government and local communities. Effective application of the mitigation hierarchy (avoid, reduce, mitigate, and compensate) to manage PUC specific contributions of cumulative impacts has been recommended as best practice for the both the Clusters.

3 ADMINISTRATIVE FRAMEWORK

This section provides an overview of the existing legal, institutional, governance and planning framework, as it pertains to CIAs for inland waterways terminal project and natural resources management in order to identify existing legal instruments, precedents and/or initiatives to review towards management of cumulative impacts in India. The review attempts to bring together Country's environmental and social policies, regulations, and World Bank policies that could be relevant for the implementation of AIWTA project.

3.1 APPLICABLE WORLD BANK SAFEGUARD POLICIES

The World Bank's environmental and social safeguard operational policies are crucial for any development project being funded by the World Bank. The main objective of these policies is to add to the process of sustainable development and poverty reduction through the projects it is funding. These policies provide guidelines for the Bank and borrower staffs in the identification, preparation, and implementation of programs and projects.

While some of the safeguard policies concentrate on the social aspect like poverty reduction, participation, rights of indigenous people, gender and the land acquisition and resettlement and rehabilitation issues, the environmental polices provides policies to manage environmental impacts, natural habitats of various wild life and species etc, and ensure better management of water resources, conservation of forests etc.

Based on the review of project the following World Bank Safeguards and Operational Policies (OPs) are found to be applicable to the Project, same is presented in **Table 3.1**.

Table 3.1 World Bank Safeguard & Operating Policies and Directives applicable for Project

WB Safeguards & OPs	Requirements	Applicability to the Project
A.	**Environment**	
OP 4.01 Environmental Assessment	Environmental assessment (EA) of projects proposed for Bank financing is required to help ensure that they are environmentally sound and sustainable. EA takes into account the natural environment (air, water, and land); human health and safety; social aspects (involuntary resettlement, indigenous peoples, and physical cultural resources). Based on the EA and the degree, extent and severity of impacts the projects are classified as Category "A", "B" and "C".	Applicable. This is an umbrella policy and will be applicable for AIWT Project. The Environment and Social Impact Assessment has been conducted for all the five terminal projects.
OP 4.36 Forests	The Policy aims to reduce deforestation, enhance the environmental contribution of forested areas, promote afforestation, reduce poverty, and encourage economic development.	Not Applicable. The projects will not take up in any forest area. Therefore, OP 4.36 would not generally apply.

WB Safeguards & OPs	Requirements	Applicability to the Project
OP 4.04 Natural Habitats	The Policy seeks to ensure that World Bank-supported infrastructure and other development projects take into account the conservation of biodiversity, as well as the numerous environmental services and products which natural habitats provide to human society.	Applicable The Brahmaputra River is the Ganges Rivers Dolphin and vulnerable turtle species habitat. The river front construction activities and operation of vessels, potential to have impact on these species; therefore, OP 4.04 is applicable.
OP 4.09 Pest Management	The procurement of any pesticide in a Bank-financed project is contingent on an assessment of the nature and degree of associated risks, taking into account the proposed use and the intended users. The need to prevent the development of resistance in pests.	Not Applicable. The project will not use any pesticides. Hence this OP 4.09 will not be applicable.
B.	**Social**	
OP 4.10: Indigenous Peoples	This policy contributes to the Bank's mission of poverty reduction and sustainable development by ensuring that the development process fully respects the dignity, human rights, economies, and cultures of Indigenous Peoples.	Not Applicable There is no direct impact on indigenous people through procurement of land for the project.
OP 4.11: Physical Cultural Resources	This policy addresses physical cultural resources, which are defined as movable or immovable objects, sites, structures, s of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance.	Not Applicable. Under AIWT Projects no activity is envisaged in areas where this requirement will need to be addressed.
OP 4.12: Involuntary Resettlement	The policy aims to avoid involuntary resettlement to the extent feasible, or to minimize and mitigate its adverse social and economic impacts.	Applicable Under AIWT projects, private land will be procured for Neamati terminals site. Three terminal sites has few temporary structures (shops) need to be relocate.

The World Bank's Operational Policy 4.01, 404 and 4.12 is applicable to the project and accordingly Environment Management Framework, Social Management Framework (SMF), RPF & Gender Development Framework, Environmental Codes of Practice has been prepared and approved by the Bank and disclosed.

3.2 ENVIRONMENT AND SOCIAL REGULATION FRAMEWORK

India has strong set of laws and regulations both on environmental and social aspects. Progressive changes in regulations covering many social and environmental aspects have been made in the recent decades. A brief analysis of the local laws and regulations and their applicability to AIWTA project is presented in **Table 3.2**.

Table 3.2 Environmental and Social Regulations Applicable for Project

S. No.	Legislation	Remarks on Applicability for this project
A	**Environmental**	
1.	The Indian Wildlife (Protection) Act, 1972, amended 1993, The Wildlife (Protection) amendment Act, 2002	The proposed terminals under PUC will be constructed on the existing sites, and those are located in protected areas like National Parks and Wildlife Sanctuary. However, the Schedule I species habitat and species are reported in the project influence area; therefore, the act is applicable for this project.
2.	Wildlife Conservation Strategy 2002	The proposed terminals under PUC do not propose any activity which goes against strategy mentioned, hence will not be applicable for this project.
3.	The Environment (Protection) Act; 1986 as amended till 2010	As an umbrella Act, all the rules and regulations promulgated under the act depending upon their individual applicability will apply on the project. Environment (Protection) act is applicable for this project.
4.	Environment (Protection) Rules 1986[1]	Construction of terminals under PUC is likely to generate fugitive emissions in terms of particulate matter and gaseous pollutants during construction and operation stages. Under the Environment (Protection) Rules pollution standards for DG sets, vehicular pollution, waste-water and terminal specific pollutants will be applicable for the Project.
5.	The Air (Prevention and Control of Pollution) Act, 1981 Including Rules 1982 and 1983	Applicable to this project, as the PUC is likely to generate fugitive emissions in terms of particulate matter and gaseous pollutants during construction and operation stages. The proposed project needs to comply with the said act.
6.	Noise Pollution (Regulation and Control) Rules, 2000	Applicable to this project, as the PUC is likely to generate noise during construction and operation stages. The proposed project needs to comply with the said rule.
7.	The Water (Prevention and Control of Pollution), Act, 1974 including Rules, 1975 (as amended up to 1988)	Applicable to this project, as the PUC is likely to generate waste-water (domestic waste water). This need to be treated and disposed as per applicable rules.

[1] A no-objection certificate from the respective State Pollution Control Board is essential for all dairy plants.

S. No.	Legislation	Remarks on Applicability for this project
8.	Central Groundwater Authority Guidelines & Ground Water (Regulation, Development and Management) Rules, 2007 and ground water extraction Notification 2020	Applicable for this project, as the proposed project will source the required water from groundwater resources, where there is supply water.
9.	The Motor Vehicles Act, 1988 and Rules	The Act will be indirectly applicable for activities under the project relating to the transportation of construction materials; manpower and such transport will be outsourced, and therefore the primary responsibility for compliance with this law will be that of the transport provider.
10.	Hazardous and Other Wastes (Management and Transboundary Movement) Rules 2016 and Amendment Rules, 2022	Not applicable, as the proposed terminals under PUC are expected to release hazardous waste. However, during the construction stage, a small quantity of waste is likely to be generated, and the same needs to be disposed of through a third-party vendor.
11.	Construction and Demolition Waste Management Rules, 2016	Applicable to all waste resulting from Construction, remodelling, repair & demolition of any civil structure.
12.	E-Waste (Management) Rules, 2016	Applicable as desired of life electronic gadgets will be generated from office, vessels etc.
13.	Plastic waste Management Rules, 2016	Applicable Rule applies to every waste generator, local body, Gram Panchayat, manufacturer, importer and producer.
14.	The Batteries (Management and Handling) Rules 2010	Applicable for disposal of used lead acid battery if likely to be used in any equipment during construction and operation stage
15.	Solid Waste Management Rule, 2016	Applicable Rule applies to every waste generator, local body, Gram Panchayat, manufacturer, importers and producer.
B.	**Land Acquisition**	
16.	Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013	Applicable. The PUC would require additional land for the redevelopment of terminals. Out of five terminals, four will be redeveloped on government land, and private land will be procured for the Neamati terminal.
C.	**Labour and Child Labour**	
17.	Laws related to labour and working (like child labour, trade union, minimum wages, maternity benefits etc.)	All the Laws related to Labour welfare and child labour will be applicable for this project during construction stages of the project.
D.	**Regulations Applicable on Vessels Plying in Inland Waterways**	

S. No.	Legislation	Remarks on Applicability for this project
18.	Prevention of Collision on National Waterways Regulations, 2002	Precautions required for vessels and crew members
19.	National Waterways, Safety of Navigation and Shipping Regulations, 2002	Ensuring safety during navigation on the national waterways
20.	The National Waterway Act, 1982	Regulation and development of rivers for navigation
21.	New Inland Vessel Act, 2015 & Rules Under IV Act	Economical and safe transportation through inland waters

4 DEVELOPMENTS IN CENTRAL AND NORTH CLUSTERS

4.1 INTRODUCTION

The Brahmaputra River is navigable for most of its length in India. The government of India realised its significant navigational potential and declared it the National Waterway-2 (NW2) in 1988 between Sadiya and Dhubri. Recent years have also witnessed a modest growth of river cruises with the advent of riverine cruise ships. The Inland Water Authority of India (IWAI) is responsible for maintaining the Brahmaputra River's navigational channel with the required draft for navigational purposes. It has also set up cargo terminal facilities for loading and unloading at strategic locations like Dhubri and Pandu as well as temporary facilities at Jogighopa, Silghat, Neamati, and Dibrugarh. The existing operating Pandu (Guwahati) cargo terminal, serves as a multimodal transport hub in the entire North East region.

The bulk cargo movements through the Brahmaputra River include coal from Meghalaya and fly ash from Farakka to various destinations in the Northeast. Limestone for cement plants, petroleum products from Numaligarh refinery, bitumen from Haldia, food grains from Kolkata, fertilisers, building materials, and bamboo are also transported through the waterway.

Assam Inland Water Transport Development Society (AIWTDS) has conceptualised promoting inland water transport as an eco-friendly, economic, and convenient mode of transport, and it is likely that the project will help in the regional and economic development of Assam and nearby states by providing better connectivity and access to the hinterland.

4.2 PROJECT UNDER CONSIDERATION

AIWTDS presently proposes to develop and modernise terminal infrastructure initially at five (5) locations, i.e., Gateway Guwahati Ghat, North Guwahati, Umananda (Central Cluster), Aphalamukh, and Neamati (North Cluster). The Clustering approach of the above-mentioned terminals as adopted in the project feasibility report has been followed for the CIA study. The justifications of the Clustering approach for the CIA study has also been discussed in determining the spatial boundary section (refer to Section 2.2). Apart from the development of terminals in these locations, 20 vessels (10 numbers of 100-pax vessels and 10 numbers of 50-pax vessels) with all modern amenities to meet safety, security, and environmental standards will be acquired. Upgradation of 'Crew Training Centre (CTC),' which is under the IWT Assam, as well as introduction of an incentivization scheme named 'Jibondinga' for private boat owners and operators to purchase new vessels and upgrade existing vessels by certifying those vessels by the IRS, are also part of the project. The aerial distance between the Central Cluster and North Cluster of terminals is around 260 km. A brief description of these five terminals is provided in **Table 4.1.**

Table 4.1 Brief Description of PUC

Parameter	Central Cluster			North Cluster	
	Gateway of Guwahati	**North Guwahati**	**Umananda**	**Aphalamukh**	**Neamati**
Location	▪ The proposed terminal in Guwahati Gateway is on the left bank of Brahmaputra River ▪ Geographical coordinates: 26°11'9.32"N; 91°44'21.48"E	▪ The proposed terminal in North Guwahati is on the right bank of Brahmaputra River ▪ Geographical coordinates: 26°11'10.05"N; 91°43'18.18"E	▪ Umananda is an island in the Brahmaputra River. ▪ Geographical coordinates: 26°11'46.12"N; 91°44'42.73"E	▪ The proposed terminal in Aphalamukh is on the right bank of Brahmaputra River. ▪ Geographical coordinates: 26°54'57.13"N; 94°17'57.80"E	▪ The proposed terminal in Neamati is on the left bank of Brahmaputra River ▪ Geographical coordinates: 26°51'39.12"N; 94°14'31.18"E
Purpose	▪ The proposed ferry terminal at Guwahati Gateway Ghat (GGG) will cater to the passenger and two-wheeler traffic traveling to and from North Guwahati ghat and other nearby terminal locations.	▪ The proposed ferry terminal at North Guwahati will cater to the passenger and two-wheeler traffic traveling to and from Gateway of Guwahati ghat and other nearby terminal locations.	▪ Umananda is an island in the Brahmaputra River and it is famous for the temple which is present on island hilltop. There is no residential areas and commercial spaces present in the island. The people visit the temple by crossing the river through ferry service after parking their vehicle on either of the river banks. ▪ The proposed ferry terminal at Umananda will cater to passengers comprising of devotees and tourists traveling to and from North Guwahati ghat and other nearby terminal locations.	▪ The proposed ferry terminal at Aphalamukh will cater to the passenger and two and four wheeler traffic traveling to and from Neamati ghat and other nearby terminal locations.	▪ Neamati terminal is the nodal point to the Majuli Island. The local residents and tourist presently use the ferry terminal services to reach Majuli Island and Kamalabari. Existing transport system from Majuli is solely dependent on inland water transport from two of its Major ghats/ terminal Kamalabari & Aphalamukh to the mainland with Neamati. ▪ The proposed ferry terminal at Neamati will cater to the passenger and two-wheeler and four-wheeler traffic traveling to and from Aplamukh and Kamalabari terminal locations.
Existing facility	▪ The ferry terminal consists of floating pontoon facility for berthing of vessels and boarding and deboarding of commuters. ▪ The terminal users use wooden planks as the access structure to reach the pontoon and currently there no existing landside facility is available. ▪ Existing jetty locations have following inadequacy i) passenger waiting area, ii) parking area iii) toilet facilities, iv) access to public road. ▪ Temporary bamboo ramps / structure ▪ Toilet waste not treated and directly release into river. ▪ Solid waste is dumped in and around the terminal area.	▪ The ferry terminal consists of floating pontoon facility for berthing of vessels and boarding and deboarding of commuters. ▪ The terminal users are having the wooden planks as access structure to reach the pontoon; ▪ Vessels plying to-from this location carries both passengers and two wheelers. ▪ There is no terminal building, dedicated waiting areas and the ticket counters etc. ▪ Currently the waiting area and the ticket counter are present in the pontoon itself. ▪ Narrow approach road to reach the terminal. ▪ Electricity connection is available in the pontoon. ▪ The water requirement is met by drawing river water by pump which is then stored in tank for usage in toilets, washing etc.	▪ The existing ferry terminal consists of floating pontoon facility for berthing of vessels and boarding and deboarding of commuters. ▪ The ferry terminal users are having the wooden planks as access structure to reach the pontoon. ▪ On the land side there are no terminal buildings, dedicated waiting area, etc. ▪ At this point of time the waiting area present in the pontoon or the vessel berth at the pontoon.	This ferry terminal located in less populated area. ▪ The existing riverine infrastructure in the ferry terminal consists of floating pontoon facility for berthing of vessels and boarding and deboarding of passengers and two-wheeler and car. ▪ At present this terminal also accommodates RO PAX vessels with inbuilt ramps for the transport of two and four-wheeler vehicles. ▪ The existing sloping road leading towards the end side of berthing/ inbuilt ramps is not constructed properly and steep slope. ▪ At the land side there is no terminal building, dedicated waiting areas and the ticketing counters etc. Presently the ticket counter is operated from waiting area	▪ The existing riverine infrastructure of the ferry terminal consists of floating pontoon facility for berthing of vessels and boarding and deboarding of passengers. ▪ This terminal also accommodates RO-PAX vessels with inbuilt ramps for the transport of two and four-wheeler vehicles. ▪ The existing sloping road leading towards the end side of berthing/ inbuilt ramps is not constructed properly and steep slope. ▪ At the land side there is no terminal building, dedicated waiting areas and the ticketing counters etc. Presently the ticket counter is operated from waiting area

Parameter	Central Cluster			North Cluster	
	Gateway of Guwahati	**North Guwahati**	**Umananda**	**Aphalamukh**	**Neamati**
		▪ Solid wastes generated in the ghat are stored in bins and handed over to the NGO, 'Pratyasha' for disposal in municipal waste disposal site.			
Passenger load (No./day)	Current (2023) - 672 passengers Projected (2045) -772 passengers	Current (2023) - 4075 passengers Projected (2045) -4156 passengers	Current (2023) - 672 passengers Projected (2045) -772 passengers	Current (2023) - 1596 passengers Projected (2045) -1660 passengers	Current (2023) - 935 passengers Projected (2045) -1660 passengers
Proposed development (land side)	Development & modernization of terminal infrastructure, which includes: ▪ Terminal building (ticket counter, office, waiting area, toilets, baby room) ▪ Utilities (DG sets, transformer, water tank) ▪ External Development (parking, plantation, ramps) ▪ Vessel maintenance facility, crew Training	Development & modernization of terminal infrastructure, which includes: ▪ Terminal building (ticket counter, office, waiting area, toilets, baby room) ▪ Utilities (DG sets, transformer, water tank, waste collection area, sewage treatment plant) ▪ Parking area; ▪ Landscaping area ▪ Approach ramp to riverine facility.	Development & modernization of terminal infrastructure, which includes: ▪ Terminal building (ticket counter, office, waiting area, toilets, baby room) ▪ Utilities (DG sets, transformer, water tank, waste collection area, sewage treatment plant) ▪ Landscaping area	Development & modernization of terminal infrastructure, which includes: ▪ Terminal building (ticket counter, office, waiting area, toilets, baby room) ▪ Utilities (DG sets, transformer, water tank, waste collection area, sewage treatment plant) ▪ External parking area; ▪ Landscaping area; ▪ Approach bund to riverine facility.	Development & modernization of terminal infrastructure, which includes: ▪ Terminal building (ticket counter, office, waiting area, toilets, baby room) ▪ Utilities (DG sets, transformer, water tank, waste collection area, sewage treatment plant) ▪ External parking area; ▪ Landscaping area; ▪ Approach bund to riverine facility.
Proposed development (river side)	The Project Development Objectives (PDOs) are to improve passenger ferry infrastructure and in land water transport services in Assam. The passenger's terminal is comprised of terminal Building in land side and in riverine it comprises of link span of approximate 173 meter and berthing pontoon of 120 meters. The riverine infrastructure comprises of the following components: ▪ Berthing pontoons – 60x15m (2 nos.) ▪ Dolphins for berthing pontoons – 7.5x7.5m (4 nos.) ▪ Steel linkspans – (approx.) 29m span x 5m wide (5 nos.) ▪ Intermediate pontoons – 20x9.75m (4 nos.) ▪ Dolphins for intermediate pontoons – 14x14m (4 nos.) ▪ Bank seat (20x11.5m)	The concept of this terminal consists of guide piles, floating pontoon, intermediate pontoons, linkspans and reinforced concrete piled deck connecting the landside facilities. The riverside facility consists of: ▪ **Pontoons** is for embarking/ disembarking of passengers/vehicles from vessel to pontoon and vice versa. A series of floating pontoons (2 nos. of 35m long). ▪ **Linkspans** is an access structure which connects landside infrastructure with intermediate landing floating platforms and berthing pontoon. There total 3nos. of 47m span linkspans proposed for the North Guwahati site ▪ **Approach platform** shall be a fixed concrete piled deck structure connecting the linkspan and the landside infrastructure. ▪ **Landing platforms** are the intermediate floating platforms which are pontoons with guide piles acting as support for the platform for the movement of the passengers and two-wheeler vehicles.	The concept of this terminal is a floating pontoon and ramp connecting to sloping access on the riverbank and floating pontoon for the safe commute of the passengers. The riverside facility consists of: ▪ **Floating pontoon with integrated ramp**- is for embarking/ disembarking of passengers/vehicles from vessel to pontoon and vice versa. The 35 m x 10 m pontoon will have self-integrated two ramp arrangement. ▪ **Approach bund** is the contact point of pontoon ramp with landside infrastructure. The passengers disembarked from the pontoon shall move through ramp will reach the approach bund. The approach bund in the Umananda is planned in a staggered / doglegged manner due to the availability of less river frontage area.	The riverside facility consists of: ▪ **Pontoons** is for embarking/ disembarking of passengers/vehicles from vessel to pontoon and vice versa. one floating pontoon (45m x 12m) for Neamati. ▪ **Floatation Tank**- The functional requirement of the floatation tank is to support one end of the linkspan and provide support to the floating pontoon or main pontoon in facilitating the embarkment & dismemberment of passenger / vehicles. The floatation tank moves in the vertical plane along with the water level fluctuations in the river during all the seasons. ▪ **Linkspans** is an access structure which connects landside infrastructure with intermediate landing floating platforms and berthing pontoon. There total 3nos. of 27m span linkspans proposed for this terminal. ▪ **Approach Bund**-The sloping access approach bund is planned to be protruding into the river. This is to accommodate the vehicles roll off and on activity on the vessel and also for the passengers embarkment and dismemberment.	There is uncertainty over the land acquisition of existing ferry terminal as it belongs to AIWT. Therefore, the proposed ferry location at Neamati has been relocated approximately to 1 km upstream. This ferry terminal will be planned for the movement of passengers and the vehicular traffic especially two and four wheelers. The operational requirement of two dedicated approach bunds for the vessels plying from Kamlabari and Aphalamukh to avoid any mishaps. The riverside facility consists of: ▪ **Pontoons** is for embarking/ disembarking of passengers/vehicles from vessel to pontoon and vice versa. Two floating pontoons (2 nos. of 45m x 12m) for Kamlabari and Aphalamuk. ▪ **Floatation Tank**- The functional requirement of the floatation tank is to support one end of the linkspan and provide support to the floating pontoon or main pontoon in facilitating the embarkment & dismemberment of passenger/ vehicles. The floatation tank moves in

Parameter	Central Cluster			North Cluster	
	Gateway of Guwahati	**North Guwahati**	**Umananda**	**Aphalamukh**	**Neamati**
					the vertical plane along with the water level fluctuations in the river during all the seasons. ▪ **Linkspans** is an access structure which connects landside infrastructure with intermediate landing floating platforms and berthing pontoon. There are in total 3 nos. of 27 m span linkspans proposed for this terminal. ▪ **Approach Bund**-The sloping access approach bund is planned to be protruding into the river. This is to accommodate the vehicles roll off and on activity on the vessel and also for the passengers embarkment and dismemberment.
Construction phase activities	▪ Site preparation including filling and leveling work, ▪ Piling activity, ▪ Transportation of construction materials (through roadways and waterways); ▪ Construction of land site facilities; ▪ Operation of base-camp and labour camp	▪ Land reclamation area, ▪ Piling activity ▪ Site preparation including compaction and leveling work, ▪ Transportation of construction materials through roadways and waterways; ▪ Construction of land site facilities; ▪ Operation of base-camp and labour camp	▪ Land reclamation area, ▪ Site preparation including compaction and leveling work, ▪ Piling activity for land reclamation area, ▪ Transportation of construction materials through waterways; ▪ Construction of land site facilities; ▪ Operation of base-camp and labour camp	▪ Site preparation including filling and leveling work; ▪ Transportation of construction materials (through roadways and waterways); ▪ Construction of land site facilities; ▪ Operation of base-camp and labour camp.	▪ Site preparation including filling and leveling work; ▪ Transportation of construction materials (through roadways and waterways); ▪ Construction of land site facilities; ▪ Operation of base-camp and labour camp.
Operational phase activities	▪ Operation of land side terminal facilities; ▪ Removal of silt/sand at jetty area and its disposal ▪ Operation of vessels.	▪ Operation of land side terminal facilities; ▪ Removal of silt/sand at jetty area and its disposal ▪ Operation of vessels.	▪ Operation of land side terminal facilities; ▪ Operation of vessels.	▪ Operation of land side terminal facilities; ▪ Removal of silt/sand at jetty area and its disposal ▪ Operation of vessels.	▪ Operation of land side terminal facilities; ▪ Removal of silt/sand at jetty area and its disposal ▪ Operation of vessels.
Land	The proposed terminal is located on Government and land requirement is 2770 m^2.	▪ The existing terminal is located on government land. ▪ Encroachment was reported in the terminal approach road. ▪ Total terminal area is 2222.08 m^2. ▪ An additional 1500 m^2 of land will be required for the proposed redevelopment work. This is likely to be government land. ▪ The entire terminal facilities will be developed on the reclaimed land.	▪ The existing terminal is located on government land. ▪ Total terminal area is 850 m^2. ▪ An additional 500 m^2 of land will be required for the proposed redevelopment work. This is likely to be government land. ▪ Umananda island is an archaeological site - approval for construction of terminal NOC has been obtained from Directorate of Archaeology, Govt. of Assam	▪ The existing terminal is located on government land. ▪ Total land requirement for proposed new terminal area is 2663.82 m^2;	▪ The existing terminal is located on government land. ▪ Total land requirement for proposed new terminal area is 4841 m^2- 3687 m^2 for terminal area and 1154 m^2 for external parking area; ▪ Private land will be acquired through Govt, process, Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 (RFCTLARR 2013). ▪ There are nine (9) titleholders land owners and 6 squatters recorded in the identified land.

Parameter	Central Cluster			North Cluster	
	Gateway of Guwahati	**North Guwahati**	**Umananda**	**Aphalamukh**	**Neamati**
Workforce during construction stage	Around 190	▪ During construction phase workforce will be required.	During construction phase workforce will be required.	During construction phase workforce will be required.	During construction phase workforce will be required.
Water requirement during operational stage (KLD)	100	▪ 38 KLD for designing phase up to 2045. ▪ Currently, there is no municipal water supply to the area, however, the state government will be providing municipal water connection till the site boundary under Jal Jeevan Mission (JJM) in the future. Till then, the water shall be sourced from the bore well planned near the water tank.	▪ 9 KLD for designing phase up to 2045 ▪ PHE Department has provided water treatment plant at Umananda temple, currently river water is pumped to the overhead tank which is used for domestic usage. ▪ Water required during operation stage will be sourced from the PHE supply.	▪ 15 KLD for designing phase up to year 2045 ▪ Currently, there is no municipal water supply to the area. However, the state government will be providing municipal water connection till the site boundary under JJM in the future. Till then, water shall be sourced from the bore well planned near the water tank.	▪ 38 KLD for designing phase up to 2045 ▪ Currently, there is no municipal water supply to the area. However, the state government will be providing municipal water connection till the site boundary under JJM in the future. Till then, water shall be sourced from the bore well planned near the water tank.
Waste water - operational stage (KLD)	60	11	3	4	11
Waste water treatment and disposal	▪ A package type STP of size 60KLD has been proposed for treating. Treated water will be used for water the landscape area. ▪ The sewage from berthed boats/vessels can be collected via dedicated pipe running to the STP or by portable vacuum collecting units to take out waste and dispose of it.	▪ A bio-digester tank of 12 KL has been proposed to treat the sewage from terminal building. ▪ The effluent from the bio-tank will be connected to the nearest municipal sewer network.	▪ A bio-digester tank of 4 KL has been proposed to treat the sewage from terminal building	▪ A bio-digester tank of 4 KL has been proposed to treat the sewage from terminal building. ▪ The effluent from the bio-tank will be used for gardening and discharge into municipal sewer in future.	▪ A bio-digester tank of 12 KL has been proposed to treat the sewage from terminal building. ▪ The effluent from the bio-tank will be used for gardening and discharge into municipal sewer in future.
Energy use and air emission during operational stage	▪ During the operation phase of the Terminal there is also provision for installation of a Grid Tied Solar Rooftop Photo Voltaic (SPV) power plant and solar exterior lights. ▪ During the project operation phase the propulsion of the boats will be diesel electric. The boats will operate on diesel only when batteries are completely discharged.	▪ During the operation phase of the Terminal there is also provision for installation of a Grid Tied Solar Rooftop Photo Voltaic (SPV) power plant and solar exterior lights. ▪ During the project operation phase the propulsion of the boats will be diesel electric. The boats will operate on diesel only when batteries are completely discharged.	▪ Project site is typically a river island and thus it is not possible/practical to tap the Electricity from SEB tapping point Hence the required power will be sourced from diesel generator (DG). ▪ During operation phase of the Terminal, provision for installation of a Grid Tied Solar Rooftop Photo Voltaic (SPV) power plant for exterior lighting arrangement.	▪ During the operation phase of the Terminal there is also provision for installation of a Grid Tied Solar Rooftop Photo Voltaic (SPV) power plant and solar exterior lights. ▪ During the project operation phase the propulsion of the boats will be diesel electric. The boats will operate on diesel only when batteries are completely discharged.	▪ During the operation phase of the Terminal there is also provision for installation of a Grid Tied Solar Rooftop Photo Voltaic (SPV) power plant and solar exterior lights. ▪ During the project operation phase the propulsion of the boats will be diesel electric. The boats will operate on diesel only when batteries are completely discharged.
Accretion and erosion status	▪ Located in accretion area; capital dredging may be required.	▪ Located in an accretion area; capital dredging may be required. ▪ The entire terminal facilities development on the reclaimed land and slope protection shall be of Gabion mattress.	▪ Located in stable zone. Accretion and erosion was not reported. ▪ The entire terminal facilities development on the reclaimed land and slope protection shall be of Gabion mattress.	▪ Located in stable zone. Accretion and erosion was not reported. ▪ There is a need to protect the riverbank from the erosion and stabilize the riverbank to have the terminal operational.	▪ Located in moderate erosion prone area. ▪ There is a need to protect the riverbank from the erosion and stabilize the riverbank to have the terminal operational.

Source: Feasibility Report for All Terminals, July 2022

4.3 PAST AND PRESENT DEVELOPMENTS

The past and the present development activities in both the Clusters related to the PUC are as follows:

- A total of 12 ferry ghats/ terminals are being operated on the central Cluster, and three (3) ferry ghats are being operated on the northern Cluster. These ghats are used to transport passengers, goods, and vehicles like bicycles, two-wheelers, and four-wheelers.
- There is a cargo facility near the central Cluster, Pandu Port/Terminal, and a minor cargo facility is located in the north Cluster at Neamati.
- River cruise facilities are located in both the Clusters.
- Water intake facilities including water treatment plants for domestic and drinking water supply in both the Clusters, those are operational.
- Construction of a six-lane bridge connecting Guwahati with North Guwahati is ongoing and is likely to be completed by 2023.
- Hatihal Sapori Jorhat-Majuli Bridge, connecting the world's largest river island Majuli with Jorhat. Land section construction activity has already completed and the bridge is planned to be completed by 2025.
- There are a number of river sand mines operating in the north Cluster, and there are probable plans for future expansion in terms of capacity or new locations.

The related past and present activities is presented in **Table 4.2.**

Table 4.2 Past and Present Development in Central and North Cluster

S. No.	Facilities	Geographical Coordinates	Location and existing facilities
A	Central Cluster		
1	Jetty or Ferry Ghat		
i.	Amingaon Jetty Ghat	26°10'45.93"N 91°40'58.98"E	▪ Located in North Guwahati, approximately 3.75 km from North Guwahati Terminal, towards western side. ▪ The Amingaon Jetty Ghat is known as Mazgaon or North Guwahati ferry ghat. The Ghat is mainly connected with south Guwahati through ferry. The ghat has pontoons to cater vessels. There are two pontoons at Ghat and from Bank of the river which are connected by wooden planks.
ii.	Brahmaputra Jetty Ghat, near Kendrya Vidyalaya	26°10'52.57"N; 91°41'49.72"E	▪ Located in North Guwahati, approximately 2.30 km from North Guwahati Terminal towards western side. ▪ The Ghat is known as Cunchali ferry Ghat which is connected to Kuruwa located in the Mangaldoi District. IWT is having one office at Cunchali Ghat respectively. There is no

S. No.	Facilities	Geographical Coordinates	Location and existing facilities
			permanent infrastructure at that Ghat. Only the wooden Boats are plying from that Ghat.
iii.	Rajduar Ferry Ghat	26°12'21.73"N; 91°44'47.57"E	▪ Located in North Guwahati, approximately 2.85 km from North Guwahati Terminal towards eastern side. ▪ The ghat is located just below the North Guwahati ropeway end portion. The Ghat is mainly connected with south Guwahati through ferry. The Ghat is operated by Section officer of Guwahati-Rajduar Ferry. The ghat having pontoons to cater vessels. There are two pontoons at Ghat and from Bank of river it is connected by wooden planks
iv.	Guwahati- Kuruwa Jetty ghat	26°11'35.70"N 91°45'3.83"E	▪ Located in South Guwahati, approximately 1.52 km from South Guwahati Terminal towards eastern side. ▪ No ground improvement is anticipated as weathered rock is available at shallow depth i.e. 2m below ground level. Risk/Concerns: No risk for foundation system. ▪ Proposed Mitigation: Buildings can be supported on isolated/raft foundation at shallower depth from FGL.
v.	Umananda Ferry Point	26°11'46.12"N 91°44'42.73"E	▪ Located in the middle of North & South Guwahati it's a river island in Brahmaputra ▪ No ground improvement is anticipated as weathered rock is available at shallow depth i.e. 2m below ground level. ▪ Risk/Concerns: No risk for foundation system. ▪ Proposed Mitigation: Buildings can be supported on isolated/raft foundation at shallower depth from FGL
vi.	Uzanbazar Ferry Ghat	26°11'13.39"N; 91°44'24.41"E	▪ Located in South Guwahati, approximately 0.15 km from South Guwahati Terminal towards eastern side. ▪ Loose to medium dense silty sand is present at the proposed location up to 6.0m depth from ground level followed by very dense silty Sand. ▪ Risk/Concerns: Immediate settlement and safe bearing capacity (SBC). ▪ Proposed Mitigation: Surface compaction shall be done for densification of loose silty sand.

S. No.	Facilities	Geographical Coordinates	Location and existing facilities
			Depth of foundation shall design suitably at DPR stage.
vii.	Guwahati - Rajduar Ferry Ghat	26°11'7.04"N; 91°44'19.79"E	▪ Located in South Guwahati, approximately 0.07 km from South Guwahati Terminal towards western side.
viii.	Kachari Ghat	26°10'59.50"N; 91°44'12.60"E	▪ Located in South Guwahati, approximately 0.40 km from South Guwahati Terminal towards western side. ▪ The Ghats have poor infrastructural facilities using temporary & poor jetty constructed with bamboo /wood and facing difficulties during berthing/de-berthing for landing & boarding of vehicles & passengers, sometimes even risky.
ix.	Fancy Bazar Ferry Ghat	26°10'53.76"N 91°44'7.90"E	▪ Located in South Guwahati, approximately 0.60 km from South Guwahati Terminal towards western side.
x.	Lachit Ferry Ghat	26°10'48.64"N 91°44'5.08"E	▪ Located in South Guwahati, approximately 0.80 km from South Guwahati Terminal towards western side.
xi.	Pandu Terminal	26°10'18.42"N 91°40'49.21"E	▪ Located in South Guwahati, approximately 6.10 km from South Guwahati Terminal towards western side.
xii.	Kurua Ferry Ghat	26°14'5.30'' N 91°49'23.51'' E	▪ Located in North Guwahati, approximately 8.9 km from North Guwahati Terminal towards eastern side.
2.	River Cruise Facility		
i.	Alfresco Grant River Cruise facility, Uzanbazar	26°11'37.94"N 91°45'10.70"E	▪ Located in South Guwahati, approximately 1.62 km from North Guwahati Terminal towards eastern side.
ii.	Jolporee Water and River Cruise	26°11'13.39"N 91°44'24.41"E	▪ Located in South Guwahati, approximately 0.15 km from North Guwahati Terminal towards eastern side.
3.	Water intake facility & treatment plant		
i.	North Guwahati water Intake facility and Treatment plant	26°11'20.44"N 91°43'29.27"E	▪ Located in North Guwahati, approximately 0.65 km from North Guwahati Terminal, towards western side.

S. No.	Facilities	Geographical Coordinates	Location and existing facilities
ii.	Water intake facility and treatment plant near Raj Bhavan	26°11'59.94"N 91°46'8.43"E	▪ Located in South Guwahati, approximately 3.36 km from North Guwahati Terminal towards eastern side.
iii.	Panbazar Water intake facility	26°11'22.53"N 91°44'32.56"E	▪ Located in South Guwahati, approximately 0.50 km from North Guwahati Terminal towards eastern side.
iv.	Water intake facility near West Guwahati College of Education	26°10'20.16"N 91°41'29.51"E	▪ Located in South Guwahati, approximately 5.10 km from North Guwahati Terminal towards western side.
4.	Other Development Projects		
i.	Guwahati Rope Way	26°11'25.42"N 91°44'46.56"E	▪ This presently is the longest river ropeway of India with a length of 1.82 kilometers. The lower terminal or station located at Panbazar, Guwahati Main City and upper terminal or Station located behind Dol Govinda Temple at North Bank of Guwahati. This is operating since August 2020.
ii.	Sarighat Road and Railway bridge	26°10'40.69"N 91°40'18.70"E	▪ Located towards western side of the central Cluster.
iii.	Panbazar Brahmaputra Bridge (under construction)	26°10'42.77"N 91°43'30.57"E	▪ The under-construction bridge will connect Panbazar (South Guwahati) to North Guwahati.
iv.	MMC Hospital	26°11'10.48"N 91°44'28.38"E	▪ A 12 storied building of the new medical and Guwahati's second college will be constructed at the premises of the present Mahendra Mohan Choudhury Hospital (MMCH). The construction will be completed within three years.
v.	River-front Development Project	26°11'21.89"N 91°44'37.34"E	A 6 km long Riverfront stretches between Rajbhawan (Kharghuli Hill) to famous Kamakhaya Temple (Nilachal Hill). Duration of construction activities is estimated about 36 months. The construction activity was started from Umananda Ferry Ghat to Rajbhawan. Feasibility Report (FR) for the Riverfront design identifies the following works: ▪ Development of Walkway, Cycle track, Jogging track along full Riverfront from Rajbhawan to Kamakhaya Temple ▪ Landscape design for 5 segments (viz: Kamakhaya, Machchowa, Governor's Hill, Kachari Ghat& Raj Bhawan) in plan and section. ▪ Bank Protection measures

S. No.	Facilities	Geographical Coordinates	Location and existing facilities
			▪ Various infrastructures works (Viewpoint, Water stairs, Fountain, Interactive pond, Ramps, Stairs, Jetty, Ferry Terminals, Kiosk, Bridges over outflow structures, etc.)
B.	North Cluster		
1.	Jetty or Ferry Ghat		
i.	Kamalabari Ferry Ghat	26°55'2.74"N 94° 9'41.99"E	▪ Located in northern side of the river and approximately 13 km from Apalamukh terminal. ▪ The Kamalabari Ghat is quite unstable. As a result, it requires shifting of Ghat locations for berthing/de-berthing of vessels/boats several times in a year depending on increase and decrease of water levels, particularly during flood season/monsoon and even sometimes disrupt ferry service due to high flood level.
ii.	Neamati Car Ferry Ghat	26°51'42.19"N 94°14'25.22"E	▪ Located in southern side of the river and approximately 0.15 km from Neamati terminal. ▪ Soft silty clay is available up to 2.5m below ground level is observed followed by stiff to hard silty-clay. ▪ Risk/Concerns: Long-term settlements and safe bearing capacity (SBC). ▪ Proposed Mitigation: 3m replacement is proposed to mitigate SBC & settlement for proposed land facilities. The risk of post construction settlement is likely to be minimized after replacement.
iii.	Aphalamukh-Neamati Ferry ghat	26°54'57.13"N 94°17'57.80"E	▪ Located in northern side of the river and approximately 0.75 km from Neamati terminal.
2.	Water intake facility		
i.	Aphalamukh Water Intake facility	26°54'51.20"N; 94°17'53.57"E	▪ Located in northern side of the river and approximately 0.20 km from Aphalamukh terminal.
3.	River Cruise Facility		
i.	Neamati River Cruise	26°51'45.56"N 94°14'0.01"E	▪ Located in southern side of the river and approximately 0.85 km from Neamati terminal.
4.	Other Development Projects		
i.	Hatihal Sapori Jorhat-Majuli Bridge	26°52'17.67"N 94°18'1.73"E	▪ The 8.25-km-long bridge over Brahmaputra, connecting the world's largest river island Majuli with Jorhat. Land section construction activity

S. No.	Facilities	Geographical Coordinates	Location and existing facilities
			has started. The bridge is likely to be completed by 2025

Note: After the construction of the Gateway of Guwahati (GGG) Terminal, the other existing terminals—(i) Umananda Ferry Point, (ii) Uzanbazar Ferry Ghat, (iii) Gateway of Guwahati Rajduar Ferry Ghat, (iv) Kachari Ghat, (v) Fancy Bazar Ferry Ghat and (vi) Lachit Ferry Ghat—will not be in operation. All the passenger vessels will be operating from GGG Terminal.

4.4 FUTURE DEVELOPMENTS

The future developmental activities in both the Clusters are as follows:

4.4.1 Central Cluster

Pandu Port: This inland Port is the most important and largest river Port in Assam state. Apart from cargo vessels, cruise vessels with international tourists regularly use this Port. This Port connects to Kolkata through Inland Waterways in Bangladesh known as Indo-Bangladesh Protocol (IBP) route. The has multi-modal inland terminal with permanent RCC jetties, a broad-gauge railway siding and road connectivity with NW-31. The Port is capable of handling all types of inland vessels including container vessels round the year. Expansion of the Pandu port on the central Cluster is likely to be implemented, and the capacity will be 3 million MT.

Elevated road: The AIWTDS Project team informed us that there is an elevated road along the south bank of the Brahmaputra River, from Panbazar Brahmaputra Bridge to Uzanbarar.

4.4.2 North Cluster

Passenger Terminal: IWAI may start a new project over the existing ferry terminal of Neamati area in near future.

Jorhat water supply project: A Composite Water Supply Scheme for Sustainability and Quality in Jorhat, Jorhat Central and Jorhat North West Development Block of Jorhat District" in Assam (India), referred to as the Jorhat project, is one of the seven large multi-village scheme subproject of the World Bank assisted Rural Water Supply & Sanitation Project for Low Income States, which was renamed as the Neer Nirmal Pariyojana (NNP). The project will have an intermediate capacity of 28.2 MLD in 2025 and ultimate design capacity 38.6 MLD in 2045. Surface water of the river Brahmaputra will be the source of raw water.

The intake is located near the bank of the river Brahmaputra at Dainigaon, just south of the river bank protection works of Water Resources Department. The river bank is steep and might be subjected to erosions and bank subsidence issues. The intake facility includes (i) Floating Barge (size 9.0 m x 5.0 m), (ii) Raw water pump sets, (iii) 250 KVA Substation with 3.8 km transmission line, (iv) 4. 200 KVA DG Set, (v) River-bank protection works and (vi) Approach Road.

The Water Treatment Plant (WTP) site is located at Potiagaon in Fokola Pathar gram Panchayat and is about 3.4 km from the Intake site.

Riverbed sand mines: New river sand mines are also proposed in the north Cluster. The sand mines are located towards northern bank in North Cluster. The identified sand mines are Sumoimari sand mine, Pokimuri sand mine, Misamari sand mine, Bhakat Chapori sand mine and Haladhibari kat Chapori sand mine.

Riverbank Protection Measures: It is also proposed to construct bank protection and erosion protection work on Majuli Island. Consultation with Water Resource Department (WRD), Jorhat revealed that under Flood and Riverbank Erosion Risk Management (FRERM) project, three subprojects has been planned for protecting urban, suburban, and other strategic areas of Assam: (i) Palasbari reach (74 km) in Kamrup (south) district; (ii) Kaziranga reach (29 km) in Golaghat district, adjacent to the Kaziranga National Park (KNP); and (iii) Dibrugarh reach (25 km) in Dibrugarh district. The consultation also revealed that there are 14 spurs in the Jorhat section of the Brahmaputra River, and WRD are now taking flood protection measures based on the requirement or emergency works in these identified erosion prone areas.

4.5 EXTERNAL STRESSORS OR DRIVERS

Human activities and natural drivers that exert an influence on VEC condition has been identified and characterized based on existing knowledge and secondary information available in the public domain. Any impacts or risks these identified drivers may have on the identified VECs has been linked and assessed.

Urbanization

Guwahati city is located on both side the Brahmaputra River. The population of Guwahati is about 9.57 lakhs, with a decadal population growth rate of 20 percent. The water requirement of the Guwahati City Corporation is in the range of 433 million liters per day. Approximately 154 million litres per day of waste-water is generated from the city. Presently, there is no STP facility available in the city and untreated waste-water is directly or indirectly discharged into the Brahmaputra River.

Natural Stressors

Natural influences and environmental drivers include those linked to climate change. This includes flood, erosion and accretion, drought etc. comprise major stressors that reportedly affect the surface water resource and aquatic biodiversity, livelihood, physical infrastructure and properties in in the river basin. The key stressors are elucidated below:

Flood: Global studies suggest that climate change could increase the risk of hydrological disasters in the future (Van Aalst, 2006; Lane and Kay, 2021). The fluvial processes of the Brahmaputra River and its tributaries continuously alter the floodplains, at times to an undesired magnitude (Sarma and Phukan, 2004; Kotoky et al., 2005, 2012; Das et al., 2012; Lahiri and Sinha, 2012). The river regularly inundates and erodes owing to high orographic precipitation on a narrow drainage basin (Shampa and Ali, 2019). The Brahmaputra flood plain (BFP) experienced high magnitude floods in 1954, 1962, 1972, 1977, 1984, 1988, 1998, 2002, 2004, 2012, and 2020 over the past half-a-century.

Erosion and Accretion: The Brahmaputra River is usually subjected to severe bank erosion leading to the widening of the river and adding more deposits forming permanent islands or chars (Sarker et al., 2003). The river is highly dynamic with erosion rates up to 1 km per year and the total erosion rate is 1.5–2 times higher than that of the Ganga River and much higher than the world average (Galy and France-Lanord, 2001).

After 1950 major earthquake, silt load of Brahmaputra River rapidly increased, and deposition of silt along plains where velocity is reduced. The geo-morphological changes of the river occurred since 1950's 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 (source: Climate Resilient Brahmaputra Integrated Flood and Riverbank Erosion Risk Management Project in Assam (adb.org)[1].

Due to abrupt change of river configuration, the flow of Brahmaputra River loses its dynamic equilibrium and ultimately unloads its slit 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.

[1] 56283-001: Climate Resilient Brahmaputra Integrated Flood and Riverbank Erosion Risk Management Project in Assam (adb.org)

Figure 4.1 PUC and other Project Location Map for Central Cluster

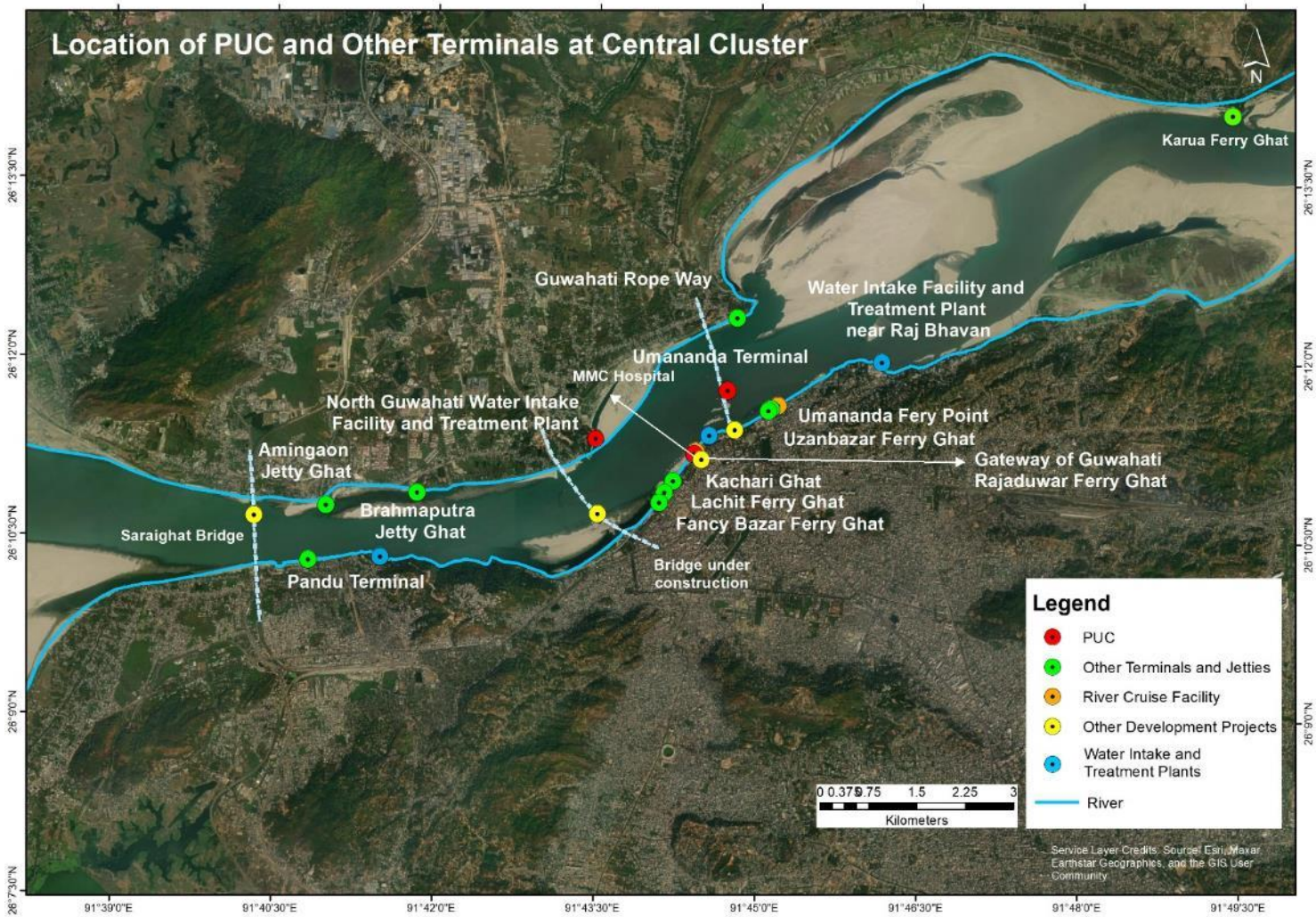
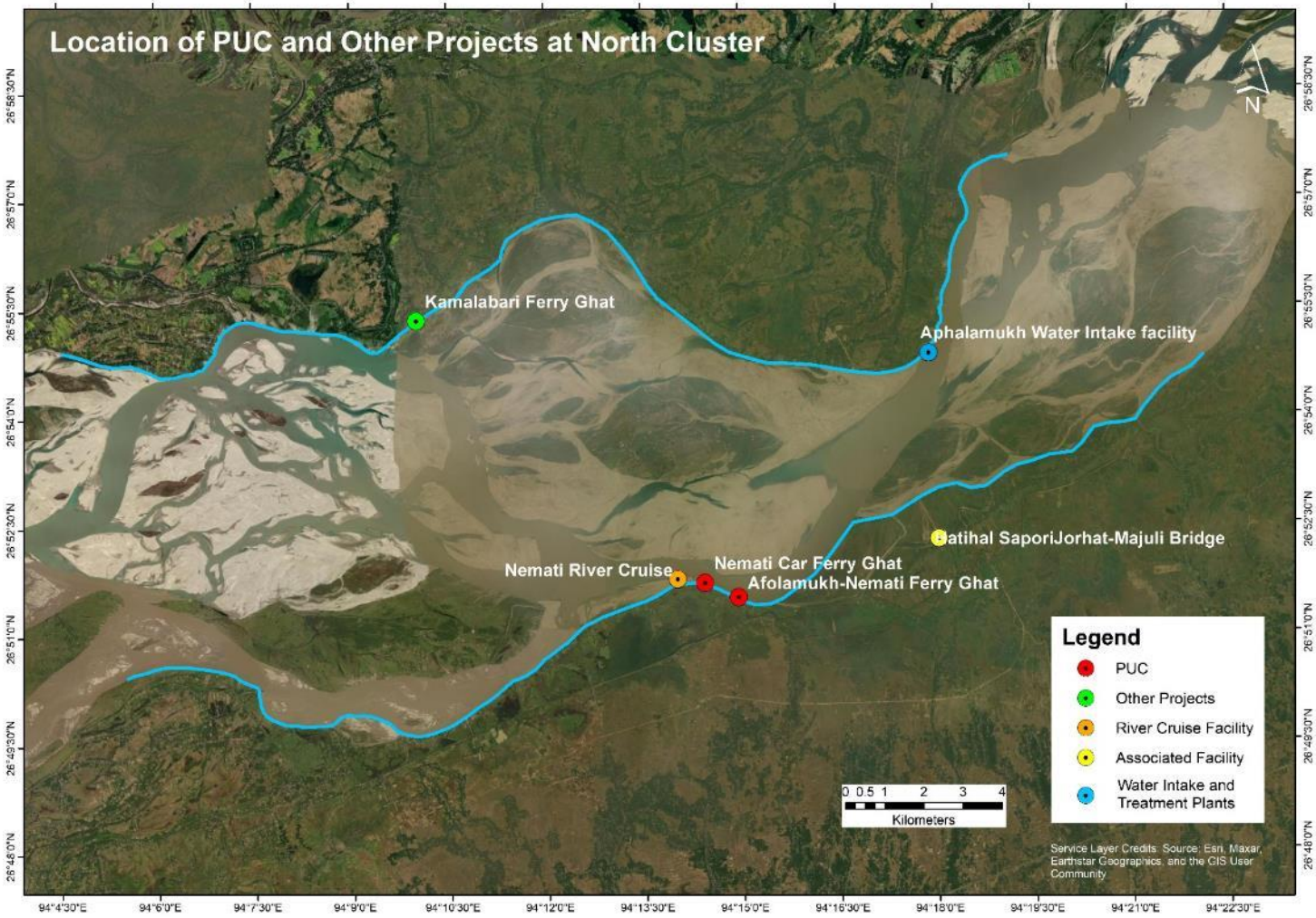


Figure 4.2 PUC and other Project Location Map for North Cluster



5 VALUED ENVIRONMENTAL AND SOCIAL COMPONENTS

5.1 IMPACT SOURCES SCOPED INTO THE CIA

SI has considered the following sources of cumulative impacts based on the IFC Good Practice Handbook Guidance:

Past and Present Projects in the CIA Spatial Area

The past and present projects or activities with a potential to cause cumulative impacts on VECs include the following:

- River front activities
  - Existing river terminals or ferry ghats: 11 in Central Cluster and 3 in the North Cluster (presented in Table 4.2)
  - River cruise facility: 2 in Central Cluster and 1 in the North Cluster.
  - Existing river cargo terminal: one in Central Cluster and one in North Cluster.
  - Water intake facility & treatment plant: 4 in Central Cluster and 1 in the North Cluster.
- Other Developmental Projects in the area
  - Existing road and railway bridge, rope way, under construction bridge over the Brahmaputra River, under construction hospital and on-going river front development project in Central Cluster.
  - River bed sand mining- number of mines and under construction bridge over the Brahmaputra River in North Cluster.

Reasonably Foreseeable Future Actions (RFFAs)

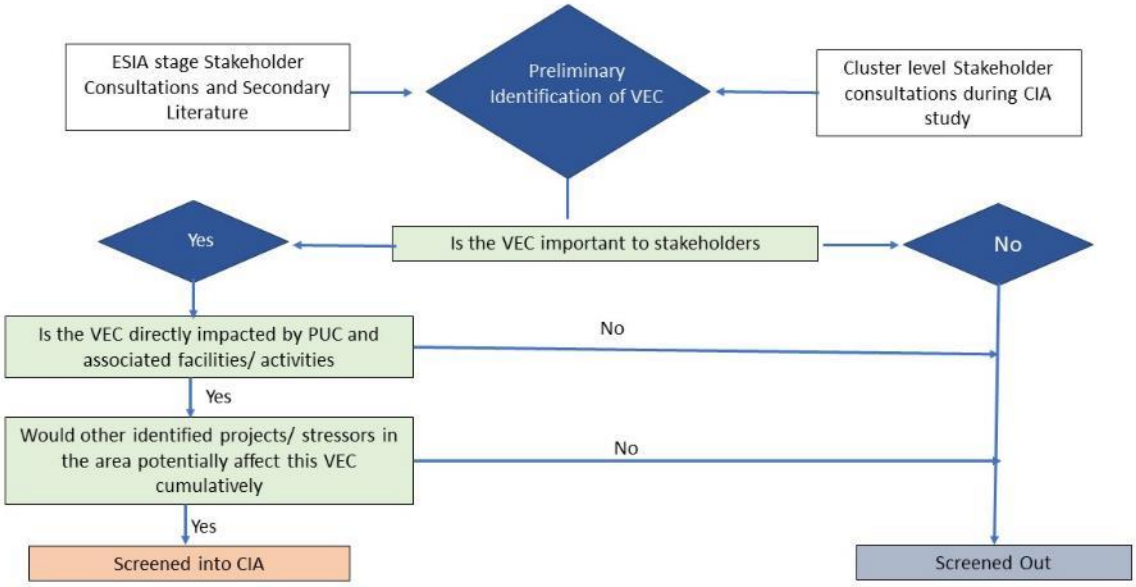
Proposed projects including new future developments in the basin that have a potential to cause cumulative impacts on VECs include the following:

- River terminal/ jetties
  - River terminals either under construction and/or planned- three in Central Cluster and two in north Cluster;
  - Expansion of Pandu River Port at Central Cluster
- Other Developmental Projects in the area
  - River bed sand mining- expansion or new riverbed sand mines in North Cluster;
  - River bank project in the North Cluster;
  - IWAI terminal at North Cluster
  - River bank protection and erosion protection measures on Majuli Island and towards Nemati side of North Cluster.
  - Jorhat water supply project at North Cluster.

5.2 VEC'S SCOPED IN FOR CIA

VEC screening process was conducted to determine which of the preliminary VECs would be included in the CIA (Refer to **Figure 5-1**). The VEC must be reasonably expected to be affected by some combination of other projects and/or external stressors and the PUC.

Figure 5.1 VEC Screening Process



Based on the above-mentioned logical framework preliminary VECs have been identified. The key VECs selected for this CIA is presented in **Table 5.1**.

Table 5.1 VEC Screening and Selection

S. No	Preliminary VECs	Importance to Stakeholders	Impacted by PUC	Impacted by other Projects and Stressors	Screened in/out of the CIA	Justification
1.	Land environment					
a.	Land use	No	Yes	Yes	Yes	Out of three terminals under PUC in the Central Cluster, two terminals will be redeveloped on the existing sites, with additional land requirement of 1500 m^2 for North Guwahati and 500 m^2 for Umananda. The other terminal, i.e. Gateway of Guwahati will be relocated near the existing terminal area, and the land requirement is 2770 m^2. Out of two terminals under PUC in the North Cluster, one terminal will be redeveloped on the existing site, with additional land requirement of 1200 m^2 for Aphalamukh. The other terminal, i.e. Neamati will be relocated near the existing terminal area, and the land requirement is 2000 m^2. It was observed that there are a number of commercial establishments (shops) along the river bank and site access road on the Neamati side and open land on the Aphlamukh site. It is expected that after the redevelopment of both terminals, more commercial establishments will be setup in both areas as a result of the induced development. The other river terminals and jetties in both Clusters are operating, and future redevelopment work is likely to require minimum land requirements. The additional lands required for the proposed terminals are government land for four terminals, except North Guwahati. North Guwahati's land is private but not used for agriculture or commercial purposes.

S. No	Preliminary VECs	Importance to Stakeholders	Impacted by PUC	Impacted by other Projects and Stressors	Screened in/out of the CIA	Justification
						The potential impact on land use from PUC is localized. The other identified projects (refer to Section 2.3) are likely to have a localized impact on land use. The cumulative impacts on this VEC is only anticipated for north Cluster, and therefore, scoped into the CIA study for north Cluster.
b.	Soil and sediment quality	Yes	Yes, during construction stage	No	No	Earthworks, improper handling and disposal of construction waste, and hazardous waste generated during construction works may have localised impacts on soil quality. The ESIAs reports prepared for individual terminals has a proposed management plan for the handling and disposal of construction waste and hazardous waste. Proper implementation of the management plan is unlikely to leave any residual effects on the quality of soil and sediment. The other identified projects (refer to Section 2.3) are likely to have a localised impact on soil and sediment quality. The cumulative impacts on this VEC are not anticipated and, therefore, not scoped into the CIA study.
2.	River geomorphology (erosion and accretion)	Yes	Yes	Yes	Yes	In Central Cluster, two terminals namely North Guwahati and Gateway of Guwahati are located in accretion area. The third terminal, Umananda is located in stable zone. The construction of bridge and river side beautification project towards south Guwahati side is ongoing. These activities have the potential to cumulatively impact the river morphology. The two terminals located in the north Cluster are in a moderately erosion-prone area. The river bank protection work was taken up on Majuli Island by the Brahmaputra Board, where the Aphalamukh is located. However, the Neamati terminal is located in an erosion-prone area; therefore, bank protection activity would be required for this terminal. WSRD is now taking flood protection measures based on

S. No	Preliminary VECs	Importance to Stakeholders	Impacted by PUC	Impacted by other Projects and Stressors	Screened in/out of the CIA	Justification
						the requirements or emergency works in these identified erosion-prone areas towards the south bank of the river, i.e., the Nemati Terminal side. A bridge from Jorhat to Neamati to Aphalamukh is going on. These activities have the potential to cumulatively impact the river morphology. Therefore, this VEC is screened in for the both the Clusters.
3.	Air environment (Air quality)	Yes	Yes	Yes	Yes	Fugitive emissions would be generated during the construction phase of the terminals. The potential impact on ambient air quality will be localised and limited. The existing terminals and jetties are currently operational, and the sources of air emissions from these activities are limited, including the movement of vessels and vehicles used for the transportation of passengers to ferry ghats, because of the low volume of traffic movement for transportation activities. The boats used for the transportation of passengers from the ferry-ghats are diesel-powered machines. It is proposed that after the implementation of PUC terminals, the propulsion of the boats will be diesel power. At normal operating speeds, the boats would operate with the help of batteries, and there would be no fuel consumption. The boats will operate on diesel only when the batteries are completely discharged. The terminals will be operated from the grid supply power. Therefore, sources of air emissions will be limited. The cumulative impacts on this VEC are only anticipated during construction stage and, therefore, scoped into the CIA study.
4.	Acoustic environment (noise quality)	No	Yes	No	No	The operation of construction machinery, equipment, and transport vehicles has a localised impact on ambient noise quality. The existing terminals and jetties are currently in the operation phase, and the sources of noise emissions from these activities are mostly

S. No	Preliminary VECs	Importance to Stakeholders	Impacted by PUC	Impacted by other Projects and Stressors	Screened in/out of the CIA	Justification
						localised including the movement of vessels and vehicles used for the transportation of passengers to ferry ghats. The cumulative impacts on this VEC are not anticipated and, therefore, not scoped into the CIA study.
5.	Underwater Noise & Vibration	Yes	Yes	Yes	Yes	Construction of riverside facilities, including piling activities, have potential impacts on underwater noise and vibration. The operations of passenger vessels and cargo vessels also generate underwater noise and vibration. During the operational stage, vessel movement is likely to increase due to improved infrastructure. The PUC and present and future activities are likely to have a cumulative impact on underwater noise and vibration. Underwater noise and vibration have a potential impact on aquatic diversity. Therefore, this VEC is screened for CIA study for the Central and North Clusters.
6.	Surface water					
a.	Water resources	No	Yes	Yes	No	The water requirement during the construction and operational stages of the terminal project is less than less than 50 KLD, and the same will be sourced from the Brahmaputra River. Since the project demand is so low possibility of the PUC leading to cumulative impacts is low; otherwise, the water supply projects abstract a lot of water and will have impacts. The cumulative impacts on this VEC are not anticipated and, therefore, not scoped into the CIA study.
b.	Water quality	Yes	Yes	Yes	Yes	The riverside construction activities are likely to contribute to the total dissolved solids (TDS) and total suspended solid (TSS) in surface water quality. The operation of diesel-operated machines and equipment is likely to contribute oil and grease to the surface water. The earthwork

S. No	Preliminary VECs	Importance to Stakeholders	Impacted by PUC	Impacted by other Projects and Stressors	Screened in/out of the CIA	Justification
						and surface runoff from the construction site during the rainy season are also likely to contribute to the TDS and TSS in the surface water quality. The implementation of proposed planned activities construction bridge near the central and north Clusters, river bank protection measures, and the expansion of the Pandu River port also have a potential impact on surface water quality. The untreated discharge of sewage from the urban area (Guwahati city) at Central Cluster is also contributing to the water pollution in the river. The annual growth rate of the city is 15%. Therefore, the contribution from other developments will continue to increase in the future. The operation of passenger and cargo vessels has the potential to have an impact on surface water quality due to accidental spillage and leakage of oil grease from machinery and the disposal of sewage from the vessels. All the above-mentioned potential sources of impact, along with PUC, will have a cumulative impact on river water quality, especially downstream of the river, as well as on a temporal scale, Considering all the potential sources of impact, surface water quality has been scoped in CIA study for both the Clusters.
7.	Terrestrial biodiversity					
a.	Key Biodiversity area for migratory bird species	Yes	Yes	Yes	Yes	There are four KBAs, namely Amchang Wildlife Sanctuary, Deepor Beel Bird Sanctuary, Dadara-Pasaria-Singimari, and Jengdia Beel, within a 15-Km radial area of the Central Cluster. There is no direct interaction with these KBAs with the PUC. The air and noise VEC are also not scoped in, therefore, any secondary impact on KBA is also not envisaged. Therefore, this VEC is not scoped in for Central Cluster.

S. No	Preliminary VECs	Importance to Stakeholders	Impacted by PUC	Impacted by other Projects and Stressors	Screened in/out of the CIA	Justification
						There are two KBS, namely Majuli and Janjimukh-Kalilamukh, located within the North Cluster. Both KBS are home to diverse resident birds and attract large numbers of migratory birds. The secondary impacts, due to noise, vibration, and light, have a potential impact on these species. The existing riverfront activities, operations of vessels, jetties, and terminals, and proposed developmental activities like the construction of bridges and bank protection measures may have a potential cumulative impact on bird nesting and roosting activities. Therefore, this VEC has been scoped in the CIA for the North Cluster.
8.	Aquatic Biodiversity					
a.	Protected aquatic fauna- Ganges River Dolphin and turtles	Yes	Yes	Yes	Yes	The Brahmaputra River is the habitat for the Ganges River Dolphin (*Platanista gangetica gangetica*). It was reported that the river system (including 2 tributaries) has approximately 635 dolphins, and the river stretch of Brahmaputra from north to south alone has nearly 583 dolphins. PUC and other terminals, ferry ghats, and river port operations have a potential impact on river water quality. Additionally, future projects, such as the construction of bridges over the river, bank protection measures, etc., have potential cumulative impacts on river water quality. The degradation of water quality in the river may have a negative potential impact on the food base. The potential impact on river erosion and accretion due to proposed PUC and future developmental projects can have a negative impact on Dolphin habitat, as it prefers the deep water and confluence of the river.

S. No	Preliminary VECs	Importance to Stakeholders	Impacted by PUC	Impacted by other Projects and Stressors	Screened in/out of the CIA	Justification
						The underwater noise and vibration for PUC, terminals, ferry ghats, and river port operations have a potential impact on dolphin, especially its communication and feeding. Accidental spillage of oil and grease from the PUC, terminals, and ferry ghats during river port operations has a potential impact on dolphins. Even a major oil spillage can cause the death of dolphins. It was reported that four critically endangered tortoises and freshwater turtles were reported in and around the Brahmaputra River. PUC and other terminals, ferry ghats, and river port operations have a potential impact on river water quality. Additionally, future projects, such as the construction of bridges over the river, bank protection measures, etc., have potential cumulative impacts on aquatic protected species. Considering these, this VEC has been scoped in CIA for both the Cluster.
9.	Socio-economy					
a.	River dependent livelihoods	Yes	Yes	Yes	Yes	During the scoping visit carried out by the SI team during the month of October 2023, it was observed that fishing activity had been carried out by the local fishermen. Consultation with local fishermen revealed that fishing activity is mainly carried out during the dry season. The consultation also revealed that fishermen in the North Cluster are local people. The fishing activity in the Central Cluster is sporadic, and local fishermen were not reported during the consultation period. The river dependent livelihood is influenced by water quality, and aquatic ecology. Therefore, based on a multidisciplinary understanding of the other related VECs, cumulative impacts on river river-dependent livelihoods such as:

S. No	Preliminary VECs	Importance to Stakeholders	Impacted by PUC	Impacted by other Projects and Stressors	Screened in/out of the CIA	Justification
						▪ Impacts on fishing activities, including commercial fishing, which may be an important diet for the communities and which acts as an important source of livelihood, ▪ Impact on tourism-based livelihood of the local people; which may be impacted due degradation of water quality and aquatic ecology. This VEC has been scoped in CIA for both the Clusters.
c.	Land based livelihood	No	Yes	No	No	The five terminals in PUC will be redeveloped on the existing site with some additional land or relocated to a nearby area. The land requirement is minimal, and the economic displacement has not been anticipated. Out of five sites, North Guwahati and Umananda terminal sites have few shops on the encroached land, and Neamati terminal site also has few shops that need to be rehabilitated, and the same has been addressed in the ESIA study. This localized impact may not have a potential cumulative impact on existing projects, future projects, or developmental activities. Therefore, this VEC has not been scoped in the CIA.
10	Community Health & Safety	Yes	Yes	Yes	Yes	It is noted that during the construction stage, piling works and increased vehicular movement would increase air and noise pollution, which may ultimately impact community health in the settlement are right next to the riverbank/terminal sites. Other concerns included communicable disease health risks such as COVID, HIV, malaria, and viral infections from the workforce migrating to the project areas. However, these impacts were understood to be temporary and localised in nature. With respect to the PUCs and community health, safety, and security, the ESIA report has not identified any risks or impacts during the construction and operations phases of the projects. The projects have

S. No	Preliminary VECs	Importance to Stakeholders	Impacted by PUC	Impacted by other Projects and Stressors	Screened in/out of the CIA	Justification
						developed a stakeholder engagement plan that includes a grievance redress mechanism. During the construction stage of North Guwahati and the Gateway of Guwahati terminal, the transport of construction materials, machinery, and equipment may cause traffic congestion on the site access roads, which already have traffic congestion-related issues. The construction of the Panbazar Brahmaputra Bridge and its connecting road along the river bank of the south Guwahati side has the potential to increase traffic congestion on the roads. During the operational stage, better terminal facilities for the above-mentioned terminals and the operation of the bridge may increase the daily passenger count. This is likely to increase the traffic load on the site access road for the terminals. The increased traffic load during the construction and operational stages may have a potential cumulative impact on the nearby community in terms of discomfort from traffic congestion as well as traffic-related accidents. The potential impact on community health and safety has a cumulative impact with other on-going activities or planned activities. Therefore, the VEC has been scoped in CIA for Central Cluster.

5.3 EXTERNAL STRESSORS OR DRIVERS CONSIDERED IN CIA STUDY

The external stressors or drivers has potential to have impact on selected VEC has been considered in the CIA study; presented in **Table 5.2**

Table 5.2 External Stressors or Divers Considered in CIA Study

Identified External Stressors or Drivers	Potential interaction with VEC	Scope in CIA
Urbanization	The urbanization in the Central Cluster has the potential to increase the generation of sewage. Considering the present sewage treatment and discharge practices in Guwahati city, they have the potential to have a negative impact on surface water quality. The urbanization also potential to increase the road traffic and river traffic. So, it has potential interaction with the following selected VECs: • Surface water quality; • Ganges River Dolphin, Protected fishes, herpetofauna; • River use and river dependent livelihoods (Ecosystem Services); • Community health and safety	Urbanization has been scoped in for the CIA study for the central Cluster
Erosion and accretion	The erosion and accretion have the potential to have a negative impact on river morphology.	Erosion and accretion have been scoped in for the CIA study for both Clusters.
Climate change	Climate change could increase the risk of hydrological disasters in the future. The flood has the potential negative impact on river morphology. Climate change could increase the drought situation and decrease the water level during the dry season. This may enhance the accretion and sand bar formation in the river. The drought has the potential to have a negative impact on river morphology.	Climate have been scoped in for the CIA study for both Clusters.

5.4 INDICATORS AND THRESHOLD TO ASSESS CUMULATIVE IMPACTS

Indicators have been developed to assess the cumulative impact on key VECs. The overall consideration for development of indicator is as follows:

- representative of VECs;
- easily measurable; and
- easily understood by the decision makers and other key stakeholder.

The indicators selected for the key VECs are presented in **Table 5.3**.

Threshold levels for the indicators have been developed to assess the significance of cumulative impacts on VECs. The threshold level for an indicator has been considered either in form of national

regulatory standard, international guideline (in absence of national standard) or by comparing with national trend. The threshold value of the indicators selected is presented in **Table 5.3.**

Table 5.3 Indicators & Threshold Value for Assessment of Cumulative Impacts

VEC	Indicator	Threshold	Reference
River geomorphology	1. Erosion – decadal changes	100 m in a decade[1]	DPR- AIWTP
	2. Accretion decadal changes	100 m in a decade	
Air quality	1. Concentration of Particulate Matter (PM_{10} + $PM_{2.5}$) in the air shed	PM_{10} - 100 µg/m^3 $PM_{2.5}$ - 60 µg/m^3	CPCB National Ambient Air Quality Standard 2009
	2. Concentration of Oxides of Nitrogen (NOx) in the air shed	NOx – 80 µg/m^3	
Underwater noise & vibration	Noise Levels applicable to aquatic mammals: 1. injury threshold 2. behavioural changes	1. injury threshold: 224 dB re 1 µPa 2. behavioural changes: SEL: 183 dB re 1µPa^2. S	Southall et al (2007 pg. 443)[2]
Surface water quality	Fish and other aquatic organisms for their respiration and therewith an important ecological parameter: 1. Dissolved oxygen (DO) and Biochemical Oxygen Demand (BOD_5)	1. DO- 4 mg/l or more; BOD – 3 mg/l or less	CPCB Surface Water Quality
	2. Turbidity and Total suspended solid (TSS)	4. Turbidity 1-5 NTU, TSS- 10 mg/l and	WHO
Key biodiversity area for migratory bird species	Migratory bird population in the river stretch		
Protected aquatic fauna- Ganges River Dolphin and turtles	Ganges River Dolphin population	Recorded dolphin population prior to implementation of project: Central Cluster: 10 individuals	Dolphin census conducted in 2012 by Dr. Wakid

[1] As per DPR-AIWTP, the decadal morphological study showed that morphological changes between 2010 and 2020 in the vicinity of the proposed ferry terminal sites were no changes, or 100 to 500 m. Considering minimum geomorphological changes of 100m has been considered as the threshold value for the CIA study.

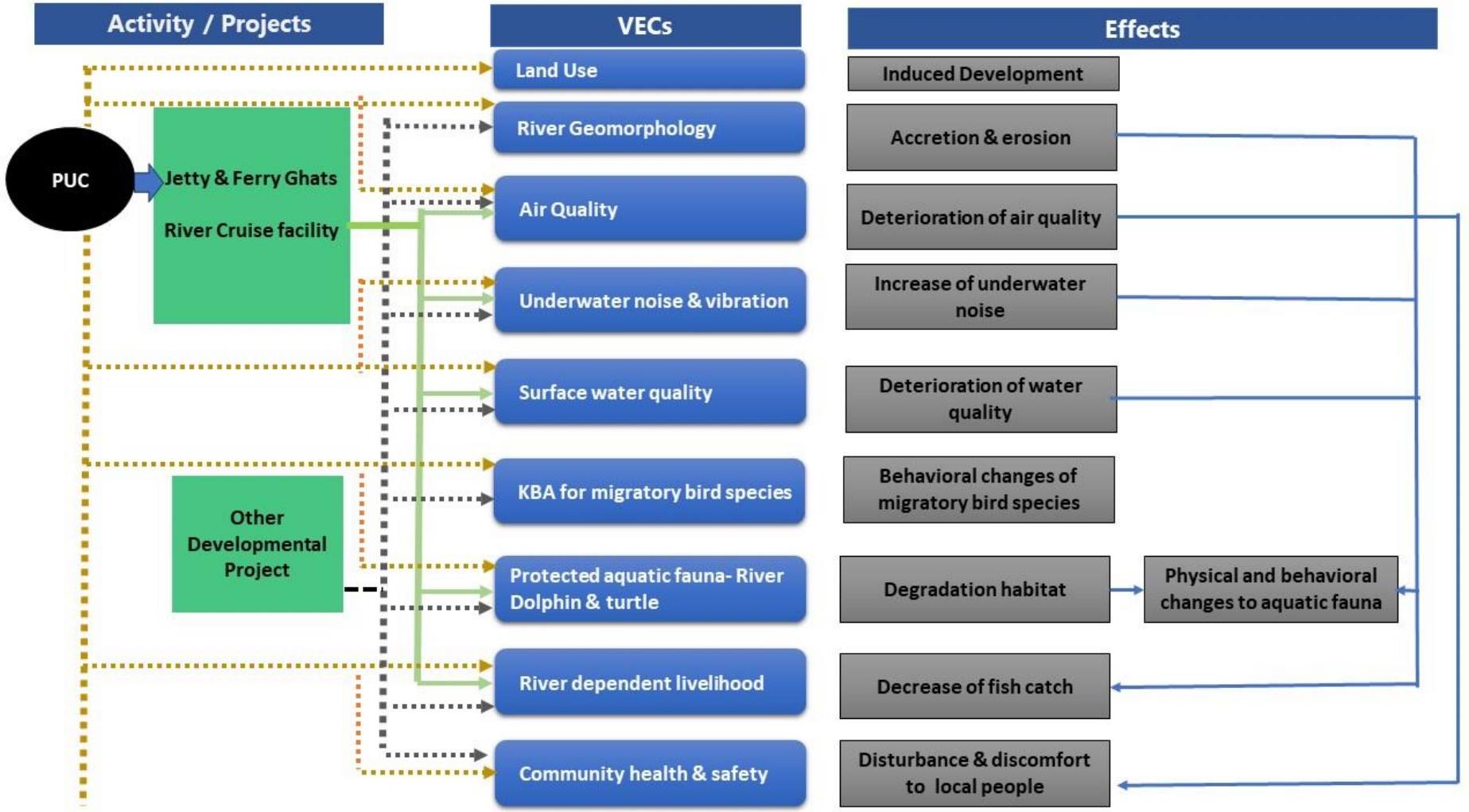
[2] Marine Mammal Noise Exposure Criteria: Assessing the Severity of Marine Mammal Behavioural Responses to Human Noise; Brandon L. Southall, Douglas P. Nowacek, Ann E. Bowles, Valeria Senigaglia, Lars Bejder, and Peter L. Tyack

VEC	Indicator	Threshold	Reference
		North Cluster: 7 individuals	
	River Turtle diversity	Species diversity: 3 endangered species	
River dependent livelihoods	Fish catch from the river stretch	Lowest fish landing -84.06 tons in 2016	
Community health & safety	Number of reported cases of respiratory diseases; morbidity and mortality rate	Rates of deaths due to respiratory diseases against reported case of respiratory disease in the industrial ≤ National trends in same respect	

5.5 ACTIVITY/ PROJECT- VEC INTERACTION AND EFFECTS

The existing terminals in the Central and North Clusters are a vital mode of transport due to the limited presence of river crossing bridges. The existing infrastructure at the terminals does not have passenger amenities, and the associated parking facilities also do not meet sufficient safety standards while operating. The proposed terminals have been planned to address the current river dynamics-maintaining the terminal operational throughout the year. The proposed terminals also planned to improve the passenger ferry infrastructure and services, both for the current scenario and for the future. The past, present and future river passenger terminal projects have various interactions with key VECs and leads to cumulative impact on the overall environment. The interaction with VECs is presented in **Figure 5.1.**

Figure 5.2 Activity/Project – VEC Interactions and Effects



6 STAKEHOLDER ENGAGEMENT

6.1 INTRODUCTION

The stakeholder engagement process provided a platform for two-way communication between the CIA study team and various stakeholder s. This helped the CIA study team develop an understanding of the key issues relevant to this study. All through the CIA study period and at different stages, several stakeholders were consulted with a view to (i) gathering information on VECs, (ii) understanding the past and present condition of VECs, (iii) assessing the cumulative impact on VECs, (iv) suggesting appropriate recommendations, and (v) finding out about reasonably foreseeable future actions. A dissemination workshop was also conducted to share the findings of the study with key stakeholders, which also paved the way for formulating the suggestions and recommendations that have been proposed as part of the CIA study.

6.2 IDENTIFICATION OF STAKEHOLDERS

The stakeholder engagement process typically refers to the efforts made to understand and involve identified stakeholder s to find solutions to shared challenges within the wider socio-economic and ecological context. The process essential begins with identification of relevant stakeholders impacting or being impacted by the project.

Stakeholders were identified basis their relevant to the CIA on the basis of information review undertaken and the guidance provided by IFC's expectations on identification, i.e., stakeholders that represent one or more entities that:

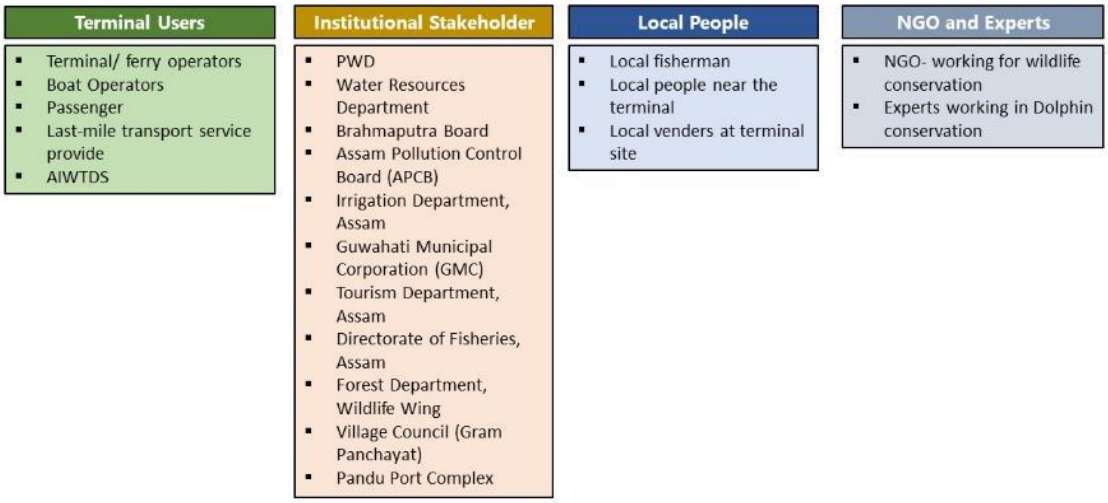
- Directly benefit from the PUCs;
- Are adversely affected by the PUCs;
- Directly interact with or oversee environmental and social components that overlap with the PUCs; and
- Indirectly influence or regulate the condition of environmental and social components.

The key stakeholders consulted during various stages of the CIA study are:

- Terminal users- directly benefited from the PUC;
- Institutional stakeholders- direct interaction with PUC;
- Local people- directly or indirectly impacted by PUC;
- NGO & Experts- indirectly influenced by PUC

Stakeholder groups consulted during the CIA process are represented in **Figure 6.1**.

Figure 6.1 Stakeholder Consulted during CIA Process



6.3 STAKEHOLDER MAPPING

Stakeholder mapping is the process of examining the relative influence that different individuals have over a project as well as the influence of the project over them. The purpose of stakeholder mapping is to:

- Study the profile of the stakeholders identified and the nature of their stake;
- Understand each 's specific issues, concerns, and expectations from the project that each retain;
- Gauge their influence on the project.

On the basis of such an understanding, the stakeholders are categorized into High Influence/ Priority, Medium Influence/ Priority and Low Influence/ Priority.

- **High Influence/Priority**: Which implies a high degree of influence of the stakeholder on the Project in terms of participation and decision making or a high priority for the Project proponent to engage that stakeholder.
- **Medium Influence/Priority**: Which implies a moderate level of influence and participation of the stakeholder in the Project as well as a priority level for the Project proponent to engage the stakeholder who are neither highly critical nor are insignificant in terms of influence.
- **Low Influence/Priority**: Which implies a low degree of influence of the stakeholder on the Project in terms of participation and decision making or a low priority for the Project proponent to engage that stakeholder.

6.4 STAKEHOLDER CONSULTATION SUMMARY

6.4.1 Draft CIA Report Preparation Stage

The stakeholder consultations were carried out during the ESIA screening and scoping stages, the ESIA report preparation stage, and the CIA draft report preparation stages. The stakeholder consultations have provided input towards the selection of VEC, VEC condition, and past and present conditions of VEC. The summary of consultations has been presented in **Table 6.1**.

Table 6.1 Stakeholders Mapping

S. No	Stakeholder	Relevance to the CIA	Engagement Priority (high, medium, low)	Concerns raised by the Stakeholders	Emerging Issues for CIA Study
1.	Boat operators	Directly influence or manage the operations of the boats on the operational ferries in the area.	High	▪ During the constriction period, the boat operators may face inconveniences for the operation of the boat. ▪ Erosion and shifting the terminal locations are issues; that need to be addressed through this project. ▪ Accessibility to the ferry ghat and basic amenities and facilities are concerns for the boat operator; these issues need to be addressed through this project. ▪ In the operational phase, river traffic is likely to increase, which may lead to traffic congestion at terminals. ▪ One of the major issues is the shifting of the navigation channel due to the accumulation of sediments, which causes problems for boat operators during the dry season.	▪ **River geomorphology**: accretion and erosion have the potential to hamper the ferry operation; ▪ **Community health and safety**: construction of terminals that may cause inconvenience to passengers and boat operators.
2.	Last-mile transport service provide	Indirectly influence; the last-mile transporter generally provides the transport services to in-going and out-going passengers to the terminals.	Low	▪ During the constriction period, the Last-mile transport service provide may face inconveniences due to construction activities and transport on construction materials. This may lead traffic congestion; ▪ In the operational phase, passenger load is likely to increase, which may lead to enhance the opportunity of the service providers.	▪ **Community health and safety**: construction of terminals that may cause traffic congestion and inconvenience to passengers and surface transporters.

S. No	Stakeholder	Relevance to the CIA	Engagement Priority (high, medium, low)	Concerns raised by the Stakeholders	Emerging Issues for CIA Study
3.	Passenger	Directly influence; they are regularly using the terminals or ferry ghat for regular commuting, transport of goods, and vehicles.	High	▪ During the constriction period, the passengers may face inconveniences for their commuting and transport of goods and vehicles. ▪ Accessibility to the ferry ghat and basic amenities and facilities are concerns for passengers; these issues need to be addressed through this project. ▪ Safety on the ferry is one of the key issues for the passengers that need to be addressed through this project.	▪ **Community health and safety**: construction of terminals that may cause inconvenience to passengers and safety of the passengers.
4.	Local fisherman	Directly influence; they are conducting fishing activities in the river during fishing period.	High	▪ Pollution from the project (construction and operation phases) may degrade the water quality in the river, which may lead to their fishing activities. ▪ The operation of vessels may cause damage to the fishing net. ▪ These issues need to be addressed through this project.	▪ **Surface water quality**: potential impact on surface water quality due to the construction of terminals; ▪ **Livelihood**: degradation of surface water quality and the operation of boats may have a negative impact on fish catch
5.	Terminal/ ferry operators	Directly influence or manage the operations of the terminals or ferry ghats in the area.	High	▪ During the constriction period, the operations of boats from the under-construction terminal may not be possible, which may cause inconveniences for the boat operators and passengers. ▪ Erosion and shifting the terminal locations are issues that need to be addressed through this project. ▪ Sedimentation at the terminal area and terminal approach channel is one of the challenges for	▪ **River geomorphology**: accretion and erosion have the potential to hamper the terminal operation; ▪ **Community health and safety**: construction of terminals that may cause inconvenience to passengers and boat operators.

S. No	Stakeholder	Relevance to the CIA	Engagement Priority (high, medium, low)	Concerns raised by the Stakeholders	Emerging Issues for CIA Study
				them that needs to be addressed through this project. ▪ They also raise concern about the continuation of the operation of other terminals in the Clusters; those are not considered under this project. ▪ Accessibility to the ferry ghat and basic amenities and facilities are concerns for the boat operator; these issues need to be addressed through this project. ▪ Accessibility to the ferry ghat and basic amenities and facilities are concerns for passengers; these issues need to be addressed through this project. ▪ Safety on the ferry is one of the key issues for the passengers that needs to be addressed through this project	
6.	Local people near the terminal	Directly influence or operation of terminal has potential socio-economic impact to the local community.	Medium	▪ During the constriction period, the local community may face air pollution, noise pollution, traffic congestion, and conflict with labour camp workers. This needs to be properly addressed through the project. ▪ Expectations of job and economic opportunity from the project ▪ Souring of construction material from the local-level vendor or suppliers	▪ **Community health and safety**: construction of terminals that may cause inconvenience to the local people due to air and noise emission and traffic congestion.
7.	Local venders at terminal site	Indirectly influence; the local vendors business mostly depend on the	Low	▪ During the constriction period, the local vendors may face air pollution, noise pollution, traffic congestion. This needs to be properly addressed through the project.	▪ **Community health and safety**: construction of terminals that may cause inconvenience to the location

S. No	Stakeholder	Relevance to the CIA	Engagement Priority (high, medium, low)	Concerns raised by the Stakeholders	Emerging Issues for CIA Study
		passengers travelling through vessels.		▪ Potential impact on livelihood due to displacement of shops (North Guwahati, Umananda and Neamati terminal sites); ▪ Efforts shall be made to avoid displacement. ▪ If displacement is not avoided, compensation shall be made as per approved Resettlement Policy Framework ▪ Increase of business opportunity during construction and operational phase	vendors due to air and noise emission and traffic congestion.
8.	Village Council (Gram Panchayat)	Indirectly influence or be responsible for approval of terminals	Medium	▪ They also raise concern about the continuation of the operation of other terminals in the Clusters; those are not considered under this project. ▪ Accessibility to the ferry ghat and basic amenities and facilities are concerns for the boat operator; these issues need to be addressed through this project. ▪ Accessibility to the ferry ghat and basic amenities and facilities are concerns for passengers; these issues need to be addressed through this project. ▪ Erosion and shifting the terminal locations are issues that need to be addressed through this project. ▪ Pollution from the terminal area and boats has an impact on river water quality, which needs to be addressed through this project. ▪ The Ganges River Dolphin's habitat is the Brahmaputra River; the potential impact on	▪ **River geomorphology**: accretion and erosion have the potential to hamper the terminal and ferry operation; ▪ **Surface water quality**: potential impact on surface water quality due to the construction and operation of terminals; ▪ **Ganges River dolphin**: construction and operation of terminals may have an impact on the Ganges River dolphin.

S. No	Stakeholder	Relevance to the CIA	Engagement Priority (high, medium, low)	Concerns raised by the Stakeholders	Emerging Issues for CIA Study
				dolphins due to the operation of terminals and boats needs to be addressed	
9.	Pandu Port Complex	Indirectly influence or be responsible for managing the river port and navigation channel	Medium	▪ In the construction and operational phase, river traffic is likely to increase, which may lead to traffic congestion at terminals. ▪ Oil spillage and disposal of solid and liquid waste in the river; this needs to be addressed through this project. ▪ Maintenance of navigation channel is the key issues in the Brahmaputra River. The construction of terminal and maintenance of terminal approach channel shall be properly designed.	▪ **River geomorphology**: accretion and erosion in the river cause problems in the navigation channel and operation of cargo vessels.
10.	Forest Department, Wildlife wing	Directly influence or be responsible for conservation of wildlife and biodiversity in the project area	High	▪ The Ganges River Dolphin's habitat is the Brahmaputra River; the potential impact on dolphins due to the operation of terminals and boats needs to be addressed. ▪ Pollution from the terminal area and boats has an impact on river water quality, which needs to be addressed through this project. ▪ Oil spillage and the disposal of solid and liquid waste in the river need to be addressed through this project. ▪ Tree cutting during the construction of terminals, noise and illumination-related issues, and impacts on terrestrial fauna need to be addressed through project-level management.	▪ **Ganges River dolphin**: construction and operation of terminals may have an impact on the Ganges River dolphin due to degradation of surface water quality and underwater noise.

S. No	Stakeholder	Relevance to the CIA	Engagement Priority (high, medium, low)	Concerns raised by the Stakeholders	Emerging Issues for CIA Study
				▪ Noise and vibration during pilling activities and the operation of boats need to be addressed through this project.	
11.	AIWTDS	Directly influence or be responsible for planning and designing the terminals; implementing management measures proposed for the construction and operation of the terminals.	High	AIWTDS is responsible for addressing all the relevant concerns raised by the different stakeholders in the project. This includes: ▪ River bank erosion measures at the PUC influence areas; ▪ Pollution control measures; ▪ Socio-economic issues of the project affected people; ▪ Conservation of dolphins and other protected species; ▪ Impact assessment study; ▪ Supervision and monitoring of EMP ▪ Grievance addressal system and its implementation. Accretion and erosion in the river, the formation of sand bars, and less water depth during the dry season in the river channel may affect the viability of the operation of terminals.	▪ **River geomorphology**: accretion and erosion in the river have the potential to have an adverse impact on the operation of terminals.
12.	NGO- working for wildlife conservation	Indirectly influence or be responsible for conservation of wildlife and biodiversity in the project area	High	▪ The Ganges River Dolphin's habitat is the Brahmaputra River; the potential impact on dolphins due to the operation of terminals and boats needs to be addressed.	▪ **Ganges River dolphin**: construction and operation of terminals may have an impact on the Ganges River dolphin due to degradation of surface

S. No	Stakeholder	Relevance to the CIA	Engagement Priority (high, medium, low)	Concerns raised by the Stakeholders	Emerging Issues for CIA Study
				▪ Pollution from the terminal area and boats has an impact on river water quality, which needs to be addressed through this project. ▪ Oil spillage and the disposal of solid and liquid waste in the river need to be addressed through this project. ▪ Tree cutting during the construction of terminals, noise and illumination-related issues, and impacts on terrestrial fauna need to be addressed through project-level management. ▪ Noise and vibration during pilling activities and the operation of boats need to be addressed through this project.	water quality and underwater noise.
13.	Pollution Control Board Assam (PCBA)	Indirectly influence or regulate the environment pollution. PCBA is responsible for assessing the pollution control measures proposed by AWITD during the construction and operational stages of the project.	High	▪ The potential impact of the project during the construction and operational stages shall be assessed. ▪ Baseline information needs to be carried out as per standard terms of reference (ToR) for this type of project. ▪ Stakeholder consultations need to be conducted, and their concerns need to be incorporated into the study. ▪ Periodical monitoring needs to be conducted	▪ **Surface water quality**: potential impact on surface water quality due to the construction and operation of terminals.
14.	Directorate of Fisheries, Assam	Indirectly influence or be responsible for guidance regarding fishing practices in the Brahmaputra River and	Medium	▪ The Directorate of Fisheries is responsible for the conservation of fish resources in the state. They are also responsible for fishing practices in the river, like the mesh size of the fishing net.	▪ The environment-friendly operation of terminals to avoid the impact on fish.

S. No	Stakeholder	Relevance to the CIA	Engagement Priority (high, medium, low)	Concerns raised by the Stakeholders	Emerging Issues for CIA Study
		addressing the concerns of the fishermen.		▪ The Directorate of Fisheries expects better and more environmentally friendly operation of these terminals, so that project has a minimum impact on fish diversity at the river and an impact on fishing activities.	
15.	Tourism Department, Assam	Indirectly influence or be responsible for the promotion of tourism, which also includes the river cruise on the Brahmaputra River.	Low	▪ The main tourist attraction at Brahmaputra River is Umananda Temple, a religious festival like Ambubachi Mela at Kamakhya Temple in Central Cluster. religious festivals like the Raas Festival at Majuli and wildlife-migratory birds at Majuli Island. ▪ The Tourism Department expects better and more environmentally friendly facilities in the river terminal to promote tourism in this region.	▪ The environment-friendly operation of terminals will attract more tourists to the region.
16.	Irrigation Department, Assam	Indirectly influence or be responsible for erosion control measures in the Brahmaputra River.	High	▪ The Irrigation Department is the key government agency with the mandate and is responsible for river-bank protection measures and flood control measures. ▪ The Irrigation Department will be responsible for assessing the bank protection measures in the terminal area and may provide their input. ▪ Erosion and shifting the terminal locations are issues that need to be addressed through this project.	▪ **River geomorphology**: accretion and erosion in the river cause damage to the river bank and flooding.
17.	Guwahati Municipal Corporation (GMC)	Indirectly influence or be responsible for treatment of sewage from the GMC	Medium	▪ GMC is located in the Central Cluster. Currently, untreated sewage from the corporation area is directly or indirectly discharged into the river.	▪ **Surface water quality**: installation of STP will reduce

S. No	Stakeholder	Relevance to the CIA	Engagement Priority (high, medium, low)	Concerns raised by the Stakeholders	Emerging Issues for CIA Study
		area and reduce the water quality impact		▪ The future growth of the urban area is likely to increase the sewage generation from the corporation area. ▪ The present practice has potential negative effects on river water quality as well as the aquatic ecology of the river. ▪ GMC, under the Smart City Program, is planning to install STP in Guwahati.,	the impact on surface water quality.
18.	PWD	Indirectly influence or be responsible for construction and maintenance of access road towards terminals.	Medium	▪ Local people, passengers, and ferry operators raised concerns about the condition of the site access road towards the terminal. After flooding, the condition of the road is generally damaged; this leads to inconvenience to the passengers	▪ Responsible for construction of road, bridge and maintenance of road.
19,	Brahmaputra Board	Indirectly influence or be responsible for 'Survey & Investigation' in Brahmaputra & Barak Valley	Medium	▪ The Brahmaputra Board is the key government agency with the mandate and is responsible for river-bank protection measures and flood control measures. ▪ The Board is responsible for bank protection measures at Majuli side. ▪ Erosion and shifting the terminal locations are issues that need to be addressed through this project.	▪ **River geomorphology**: accretion and erosion in the river have the potential to have an adverse impact on the operation of terminals and other river front development activities.
20	Water Resources Department	Indirectly influence or be responsible for 'Survey & Investigation' in Brahmaputra & Barak Valley and	Medium	▪ The Brahmaputra Board is the key government agency with the mandate and is responsible for river-bank protection measures and flood control measures.	▪ **River geomorphology**: accretion and erosion in the river have the potential to have an adverse impact on the operation of terminals and

S. No	Stakeholder	Relevance to the CIA	Engagement Priority (high, medium, low)	Concerns raised by the Stakeholders	Emerging Issues for CIA Study
		implementation of projects		▪ The Board is responsible for bank protection measures at Jorhat side. ▪ Erosion and shifting the terminal locations are issues that need to be addressed through this project. ▪ A number of development projects, especially large-scale development activities in the river, may have a significant impact on river geomorphology.	other river front development activities.

6.4.2 CIA Report Finalization Stage

The SI team, along with the AIWTDS team, has conducted stakeholder consultations with institutions (listed in Table 6.2) identified in the CIA scoping to validate the VEC selection, VEC baseline condition, and future developmental plans in these two Clusters. A non-technical executive summary was shared with the above-mentioned key stakeholders during the consultation process, and the findings of the draft CIA have been discussed, along with recommendations towards the management of significant impacts (refer to **Appendix A**). In the stakeholder consultations, cumulative impact assessment and future recommendations were discussed, as well as obtaining their inputs towards the finalization of the report. The summary of consultation has been presented in **Table 6.2**.

Table 6.1 Stakeholders Consultation – CIA Report Finalization Stage

S. No.	Stakeholder Consulted	Issues Discussed
1.	PCCF Wildlife & Chief Wildlife Warden	▪ The major threats to Ganges River dolphins are anthropogenic impacts like river water quality, degradation of habitat, illegal hunting, prey depletion, sedimentation, habitat fragmentation, entanglement in fishing nets, etc. ▪ Porcupine systems are sometimes implemented for erosion control in the river, which is also dangerous for the river dolphins, and projects should avoid this system. ▪ There is a need for a basin-level detailed study of the river dolphin through a reputed government institute.
2.	Member Secretary, Pollution Control Board Assam	▪ PCBA has 237 surface water quality monitoring locations and nine monitoring locations in the Brahmaputra River. ▪ PCBA also has five online ambient air quality monitoring locations in Guwahati City. ▪ Guwahati Municipal Corporation has a plan to implement the STP to treat the sewage.
3.	Director, Directorate of Fisheries	▪ The Fisheries Department has a major focus on inland fisheries deployment, which includes ponds, lakes, and bills. ▪ Captured fisheries are also practiced in the Brahmaputra River. But fish land data for the entire river is not available with the Fisheries Department. ▪ The Fisheries Department has not conducted any studies on the fishery of the Brahmaputra River. ▪ The Indian Council of Agricultural Research (ICAR)-Central Inland Fisheries Research Institute (CIFRI) at Guwahati has conducted fisheries studies in the Brahmaputra River. ▪ There is a requirement for fishery studies in the Brahmaputra River, and ICAR-CIFRI can do such studies.
4.	Technical consultant, Assam Climate Change Management Society	▪ Large-scale development projects like the construction of bridges over the Brahmaputra River have a potential impact on river morphology, erosion, and accretion, and this will increase bank erosion. ▪ The project should consider climate change adaptation measures like solar-powered vessels.

S. No.	Stakeholder Consulted	Issues Discussed
		▪ The new climate change action plan is in the final stages and will be published within a few months. ▪ There are also small boat operators in this region, and these boats are operating on diesel. They may be converted to battery/CNG operated on phase wise as per the feasibility. ▪ The water quality of the Brahmaputra River near Guwahati City is impacted due to certain reasons so scientific treatment and disposal of municipal solid waste and sewerage water treatment may be implemented for the improvement of the water quality.
5.	Director, Inland Water Transport Assam	▪ The Brahmaputra River has been traditionally used for cargo movement. During the 1960s and 1980s, river traffic volume was quite high. However, after that, river traffic movement was drastically reduced. ▪ During the 1960s and 1980s, the river dolphin population was quite significant, and now it is much less. ▪ The vessel movement and underwater noise are not the only driving factors in the decrease in the dolphin population. ▪ The other factors may have an influence on the dolphin population, which is why a basin-level study on dolphins is required.
6.	Chief Engineer, Water Resource Department (WRD)	▪ Climate change has an influence on floods and droughts in the river basin, which are major natural stressors on the river geomorphology of the Brahmaputra River. ▪ WRD is only responsible for river bank protection and flood control measures. WRD has own design division, and they are responsible for project level designing of WRD project. ▪ Brahmaputra Board may also responsible for river bank protection and flood control measures of entire North-Eastern states including Assam; ▪ Central Water Commission (CWC)may also be responsible for flood control, irrigation, navigation, drinking water supply and water power development. It also undertakes the investigations, construction and execution of any such schemes as required. ▪ CWC can play can central agency for all developmental projects in Brahmaputra River.
7.	Assistant Chief Engineer, WRD	
8.	Chief Design, Director of Planning, WRD	
9.	Dy. CEO, FREMA	
10.	Zoology Department, Guwahati University.	▪ River dolphins face several threats, including infrastructure development, illegal hunting, prey depletion, sedimentation, habitat fragmentation, entanglement, habitat degradation, water extraction, sand mining, siltation, hydrological alterations, and the disposal of soil waste in the river. ▪ Appropriate mitigation measures need to be implemented to conserve the dolphins. ▪ Riparian habitat is an important ecosystem for riverine ecosystems; therefore, bank protection works should be planned accordingly.

6.4.3 CIA Final Disclosure

The draft final CIA report summary was disclosed to the stakeholders identified in the CIA report. Stakeholders were informed and invited to participate in the meeting by AIWTDS (refer **Appendix B**). The invitation was extended to all the stakeholders identified in the CIA studies. The invitation was also shared on social media, i.e., Facebook, for public participation outreach (refer **Appendix B**).

The public disclosure meeting was organized in the Assam Administrative Staff College, Guwahati. The participants in the CIA final disclosure included representation from institutional stakeholders, experts. The attendance record for the CIA Final Disclosure is provided in **Appendix B**. Photographs of the final disclosure has been presented in **Appendix B**.

The CIA consultants presented summarized findings from the CIA study using a PowerPoint slide deck. At the onset, the objective and purpose of the study were explained. This was followed by a presentation covering the following components:

- Project background;
- Purpose and objective of CIA;
- Approach and methodology adopted for the study;
- PUC, Present & Past Activities and RFFAs;
- VEC selection;
- Spatial and Temporal Boundary for CIA Study;
- Stakeholder concerns and issues raised at various stages of the studies;
- Cumulative Impacts on VEC and recommendation.

This was followed by an interactive session in course of which the participants expressed their opinion. The issues discussed during the final disclosure and responses provided have been summarised in **Table 6.3**.

Table 6.3 Issues Discussed in CIA Final Disclosure

S. No.	Stakeholders provided Remarks and Opinions	Topic of Discussion	Queries/ Remarks	Response Provided
1.	▪ Assam Climate Change Management Society ▪ Water Resource Government of Assam ▪ Guwahati Smart City Limited ▪ Pollution Control Board Assam ▪ Department of Zoology, Guwahati University ▪ Wildlife Division, Forest Department, Government of Assam	Transport system and community health and safety	▪ There is an existing bridge at Guwahati and another bridge under construction; however, the AIWTDS is implementing the terminal projects in Guwahati. After the construction of the new river bridge, transport will be more convenient for the local people of Guwahati. Has AIWTDS conducted any study of the future traffic load and feasibility of the proposed terminals? ▪ The existing access road to North Guwahati Terminal is narrow and passes through the settlement area; this may inconvenience the local people. There is an alternative road, which is a comparative wider road. Proper transport planning is required.	▪ The new bridge will improve the existing transport situation, especially crossing the river. However, some parts of the city are not close enough to the bride, so river transport may be convenient for them. ▪ AIWTDS has conducted a feasibility study of all the proposed terminals, including future traffic loads. ▪ Considering the growth of Guwahati City, different types of transport systems are required. River transport is less polluting compared to road transport. ▪ CIA study also recommended a transport planning, considering existing, river terminals, proposed river terminals, existing and proposed bridges.
2.		Protected aquatic fauna-Ganges River Dolphins and Turtles	▪ The dolphin population studies were not conducted; now, these studies have been conducted by various agencies. ▪ During the dry season, the water level of the river has been reduced, and the dolphin population is restricted to only the deeper sections of the river. The vessel movement and other anthropogenic activities have the potential to have an impact on dolphin breeding activities. Considering this dolphin breeding ground, the Brahmaputra River and a conservation plan need to be developed.	▪ The CIA study recommends the basin-level dolphin study; ▪ Project-level solid waste management studies have been considered in the project design. Additionally, restrictions on vendors in the terminal area will be recommended in the CIA. ▪ The riverside structure of the proposed terminals was also considered to avoid any negative impact on the dolphin.

S. No.	Stakeholders provided Remarks and Opinions	Topic of Discussion	Queries/ Remarks	Response Provided
			▪ The dredging activities to maintain the navigation channel and river bed sand mining have a positive impact on dolphin habitat as they increase the river depth. However, overexploitation has a potential impact on river geomorphology. ▪ A basin-level dolphin study should be conducted through the government-reputed agency; ▪ Dolphins in the river have been adopted for the movement of vessels; however, the river site jetty structure has the potential to have a negative impact on dolphins. ▪ The establishments of small vendors, pan-shops, small fast-food vendors, tea shops, etc. that produce huge amounts of non-degradable solid waste by themselves and their consumers. This may have a negative impact on dolphins.	
3.		Key Biodiversity Area	▪ Noise from vessel movement has potential negative effects on migratory birds in the North Cluster, as the KBAs are located within the spatial boundary. ▪ The identified protected areas in the central © are away from the proposed terminal area and may not have a direct impact on KBA. However, during the winter season, migratory birds are generally seen in the sand bars of the Brahmaputra River; therefore, VEC for the Central Cluster can consider the impact on KBA.	▪ The potential impact on KBA for the North Cluster has been included in the CIA, and based on the impact assessment, a recommendation has been provided. ▪ The final CIA report will include the VEC of KBA.

S. No.	Stakeholders provided Remarks and Opinions	Topic of Discussion	Queries/ Remarks	Response Provided
4.		River water quality	▪ Under the JICA project, STP has been planned for Guwahati City; ▪ Vessels should have a sewage treatment system; ▪ Jetties should have a sewage treatment system. ▪ After the NGT order, GMC has planned to implement the sewage treatment plant for the city.	▪ PUC has already planned waste water treatment facilities in the terminal and vessels. ▪ AIWTDS has already procured modern vessels with sewage treatment facilities ▪ Proposed additional project level mitigation measures will be included in the CIA
5.		River based livelihood	▪ The small boat operators may lose their livelihoods due to the introduction of modern vessels. ▪ As an alternative livelihood, these boat operators can be engaged in ecotourism. Ecotourism can offer economic benefits while preserving natural ecosystems, with local communities contributing through knowledge sharing and participation. This initiative should be planned with the Forest Department and the Tourism Department.	▪ The livelihood restoration options will be included in the final CIA.

7 ASSESSMENT OF CUMULATIVE IMPACTS

7.1 RIVER GEOMORPHOLOGY

The VEC interaction and effect diagram (**Figure 5.2**) indicates that the PUC and other terminal (passenger and cargo) projects along with other development projects, especially construction of bridge and bank erosion protection project, and river front development projects and external factors directly or indirectly interacted with geomorphology of the river. The cumulative impact on geomorphology is assessed through erosion and accretion rate.

7.1.1 Baseline Condition

The morphology of the Brahmaputra River is characterized by intense braiding and bar formation—where channels exhibit successive bifurcation and rejoining of flow around sand bars and islands—and highly dynamic river bank line and bed configuration. The morphology and behaviour of the river undergoes drastic changes in response to variations in the flow regime and pattern of sediment transport and deposition in the river following the seasonal rhythm of the monsoon.

The Brahmaputra River experiences major changes in response to variations in the flow and sediment load. During November to March when the river discharge is low the channel is highly braided with several bars and islands. After April, May when discharge start increasing these islands and bars get submerged and river looks straight. During low water stage the main channel in a braided river, which carries portion of the discharge, is commonly situated nearby one of the riverbanks and is slightly curved moving from one bank to other. During rising stage when the flow increases rapidly, while the flow inclines to follow the deep channel, it is not able to develop rapidly to accommodate increasing flow and hence there is tendency for bank cutting and sloughing. This action helps migration of the thalweg in lateral direction.

Channel bars

The sand bars are commonly observed in Brahmaputra riverbed. There are many bar types can be observed in the river- principally compound bars (mid-channel and side bars) and unit bars.

Mid-channel Bars: Mid-channel bars divide the primary and secondary channels into smaller channels. These were reported in both the central and north Clusters. All mid-channel bars have complex depositional histories. During the peak stage, the river flows in mainly one direction. As the floods recede, several secondary channels emerge. These channels flow in various directions. Thus, the deposition of sediments takes place with flow in different directions along and across the channel. Episodes of deposition and erosion with passing time result in the formation of mid-channel bars.

Side Bars: Side bars are compound bars that develop in a similar way to mid-channel bars but occur along the river bank. During the lower flow regime, the bar surfaces are dissected by chutes and abandoned channels.

Unit Bars: Unit bars are present throughout the river reach. They emerge during the lower flow regime. In the area of study, two categories of unit bars were reported. In the first category, unit bars occur within primary and secondary channels. These bars are subjected to constant erosion by flowing water during the lower flow regime and are liable to disappear within a short period of time.

Unit bars in the second category are subjected to constant erosion by wind during the lower flow regime. They consist of structures such as ripple-drift cross-lamination, horizontal bedding, trough cross bedding, mud layers, and planar (tabular) cross bedding.

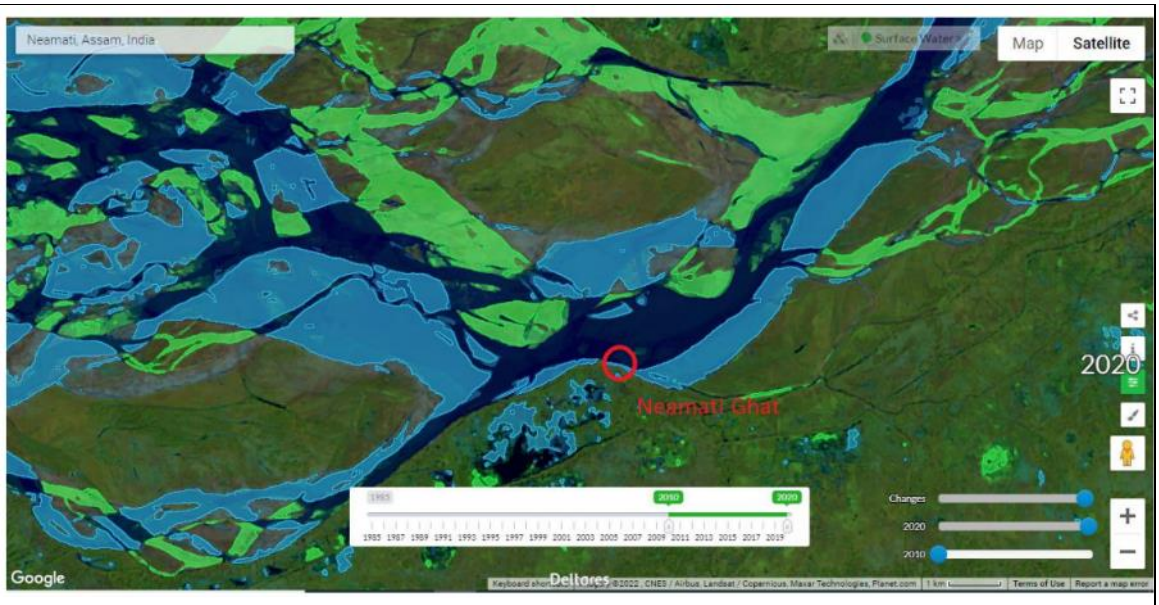
Erosion and Accretion

The hydrological modelling study was conducted for the project to understand the erosion and accretion patterns of the rivers for the purpose of designing the ferry terminals. The aqua monitor images were analysed to understand the erosion and accretion changes from 2010 to 2020. The North Cluster modelling results revealed that erosion was reported towards the southern bank, i.e., the Neamati side, and accretion towards the northern bank. The central Cluster modelling results revealed that accretion was reported towards the northern bank, i.e., the North Guwahati terminal side. Sand bar formation is also reported in this Cluster. The morphological changes between 2010 and 2020 in both the Clusters has been presented in **Figure 7.1** and terminal wise changes has been provided in **Table 6.1**.

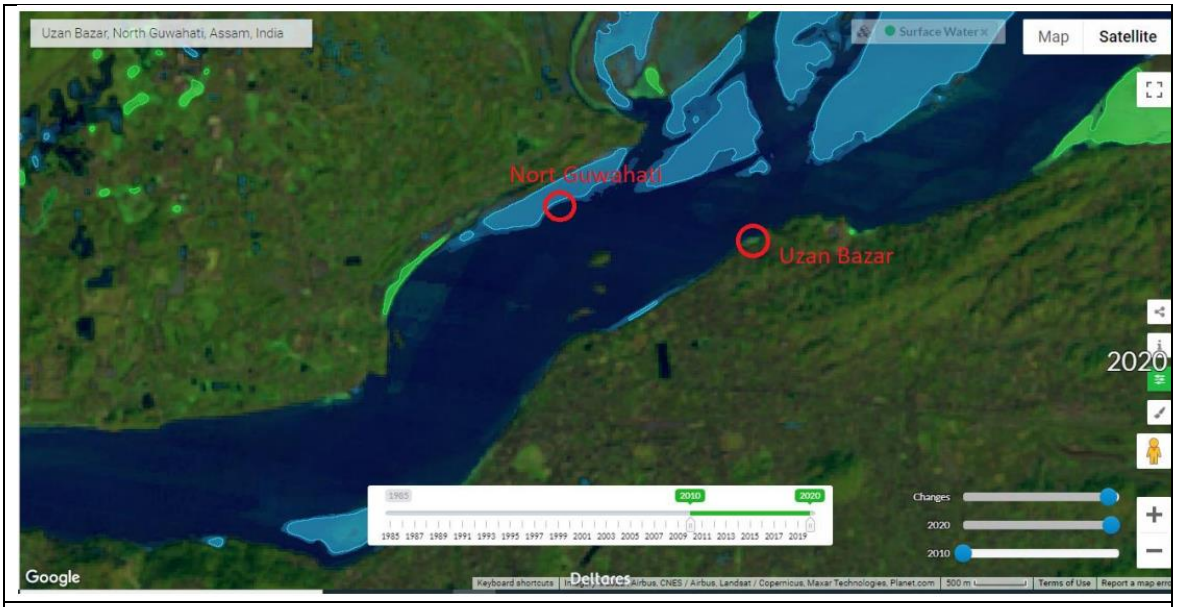
Table 7.1 Morphological Changes between 2010 and 2020 in proposed terminals

Terminals	Approximate bank erosion between 2010 and 2020 (m)	Approximate bank accretion between 2010 and 2020 m)
Umananda	No change	No change
North Guwahati	~ 200m	-
Uzan Bazar/ Gateway of Guwahati	No change	No change
Aphalamukh	~100 to 300m	-
Neamati	~100 to 300m	-

Figure 7.1 Morphological Changes between 2010 and 2020 in North & Central Cluster



Aqua monitor images showing erosion and accretion changes from 2010 to 2020 at North Cluster (*Blue colour polygon indicates: land has become water and green colour polygon indicates water has become land*)



Aqua monitor images showing erosion and accretion changes from 2010 to 2020 at Central Cluster (*Blue colour polygon indicates: land has become water and green colour polygon indicates water has become land*)

Climate Change on Hydrological Regime of Brahmaputra River

The water resources in the Brahmaputra River basin have been widely utilized for drinking, irrigation, navigation, and industry and provide the basis for local livelihoods. In recent years, there has been increasing concern that the water resources of the river system may be vulnerable in the context of global climate change (IPCC, 2007; Kundzewicz et al., 2007), which could have considerable implications for the water resources, livelihoods, and well-being of the people in the region (Eriksson et al., 2009). Rising temperatures and changes in precipitation could affect the hydrological regime through factors such as changes in seasonal extremes, increased evapotranspiration, changes in glacier volume (Bolch et al., 2012), and changes in snow and glacier melt (Lutz, Immerzeel, Shrestha, & Bierkens, 2014).

The Brahmaputra (Yarlung Zhanbo in China; Jamuna in Bangladesh) also originates in the Himalayan mountain range, flowing east through the southern part of China into eastern India and thence to Bangladesh, where it merges with the Ganges (FAO, Aquastat, 2011b). With the exception of the upper reaches, which lie in the Himalayan rain-shadow area, the basin is heavily influenced by the summer monsoon, with annual rainfall ranging from 1200 mm in parts of Nagaland (India) to over 6000 mm on the southern slopes of the Himalayas, with a mean annual value of 2300 mm. Some 60 –70% of annual rainfall falls in the monsoon from June to September with a further 20– 25% in the pre-monsoon from March through May. At least some precipitation falls as snow at elevations above 1500 m asl. The basin is characterized by high seasonal variability in flow, sediment transport and channel configuration (Goswami, 1985). Floods are quite common during the monsoon in the plains areas of India, while in the low-flow period, the river becomes a multiple channel stream with sand bars and channels shifting back and forth between the main stream banks (FAO, Aquastat, 2011b).

Flu¨gel et al. (2008) studied the variation in annual mean and seasonal precipitation in the upper Brahmaputra River basin from 1961 to 2005 and found a slight increase in mean annual precipitation as well as in autumn, spring and summer, but no statistically significant trends.

Pervez and Henebry (2014) projected an overall 12% and 16% increase in monsoon precipitation over the Brahmaputra Basin compared to baseline for the A1B and A2 emission scenarios, respectively, using the Statistical Downscaling Model, with a decrease during the pre-monsoon and increase during the post-monsoon season. Immerzeel (2008) projected future precipitation based on six different GCMs and found an accelerated increase in precipitation with a greater increase over the Tibetan Plateau than over the plains area; the increase in precipitation in summer could indicate a potential increase in extreme events. Overall, the studies suggest that there has been no statistically significant change in precipitation in the Brahmaputra Basin over the past 50 – 100 years, although there is some indication of a small overall increase. The projections indicate an increase in monsoon and post-monsoon precipitation over the basin, decrease in pre-monsoon precipitation, and a shift in the timing of peak monsoon precipitation.

Flu¨gel et al. (2008) identified an increase in average annual temperature in the upper Brahmaputra River basin of 0.28 °C per decade from 1961 to 2005, and of average winter, autumn, spring and summer temperatures of 0.37, 0.35, 0.24, and 0.17 °C per decade.

Immerzeel (2008) projected an accelerated seasonal increase in both maximum and minimum temperatures in the Brahmaputra Basin from 2000 to 2100 based on the results of six statistically downscaled GCM models. Plateau than on the flood plain and the A2 storyline showed more extreme changes in temperature than the B2. By the end of the century, the average temperature of the basin is projected to increase by 3.5 and 2.3 °C for the A2 and B2 scenarios, respectively.

Immerzeel et al. (2010) estimated that the discharge generated by snow and glacier melt in the Brahmaputra Basin is 27% of the total discharge naturally generated in the downstream areas of the Brahmaputra Basin. Climate change is expected to have a significant effect on the hydrology and water resources of this basin (Immerzeel et al., 2010; Mirza, 2002). The study by Immerzeel et al. (2010) for 2046– 2065 under the A1B scenario projected a decrease of 19.6% in mean upstream water supply, with the reduction in melt runoff partly compensated for by increased upstream rainfall (þ25%).

7.1.2 Stressors and Impacts- Central Cluster

PUC: Three terminals will be developed under PUC, i.e., the Gateway of Guwahati, North Guwahati, and Umananda. The Gateway of Guwahati and North Guwahati terminals are located in the accretion area, whereas the Umananda is located in the stable zone. The land reclamation will be required for the North Guwahati and Umananda terminals. Piling activity would be required for the Gateway of Guwahati, and limited piling activity would be required for the North Guwahati terminal. The above-mentioned construction activities may generate sediments, which are likely to be deposited in the accretion area. However, it is proposed that construction activities will be conducted during the dry season. Therefore, the generation of sediment, dispersion in the downstream, and accretion will be limited. The construction of riverside structures may reduce the localized natural flow of the river, which may cause accretion near the terminal areas. The accretion area and rate of accretion will depend on river hydrology.

Operation of mechanized vessels and propeller actions near the river bank may cause resuspension of sediments. However, it is proposed to implement erosion protection measures in all the proposed

terminal construction areas. The appropriate erosion protection measures may not cause significant geomorphological changes. The potential impact due to the construction of three terminals and operation of these terminals on geomorphological changes is assessed to be low

Existing Jetties & Terminals and River Cruise Facility: There are 11 operating jetties, one cargo terminal, and two river cruise facilities in the Central Cluster. After the construction of the Gateway of Guwahati (GGG) Terminal, the other existing terminals, viz., Umananda Ferry Point, Uzanbazar Ferry Ghat, Gateway of Guwahati Rajduar Ferry Ghat, Kachari Ghat, Fancy Bazar Ferry Ghat and Lachit Ferry Ghat will not be in operation. Operation of mechanized vessels and propeller actions near the river bank may cause resuspension of sediments. In cases where the operating jetties are located in an erosion-prone area, the resuspension of sediments will be higher. The operating jetties on the southern bank of the river are mostly located in the stable zone, while the jetties on the northern bank are located in a moderately erosion-prone area. The morphological changes are likely to occur in the northern part of the Central Cluster (refer to **Figure 7.1**). The potential impact due to the operation of existing jetties and terminals on geomorphological changes is assessed to be medium.

Panbazar Brahmaputra Bridge: This is an under-construction bridge that will connect the south and north Guwahati. The construction piling activity for the construction of pillars on the river bed and river bank protection measures in the construction area may cause a change in flow concentration and a reduction in sediment entrainment from the eroding bank. The construction activity is likely to increase the sediment load in the water and sedimentation in the accretion area; this will lead to geomorphological changes (erosion and accretion in the downstream of the river stretch). The potential impact of the construction of the bridge on geomorphological changes is assessed to be high.

Elevated Panbazar connecting road: The AIWTDS Project team informed us that there is an elevated road along the south bank of the Brahmaputra River, from Panbazar Brahmaputra Bridge to Uzanbarar. Pilling activity in the river may have a potential impact on accretion towards the south Guwahati side. The potential impact of the construction of the riverfront development project on geomorphological changes is assessed to be medium.

Riverfront Development activity: The riverfront development activity under the Smart City Project of Guwahati has been initiated. The total length of riverfront activity is 6.4 km from Rajbhawan to Kalipur. Bank protection measures, including piling activities, may cause geomorphological changes (erosion and accretion in the downstream of the river stretch). The proposed riverfront stretch is mostly located in the stable zone and accretion area. The proposed construction activities (piling) have the potential to increase the accretion along the south bank of the river and erosion on the opposite bank of the river, which will have an impact on geomorphology. The potential impact due to the construction of the riverfront development project on geomorphological changes is assessed to be medium.

Expansion of Pandu Port: The RFFA list indicates the possibility of expansion of Pandu Port. The construction activities in the riverfront area of the port may cause morphological changes (erosion and accretion in the downstream of the river stretch). The existing port is located in the stable zone, so the proposed construction activities with appropriate mitigation measures may not have a significant impact on geomorphology.

Natural Stressors: The natural stressors like floods and droughts in the Brahmaputra River basin have influenced the flow regime and pattern of sediment transport and deposition in the river. The geomorphological study for the project revealed that the northern bank of the river is an erosion-prone area, especially upstream of the proposed North Guwahati Terminal. The mid-channel sand bars are not recorded in the central Cluster of the river. The natural periodical floods and draughts in the river basin have influenced the geo-morphological changes of the river.

Climate change: Climate change is expected to have a significant effect on the hydrology and water resources of this basin. The projections of a climate change impacted future are not inevitable. The state is characterized by high rainfall and a subtropical climate. It gets annual floods and frequent droughts, both of whose severity has risen due to adverse climatic conditions. The major findings from different studies on the projected impacts of climate change on the hydrology of the Brahmaputra River basin indicate a reduction in snow (and thus snow melt) and an increase in glacier melt to approximately mid-century, followed by a decrease. Although there are likely to be increased amounts of meltwater available for the next few decades, the amount might decrease abruptly thereafter as glacier storage is reduced. The exact timing remains uncertain. The projections indicate an overall increase in annual precipitation in Brahmaputra River under climate change scenarios, with some seasonal variation. In the Brahmaputra Basins, monsoon precipitation is projected to increase but pre-monsoon precipitation to decrease; in the Brahmaputra Basin, post-monsoon precipitation is also projected to increase, with a shift in timing of peak monsoon precipitation. The changes are expected to increase the risk of flooding and riverbank erosion. The potential impact of climate change on geomorphological changes is assessed to be high.

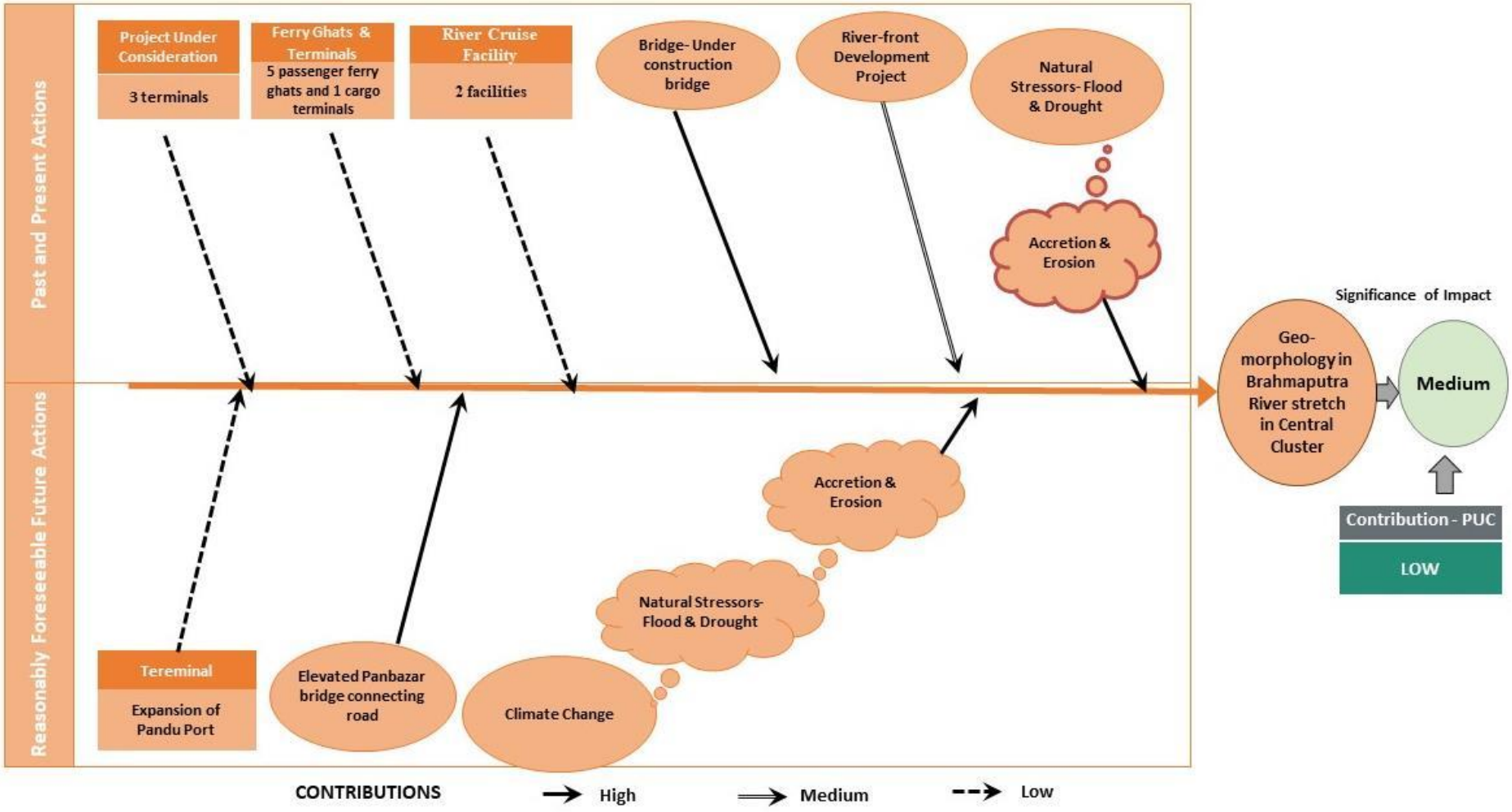
The contribution towards geomorphological changes in the river due to PUC and different riverfront activities and projects, along with their cause-and-effect relationship, is graphically presented in **Figure 7.2.**

Significance of Cumulative Impact

The contributions to geomorphological changes in the Brahmaputra River in the Central Cluster from past and present activities (jetties or terminals, developmental stressors and natural stressors) are medium. The erosion and accretion changes in the river stretch is well below the threshold[1] limit. The past, present and future river front activity along with external factors (natural stressors and climate change) will cumulatively impact the river geomorphology in terms of increasing the erosion and accretion in the river. The geomorphological changes of the river have a potential negative impact on surface water quality as well as protected aquatic fauna (Ganges River dolphins and turtles). The same has been discussed in Sections 7.4 and 7.6, respectively. The cumulative impact is assessed to be medium. Direct contribution of geomorphology in terms of increasing the erosion and accretion in the river from PUC is assessed to be **Low**.

[1] As per DPR-AIWTP, the decadal morphological study showed that morphological changes between 2010 and 2020 in the vicinity of the proposed ferry terminal sites were no changes, or 100 to 500 m. Considering minimum geomorphological changes of 100m has been considered as the threshold value for the CIA study.

Figure 7.2 River Geo-morphological -Cause Effect Relationship in Central Cluster



7.1.3 Stressors and Impacts- North Cluster

PUC: The Aphalamukh and Neamati terminals are located in the moderate erosion prone area. The gabion mattress will be laid from the bed of the river and the slope for movement of the Gangway for both terminals. The land filling and piling activities will not be required for both terminals. Again, the construction activities will be conducted during the non-monsoon period. Therefore, the generation of sediment, dispersion in the downstream, and accretion will be limited. As the southern bank of the river is more erosion-prone, the bank protection work at Neamati Terminal may cause erosion in the nearby spurs.

Operation of mechanized vessels and propeller actions near the river bank may cause resuspension of sediments. However, it is proposed to implement erosion protection measures in all the proposed terminal construction areas. The appropriate erosion protection measures may not cause significant geomorphological changes. The potential impact due to the construction of three terminals and operation of these terminals on geomorphological changes is assessed to be **low.**

Existing Jetties & Terminals and River Cruise Facility: There are three operating jetties, one river cruise facilities in the North Cluster. Operation of mechanized vessels and propeller actions near the river bank may cause resuspension of sediments. In cases where the operating jetties are located in an erosion-prone area, the resuspension of sediments will be higher. The operating jetties on the southern bank of the river are mostly located in the moderately erosion-prone area. The geo-morphological changes are likely to occur in the southern bank of river of the North Cluster (refer to **Figure 7.1**). The potential impact due to the operation of existing jetties and terminals on geomorphological changes is assessed to be medium.

Hatihal Sapori Jorhat-Majuli Bridge: This is an under-construction bridge that will connect Jorhat and Majuli Island. The construction piling activity for the construction of pillars on the river bed and river bank protection measures in the construction area and construction site access on the river bed may cause a change in flow concentration and a reduction in sediment entrainment from the eroding bank. The construction activity is likely to increase the sediment load in the water and sedimentation in the accretion area; this will lead to geomorphological changes (erosion and accretion in the downstream of the river stretch). The potential impact of the construction of the bridge on geomorphological changes is assessed to be **high**.

Riverbed sand mining: The river bed sand mines are mainly operating towards Majuli. Sands are generally extracted from the sand bars through an excavator and transported to the landside storage area by dumper. Mines are generally operated during the dry season (winter and summer). The depth of the mines is 2–3 meters, depending on the sand deposit depth. There are also proposed new and expansion of mines. As per EIA Notification 2006 and its amendment, all riverbed sand mining projects need to obtain environmental clearance from the District Level Environment Impact Assessment Authority (DEIAA) or State Level Impact Assessment Authority (SEIAA). However, the implementation of environmental clearance conditions (EC) and EC monitoring is weak. The non-implementation of EC conditions in these mines has the potential to have a negative impact on geomorphology, and the impact is assessed to be **medium**.

Construction of AWT Terminal: The RFFA list indicates the possibility of construction of passenger terminal at Neamati by Assam Inland Transport (AWT). The construction activities in the riverfront

area of the terminal may cause geomorphological changes (erosion and accretion in the downstream of the river stretch). The existing Neamati terminal is located in the erosion prone zone, so the proposed construction activities may increase the erosion of nearby area. The potential impact on geomorphology is assessed to be **medium**.

Riverbank Protection Project: The bank protection project will reduce the erosion of the bank and improve the flood-related risk to adjacent areas. The construction of riverbank protection leads to a river response to the implemented work, commonly deepening of the channel alongside the protection work. This is a consequence of flow concentration and/or a reduction in sediment entrainment from the eroding bank. It is commonly believed that the Brahmaputra instability is largely associated with excessive sediment transport. The proposed interventions, revetments, and anti-erosion measures reduce the sediment. The reduced sediment entrainment along the protected reach has the tendency to encourage more pronounced and stable channels without affecting the opposite bank or the upstream area. However, during the construction of bank protection measures, especially the deepening of the channel alongside the protection work likely to generate sediments, these have a potential impact on river morphology. The potential impact due to bank protection measures is assessed as **low**.

Jorhat water intake Project: The construction of water intake facility, especially the deepening of the site and earth work along the riverbank, is likely to generate sediments, which have a potential impact on river morphology. The potential impact due to bank protection measures is assessed as **low**.

Natural Stressors: Natural stressors like floods and droughts in the Brahmaputra River basin have influenced the flow regime and pattern of sediment transport and deposition in the river. The geomorphological study for the project revealed that the southern bank of the river is an erosion-prone area. The mid-channel sand bars are recorded in the North Cluster of the river. The natural periodical floods and draughts in the river basin have influenced the geo-morphological changes of the river.

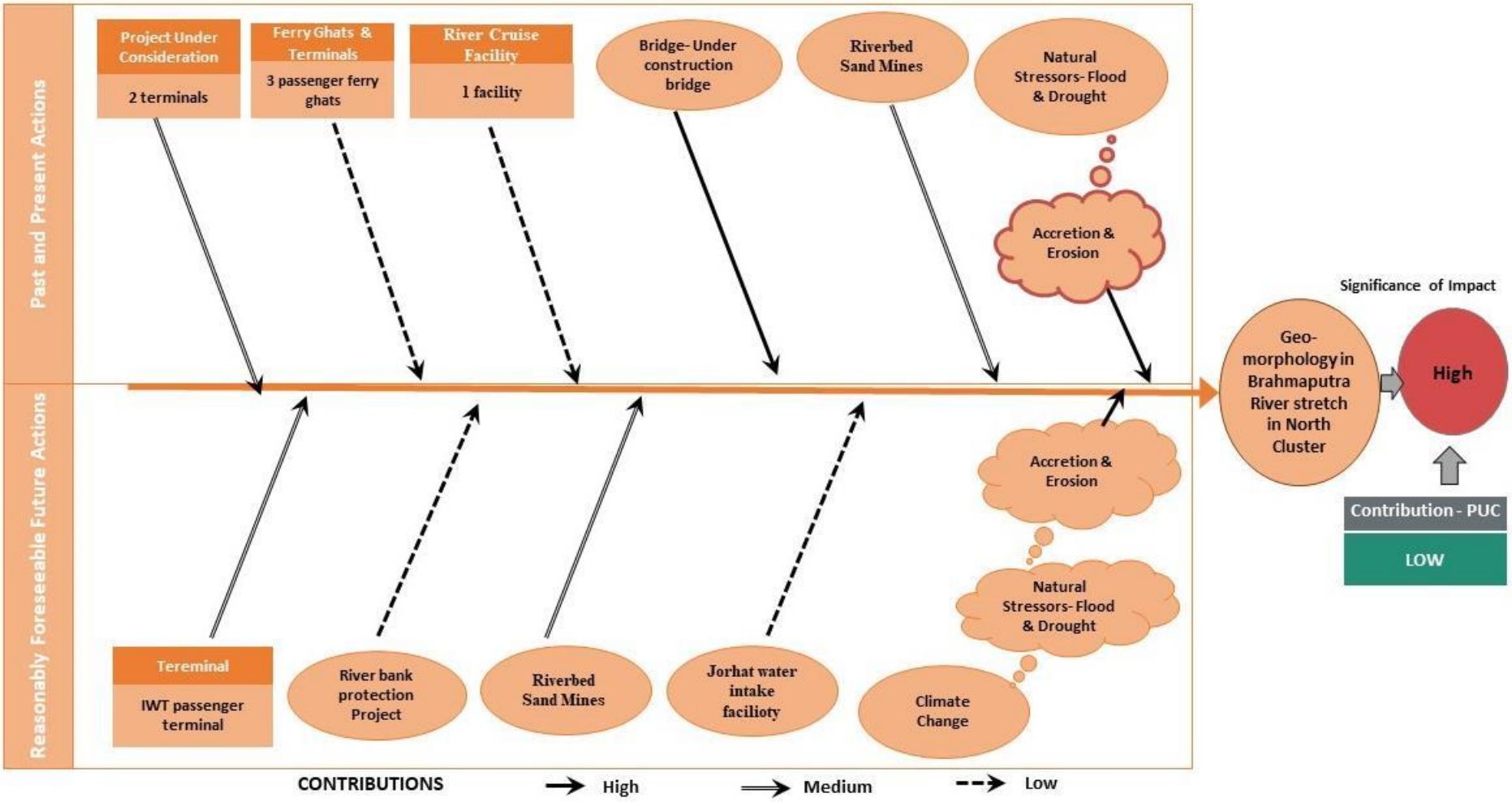
Climate change: Climate change is expected to have a significant effect on the hydrology and water resources of this basin. The potential impact of climate change on geomorphological changes is assessed to be **high** (*refer to Central Cluster impact assessment section*).

The contribution towards geomorphological changes in the river due to PUC and different riverfront activities and projects, along with their cause-and-effect relationship, is graphically presented in **Figure 7.3.**

Significance of Cumulative Impact

The contributions to geomorphological changes in the Brahmaputra River in the North Cluster from past and present activities (jetties or terminals, developmental stressors and natural stressors) are **high**. The erosion and accretion changes in the river stretch is more than the threshold limit. The past, present and future river front activity along with external factors (natural stressors and climate change) will cumulatively impact the river geomorphology in terms of increasing the erosion and accretion in the river. The cumulative impact is assessed to be high. Direct contribution of geomorphology in terms of increasing the erosion and accretion in the river from PUC is assessed to be **medium**.

Figure 7.3 River Geo-morphological -Cause Effect Relationship in North Cluster



7.2 AIR QUALITY

The VEC interaction and effect diagram (Figure 5.2) indicates that the diesel-operated vessels in the Central Cluster and development stressors, i.e., roads and traffic, directly interact with the air environment. The emissions from the above-mentioned activities lead to a deterioration of air quality. The following indicators were used to assess the impacts on the air quality: (i) the concentration of particulate matter (PM) and (ii) the concentration of oxides of nitrogen (NOx). Ambient air quality VEC has been scoped in for the Central Cluster.

7.2.1 Baseline Condition

The ambient air quality of the Central Cluster was carried out for terminal projects under ESIA studies for terminal projects. The ambient air quality was monitored in nine locations for the Central Cluster. The air quality was monitored in the month of August 2022 and following is a brief summary of the results:

- PM_{10}: The PM_{10} level varied from 59.13µg/m^3 to 63.13µg/m^3 which is below the permissible limit of CPCB being 100 µg/m^3 for industrial, residential, rural and other areas.
- $PM_{2.5}$: The $PM_{2.5}$ level varied from 32.34µg/m^3 to 35.76µg/m^3 which is below the permissible limit of CPCB being 60 µg/m^3 for industrial, residential, rural and other areas.
- NOx: The NOx level varied from11.53 µg/m^3 to 18.2 µg/m^3 which is below the permissible limit of being CPCB 80 µg/m^3 for industrial, residential, rural and other areas.

7.2.2 Stressors and Impacts- Central Cluster

Concentration of PM and NOx

PUC: During the construction stage of the proposed terminals, fugitive dust may be generated due to the handing (unloading from transport vehicle to storage area and handing during construction activity) of construction materials (sand, aggregate, cement) and earth work. Heavy equipment such as excavators, payloaders, trucks, concrete mixers, lifting equipment, etc. will be deployed onsite. Emissions from this equipment can affect the ambient air quality of the surrounding areas. Exhaust emissions from the operation of machinery and equipment are likely to contribute to the air pollutant load, including but not limited to pollutants such as PM, NOx, SO_2, and CO. The pollutants, especially particulate matter, will settle in areas surrounding the site and are expected to last for the entire duration of the site development stage.

During the operational stage of the PUC, the required power will be supplied from the grid supply with a backup diesel generator. Currently, the vessels in this Cluster are operating on diesel. It is proposed that for the vessels operating under this project, the propulsion of the boats will be diesel-electric combines. The boats will operate on diesel only when the batteries are completely discharged. During the operation stage, there will be an increase in traffic in the area, which may cause an increase in air emissions and lead to a degradation of local air quality. Considering the stage activities and operational stage air emission sources, the potential impact on air quality construction is assessed to be low.

Existing Jetties & Terminals and River Cruise Facility: There are 5 operating jetties, one cargo terminal, and two river cruise facilities in the Central Cluster. Currently, the vessels in this Cluster are operating

on diesel. The air emission from these vessels and contribution to ambient air quality is assessed to be low.

Panbazar Brahmaputra Bridge: This is an under-construction bridge that will connect the south and north Guwahati. The fugitive emission from construction activity- like handling and transport of construction materials (sand, cement, aggregates, etc), operation of batching plant. The operating heavy equipment such as excavators, payloaders, trucks, concrete mixers, lifting equipment, etc. are also contributed the air pollutant (PM, NOx, SO_2 and CO) in the ambient air quality. In the operational stage, traffic will increase due to the operation of bridges (existing Saraighat Road & Railway bridge and Panbazar Brahmaputra bridge) and connecting roads, which may cause an increase in air emissions and lead to a degradation of local air quality. The air emission from bridge project contribution to ambient air quality is assessed to be low.

Construction of MMC Hospital and Riverfront Development activity: The air emissions from these projects are also similar to those from the construction of bridges. Both projects are located in south Guwahati. The air emissions from these two projects as incremental contribution to ambient air quality have been assessed to be low.

Expansion of Pandu Port: The RFFA list indicates the possibility of expansion of Pandu Port. The proposed expansion of the port is likely to generate air pollutants during construction and operational stages. The potential impact on the air quality of the expansion of the port is assessed to be **low**.

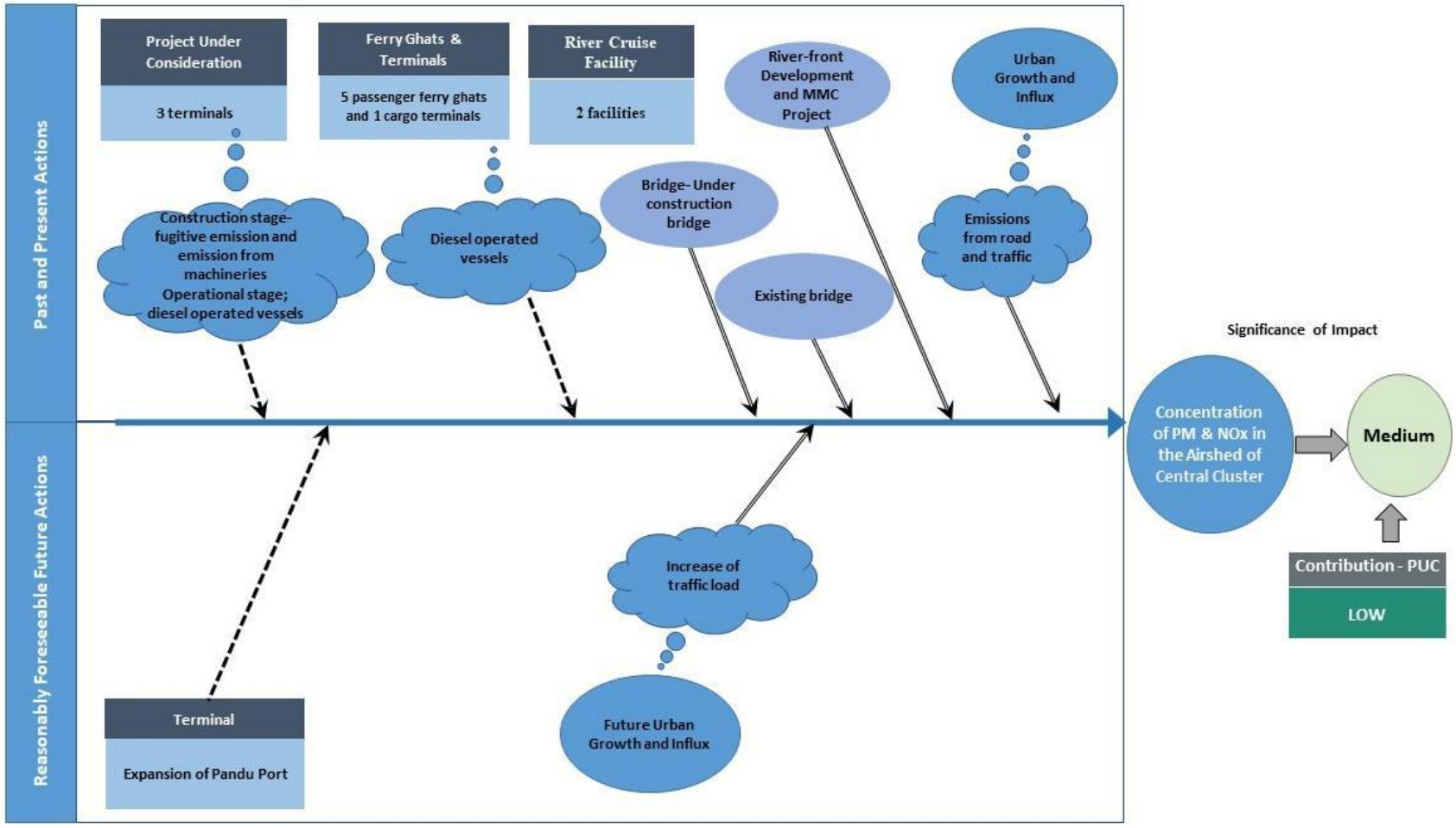
Urban growth: The population growth rate of the city is 20 percent. The improvement of transport infrastructure in the form of bridges, improved passenger terminals, medical infrastructure, etc. will increase the additional floating population in the area and subsequently the traffic load. The increased traffic load will contribute to the air emissions in the airshed.

The contribution towards increases in the PM and NOx in the air-shed due to PUC, other jetties or terminals and development activities along with their cause effect relationship is graphically presented in **Figure 7.4**.

Significance of Cumulative Impact

The contributions to PM and NOx in the airshed from past and present activities are already moderate. The existing PM and NOx concentrations in the North Cluster are well within the threshold limit for NAAQS for PM_{10}, $PM_{2.5}$ and NOx. The past, present, and future development activities, along with external factors (rapid urban growth, traffic, etc.), will cumulatively impact the condition of the North Cluster air shed. The cumulative PM and NOx concentrations will not breach the threshold limits for PM_{10}, $PM_{2.5}$ and NOx. The cumulative impact is assessed to be **medium**. However, the contribution of PM and NOx from PUC towards the air shed is assessed to be **low**.

Figure 7.4 PM and NOx Concentration in Air -Cause Effect Relationship in Central Cluster



7.3 UNDERWATER NOISE & VIBRATION

The underwater noise generated during piling activities for PUC and other developmental projects construction of bridge and river front activities will generate underwater noise. In addition, the operation of vessels is also expected to generate substantial underwater noise from their propellers, motors, auxiliary machinery, gear boxes and shafts, plus their hull wake and turbulence. The underwater noise may impact the behaviour of various aquatic organisms and may lead to other injuries like tissue injury, temporary & permanent hearing loss. These impacts are analysed and presented in the following sections:

7.3.1 Stressors and Impacts- Central Cluster

PUC: With the construction of riverside infrastructure, especially the piling activity, underwater noise will be generated. The sound pressure level (SPL) and sound exposure level (SEL) expected during pile driving will be impulsive. During the construction phase, there will be a potential impact on the Gangetic Dolphin due to underwater noise generation, mainly during pile driving activities for jetty construction. The sound energy generated from the source of pile driving due to the hammering of piles into the riverbed propagates compression and transverse waves along the length of the piles into the riverbed through the river water column. The noise produced is typically broadband noise, with some low-tone peaks. The typical underwater noise levels expected to be generated from piling activity described in **Table 7.2.** The underwater noise may have potential adverse impacts on river dolphins, and the same has been discussed in *Section 7.6*.

Table 7.2 Underwater Noise Level due to Piling Activity

Underwater Noise Sources	Noise Source	Frequency (Range)Hz##	Assumptions
Pile Driving for jetty construction	SPL $_{peak}$: 225 dB re 1µPa at 1m SPL $_{rms}$: 210 dB ref 1µPa at 1m SEL: 200 dB re 1µPa^{2}s*	25 to 4,000 (62 to 10,000)	■ Pulse signal - impulsive noise of ~90 milliseconds with 1 strikes per second ■ Prevailing shallow water depth of ~15 m

Note# =Sound Pressure Level (SPL) Peak and Root Mean Square (RMS) are expressed on a decibel scale (dB) and referenced to 1 micro-Pascal at 1 m from the source [dB re 1 µPa @ 1m]; The Sound Exposure Level (SEL) measured over a period of time SEL = SPLrms + 10 Log(T) where T is time in seconds.
= Sound frequency is expressed in Hertz. Only the approximate range of peak frequencies is presented, frequencies outside this range are likely to exist but be lower in sound level.
* = Pile driving data is sourced from Compendium of Pile Driving Sound Data prepared for The California Department of Transportation by Illingworth and Rodkin, September 2007. The data chosen is of Impact Hammer Pile Type of 0.6 meter (24-inch) AZ Steel Sheet Pile Type measured values of SPL peak of 205 dB re 1 µPa, SPL rms of 190 dB re 1 µPa and SEL of 180 dB re 1 µPa^2 s at 10 m from source in relative water depth of ~15 m

Panbazar Brahmaputra Bridge, River front development Project: The construction of pillars for Panbazar Brahmaputra Bridge has already been completed; no major piling activities may be required. The riverfront development project and the pilling activity are going on, and the same will be continued for the remaining stretch of the project. The potential impact due to piling activity will be the same as discussed for PUC.

Jetties or terminals: There are 11 operating jetties, one cargo terminal, and two river cruise facilities in the Central Cluster. After the construction of the Gateway of Guwahati (GGG) Terminal, the other existing terminals, viz., Umananda Ferry Point, Uzanbazar Ferry Ghat, Gateway of Guwahati Rajduar Ferry Ghat, Kachari Ghat, Fancy Bazar Ferry Ghat and Lachit Ferry Ghat will not be in operation. The operating vessels generate substantial broadband underwater noise from their propellers, motors, auxiliary machinery, gear boxes, and shafts, as well as their hull wake and turbulence. The underwater noise will also be generated by the vessels operating under PUC. The typical underwater noise levels expected to be generated from the movement of vessels has been carried out by AIWTP Environmental Impact Assessment Report.

This assessment has been carried out considering the outputs of various studies vs noise and using mathematical techniques (underground noise modelling) to assess the expected noise from vessel movement in IWT. The studies references are presented first followed by noise modelling outputs followed by impact on auditory System of Dolphins.

Study by Southall et al. (2007)[1]and Environmental Impact Statement of South Embley Project: A review of various studies into behavioural disturbance in high frequency cetaceans from continuous man-made noise was carried out. As per review it was concluded that not all behavioural responses are equally significant. Behavioural changes may be relatively minor and/or brief, have the potential to affect important behaviours such as foraging, breeding and resting. Study concluded that the behavioural changes to levels below 120 dB re 1 µPa were relatively minor or brief in case of harbour porpoise. Significant and sustained avoidance behaviour was recorded when noise levels exceeded 140 dB re 1 µPa in case of harbour porpoise. For turtles and Dolphin this level is 150 dB and 177 d(B) respectively.

Study by Kelkar (2008)[2] into the habitat use and distribution of Ganges River Dolphins in the Vikramshila Gangetic Dolphin Sanctuary (VGDS). As per the study it was concluded that the number of motorised boats and boat noise were not significantly correlated with dolphin encounter rates. Small boats equipped with outboard engines can produce source levels in the order of 160 dB re 1 µPa at 1 m, with the received levels of over 120 dB re 1 µPa at 1 m up to 500 m. Although the study results suggest that boat noise is not displacing dolphins, it is not conclusively showing that such noise levels do not impact Dolphin behaviour.

Table 7.3 Vessel noise at different speeds

Vessel, speed	**SL (0.2–40 kHz)**	**SL (2–12.5 kHz)**
dB re 1 µPaRMS at 1 m	dB re 1 µPaRMS at 1m	
2-stroke, 2.5 knots	112 ± 1.0	108 ± 3.0
4-stroke, 2.5 knots	110 ± 2.6	106 ± 2.2

[1] Southall et al. (2007). Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations. Aquatic Mammals, 33(4)

[2] Kelkar, N. (2008). Patterns of habitat use and distribution of Ganges river dolphins Platanista gangetica in a human dominated river scape in Bihar, India. Master Thesis, Manipal University, Centre for Wildlife Studies, Bangalore

Vessel, speed	SL (0.2–40 kHz)	SL (2–12.5 kHz)
2-stroke, 5 knots	139 ± 1.0	132 ± 3.0
4-stroke, 5 knots	138 ± 2.6	134 ± 2.2
2-stroke, 10 knots	149 ± 0.6	146 ± 0.6
4-stroke, 10 knots	152 ± 0.3	144 ± 0.5

(Source: Acoustics in marine ecology' (Vessel noise effects on dolphin's communication -Vol. 395: 161–175, 2009doi: 0.3354/meps08204)

Mathematical Noise Modelling: Noise are the mechanical waves and the energy content dissipates in surroundings with the distance of the waves movement. Noise level received by the receiver is not of same intensity as the noise intensity at the source. There is always a propagation loss associated with the noise transmission distance. Therefore, the noise received can be written as follows:

RL = SL-PL

RL- Received noise level

SL- Source Sound Level

PL-Propagation Loss

PL can be estimated using simple equation:

PL = Nlog10 (R),

Where N is scaling factor and R is distance of receptor from source. N values differ for different environments.

Propagation loss is expected to be high in shallow waters due to strong interface with the surface of the river bed. N values for shallow waters typically vary from 15-20. For mathematical noise modelling purposes, minimum noise levels considered are 130 d(B) due to barge movement and maximum noise levels are taken to be 160 d(B) (20 d(B) more than highest noise levels as per reference studies above to consider worst case scenario). Considering the noise level variation from 130-160 d(B) and N value variation from 15-20, noise level modelling carried out at different receptor distances of 22.5 and 15 m from the centre line of the vessel. The results for noise level modelling are presented in **Table 7.4**.

Table 7.4 Noise Level Modelling Result

Source Sound Level (SL)-dB	130	160	130	160	130	160	130	160
Scaling Factor considered (N Value)	15	15	20	20	15	15	20	20
Distance of receptor (R) in meter	22.5	22.5	22.5	22.5	15	15	15	15
Propagation Loss (PL)	20.25	20.25	27	27	17.7	17.7	23.6	23.6
Received Noise Level in dB by receptor	109.75	139.75	103	133	112.3	142.3	106.4	136.4

An estimation has been carried out to assess distance of achieving the safe threshold noise level of 150 d(B) for turtle and 177 d(B) Dolphin from behavioural consideration perspective as per EIA Study of "South of Embley Project" sited above. The same is illustrated in **Table 7.5** for scaling factor of 15 and 20 N. It is concluded that noise level of 150 d(B) will be attained at a distance less than 4.6 m from the centre of the vessel for turtles who may be in proximity.

Table 7.5 Distance estimation for achieving 150 d(B) of noise from centre of vessel

Description	Scenario 1-considering N Value 15		Scenario 2-considering N vale 20	
	For Turtles	For Dolphins	For Turtles	For Dolphins
Threshold Safe Noise Level -dB	150	177	150	177
Source Sound Level (SL)-dB	160	160	160	160
Safe Distance-R (m)	4.6	Noise level generated are less than the threshold safe level	3.16	Noise level generated are less than the threshold safe level

The contribution towards underwater noise due to PUC, other jetties or terminals and development activities along with their cause effect relationship is graphically presented in **Figure 7.5**.

Significance of Cumulative Impact

The underwater noise due to movement of vessels and river side construction activities in the area with sensitive habitats (dolphin and turtles) prevailing within the impact zone, potential impact on dolphin and turtles is assessed to be medium. However, the contribution of underwater noise from PUC is assessed to be low.

7.3.2 Stressors and Impacts- North Cluster

PUC: As discussed in Section 7.1, construction of riverfront activities for North Cluster terminals would not require any piling activity; therefore, underwater noise generation has not been envisaged during the construction stage. The operation of vessels under PUC will contribute to underwater noise. The potential impact on underwater noise due to the operation of vessels has been discussed in the Central Cluster.

Jetties or terminals: There are three operating jetties and one river cruise facility in the North Cluster. The operating vessels will generate underwater noise, and the potential impact due to the operation of vessels has been discussed in the Central Cluster.

Hatihal Sapori Jorhat-Majuli Bridge, Jorhat water treatment project and river bank protection Project: The construction of land-side pillars for Hatihal Sapori-Jorhat-Majuli Bridge has been started; the riverside construction has not been started. The piling activity for the construction of pillars in the river will generate underwater noise. Other river construction activities, like the Jorhat water treatment project and river bank protection towards the Neamati side, have the potential to generate underwater noise.

The contribution towards underwater noise due to PUC, other jetties or terminals and development activities along with their cause effect relationship is graphically presented in **Figure 7.6**.

Significance of Cumulative Impact

The underwater noise due to movement of vessels and river side construction activities in the area with sensitive habitats (dolphin and turtles) prevailing within the impact zone, potential impact on dolphin and turtles is assessed to be medium. However, the contribution of underwater noise from PUC is assessed to be low.

Figure 7.5 Underwater Noise -Cause Effect Relationship in Central Cluster

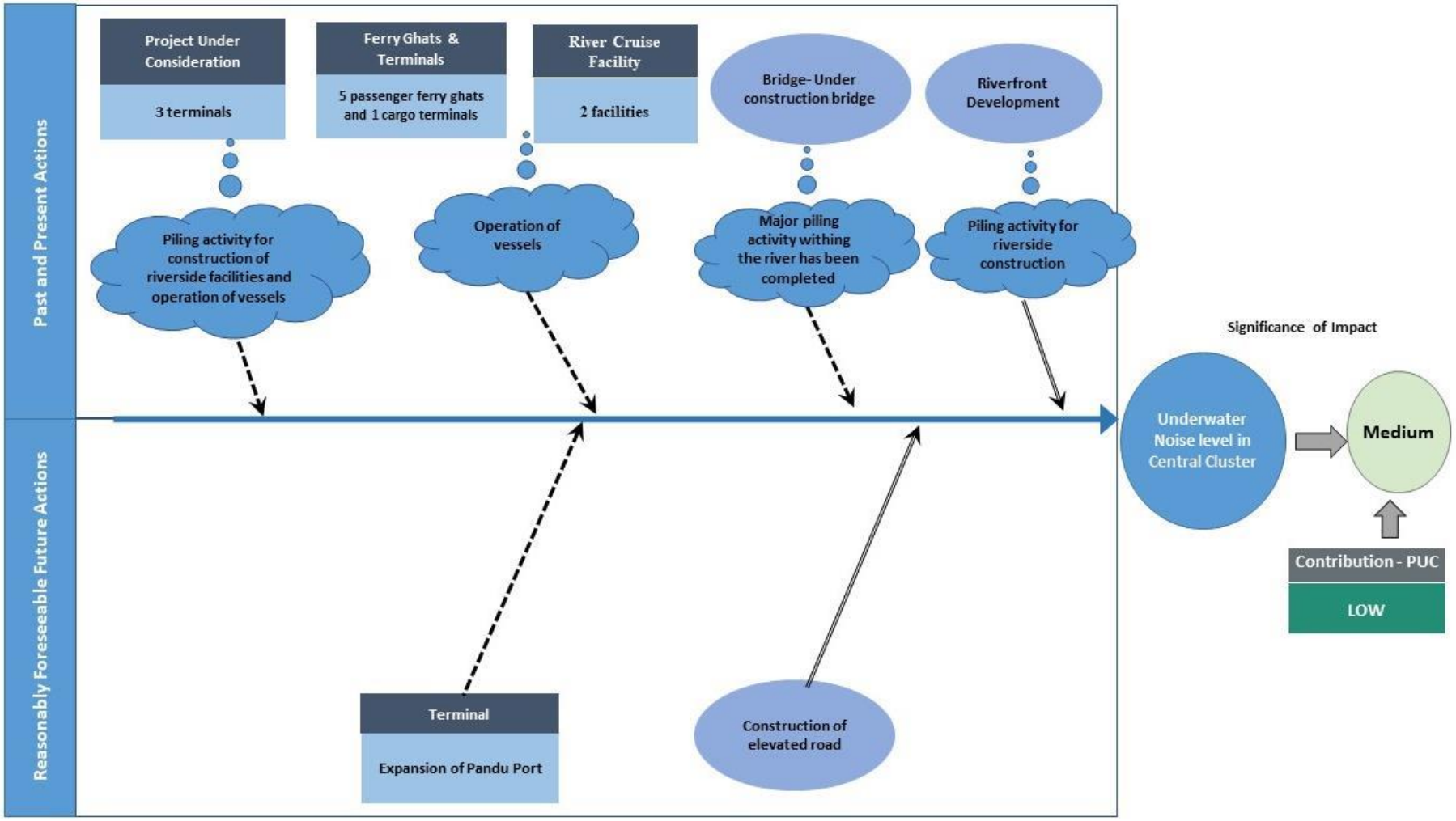
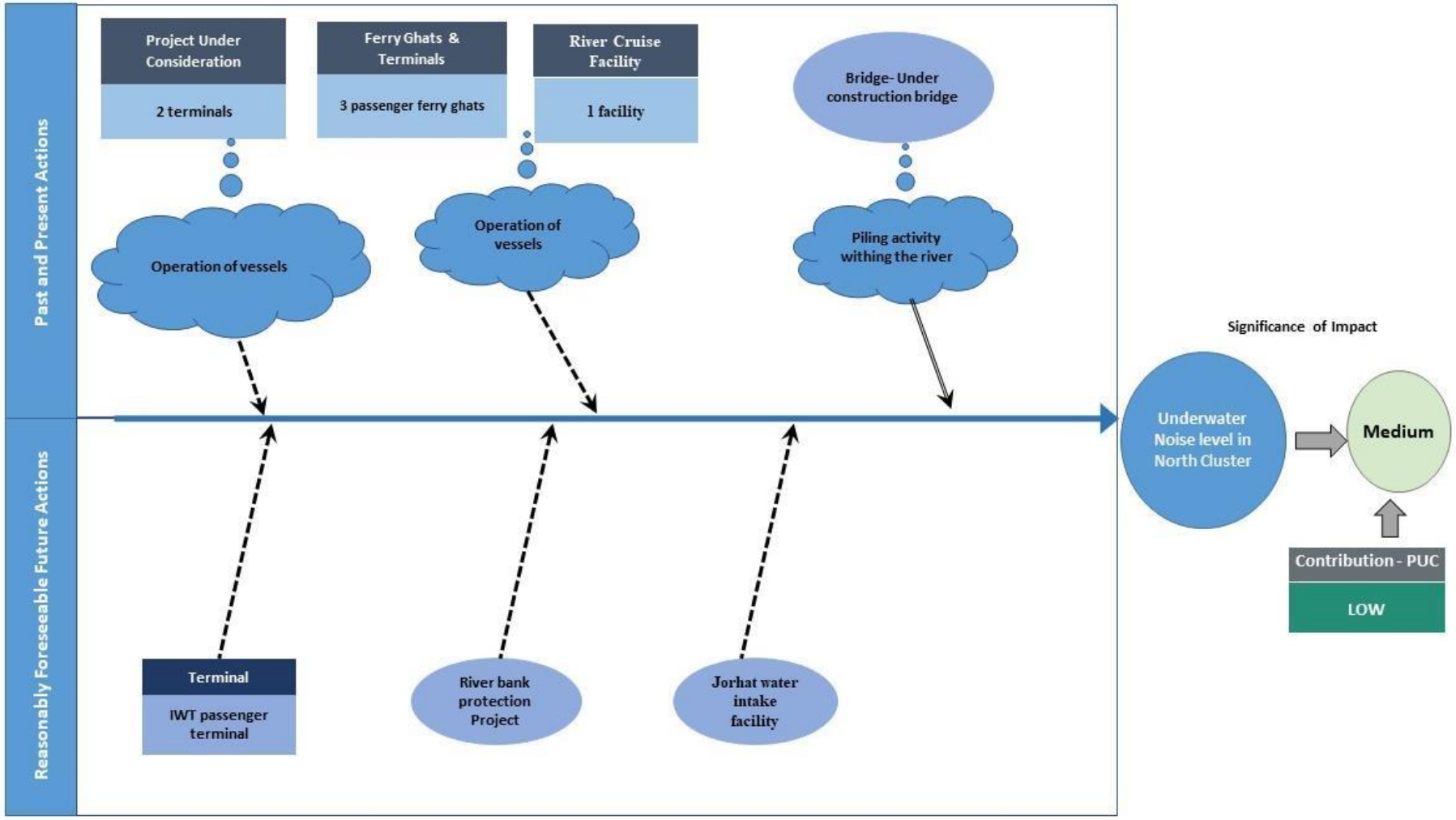


Figure 7.6 Underwater Noise -Cause Effect Relationship in North Cluster



7.4 SURFACE WATER QUALITY

The VEC interaction and effect diagram (**Figure 7.2**) indicated that the PUC, and other terminal (passenger and cargo) projects along with other development projects, especially construction of bridge and bank erosion protection project, and river front development projects and external factors directly or indirectly interacted with surface water quality of the river. The cumulative impact on surface water quality is assessed through (i) organic load (BOD) in the river water, (ii) ecological health of the river.

7.4.1 Baseline Condition

Water Quality-NWMP study

In compliance of the direction of Hon'ble National Green Tribunal, in the matter of news published in 'The Hindu' authored by Jacob Koshy, titled 'More river stretches are now critically polluted CPCB', Government of Assam constituted River Rejuvenation Committee (RRC) for effective abatement of pollution, rejuvenation, protection and management of the identified polluted stretches of Brahmaputra River.

Under the NWMP water quality has been monitored at eleven (11) monitoring locations in 373 km stretch of the Brahmaputra River (from Bogibeel to Sualkuchi) to assess the prevailing pollution levels in river. Monthly water quality has been monitored from January 2016 to March 2020 at several stations. Of these, the Neamati ghat monitoring location is located in North Cluster and Chandrapur, Kachari ghat and Pandu monitoring locations are located in Central Cluster.

The water quality trend in terms of BOD value from January 2016 to March 2020 in Chandrapur, Kacharighat, and Pandu monitoring locations was below 3 mg/l. In two instances, the BOD level was higher than 3 mg/l; it was 4.7 mg/l in April 2016 for Chandrapur and 3.2 mg/l in December 2017 for Kacharighat. Neamati ghat monitoring location was below 3 mg/l, and one instance was 3.9 mg/l in July 2016.

The concentration of DO in all the monitoring locations during January 2016 to March 2020 was well above 4 mg/l. Based on water quality monitoring reports under the NWMP project, it is reported that the Brahmaputra River does not have any highly polluted stretch at present. This can be attributed to the high volume of hydraulic discharge, leading to dilution and mixing of polluted streams that flow into the river and resulting in a self-purification phenomenon.

The concentration of total suspended solids (TSS) in the Neamati ghat monitoring location (March 2020) was 48 mg/l and the turbidity was 7 NTU. The concentrations of total suspended solids (TSS) in three monitoring locations at the Central Cluster (Chandrapur, Kacharighat, and Sualkuchi) monitoring locations (March 2020) were 54, 52, and 68 mg/l, respectively, and the turbidity was 5 NTU for all the monitoring locations. The high levels of suspended solids is attributable to high level of sediment load that the river carries from the higher reaches.

Water Quality- Terminal Project ESIA Study

More focussed surface water quality analysis of the Brahmaputra River was carried out for the terminal projects as a part of the site-specific ESIA studies for terminal projects. The surface water quality was monitored at nine locations for the Central Cluster and six locations for the North Cluster in the month of March, 2022.

Central Cluster

pH: The pH level varied from7.1 to 7.6, which conforms to CPCB use Class C- Drinking water source after conventional treatment and disinfection (6–9); and Class D- Propagation of wildlife and fisheries (6.5–8.5).

DO: The dissolved oxygen (DO) varied from 6.4 to 7 mg/l, which conforms to CPCB use Class C (4 mg/l or more); and Class D- (4 mg/l or more).

BOD: The biochemical oxygen demand (BOD) for all the nine monitoring locations was less the 2 mg/l, which conforms to CPCB use Class C (3 mg/l or less).

Turbidity: The turbidity for all the nine monitoring locations was less than 1 NTU.

North Cluster

pH: The pH level varied from 6.85 to 7.16, which conforms to CPCB use Class C- Drinking water source after conventional treatment and disinfection (6–9); and Class D- Propagation of wildlife and fisheries (6.5–8.5).

DO: The dissolved oxygen (DO) varied from 6.3 to 6.5 mg/l, which conforms to CPCB use Class C (4 mg/l or more); and Class D- (4 mg/l or more).

BOD: The biochemical oxygen demand (BOD) for all the six monitoring locations were less the 2 mg/l, which conforms to CPCB use Class C (3 mg/l or less) and European Union (EU) use Class III fishery (6 mg/l or less).

7.4.2 Stressors and Impacts- Central Cluster

Organic load (BOD) and Concentration of DO

PUC: During the construction stage, the proposed three terminals would like to generate some amount of domestic waste water at the construction sites, and the same will be treated through bio digester tanks.

During the operational stage of these terminals, domestic waste water will be treated through a bio-digester tank (North Guwahati and Umananda) and STP (Gateway of Guwahati), and treated waste water will be discharged into the river after meeting the discharge standard. The domestic waste water generated from the vessels is likely to directly discharge into the river. The potential impact on the organic load of the river from PUC is assessed to be low.

Existing Jetties & Terminals and River Cruise Facility: After the construction of GGG terminal, there will be five operating jetties, one cargo terminal, and two river cruise facilities in the Central Cluster. In all the terminals, the availability of domestic water and the generation of domestic waste water are low. Presently, there is no treatment system to treat this waste water. The vessels operating from these jetties also do not have a waste water treatment facility, and domestic waste water is directly discharged into the river. The potential impact on the organic load of the river from existing terminals or jetties is assessed to be **medium**.

Urban area: The population of Guwahati is 9.57 lakhs and the population growth rate is 20 percent. Approximately 154 million litres per day of waste water are generated in the city. There is no STP facility available in the city, and untreated waste water is directly or indirectly discharged into the Brahmaputra River. The potential impact on the organic load of the river from the urban area is assessed to be **high**.

Expansion of Pandu Port: The RFFA list indicates the possibility of expansion of Pandu Port. The proposed expansion of the port is likely to generate additional volumes of sewage. As per EIA Notification 2006 and amendments, riverine ports need to obtain environmental clearance (EC) from the Ministry of Environment, Forests, and Climate Change (MoEF&CC) or the State Level Impact Assessment Authority (SEIAA). As per the EC condition and consent to establish (CTE) and consent to operate (CTO) conditions, the proponent needs to implement a waste water treatment system and comply with the discharge standard. However, in the event of the accidental discharge of untreated sewage into the river, organic loads will increase in the river. The potential impact on the organic load of the expansion of the port is assessed to be **low**.

Urban growth: The population growth rate of the city is 20 percent. With population growth, sewage generation would increase. Under the smart city project, it is proposed to construct a 185 MLD STP under the Mora Bharalu River rejuvenation project and an 85.5 MLD STP under the Bharalu River rejuvenation project. These STPs are planned for south Guwahati; however, there is no plan for STPs in north Guwahati. If these STPs are implemented, the organic load from the city, especially south Guwahati, will be reduced. As there is no proposal for STP in north Guwahati, future urban growth will increase the organic load in the river. The potential impact on the organic load of the river from urban growth is assessed to be **medium**.

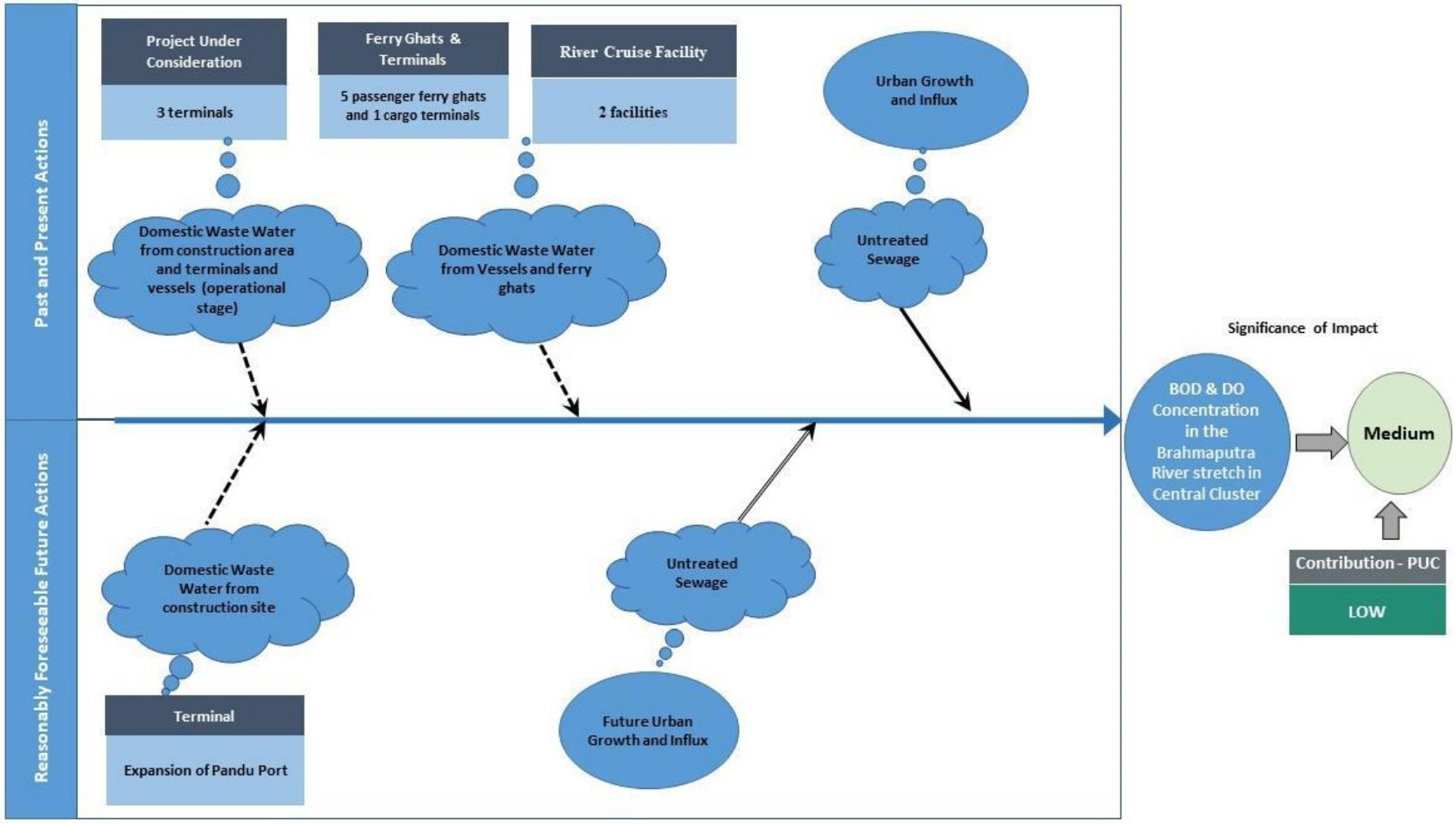
The contribution towards organic load in the river due to PUC and different riverfront activities and projects, along with their cause-and-effect relationship, is graphically presented in **Figure 7.7.**

Significance of Cumulative Impact

The contributions to the organic load in the Brahmaputra River from past and present activities (jetties or terminals, developmental stressors) are moderate. The existing BOD level in the river water is within the threshold limit for Class D waters (i.e., propagation of wildlife and fisheries). The concentration of DO in the river was well above the threshold limit for Class D waters. The increase in BOD in the river has a potential negative impact on DO. However, the organic load in the river water was good, and the concentration of DO was good. The past, present, and future development activity, along with external factors (rapid urban growth), will cumulatively impact the surface water quality in terms of increasing the BOD levels in the river. The cumulative impact is assessed to be

medium. The direct contribution of any organic load from the PUC (three terminals) is assessed to be **low**.

Figure 7.7 BOD & DO Concentrations of River Water - Cause Effect Relationship in Central Cluster



Turbidity and Total Suspended Solid (TSS)

The Turbidity and total suspended solids TSS could be easily used for indicating water quality because they are the most visible indicators for water. The particles of suspended solids can come from runoff, discharges, soil erosion, stirred bottom sediments or algal blooms. The clarity of water has generally been used as an indicator of healthy water, whereas a sudden increase in turbidity in a previously clear water body could be used as a cause of concern.

PUC: During the construction stage, the proposed three terminals would lead resuspension of suspended solids due to foundation work in the river side and surface runoff during monsoon season from land side construction activities. This may have negative impact on turbidity and TSS of the river water. Operation of mechanized vessels has the potential to contribute to the sediment load in the river water discussed in the geo-morphological impact section. The potential impact due to the construction of three terminals and operation of these terminals on turbidity and TSS in river water is assessed to be low.

Existing Jetties & Terminals and River Cruise Facility: After the construction of GGG terminal, there will be five operating jetties, one cargo terminal, and two river cruise facilities in the Central Cluster. The operation of jetties and terminals has the potential to contribute to the sediment load in the river water discussed in the geo-morphological impact section. The potential impact due to the operation of existing jetties and terminals on turbidity and TSS in river water is assessed to be low.

Panbazar Brahmaputra Bridge: This is an under-construction bridge has the potential to contribute to the sediment load in the river water discussed in the geo-morphological impact section. The potential impact due to the construction of bridge on turbidity and TSS in river water is assessed to be medium.

Riverfront Development activity: The riverfront development project also has the potential to contribute to the sediment load in the river water discussed in the geo-morphological impact section. The potential impact due to the riverfront development project on turbidity and TSS in river water is assessed to be medium.

Expansion of Pandu Port: The construction activities of the Pandu port expansion project also have the potential to contribute to the sediment load in the river water discussed in the geo-morphological impact section. The potential impact of the Pandu expansion project on turbidity and TSS in river water is assessed to be low.

Natural Stressors: The natural stressors like floods and droughts in the Brahmaputra River basin have influenced the flow regime and pattern of sediment transport and deposition in the river. The natural periodical floods in the river basin have influenced the turbidity and TSS in the river water. Climate change and increase of flooding has potential to increase the sediment load as a result increase of turbidity and TSS concentration in the river water. The potential impact on the turbidity and TSS of the river from the natural stressors is assessed to be **medium**.

Urban Sewage: Approximately 154 million litres per day of wastewater are generated in the city. There is no STP facility available in the city, and untreated waste water is directly or indirectly discharged

into the Brahmaputra River. The potential impact on the turbidity and TSS of the river from the urban area is assessed to be **high**.

Dredging: The IWTDA is responsible for the maintenance of the navigational channel of the Brahmaputra River. It was reported that, periodic dredging has been carried out in the navigational channel. Dredging activity of disposal of dredged material has the has the potential to have a negative impact on the turbidity and TSS of the river, and its contribution is assessed to be medium during the dredging period.

Decommissioning of Existing Ghats: After the construction of the Gateway of Guwahati (GGG) Terminal, the other existing Ghats (i) Umananda Ferry Point, (ii) Uzanbazar Ferry Ghat, (iii) Gateway of Guwahati Rajduar Ferry Ghat, (iv) Kachari Ghat, (v) Fancy Bazar Ferry Ghat and (vi) Lachit Ferry Ghat—will not be in operation. The existing terminals consist of a floating pontoon facility for berthing vessels and boarding and deboarding commuters. The terminal users use wooden planks as the access structure to reach the pontoon, and currently, no existing landside facility is available. After the commissioning of GGG, these terminals will be decommissioned, and materials will be reused for similar types of construction activities. During decommissioning activity, there is a potential negative impact on river water quality, turbidity, and TSS; the same has been included in the impact section. The potential impact of the decommissioning activities on the turbidity and TSS is assessed to be **low**.

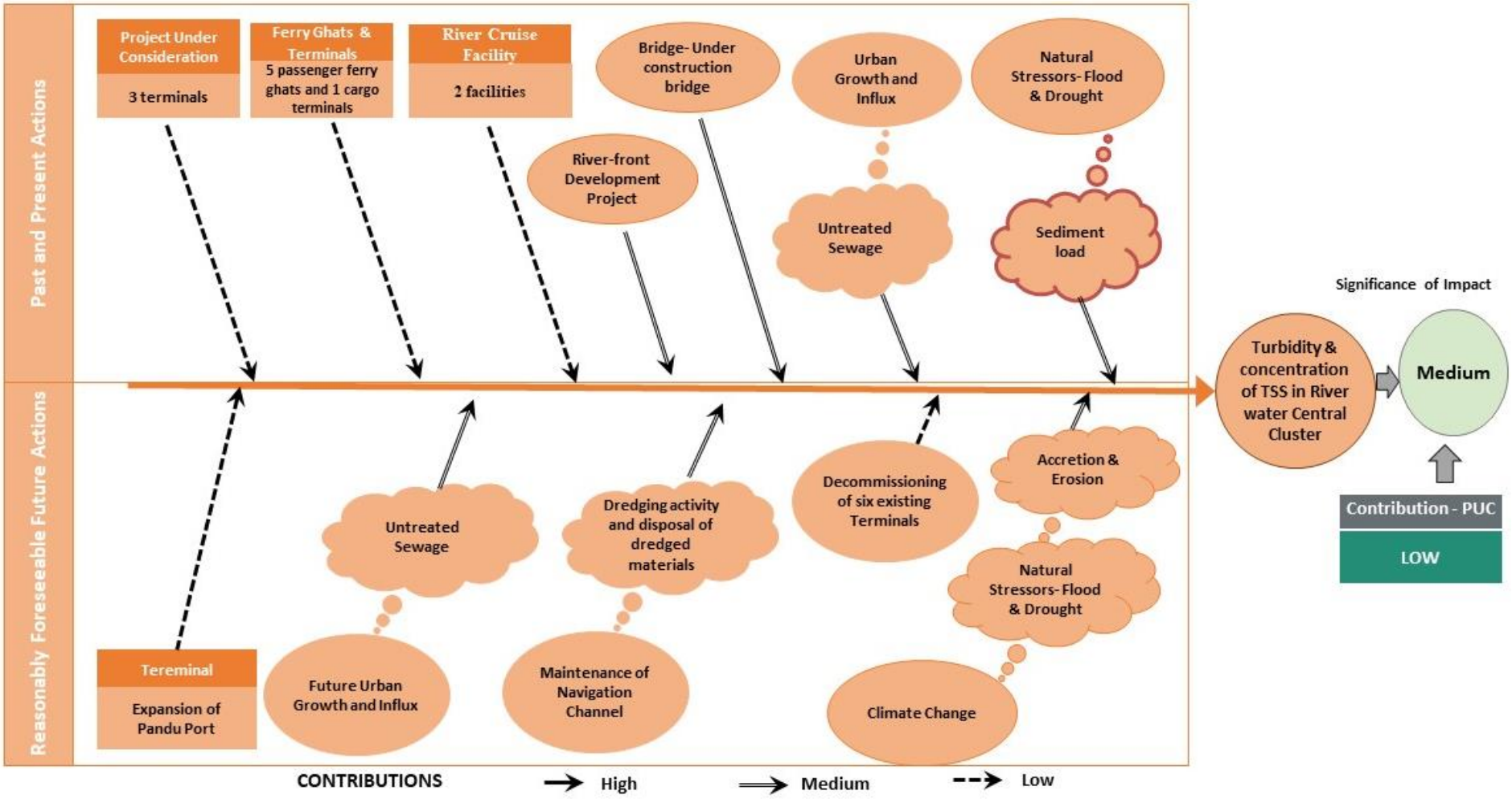
Urban growth: The population growth rate of the city is 20 percent. With population growth, sewage generation would increase. Under the smart city project, it is proposed to construct a 185 MLD STP under the Mora Bharalu River rejuvenation project and an 85.5 MLD STP under the Bharalu River rejuvenation project. These STPs are planned for south Guwahati; however, there is no plan for STPs in north Guwahati. If these STPs are implemented, the concentration of TSS concentration from the city, especially south Guwahati, will be reduced. As there is no proposal for STP in north Guwahati, future urban growth will increase the TSS load to the river. Overall, the potential impact on the turbidity and TSS of the river from urban growth is assessed to be **medium**.

The contribution towards turbidity and TSS concentration changes in the river due to PUC and different riverfront activities and projects, along with their cause-and-effect relationship, is graphically presented in **Figure 7.8.**

Significance of Cumulative Impact

The contributions to the turbidity and TSS concentration in the Brahmaputra River from past and present activities (jetties or terminals, developmental stressors) are medium. The existing turbidity level and concentration of TSS in the river water is within the threshold limit for Class D waters (i.e., propagation of wildlife and fisheries). The past, present, and future development activity, along with external factors (rapid urban growth), will cumulatively impact the surface water quality in terms of increasing the turbidity and TSS levels in the river. The cumulative impact is assessed to be **medium**. The direct contribution of any organic load from the PUC (three terminals) is assessed to be **low**.

Figure 7.8 Turbidity & TSS Concentrations of River Water - Cause Effect Relationship in Central Cluster



7.4.3 Stressors and Impacts- North Cluster

Organic load (BOD) and Concentration of DO

PUC: During the construction stage, the proposed three terminals would like to generate some amount of domestic waste water at the construction sites, and the same will be treated through a septic tank and soak pit or bio-digestor tanks.

During the operational stage of these terminals, domestic waste water will be treated through a bio-digestor tank, and treated waste will be used for gardening. The domestic waste water generated from the vessels is likely to directly discharge into the river. The potential impact on the organic load of the river from PUC is assessed to be **low**.

Existing Jetties & Terminals and River Cruise Facility: The operating terminals in the North Cluster, the availability of domestic water and the generation of domestic waste water are low. Presently, there is no treatment system to treat this waste water. The vessels operating from these jetties also do not have a waste water treatment facility, and domestic waste water is directly discharged into the river. The potential impact on the organic load of the river from existing terminals or jetties is assessed to be **low**.

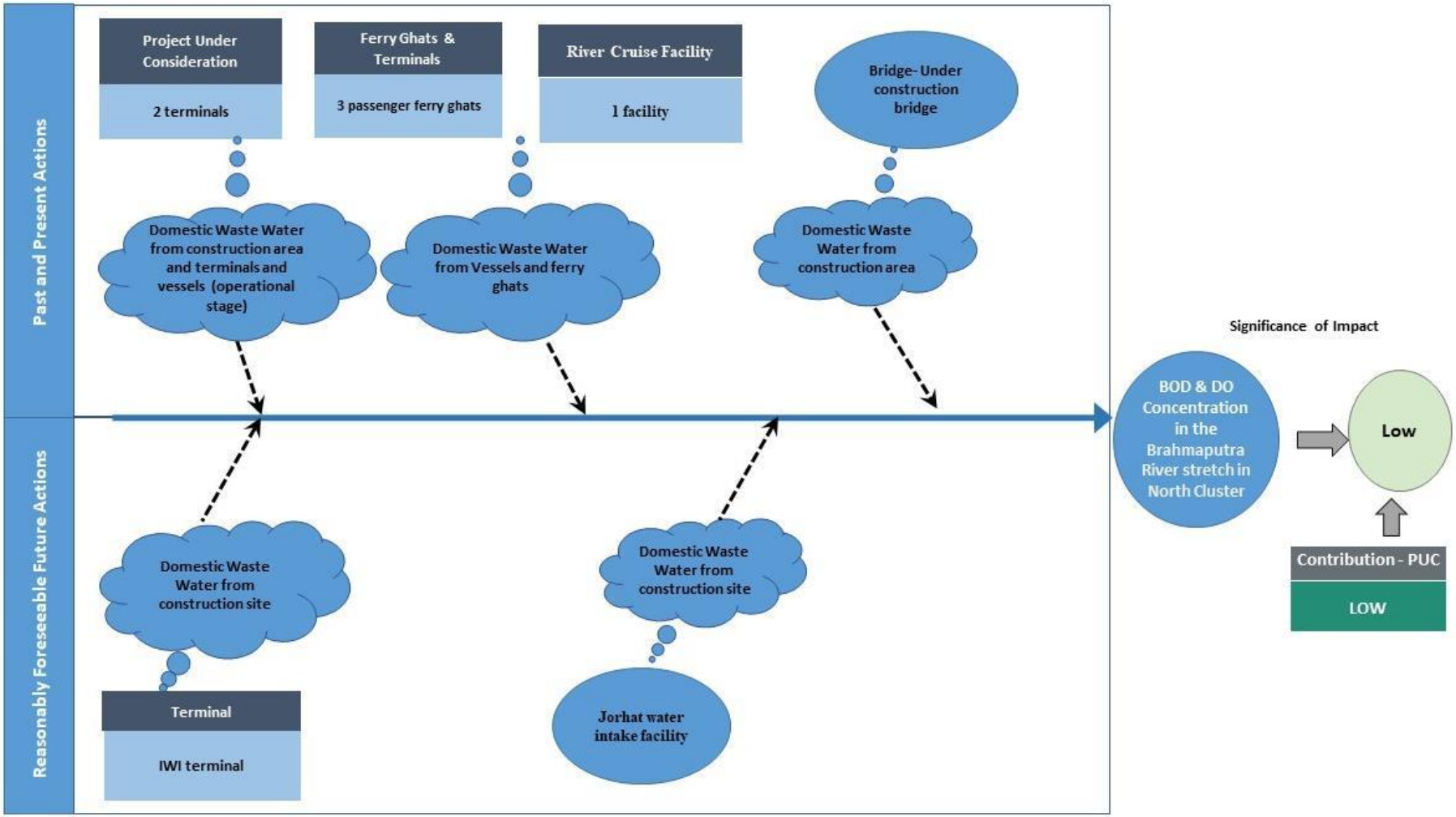
Jorhat water treatment project. IWAI Terminal and river bank protection Project: During the construction stage of these projects, some amount of domestic waste water would be generated at the construction sites. If this waste water is directly discharged into the river without treatment, it has the potential to increase the BOD load, which will ultimately affect the concentration of DO in the river water. The potential impact on the organic load of the river from proposed development activities is assessed to be **low**.

The contribution towards organic load in the river due to PUC and different other riverfront activities and projects, along with their cause-and-effect relationship, is graphically presented in **Figure 7.9.**

Significance of Cumulative Impact

The contributions to the organic load in the Brahmaputra River from past and present activities (jetties or terminals, developmental stressors) are low. The existing BOD level in the river water is within the threshold limit for Class D waters (i.e., propagation of wildlife and fisheries). The concentration of DO in the river was well above the threshold limit for Class D waters. The increase in BOD in the river has a potential negative impact on DO. However, the organic load in the river water was good, and the concentration of DO was good. The past, present, and future development activity, along with external factors, will cumulatively impact the surface water quality in terms of increasing the BOD levels in the river. The cumulative impact is assessed to be **low**. The direct contribution of any organic load from the PUC (two terminals) is assessed to be **low**.

Figure 7.9 BOD & DO Concentrations of River Water - Cause Effect Relationship in North Cluster



Turbidity and Total Suspended Solids (TSS)

PUC: During the construction stage, the proposed two terminals would like to suspended solids due to foundation work in the river side and surface runoff during monsoon season from land side construction activities. This may have negative impact on turbidity and TSS of the river water. Operation of mechanized vessels has the potential to contribute to the sediment load in the river water discussed in the geo-morphological impact section. The potential impact due to the construction of three terminals and operation of these terminals on turbidity and TSS in river water is assessed to be **low**.

Existing Jetties & Terminals and River Cruise Facility: There are 3 operating jetties, one river cruise facilities in the North Cluster. The operation of jetties and terminals has the potential to contribute to the sediment load in the river water discussed in the geo-morphological impact section. The potential impact due to the operation of existing jetties and terminals on turbidity and TSS in river water is assessed to be **low**.

Hatihal SaporiJorhat-Majuli Bridge: This is an under-construction bridge has the potential to contribute to the sediment load in the river water discussed in the geo-morphological impact section. The potential impact due to the construction of bridge on turbidity and TSS in river water is assessed to be **medium**.

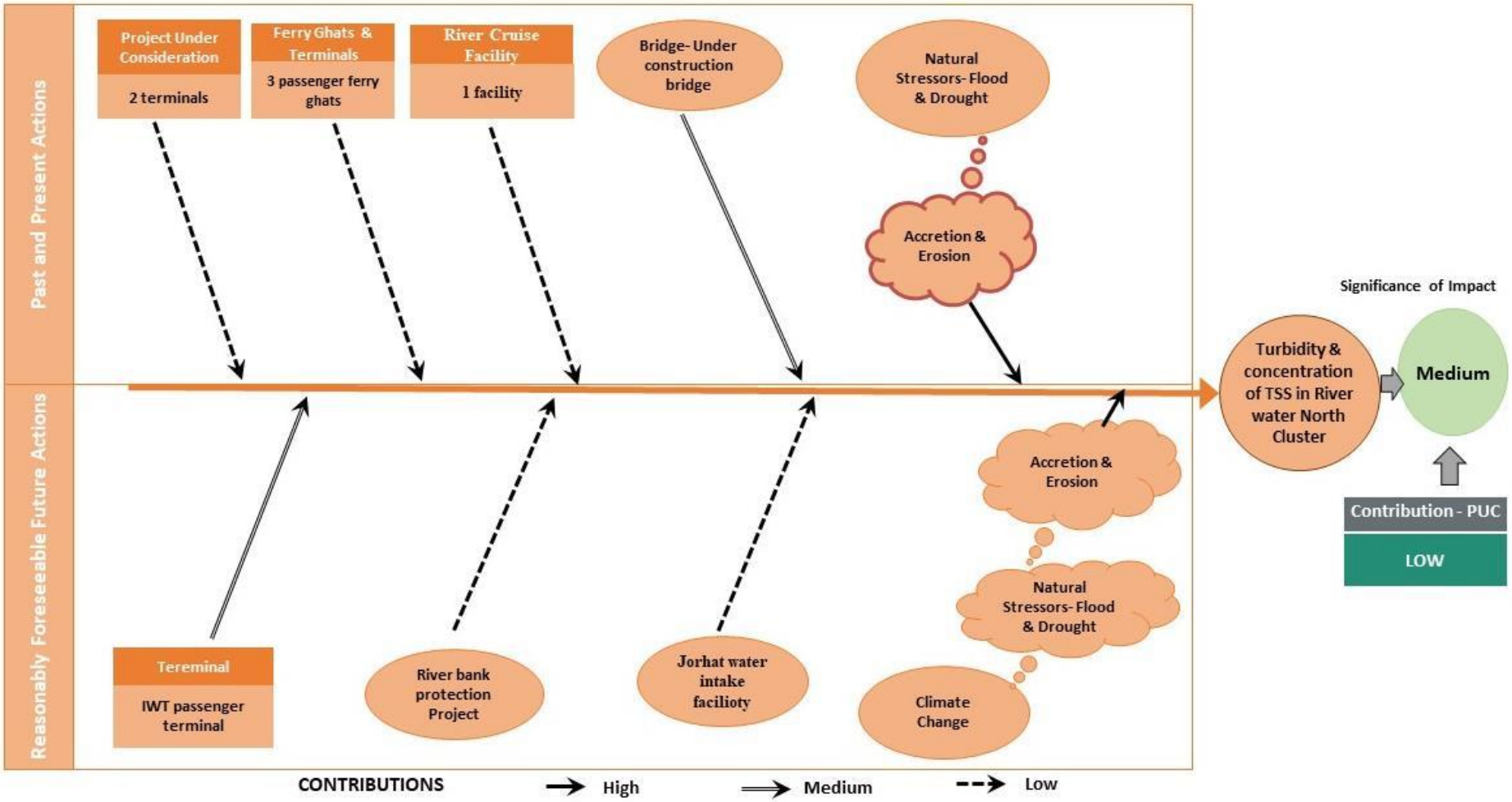
Jorhat water treatment project and riverbank protection Project: These projects also has the potential to contribute to the sediment load in the river water discussed in the geo-morphological impact section. The potential impact due to the riverfront development project on turbidity and TSS in river water is assessed to be **medium**.

IWAI terminal: The construction activities of the IWI terminal project also have the potential to contribute to the sediment load in the river water discussed in the geo-morphological impact section. The potential impact of the IWI terminal on turbidity and TSS in river water is assessed to be **low**.

Natural Stressors: The natural stressors like floods and droughts in the Brahmaputra River basin have influenced the flow regime and pattern of sediment transport and deposition in the river. The natural periodical floods in the river basin have influenced the turbidity and TSS in the river water. Climate change and increase of flooding has potential to increase the sediment load as a result increase of turbidity and TSS concentration in the river water. The potential impact of the IWI terminal on turbidity and TSS in river water is assessed to be **low**.

The contribution towards turbidity and TSS concentration changes in the river due to PUC and different riverfront activities and projects, along with their cause-and-effect relationship, is graphically presented in **Figure 7.10.**

Figure 7.10 Turbidity & TSS Concentrations of River Water - Cause Effect Relationship in North Cluster



Significance of Cumulative Impact

The contributions to the turbidity and TSS concentration in the Brahmaputra River from past and present activities (jetties or terminals, developmental stressors) are medium. The existing turbidity level and concentration of TSS in the river water is within the threshold limit for Class D waters (i.e., propagation of wildlife and fisheries). The past, present, and future development activity, along with external factors (rapid urban growth), will cumulatively impact the surface water quality in terms of increasing the turbidity and TSS levels in the river. The cumulative impact is assessed to be medium. The direct contribution of any organic load from the PUC (three terminals) is assessed to be **low**.

7.5 KEY BIODIVERSITY AREAS

There are two KBS, namely Majuli and Janjimukh-Kalilamukh, located within the North Cluster. Both KBS are home to diverse resident birds and attract large numbers of migratory birds. The VEC interaction and effect diagram (Figure 5.2) indicates that secondary impacts, due to noise, vibration, and light, have a potential impact on these species. Endangered birds species diversity used to assess the impacts on the KBA for migratory and protected bird species.

7.5.1 Baseline Condition

Majuli Island, the second largest river island in the world, comprises a large riverine island with innumerable small islets, locally called *chapories*. The main island is surrounded by more than twenty *chapories* (sandbars) (Bhagabati and Lahkar 1998).

More than 250 species of birds have been recorded (A. U. Choudhury pers. comm. 2002). The endangered species like Black-breasted or Black-throated Parrotbill (*Paradoxornis nipalensis*), Marsh Spotted Babbler (*Pellorneum palustre*) and Jerdon's Babbler (*Chrysomma altirostre*) were recorded at Kamalabari (Stevens 1914-15). In winter, the Spot-billed Pelican (*Pelecanus philippensis*) can be observed in small numbers in all major beels, especially Chakuli, Bhereki, Duboritoli and Saru-Kakarikata. Lesser Adjutant (*Leptoptilos javanicus*) is a common breeding bird, nests are sometimes found in tall trees close to human settlements. Greater Adjutant (*L. dubius*) is rare, or seen occasionally. No nest has been found in recent years. A nest of Pallas's Fish-Eagle (*Haliaeetus leucoryphus*) was found on a Ficus tree, near Duboritoli beel (Bhagabati and Lahkar 1998). Majuli is famous for its waterfowl, both resident and migrant. The Lesser Whistling Duck (*Dendrocygna javanica*) sometimes gathers in hundreds on large beels, along with other waterfowl. Northern Pintail (*Anas acuta*), Northern Shoveller (*A. clypeata*), Gadwall (*A. strepera*), and Garganey (*A. querquedula*) are abundant. Three Falcated Teal (*Anas falcata*) were found in Bhereki beel, together with other ducks (Bhagabati and Lahkar 1998). On the river banks, the Brahminy Duck or Ruddy Shelduck (*Tadorna ferruginea*) is common in winter, along with the Bar-headed (*Anser indicus*) and the Greylag geese (*A. anser*). Swamp Francolin (*Francolinus gularis*) is found in the grassland, but in very low numbers, mainly due to restriction of its habitat. Bengal florican (*Houbaropsis bengalensis*) was also reported occasionally, but there does not appear to be a viable population in Majuli. Being closer to the northern bank of Brahmaputra, Majuli must have had Bengal florican habitats before cultivation took over (Rahmani et al. 1990). The Bengal Florican is still present on similar but uninhabited islands near Kaziranga, only about 40 km downstream. The Bishwanath plain on the northwestern side of Majuli was once a suitable florican area. Choudhury (2002) mentions that florican is sighted sporadically in scattered grasslands, mostly in the *chapories* (sand bars) of Brahmaputra River.

Therefore, it is likely that this bird is also found in Majuli and adjoining areas. The Common Crane (*Grus grus*) regularly visits Majuli in small numbers (5-10 birds), especially in an area called Bhakat Chapori near Auniati-Alimurgaon, having habitats of grasses and sedges.

Deepor Beel, covering an area of 41 km^2, the only Ramsar site in Assam and among the third Ramsar site of the north eastern region of India. It is considered to be one of the largest aquatic bird habitats in Assam and home for around 232 local and migratory bird species, thereby listing itself in Birdlife International's list of Important Bird Areas (IBA). There are around 70 species of migratory birds. Some of the species you can see are the lesser and greater adjutant stork (*Leptoptilos javanicus* and *dubius*), spot-billed pelican *(Pelicans philippensis*), and Baer's pilchard (*Pythia bear*). The lake has 38 species of reptiles and amphibians, around 50 species of fish. In the CIA final disclosure meeting, the wildlife experts reported that migratory birds from the Deepor Beel, visited to the sand bars in the Brahmaputra River.

7.5.2 Stressors and Impacts- Central and North Cluster

Construction of PUC terminals, Bridge: The construction of PUC terminals, bridge, etc. would generate noise and illumination. The noise and illumination have the potential to affect important behaviours such as foraging, breeding, and resting. The baseline condition revealed that endangered bird species were mostly reported in water bodies and *chapories* (sandbars) in Majuli. Those are mostly away from the PUC and terminal sites. The noise and illumination generated from the PUC and other construction activities in the Central Cluster has potential impact on foraging of migratory birds visited to sand bars in the central Cluster. The potential impact on the diversity of these species is assessed to be low.

Vessel movement: Vessel movement for passenger terminals, vessels used for construction materials for the above-mentioned projects, river cruise facilities, etc. would generate noise. The noise and illumination have the potential to affect important behaviours such as foraging, breeding, and resting. As discussed in the earlier section, the occurrence of endangered and migratory bird species is mostly in the water bodies and *chapories* (sandbars) in Majuli. The noise and illumination generated from the vessel movement in the Central Cluster has potential impact on foraging of migratory birds visited to sand bars in the central Cluster. The potential impact on the diversity of endangered and migratory bird species is assessed to be low.

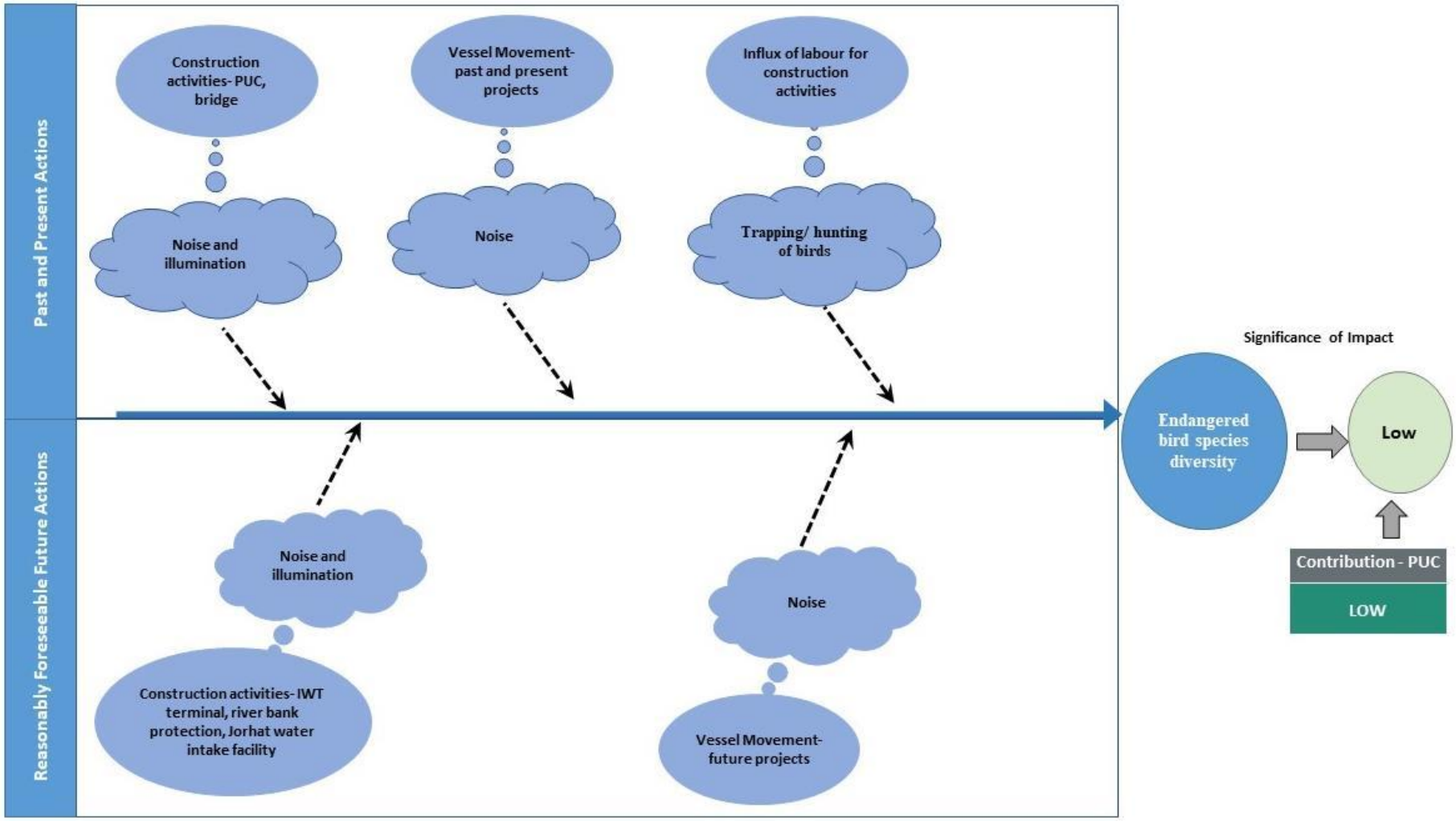
Influx of labour: The various construction activities, existing, proposed, and future projects would require a large number of workers. The workforce may reside in the labour camp near the project sites. There is a potential threat to capture or hunt the protected bird species. The potential impact on the diversity of endangered and migratory bird species is assessed to be low.

The potential impact on KBA for endangered and migratory bird species due to PUC and different riverfront activities and projects, along with their cause-and-effect relationship, is graphically presented in **Figure 7.11.**

Significance of Cumulative Impact

The noise, artificial illumination, and influx of workforce in the Central and North Cluster, with sensitive habitats (KBA for endangered and migratory bird species) prevailing within the impact zone, have a potential impact on the diversity of these species that is assessed to be low. The contribution of the potential impact of diversity of endangered and migratory bird species from PUC is assessed to be low.

Figure 7.11 KBA for Endangered and Migratory Bird Species - Cause Effect Relationship in Central & North Cluster



7.6 PROTECTED AQUATIC FAUNA- GANGES RIVER DOLPHIN AND TURTLES

Gangetic dolphins (*Platanista gangetica gangetica*) categorized as an endangered species by IUCN (International Union for Conservation of Nature). It is included in the Schedule I of the Indian Wildlife (Protection) Act 1972. The species was declared as National Aquatic Animal of India and notification was issued on 10th May, 2010.

7.6.1 Baseline Condition

As per the secondary data and authentic reports[1], in Brahmaputra River, altogether 197 dolphins (27 calves, 32 sub-adults and 138 adults) were recorded from 82 locations of the river with an encounter rate of one dolphin per 4.2 km. Dr. Abdul Wakid has conducted a series of dolphin surveys in the Brahmaputra river system, starting from 2005. In the last census conducted in 2012, Dr. Wakid and his team estimated dolphin population in Brahmaputra River system. The total dolphin population in Brahmaputra River system (including 2 tributaries) was 635 dolphins. Brahmaputra River (not including tributaries): 583 dolphins. Dr. Wakid recorded the highest density of the dolphin population in the section between the Goal Para Bridge and the Bangladesh border, including the river, the breeding season for the Gangetic dolphins of Brahmaputra River is recorded as February to June. The population has had an upward trend since 2008 because of the lot of community engagement and awareness activities conducted since 2008. As per the census survey from Silcher to Guwahati in the state of Assam during March 26–29, 2019[2]. 11 transects for a census stretch survey were carried out during this period. During the survey, seven (7) dolphins were sighted in Neamati to Kamabari ghat and four dolphins in Neamati to Aphalamukh ghat in the North Cluster, and four dolphins were sighted in Jolporee Ghat to Umananda ghat.

As per ESIA study report for proposed terminal projects, population of around 10 Dolphins have been recorded in the Central Cluster's area of influence. The study also reported about the presence of the chelonians (turtle) nesting ground in both the Clusters. Three reported vulnerable species were reported in the study area, these are South Asian Box Turtle (*Cuora amboinensis*), Indian Soft-Shell Turtle (*Nilssonia gangetica*) and Peacock soft shell Turtle (*Nilssonia hurum*).

7.6.2 Stressors and Impacts- Central Cluster

<u>*Underwater noise*</u>: The potential source of underwater noise from PUC, past, present, and future projects and activities has been discussed in Section 6.3.1. The potential cumulative impact on underwater noise is assessed to be medium. In riverine 'soundscapes', complex interactions between sound, substrate type, and depth create difficulties in assessing impacts of anthropogenic noise pollution on freshwater fauna. A review of various studies into behavioural disturbance in

[1] (i) Conservation of Gangetic dolphin in Brahmaputra river system, India, Dr. Abdul Wakid, 2004; (ii) Report on the initiatives to involve the major stakeholders of Assam in the conservation of Gangetic dolphin, Dr. Abdul Wakid, 2009; (iii) 3. Protection of endangered Ganges river dolphin in Brahmaputra river, Assam, India and (iv) 4. Final technical report to sir peter Scott fund, IUCN, Dr. Abdul Wakid, 2009

[2] Report on Ganges River Dolphin (Platanista gangetica Roxburgh, 1801) Population Census Survey in Brahmaputra River System

high-frequency cetaceans from continuous man-made noise was carried out. As per review, it was concluded that not all behavioural responses are equally significant. Behavioural changes may be relatively minor and/or brief but have the potential to affect important behaviours such as foraging, breeding, and resting. The study concluded that the behavioural changes to levels below 120 dB re 1 µPa were relatively minor. Significant and sustained avoidance behaviour was recorded when noise levels exceeded 140 dB re 1 µPa in the case of harbour porpoise. For turtles and dolphins, this level is 150 dB and 177 d(B) respectively.

Another impact of high noise level generated due to various project and development activities is masking of biologically important sounds. These sounds may interfere with communication and social interaction and cause changes in behaviour as well. The zone of masking impact will be highly variable and depends on many factors including the distance between the listener and sources of the signal and masking noise, the level of the signal and masking noise, and the propagation of noise from the signal and masking source to the listener. It is however important to note that masking of communication and echolocation signals naturally occurs by the ambient noise environment. Man-made noise causes additional masking of a signal only when it is of a higher level than the ambient environment within the species critical hearing bandwidth at the signal's dominant frequencies. Echolocation clicks produced by the Ganges River Dolphin have dominant energy around 65 kHz (Sugimatsu et al., 2011)[1]. This is well above the dominant frequency range of most man-made noise, including pump noise. Masking of echolocation signals is therefore not a significant issue for most man-made sources (Richardson et al., 1995).

Mayukh Dey, et.al, 2019[2], conducted the study on "Interacting effects of vessel noise and shallow river depth elevate metabolic stress in Ganges River dolphins". The study revealed that underwater noise from vessels can negatively affect endangered Ganges River dolphins, which are 'almost blind' and rely entirely on high-frequency echolocation clicks to sense their environment. The field-based acoustic recordings and modelling to assess acoustic responses of Gangetic dolphins to underwater noise exposure from vessels showed enhanced activity during acute noise exposure and suppressed activity during chronic exposure.

Dolphins are especially susceptible to underwater noise as they depend almost entirely on pulsed and tonal sounds for long-distance communication, foraging, navigation, and sensing their environment. Low-frequency acoustic signals emitted by dolphins are prone to interference from similar low-frequency noise produced by ship engines. Dolphins emit a range of low-frequency to ultrasonic acoustic signals and have wide hearing ranges, making them sensitive to diverse anthropogenic sound frequencies. Underwater noise from vessel SONAR or cavitation noise from propellers can displace cetaceans from preferred habitats. Enhanced acoustic activity can induce changes in foraging and diving behaviour. This can result in temporary hearing loss high metabolic energy expenditure, and corresponding increases in stress hormone levels. Noise interference can

[1] Sugimatsu et al. (2011). Annual Behavioural Changes of the Ganges River Dolphins (Platanista gangetica) Based on the Three Long-Term Monitoring Seasons using 6-Hydrophone Array System. IEEE Symposium on and 2011 Workshop on Scientific Use of Submarine Cables and Related Technologies, (pp. 1-7) Tokyo.

[2] Mayukh Dey, Jagdish Krishnaswamy, Tadamichi Morisaka & Nachiket Kelkar; Interacting effects of vessel noise and shallow river depth elevate metabolic stress in the Ganges River dolphins; Scientific Reports volume 9, Article number: 15426 (2019).

further force cetaceans to modify their acoustic signals to avoid masking. Resulting energetic costs may cause loss of opportunities for feeding and resting, and reduce fitness. Altered behaviour could further lead to fine-scale behavioural shifts or disorientation, which could lead dolphins to closer proximity to fishing nets or vessel propellers. This can potentially aggravate collision risk or bycatch from net entanglement, increasing mortality or injury at the individual and population levels. Noise impacts were further aggravated during dry-season river depth reduction.

Most studies on the effect of underwater noise have been conducted on marine cetaceans, whose avoidance of noise is not limited by the availability of space. This contrasts with dolphins inhabiting spatially restricted and depth-limited environments such as rivers, in which noise impacts are poorly understood. A general prediction is that underwater noise pollution will be higher in shallow rivers due to greater reflection from the bottom and sides and a longer persistence of sound. Large rivers like Brahmaputra show strong seasonal variability in depth, flood, sediment fluxes, and temperature, which can influence the extent of the impact of underwater noise on river dolphins in complex ways.

The underwater noise due to various project and development activities in the area, with sensitive habitats (dolphins and turtles) prevailing within the impact zone, has a potential impact on dolphins and turtles that is assessed to be of medium level. However, the potential impact on aquatic protected species from PUC is assessed to be low.

Geomorphological changes: The potential source of geomorphological changes from PUC, past, present, and future projects and activities in the river stretch has been discussed in Section 6.1.2. The potential cumulative impact on geomorphological changes is assessed to be medium. The accretion and sand bar formation in the riverbed will decrease the water depth, which is not suitable for the dolphin. Again, the appearance of sand bars during the winter season causes danger to the dolphins as the river is divided into small segments, causing segregation of populations in deeper pools, narrowing of the gene pool, an increase in the intensity of fishing, an increase in river traffic, pollution due to the release of untreated effluents, etc., which have become major threats to its survival. Altered habitat due to dry-season river depth reduction could lead to the concentration of a large number of habitats in a limited space. This could lead dolphins to be in closer proximity to fishing nets or vessel propellers, with the potential to cause injuries due to collisions between vessels or propellers or being entangled in fishing nets.

Sanchita Boruah et. al, 2002[1] has conducted the study on ecohydrology and fisheries of the upper Brahmaputra basin. As per this report, the Brahmaputra changes its course and pattern along with its current flow very frequently, especially in its upper stretches, and this has a strong bearing on its hydrobiology. Natural stressors, like hydrology and climate, low gradient, seismic zone, alluvial soil, and heavy rainfall, have the potential to have an impact on the braided nature of rivers, frequent changes in river course, and high turbidity. Again, the anthropogenic activities, viz., large-scale felling of trees in the catchment areas and construction of embankments along the river banks, have altered the riverine ecosystem drastically, as a result of which the river has become heavily silted and the connecting channels of the floodplain lakes are also dammed. Natural stressors and anthropogenic

[1] Sanchita Boruah and S.P. Biswas, 2002, Ecohydrology and fisheries of the upper Brahmaputra basin, Department of Life Sciences, Dibrugarh University, Assam,

activities have a negative impact on the loss of aquatic biota and fish diversity or abundance, as well as megafauna like Gangetic dolphins.

Water Intake Facility: There are four water intake facilities in the Central Cluster of the river. Decrease of water flow of the river during dry season causes the decreases river depth, and the appearance of sand bars. Water intake facilities may not any significant impact on decrease of water level in the river. Decrease of water level during winter season causes danger to the dolphins as the river is divided into small segments, causing segregation of populations in deeper pools, narrowing of the gene pool, an increase in the intensity of fishing, an increase in river traffic, pollution due to the release of untreated effluents, etc., which pose major threats to its survival.

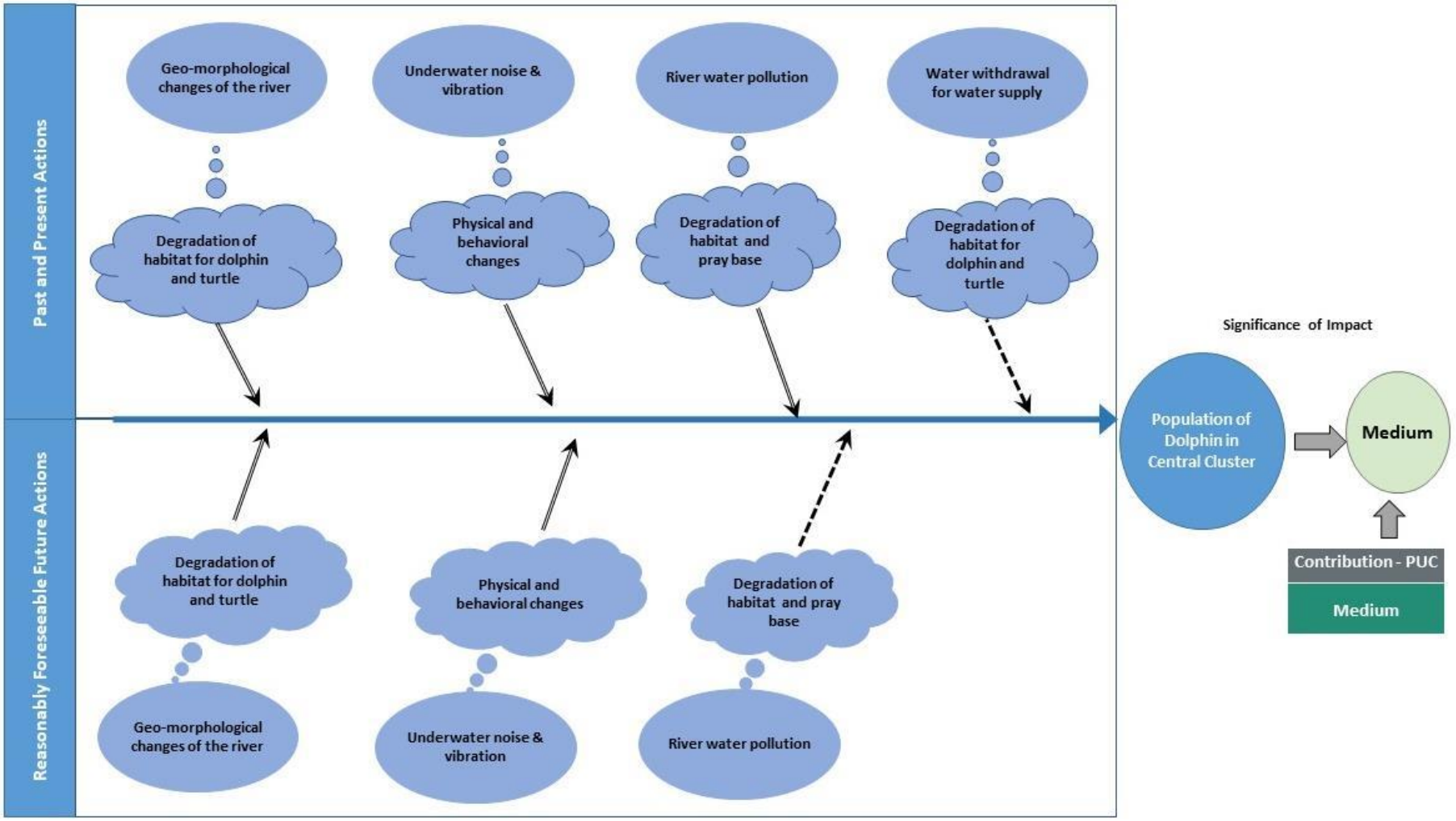
River water pollution: The potential source of impact on water quality from PUC, past, present, and future projects and activities in the river stretch have been discussed in Section 6.4.2. The potential cumulative impact on river water quality is assessed to be medium. Inland Waterways Authority of India has conducted a "Study on Effect of Navigational Activities on Dolphin in the National Waterway-1". The study revealed that the few physicochemical water quality parameters have a direct bearing on the distribution pattern, presence or absence, and ultimately the population dynamics of the Gangetic Dolphins in the studied area, the eco-biological components have an indirect influence on diverse variables.

The BOD is on a higher side due to sewage drains. Dredging has a short-term effect as increase in turbidity, TDS, TSS and metals like Cadmium and lead. The increase in TDS and turbidity may affect the primary productivity of the river ecosystem and, subsequently, the fish population, but the effect will be temporary. The study also found that flow and depth are principal components that determine presence of Dolphins. Apart from that, DO, BOD, TDS are also major factors that determine Dolphin distribution. It was also observed that, polluted areas are generally avoided by the Dolphins on account of shallowness, higher turbidity, low oxygen contents, higher BOD, foul smell and higher temperature. The pollution of river water quality has a potential adversely impact the primary productivity of the ecosystem, which will ultimately affect the food of the dolphin. The potential impact on aquatic protected species due to PUC and different riverfront activities and projects, along with their cause-and-effect relationship, is graphically presented in **Figure 7.12.**

Significance of Cumulative Impact

The underwater noise, geomorphological changes, water withdrawal, and river water pollution in the Central Cluster water stretch, with sensitive habitats (dolphins and turtles) prevailing within the impact zone, have a potential impact on dolphins and turtles that is assessed to be medium. The contribution of underwater noise, geomorphological changes and river water pollution from PUC is assessed to be medium.

Figure 7.12 Aquatic Protected species - Cause Effect Relationship in Central Cluster



7.6.3 Stressors and Impacts- North Cluster

Underwater noise: The potential source of underwater noise from PUC, past, present, and future projects and activities has been discussed in Section 6.3.2. The potential cumulative impact on underwater noise is assessed to be medium. The potential impact due to underwater noise has been discussed in Section 6.6.2.

The underwater noise due to various project and development activities in the area, with sensitive habitats (dolphins and turtles) prevailing within the impact zone, has a potential impact on dolphins and turtles that is assessed to be medium. However, the contribution of impact on aquatic protected species from PUC is assessed to be low.

Geomorphological changes: The potential source of geomorphological changes from PUC, past, present, and future projects and activities in the river stretch has been discussed in Section 6.1.2. The potential cumulative impact on geomorphological changes is assessed to be medium.

Water Intake Facility: There is one water intake facility in the North Cluster of the river and it is proposed construction Jorhat water intake facility. Potential impact due to water withdrawal has been discussed in Section 6.6.2.

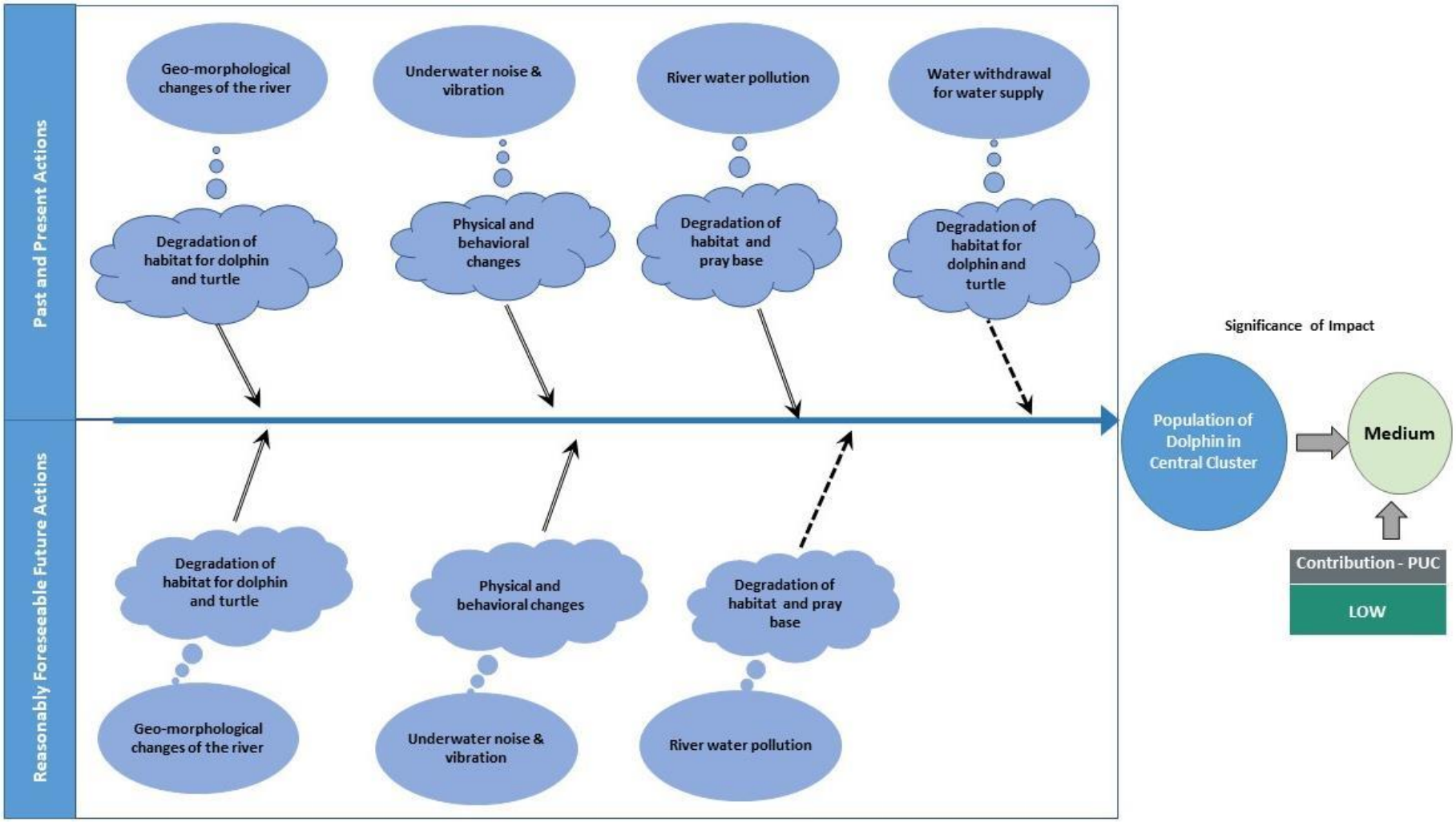
River water pollution: The potential source of water quality from PUC, past, present, and future projects and activities in the river stretch have been discussed in Section 6.4.2. The potential cumulative impact on river water quality is assessed to be medium. The pollution of river water quality has a potential negative impact on the primary productivity of the ecosystem, which will ultimately affect the food of the dolphin.

The potential impact on aquatic protected species due to PUC and different riverfront activities and projects, along with their cause-and-effect relationship, is graphically presented in **Figure 7.13.**

Significance of Cumulative Impact

The underwater noise, geomorphological changes, water withdrawal, and river water pollution in the North Cluster water stretch, with sensitive habitats (dolphins and turtles) prevailing within the impact zone, have a potential impact on dolphins and turtles that is assessed to be medium. However, the contribution of underwater noise, geomorphological changes and river water pollution from PUC is assessed to be low.

Figure 7.13 Aquatic Protected species - Cause Effect Relationship in North Cluster



7.7 RIVER DEPENDENT LIVELIHOOD

The VEC interaction and effect diagram (Figure 5.2) indicated that the PUC and other terminal (passenger and cargo) projects, along with other development projects, have the potential to have a negative impact on surface water quality, which will ultimately affect fish availability in the concerned river stretches.

7.7.1 Baseline Condition

Fish landing

According to Indian Council of Agricultural Research over a long period (1987-2019), an average of 191.93 tons of fish were landed each year at the Uzanbazar (Guwahati) landing center on the Brahmaputra River. The highest annual landings were recorded in 2002, reaching 471.8 tons, but they then declined significantly to their lowest levels of 84.06 tons in 2016. The quantity and composition of fish landings in the Brahmaputra River fishery in Assam have undergone significant changes. Compared to the previous two decades (1987-2009), when average annual landings were 234.97 tons, average total landings in the last decade have decreased by nearly 60%. Additionally, the contribution of Indian major carps (IMC) and minor carps to total landings has declined, from 17.54% and 35.11% in 1987-2009 to just 4.86% and 8.94%, respectively, in 2010-2019.

Miscellaneous fishes have emerged as the dominant, accounting for 58.28% of average annual landings in the last decade (54.30 tons), compared to 69.38 tons per year in 1987-2009. Although average catfish landings have decreased from 26.96 tons per year in 1987-2009 to 19.77 tons per year in 2010-2019, their percentage contribution has increased from 11.47% to 21.28% over the decades. Similarly, average Hilsa landings have decreased from 8.24 tons per year to 3.42 tons per year, but their percentage contribution has remained unchanged. These changes can be attributed in part to climate change, habitat modification, overfishing, and other human activities. The sharp decline in IMC landings and the changes in landing composition from the river due to these alterations in the last decade are directly impacting the livelihoods of the fishing community.

Fisherman

According to International Journal of Aquatic Science, Assam's fishing community comprises approximately 2,524,106 in the year 2019 individuals, with 36% being women and 64% being men. The state offers five types of fishing resources: *beel* fisheries, ponds and tanks fisheries, derelict fishing, forest fisheries and river fishing it is difficult to distinguish river fishermen population.

The SI team has conducted field visits to the CIA study and also conducted stakeholder consultations with fishermen, the community, and fish traders at the fish landing sites of Uzanbazar and Majuli in the months of October and November 2023. The consultation and site visit revealed that limited fishing activity has been conducted in the central Cluster and organized fishing has been carried out in the North Cluster. During the site visit, it was observed that some fishing activity was being undertaken by local fisherman along the river stretches in proximity to the project clusters. However, due to the river's current, fishing activity has been observed to be more prevalent near the northern cluster as compared to the central cluster.

7.7.2 Stressors and Impacts- Central and North Cluster

River Water quality: The potential source of impact on water quality from PUC, past, present, and future projects and activities in the river stretch have been discussed in Section 6.4.2. The potential cumulative impact on river water quality is assessed to be medium. The pollution of river water quality has a potential negative impact on the primary productivity of the ecosystem, which will ultimately affect the fish diversity and fish catch.

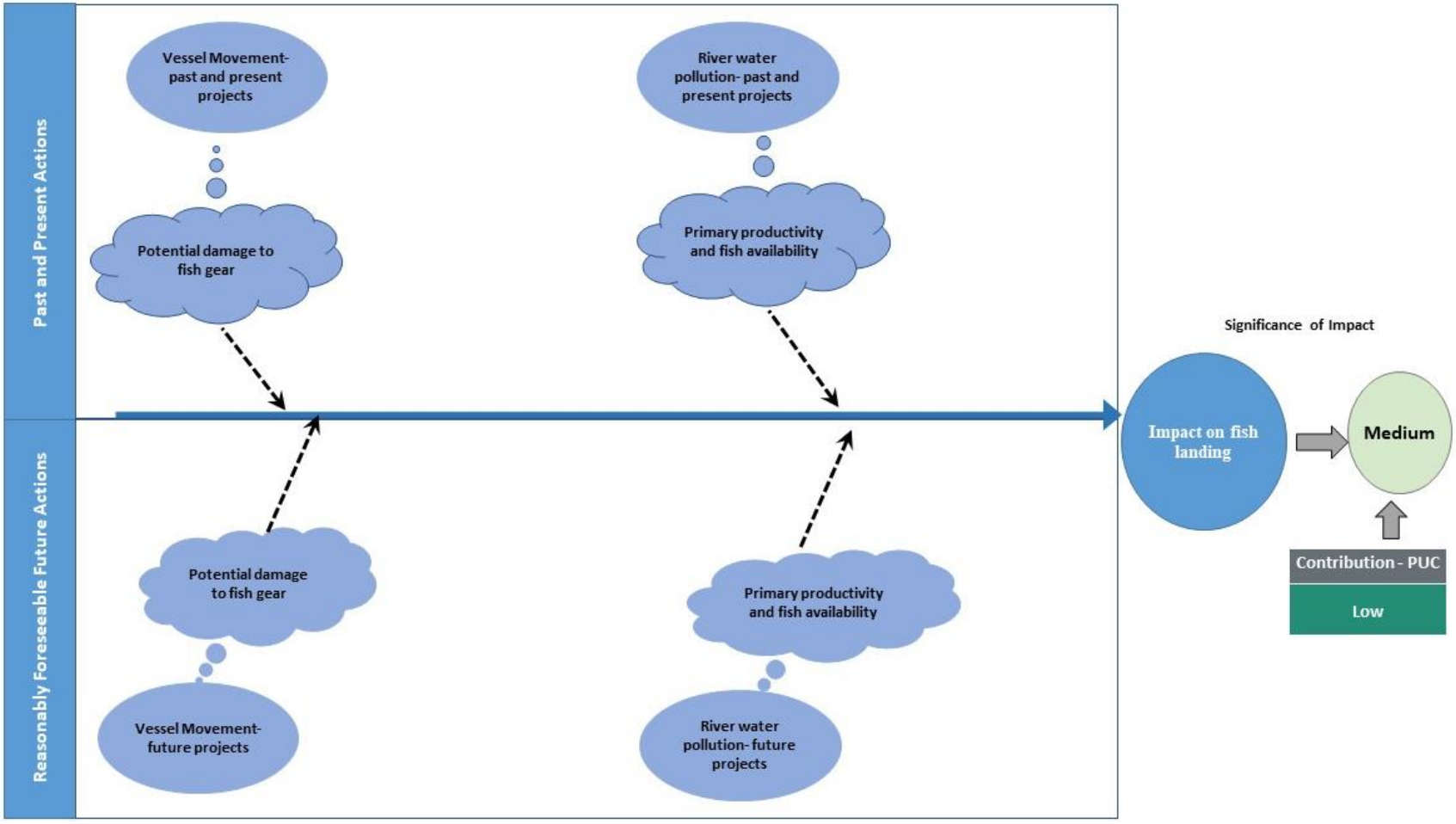
Vessel Movement: During the post-monsoon and pre-monsoon seasons, fishing activities have been carried out in the Brahmaputra River. During this season, sand bards have been exposed; therefore, only fishing has been carried out in the main river channel. Small motorized and non-motorized boats have been used. Generally, they use passive gear, especially gillnets. The gear used extends over very long distances from the boat, sometimes more than 1 km. The movements of passenger vessels and vessels used for carrying construction materials may overrun fishing gear, causing partial or total damage to the gear deployed. This may incur an additional cost for fishermen. In the central Cluster the operations will increase in frequency as well as night time navigation. This may have increase in conflicts.

The potential impact on river dependent livelihood due to PUC and different riverfront activities and projects, along with their cause-and-effect relationship, is graphically presented in **Figure 7.14.**

Significance of Cumulative Impact

The river water pollution and movement of vessels in the Central and North Cluster water stretches have a potential impact on fish catch and damage to fish gear, which ultimately has an effect on the livelihood of the fishermen that is assessed to be medium. The contribution of fish land from PUC is assessed to be medium.

Figure 7.14 River-based Livelihood - Cause Effect Relationship in Central & North Cluster



7.8 COMMUNITY HEALTH & SAFETY

Community health is assessed as a VEC in the present study because it has a strong interaction with existing conditions of other VECs like air and water quality. Number of stakeholder grievances has been selected as the key indicator for the present study. The community health and safety VEC has been scoped in for the Central Cluster.

7.8.1 Stressors and Impacts- Central Cluster

River Water quality: The potential source of impact on water quality from PUC, past, present, and future projects and activities in the river stretch have been discussed in Section 6.4.2. The potential cumulative impact on river water quality is assessed to be medium. The pollution of river water quality has a potential negative impact on the river quality, which will ultimately affect the water supply for the city.

Air quality: The potential sources of impact on air quality from PUC, past, present, and future projects and activities in the North Cluster have been discussed in Section 6.2.2. The potential cumulative impact on air and water quality is assessed as medium. The pollution of air emissions from various sources has a potential negative impact on the air quality, which will ultimately affect the ambient air quality of the city.

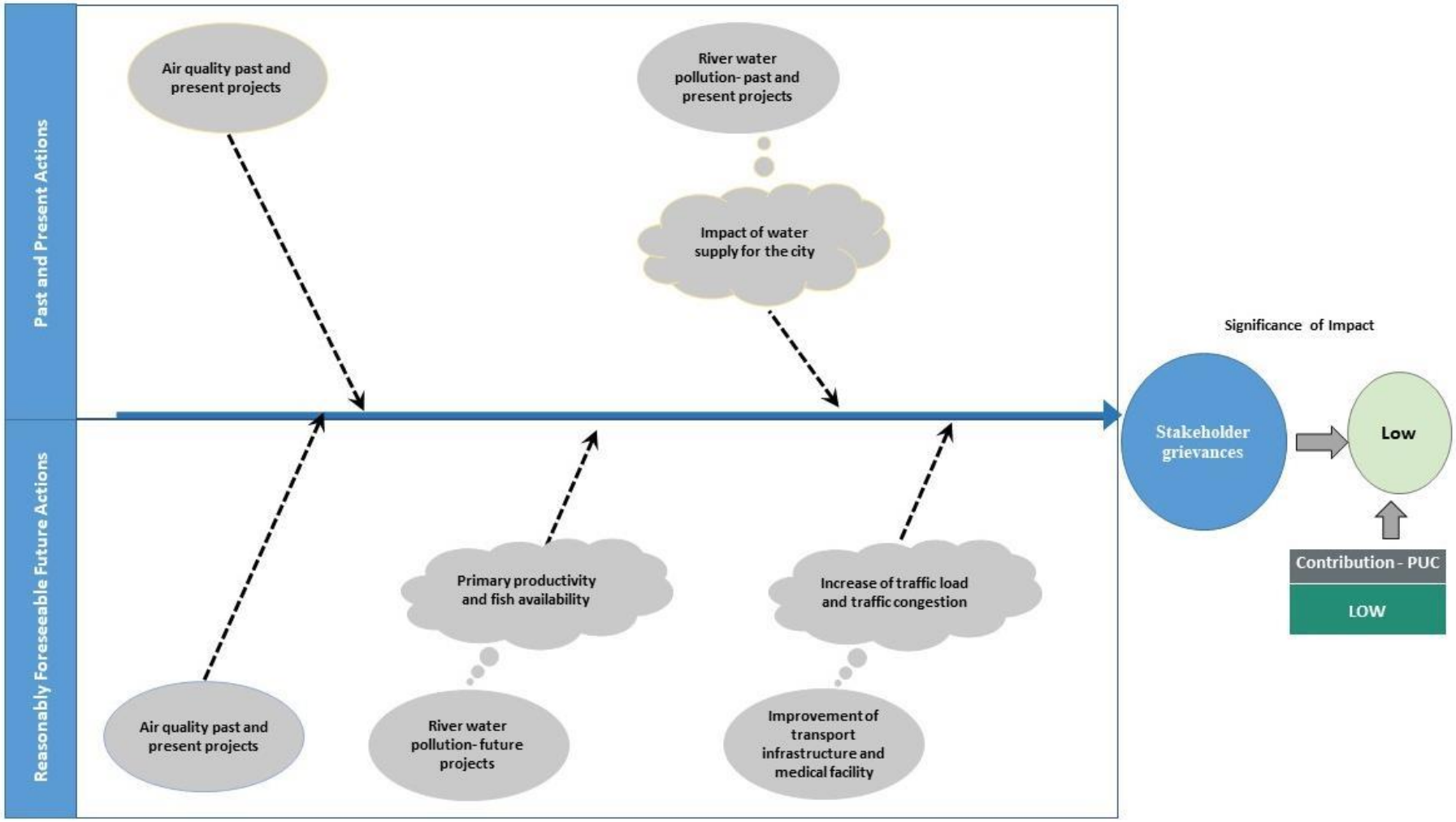
Urban Infrastructure: Again, various large-scale construction activities (PUC, riverfront development project, construction of a bridge and hospital in south Guwahati) may lead to traffic congestion. Again, improvement of transport infrastructure through the implementation of river passenger terminals, bridges, and medical infrastructure has the potential to increase the traffic load in south Guwahati. This may lead to traffic congestion and discomfort for the local community. The increase of traffic may cause noise related discomfort to the local community.

The potential impact on community health and safety due to PUC and different riverfront activities and projects, along with their cause-and-effect relationship, is graphically presented in **Figure 7.15.**

Significance of Cumulative Impact

The potential impact on ambient air quality and river water quality and urban infrastructure have a potential impact on community health and safety that is assessed to be low. The contribution of community health and safety from PUC is assessed to be low.

Figure 7.15 Community Health & Safety - Cause Effect Relationship in North Cluster



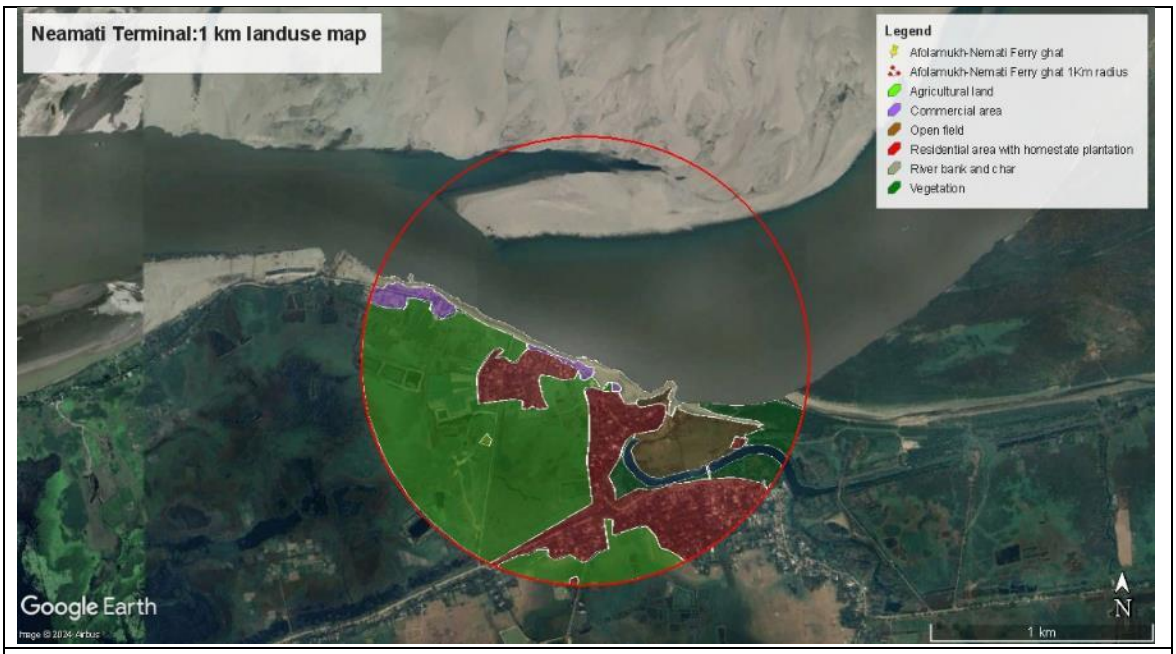
7.9 LAND USE

Land use has been assessed as a VEC in the present study because the proposed upgradation of terminals in the North Cluster may have influence of induced developed near the terminal area. The land use VEC has been scoped in for the North Cluster.

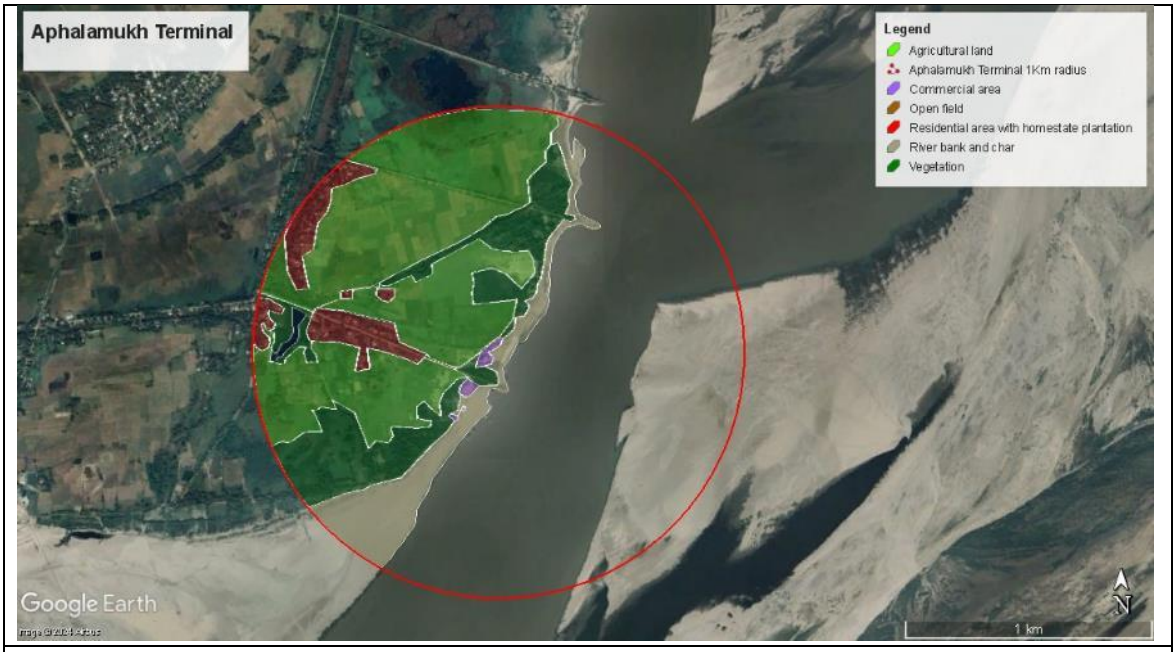
7.9.1 Baseline Condition

The land use study was undertaken basis the analysis of Google imagery and site visit input. Land use in the Neamati terminal area (1 km buffer) revealed that 55.9% of the area comprises of agriculture land, 24.3% is residential area with homestead plantations, 4.2% is river bank and char with commercial area, 6.3% vegetation covered area and 6.9% open area. Land use in the vicinity of the Aphalamukh terminal revealed that 38.8% of the area is agriculture land, 18.7% is residential area with homestead plantations, 18.7% is riverbank and char with commercial area, 0.9% vegetation covered area and 0.1% open area

Figure 7.16 Land use and Land cover of Neamati and Aphalamukh Terminal



Neamati Terminal -1 km radius area



Aphalamukh terminal-1 km radius area

7.9.2 Stressors and Impacts- North Cluster

It was observed that the river bank and the Char area have a number of commercial establishments, mostly shops. The proposed upgradation and modernization of PUC terminals and other developmental activities like AIWI terminals and cargo terminals may have induced an impact on commercial establishments, leading to unplanned developmental activities. The unplanned development may cause inconvenience to passengers, traffic congestion, problems in parking vehicles, and the generation of domestic waste water and discharge into the river.

Significance of Cumulative Impact

The potential impact on land use is assessed to be low. The contribution of PUC is also assessed to be low.

8 RECOMMENDATIONS AND CONCLUSIONS

8.1 SUMMARY OF CUMULATIVE IMPACTS

The cumulative impact assessment of the selected VECs have clearly indicated that there is level of stress on the VECs not only due to the proposed terminals under PUC but also due to other developmental projects in both the Clusters, which were studied. Summary of cumulative impacts are presented in **Table 8.1.**

8.2 MANAGEMENT MEASURES

In order to reduce further adverse impacts on the VECs as well as to mitigate some of the impacts, which were identified as key differentiators, following recommendations have been provided for better environmental and social management. The management of cumulative impacts is being proposed at two levels:

- **Project Specific**: The responsibility for management of cumulative impacts on the VECs for the PUC will be entirely on project developers.
- **Cluster Specific**: The cumulative impacts on the VECs in the entire CIA spatial boundary in Central and North Clusters could be managed through collaborative efforts from other project developers, local communities and government and public authorities.

The management approaches discussed in **Table 8.1** vary across various project components with respect to the level of conformance to IFC-World Bank Group Environmental, Health, and Safety Guidelines Ports, Harbors, and Terminals February 2, 2017. The proposed time-frame for implementation of the various actions range from immediate (within six months), short-term (1-3 years), medium-term (3-5 years) and long-term (5+ years).

Table 8.1 Cumulative Impacts and Management Measures

VEC	Indicator/ Assessment parameter	Specific conclusion from cumulative impact assessment	Management Measures		Key Performance Indicator	Timeframe	Actor / Agencies	Source of Fund
			Project specific	**Cluster Specific**				
River geo-morphology	Accretion and erosion rate	The cumulative impact of river geomorphology in terms of erosion and accretion: *Central Cluster*: assessed as medium and PUC contribution low; *North Cluster*: assessed as medium and PUC contribution low.	*Construction stage*: ▪ Protection of river-bank in the terminal area for Neamati terminal and its impact zone in consultation with Water Resource Department. ▪ Riverfront development activities during dry season to avoid sedimentation. *Operation stage*: ▪ Periodic de-siltation at terminal area under the guidance of IWT or through IWT	▪ The Central Water Commission (CWC) shall conduct regional-level river geomorphological studies, considering all the development projects (ongoing and future projects). Based on the study, regional-level implementation measures are to be prepared. ▪ CWC can serve as a central coordinating agency for conducting all the geo-morphological studies and their implementation by all development project proponents in both Clusters.	Regional level geomorphological study	Short term	Water Resource Department and central water commission	WRD and CWC
Air quality	PM and NOx concentration in ambient air	The cumulative impact of ambient air quality in terms of concentration of PM (PM_{10} and $PM_{2.5}$) and NOx: *Central Cluster*: assessed as medium and PUC contribution low	*Construction stage*: ▪ Dust suppression at construction site and site access road; ▪ Covered storage for construction materials; ▪ Diesel operated machineries & equipment and vehicles used during construction activity is having fit certificate (PUC); ▪ DG set with proper stack heights; ▪ Periodic ambient air quality monitoring in the area of influent of terminals. *Operation stage:* ▪ Grid connection for terminal and only back DG with proper stack height; ▪ Solar power unit at terminal area; ▪ Diesel and battery operated vessels.	▪ Regional level regular ambient air quality in the Guwahati city; ▪ Zonal land use planning for future expansion of the city- residential, commercial and industrial area; ▪ Promotion of green fuel or low emission fuel for public transport (Battery operated or natural gas operated); ▪ Traffic management plan considering existing traffic and future traffic due to the operation of bridges and terminals to minimize the impact on ambient air quality.	Air quality pollution trend in the Guwahati city	Long term	Pollution Control Board Assam (PCBA)	PCBA
Underwater noise & vibration	Aquatic mammals behavioural changes threshold value	The cumulative impact of underwater noise & vibration in terms behavioural changes threshold value: *Central Cluster*: assessed as medium and PUC contribution low; *North Cluster*: assessed as medium and PUC contribution low.	*Construction stage*; ▪ Monitoring the presence of Dolphins in the construction area through hydrophones and observation; ▪ Generate low intensity impulsive noise prior to start of pile driving activities and ensure that any visible marine fauna moves away from the underwater noise source; ▪ Periodic monitoring of underwater noise during pile driving activity;	▪ Identify all the riverside construction activities planned in both Clusters and their construction schedule, especially piling activities; ▪ Discuss with all the project-implementing agencies how to phase out the piling schedule to avoid simultaneous piling activity; ▪ Formulate the seasonal restriction of piling activities considering the breeding season of dolphins in consultation with the wildlife wing of the forest department.	Riverside construction guidelines and its implementation	Short term	Inland Water Transport, Assam	IWTA

VEC	Indicator/ Assessment parameter	Specific conclusion from cumulative impact assessment	Management Measures		Key Performance Indicator	Timeframe	Actor / Agencies	Source of Fund
			Project specific	**Cluster Specific**				
			▪ Using High frequency - low energy piling technology. *Operational Stage* ▪ Installation of low intensity impulsive noise generating device can be installed in the vessels to avoid any accidental collision with vessels.	▪ Conduct long term regional study on effect of navigational activities and other riverfront activities on Dolphin In the National Waterway-2				
Surface water quality	Concentration of DO & BOD Turbidity & TSS concentration	The cumulative impact of river water quality in terms threshold value of DO, BOD, turbidity & TSS: *Central Cluster*: assessed as medium and PUC contribution low; *North Cluster*: assessed as medium and PUC contribution low.	*Construction stage*; ▪ Usage of silt or air bubble screens/curtains will be explored to minimize the sediment release during construction activity; ▪ Treat the domestic waste water though septic tank and soak-pit ▪ Channelize the surface runoff from construction site to sedimentation tank; *Operation stage*: ▪ Domestic waste water treatment system in the terminals; ▪ Domestic waste water collection system in the passenger vessels and transfer the waste water in the terminal side sewage treatment system.	▪ Implement the sewage treatment plant (STP) for Guwahati city under smart city project; ▪ Plan the STP for north Guwahati as future urbanization area; ▪ Regional level periodical river water quality monitoring. ▪ Plan and implement the municipal solid waste management system for Guwahati city.	Water quality pollution trend in NWMP stations	Long term	Pollution Control Board Assam (PCBA)	PCBA
KBA for endangered & migratory birds	Species diversity	The cumulative impact of KBA for endangered & migratory birds in terms diversity: *North Cluster*: assessed as low and PUC contribution is also low	*Construction stage*; ▪ Low-noise equipment shall be used where practical; ▪ Vehicle, equipment, and machinery used for construction activities would conform to applicable source noise standards; ▪ Only well-maintained equipment will be operated on-site; ▪ The number of equipment operating simultaneously shall be reduced where practical; ▪ The job intensity during bird migratory season will be reduced as practicable as possible. ▪ Awareness among the workforce regarding conservation of bird's species; ▪ Directional illumination at construction site.	▪ Develop a biodiversity management plan for KBAs. ▪ Awareness generation program among the local community and other stakeholders regarding conservation of biodiversity in the KBA; ▪ Periodical monitoring of bird species with special emphasis on endangered and migratory birds.	Diversity index of the birds species in KBAs	Long term	Forest Dept.	Forest Department
Protected aquatic fauna- Ganges	Dolphin population reported in last census	The cumulative impact of Protected aquatic fauna- Ganges River dolphin and turtles in terms number of dolphin population:	▪ Project specific erosion control measures as suggested under river geo-morphology section;	Develop a regional level dolphin conservation plan Brahmaputra River basin. Which includes: ▪ Identify the pressure and threats on dolphin; and river turtles;	Dolphin population in the river basin	Long term	Forest Dept.	Forest Department

VEC	Indicator/ Assessment parameter	Specific conclusion from cumulative impact assessment	Management Measures		Key Performance Indicator	Timeframe	Actor / Agencies	Source of Fund
			Project specific	**Cluster Specific**				
River dolphin and turtles		*Central Cluster*: assessed as medium and PUC contribution is low. *North Cluster*: assessed as medium and PUC contribution is low.	▪ Project specific underwater noise control measures as suggested under underwater noise and vibration section; ▪ Project specific river water pollution control measures as suggested under surface water quality section. ▪ Restrict the establishment of vendor activities, those are potential to generate solid waste within the range of 500 meter these are like, Pan Shop, Tea Shop, any other fast-food shop, Tobacco related shops, etc.	▪ Identify the dolphin breeding ground and prepare a conservation plan ▪ Awareness generation among the fishermen and riverside community towards dolphin conservation; ▪ Periodical census of dolphin in the river basin; ▪ Conduct a basin level dolphin status survey through a reputed government agency and prepare a basin level conservation plan; ▪ Pilot test for pinger like device in fishing net to potentially eliminates river dolphin bycatch, while improving local fishers' income and reducing their costs. ▪ Protection of Riparian zones are also very much important, because this habitat is most important habitat for aquatic and amphibious organism. The riverbank protection work should be nature based erosion control measures.				
River dependent livelihood	Fish catch at fish landing site	The cumulative impact of river dependent livelihood in terms fish landing: *Central Cluster*: assessed as low and PUC contribution is also low. *North Cluster*: assessed as low and PUC contribution is also low.	▪ Project specific erosion control measures as suggested under river geo-morphology section; ▪ Project specific river water pollution control measures as suggested under surface water quality section.	▪ Regional level fishery study focusing on fish species, endangered fish species, trends in fish yield and species composition, fishermen livelihood and fish conservation ▪ As an alternative livelihood of the small boat operators can be engaged in ecotourism. This initiative should be planned with the Forest Department and the Tourism Department.	Fish landing trend from the river	Long term	Fisheries Department	Fisheries Department
Community health & safety	Number of stakeholder grievances	The cumulative impact of community health and safety in terms number of stakeholder grievances: *Central Cluster*: assessed as low and PUC contribution is also low.	▪ Project specific air pollution control measures as suggested under air quality section. ▪ Project specific river water pollution control measures as suggested under surface water quality section. ▪ External stakeholder grievance system	▪ Traffic management plan for south Guwahati section.	Regional level traffic management plan	Medium term	Transport Department	Transport Department
Land use	Rate if landuse change /unplanned urbanisation	The cumulative impact of land use North Cluster assessed as low and PUC contribution is also low.	NA	▪ Zonal land use planning for future expansion of the city- residential, commercial and industrial area;	Land use plan	Medium term	Local Gram Panchayat	Local Gram Panchayat

8.3 MONITORING

A plan has been developed for monitoring the effectiveness of measures that has been recommended as part of the CIA. This plan will track the progress of the program/actions during the implementation phase and accordingly informs agencies that are responsible for implementation / supervision.

Principally the monitoring will entail:

- Collection of data on the implementation of activities and outputs, according to the indicators specified in the recommended action plan;
- Collecting data on the delivery of results and impacts according to the indicators identified in the monitoring framework and evaluation programs to be able to follow an adaptive management approach to initiate any changes (if required) to the programs that have been proposed as part of the CIA Study;

The monitoring plan is presented in Table 8.2

Table 8.2 Monitoring Plan

VEC	**Key Performance Indicator**	**Timeframe**	**Responsibility for Supervision**
River geo-morphology	Basin level geomorphological study	During formulation of study (Draft / Final)	WRD and CWC
Air quality	Air quality pollution trend in the Guwahati city through continuous ambient air quality monitoring	Continuous monitoring	PCBA
Underwater noise & vibration	Riverside construction guidelines and its implementation	During formulation of study (Draft / Final)	IWTA
Surface water quality	Water quality pollution trend in NWMP stations	Monthly monitoring	PCBA
KBA for endangered & migratory birds	Diversity index of the bird species in KBAs	Pre-monsoon and winter seasons	Forest Department
Protected aquatic fauna-Ganges River dolphin and turtles	Dolphin population in the river basin	Every 3-5 years cycle	Forest Department
River dependent livelihood	Fish landing trends from the river	Every 3-5 years cycle	Fisheries Department
Community health & safety	Regional level traffic management plan	During formulation of study (Draft / Final)	Transport Department

Appendix A: Non-Technical Summary for Stakeholder Consultation

Cumulative Impact Assessment for Assam Inland Water Transport Project

Summary | February 2024 | AIWTDS

Introduction

The Inland Waterways Authority of India (IWAI), and the Inland Water Transport Department, Assam (IWTDA), are both keen to realize NW-2's full potential for cargo and passenger transportation. River tourism is another key potential area that can hugely contribute to the economies of the northeastern states. The state Government of Assam (GoA) has taken up the "Assam Inland Water Transport (AIWT) Project" to improve the quality of inland water transport services and integrate high-quality passenger and vehicle ferry services in the Brahmaputra River.

The World Bank is financing the GoA to achieve this objective. The Assam Inland Water Transport Development Society (AIWTDS) has been formed by the GoA under the Transport Department to implement the AIWT projects to modernise Inland Water Transport (IWT) in Assam. Under the AIWT Project, five terminals have been planned in the first phase; these are located within the Central Group Terminals (three numbers) located at Guwahati and the North Group Terminals (two numbers) located at Jorhat.

There are several operating ferry ghats within the Central and North Group Terminals. There are also cargo operations in the NW-2, and cargo terminals are also located in both the Central and North Group Terminals. Other developments, including the construction and operation of bridges over the river, river-bank protection measures, construction roads associated with bridges and terminals or ferry ghats, urbanization, and tourism, can also be triggered as a result of inland navigation.

Over time, all the existing projects together are expected to cumulatively contribute to environmental impacts on Valued Environment Components (VECs) like water quality, aquatic ecology, community health and safety, socioeconomics, etc. Because of the situation prevailing in these Group Terminals, it is important to understand the cumulative impact on VECs. This Cumulative Impact Assessment (CIA) study has been commissioned to identify and evaluate potential cumulative impacts on key VEC's and recommend appropriate management measures to mitigate them.

Two clusters namely, Central Cluster and North Cluster have been considered for CIA study with the aerial distance between them being around 260 kms. The spatial boundaries considered for each cluster is 2 kms upstream and 5 kms downstream of the river and 1 km towards the land side from the group of terminals. Temporal delineation for a CIA is a challenge due to the inherent uncertainty about potential future projects and activities. At this time, the temporal boundary for the CIA study has been considered for 10 years, considering the foreseeable projects planned in both clusters.

Developments Considered in CIA

AIWTDS presently proposes to develop and modernise terminal infrastructure initially at five (5) locations, i.e., Gateway Guwahati Ghat (GGG), North Guwahati, Umananda (Central Cluster), Aphalamukh, and Neamati (North Cluster)-Refer attached Figures. The past and present development activities that have been considered in the CIA study as a part of the Central and North clusters are as follows:

- Riverfront activities
  - Existing river terminals or ferry ghats: 12 in the Central cluster and 3 in the North Cluster
  - River cruise facility: 2 in the Central cluster and 1 in the North cluster.
  - Existing river cargo terminal: one in the Central cluster and one in the North Cluster.
  - Water intake facility & treatment plant: 4 in the Central cluster and 1 in the North cluster.
- Other Developmental Projects in the area
  - Bridge over the Brahmaputra River- one at Central Cluster and one at North Cluster
  - River-bed sand mining- number of mines in North cluster
  - River-bank protection projects
  - Under construction MMC Hospital
  - Under construction river-front development project

Proposed projects including new future developments in the basin that have the potential to cause cumulative impacts on VECs that have been considered include the following:

- River terminal/ jetties

- River terminals either under construction and/or planned;
- IWAI proposed terminal at Neamati side;
- Expansion of Pandu River Port.

- Other Developmental Projects in the area
  - River-bed sand mining- expansion or new riverbed sand mines in the north cluster;
  - River-bank project in the north cluster;
  - Elevated road from Panbazar Brahmaputra Bridge to Uzanbazar along the river bank at the central cluster.

In addition, the following stressors and developmental drivers have been considered to understand how the cumulative impacts on VEC's over time will occur:

Urbanization: The population of Guwahati is about 9.57 lakhs, with a decadal population growth rate of 20%. Urbanization has the potential to stress surface water resources and river water quality.

Natural Stressors: Natural influences and environmental drivers include those linked to climate change. This includes flood, erosion and accretion, drought etc. comprise major stressors that reportedly affect the surface water resource and aquatic biodiversity, livelihood, physical infrastructure and properties in in the river basin.

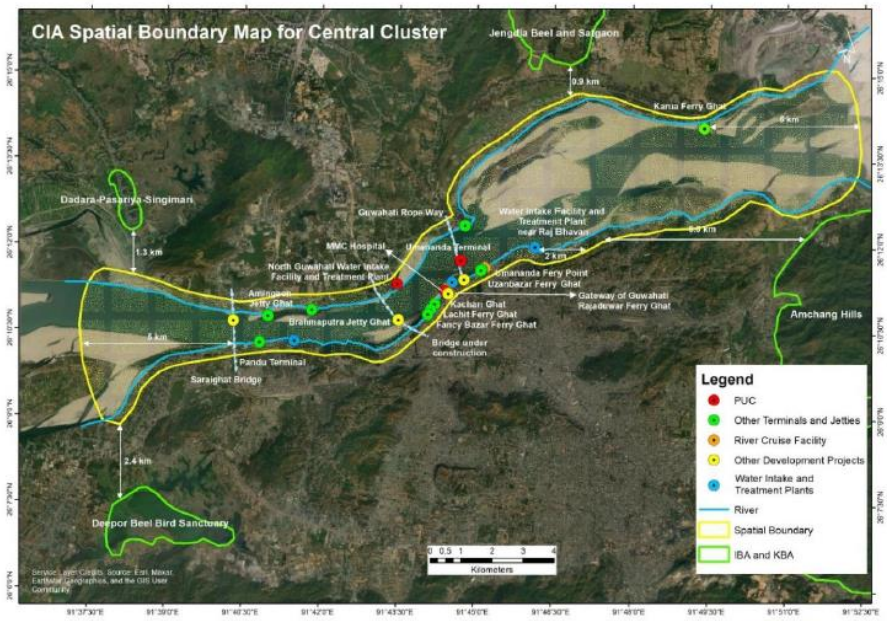


Figure 1 - CIA Spatial Boundary Map for Central Cluster

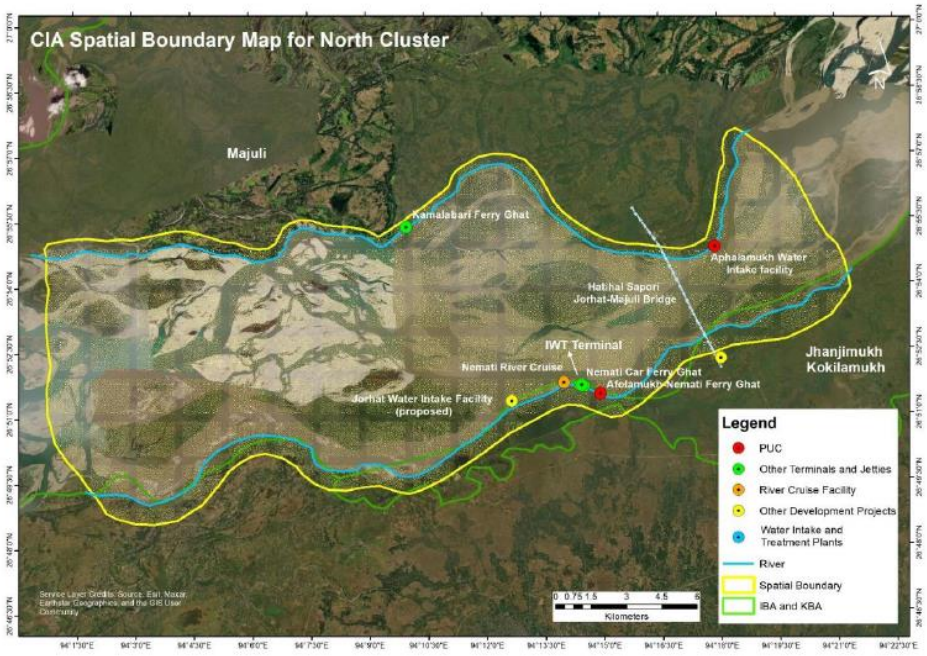


Figure 2 - CIA Spatial Boundary Map for North Cluster

Valued Environmental Components

A VEC screening process was adopted to determine which of the preliminary VECs identified would be assessed in further detail as a part of the CIA and the results of the screening process are summarised in the Table below.

Preliminary VEC	Importance to Stakeholders	Impacted by PUC	Impacted by other Projects and Stressors	Screened in/out of the CIA	
				Central Cluster	North Cluster
Land Use	No	Yes	Yes	No	Yes
Soil and sediment quality	No	Yes	No	No	No
River geomorphology (erosion and accretion)	Yes	Yes	Yes	Yes	Yes
Air environment (Air quality)	No	Yes	Yes	Yes	No
Acoustic environment (noise quality)	No	Yes	No	No	No
Underwater Noise & Vibration	Yes	Yes	Yes	Yes	Yes
Surface Water Resources	No	Yes	Yes	No	No
Surface Water Quality	Yes	Yes	Yes	Yes	Yes
Key Biodiversity area for migratory bird species	Yes	Yes	Yes	No	Yes
Protected aquatic fauna- Dolphin and turtles	Yes	Yes	Yes	Yes	Yes
River dependent livelihoods	Yes	Yes	Yes	Yes	Yes
Land based livelihood	No	Yes	No	No	No
Community Health & Safety	Yes	Yes	Yes	Yes	No

Figure 3 - Table- Outcome of VEC Screening for CIA

In the process, past, present and future river passenger terminal projects that have a range of interactions with key VECs and therefore has the potential to adversely

impact the VEC's have been taken into account. The possible interactions with the VECs is presented in the Figure below.

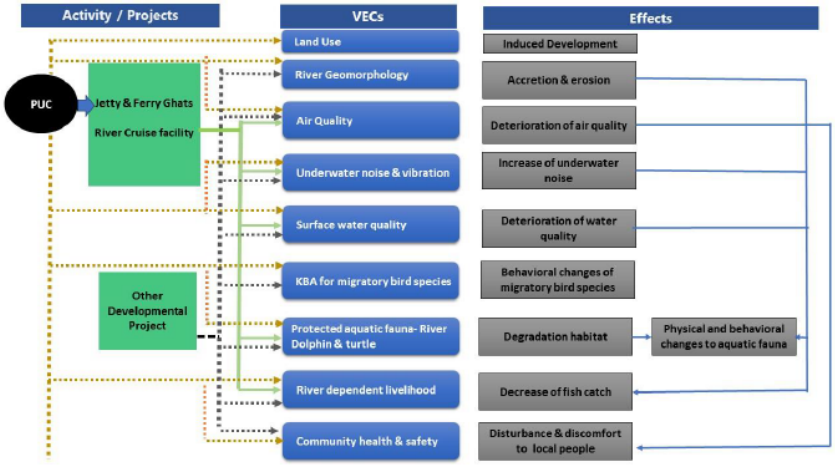


Figure 4 - Activity/Project – VEC Interactions and Effects

Stakeholder Inputs

The stakeholder engagement process provided a platform for two-way communication between the CIA study team and various stakeholder groups. This helped the CIA study team develop an understanding of the key issues relevant to this study. All through the CIA study period and at different stages, several stakeholders were consulted with a view to (i) gathering information on VECs, (ii) understanding the past and present condition of VECs, (iii) assessing the cumulative impact on VECs, (iv) suggesting appropriate recommendations, and (v) finding out about reasonably foreseeable future actions. Stakeholders consulted during the CIA process are represented in the Figure below.

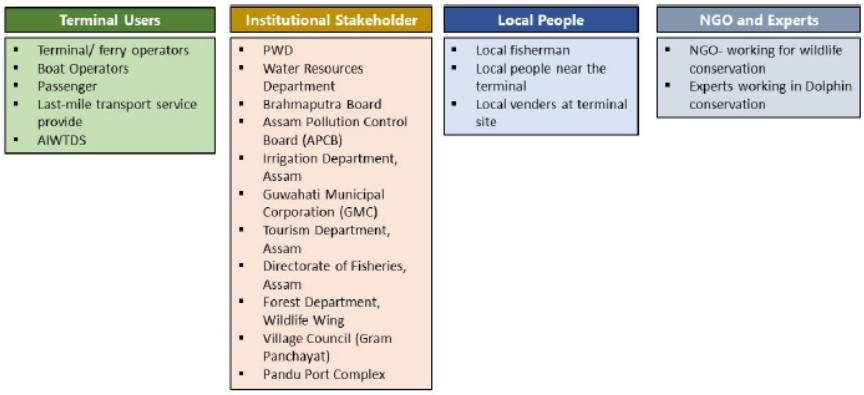


Figure 5 - Stakeholder Consulted during the CIA Process

The key issues and concerns raised by the stakeholders till now are as follows:

- River geomorphology: accretion and erosion have the potential to hamper the ferry operations;
- Community health and safety: construction of terminals that may cause inconvenience to passengers, boat operators and surface transporters.
- Surface water quality: potential impact on surface water quality due to the construction of the terminals;
- Livelihood: degradation of surface water quality and the operation of boats may have a negative impact on fish catch
- Gangetic River dolphin: construction and operation of terminals may have an impact on the Gangetic River dolphin due to degradation of surface water quality and underwater noise.
- Carrying out operations of the Terminals in an environment-friendly manner to avoid the impact on fishes and other aquatic life.

Cumulative Impacts & Recommendations

The assessment of cumulative impacts on the selected VECs has indicated that there will be an incremental level of stress on the VECs, not only due to the proposed terminals under PUC, but also due to other developmental projects in both the clusters, which were studied. Specific potential impacts along with key management measures are discussed in the section below.

River geo-morphology: The cumulative impact of river geomorphology in terms of erosion and accretion is assessed to be medium for both the cluster and contribution from PUC is low. The following management measures are proposed to be taken up by the Water Resource Department (WRD):

- Conduct regional-level river geomorphological studies, considering all the developmental projects (ongoing and future projects). Based on the study, regional-level implementation measures are to be prepared. WRD can serve as a central coordinating agency for conducting all such geo-morphological studies and ensure appropriate mitigation measures are implemented by all development projects in both clusters.

Underwater noise & vibration: The cumulative impact of underwater noise & vibration in terms of behavioural changes threshold value is assessed as medium

for both cluster and PUC contribution is low. The following management measures are proposed:

- Identify all the riverside construction activities planned in both clusters and their construction schedule, especially piling activities;
- Discuss with all the project-implementing agencies how to phase out the piling schedule to avoid simultaneous piling activities;
- Formulate seasonal restrictions on piling activities considering the breeding season of dolphins in consultation with the wildlife wing of the forest department.
- Conduct a long-term regional study on the effect of navigational activities and other riverfront activities on dolphins in the NW-2.

Surface water quality of Brahmaputra river: The cumulative impact of river water quality in terms of the threshold value of DO, BOD, turbidity & TSS is assessed as medium for both the clusters and PUC contribution low. The following management measures are proposed:

- Implement sewage treatment plants (STPs) for Guwahati city in a planned manner under the smart city project;
- Design a monitoring network and carry out regional-level periodic river water quality monitoring to understand adverse impacts on river quality and the sources contributing to the same.

Protected aquatic fauna- Gangetic River Dolphin and Turtles: The cumulative impact of Protected aquatic fauna- Gangetic River dolphin and turtles in terms number of dolphin population is assessed as medium for both the clusters and PUC contribution is low. The key management measure to reduce impacts on the Gangetic Dolphin will be to develop a regional-level dolphin conservation plan Brahmaputra River basin which includes:

- Identification of specific pressures and threats on dolphins and create awareness amongst fishermen and riverside community towards dolphin conservation;
- Undertaking periodical census of dolphins in the river basin;
- Pilot testing pinger-like devices in the fishing net to potentially eliminate river dolphin bycatch, while improving local fishers' income.

River Dependant Livelihood: The cumulative impact of river-based livelihood in terms of fish landing is assessed as low for the Central and North Cluster, and PUC contribution is also low. Management Measures:

- Project specific erosion control measures as suggested under the river geo-morphology section;
- Project specific river water pollution control measures as suggested under the surface water quality section.
- Regional-level fishery study focusing on fish species, trends in fish yield and species composition, fishermen's livelihood and fish conservation.

Community health & safety: The cumulative impact of community health and safety in terms number of stakeholder grievances is assessed as low for the Central cluster, and PUC contribution is also low. The following management measures are proposed:

- Regional level regular ambient air quality monitoring in Guwahati city;
- Zonal land use planning for future expansion of the city- residential, commercial and industrial areas;
- Promote of green fuel or low emission fuel for public transport (Battery operated or natural gas operated);
- Develop appropriate traffic management plan considering existing and future traffic and planned infrastructure to reduce congestion and minimize the impact on ambient air quality.

Appendix B: CIA Final Disclosure Documents

List of Invitte in the Final Disclosure Meeting

AIWTD-11013/52/2023-AIWTDS-Assam Inland Water transport Development Society

I/433127/2024

Government of Assam
Assam Inland Water Transport Development Society
3rd floor, Directorate of Inland Water Transport, Ulubari, Guwahati
Email: dir.iwtds-as@gov.in :: Tel:+91361-2526421

No: E 397994/01 Date: 05/02/2024

To

1. The Principal Chief Conservator of Forests (Wild Life and Biodiversity) Assam, Aranya Bhawan, Panjabari, Guwahati – 781037
2. The Additional PCCF (Climate Change) and CEO of Assam Climate Change Management Society (ACCMS), Aranya Bhawan, Panjabari, Guwahati – 781037
3. The Chief Engineer, Assam Water Resources Department, Basistha, Guwahati-29.
4. The Member Secretary, Assam Pollution Control Board, Bamunimaidam, Guwahati-21
5. The Director, Directorate of Fisheries, Meen Bhawan, Gopinath Nagar, Guwahati- 781016
6. The Dy. Commissioner of Police(Traffic), Guwahati
7. The District Superintendents of Police, Jorhat, Assam
8. The Director, Inland Water Transport, Assam

Subject: Invitation for the half-day workshop on the Cumulative Impact Assessment (CIA) Study for the Assam Inland Water Transport project at Assam Administrative Staff College on February 7, 2024…Reg

Sir,

With reference to the subject cited above, we are glad to inform you that the Assam Inland Transport Development Society (AIWTDS) has taken up the "Assam Inland Water Transport Project (AIWTP) " to improve the quality of inland water transport services and integrate high-quality passenger and vehicle ferry services in the Brahmaputra River. The World Bank is financing the GoA to achieve this objective.

A Cumulative Impact Assessment (CIA) study has been commissioned to identify and evaluate potential cumulative impacts on Valued Environmental and Social components (VECs) like aquatic ecology, community health and safety, socioeconomics, etc. Further, a draft report on the Cumulative Impact Assessment Study for the Assam Inland Water Transport project was prepared.

In this regard, a summary of the draft CIA report is attached for your kind reference. kindly make it convenient to attend the workshop or nominate a concerned representative from your department to participate in the event scheduled on **February 7, 2024 (Wednesday)**, **at Assam Administrative Staff College**, Resham Nagar, Khanapara, Guwahati, Assam-781028 from **11:00 am** onwards. Looking forward for your kind participation.

Enclosures: Agenda for the workshop and Summary of the study

Yours Faithfully,

Signed by
Gaurav Upadhyay (IPS)
Date: 06-02-2024 11:47:14
State Project Director,
AIWTDS

Memo No: E 397994/01-

1/433127/2024

Copy to

1) The Director, Fire & Emergency Services, Assam, Near Lakhtokia Panbazar, Guwahati-781001 for favour of your kind information
2) The Director, Pandu Port Complex, Pandu, Guwahati 781012 for favour of your kind information
3) The Director of Tourism, Directorate of Tourism, Station Road, Guwahati 781001 for favour of your kind information
4) The Chief Engineer, Irrigation, Assam, Chandmari, Guwahati-781 003 for favour of your kind information
5) The Managing Director, Guwahati Smart City Limited, 4th Floor, Aditya Tower, Opp. Down Town Hospital, Down Town, Dispur, Guwahati-781006 for favour of your kind information
6) The Commissioner, Guwahati Municipal Corporation, Ganesh Mandir, Guwahati – 781006 PWD for favour of your kind information
7) The Chief Engineer –I, Brahmaputra Board, Basistha Guwahati-781029 for favour of your kind information
8) The Chief Engineer, PWD (Roads), Public Works (Roads) Department, Chandmari, Guwahati 781003 for favour of your kind information
9) Prof. P. C. Bhattacharjee, Professor, Department of Zoology, Gauhati University, Guwahati -781014 for your kind participation.
10) Prof. P.K. Saikia, Professor, Department of Zoology, Gauhati University, Guwahati -781014 for your kind participation.
11) Dr. Bhrigu Prasad Saikia, Consultant Environment & Biodiversity, Assam for favour of your kind participation.

/Sd
State Project Director,
AIWTDS

Social Media Posting for CIA Final Disclosure

Agenda for the Stakeholder Consultation

Cumulative Impact Assessment (CIA) Study for
Assam Inland Water Transport Project
Tentative Agenda

Date: February 07, 2024
Location: Assam Administrative Staff College, Resham Nagar, Khanapara, Guwahati, Assam-781028

Objectives:

- To inform the Key Stakeholders on the final draft Cumulative Impact Assessment (CIA) report prepared for the Assam Inland Water Transport Project (AIWTP).
- To obtain feedback from Public and Departmental officials on the Cumulative Impact Assessment (CIA) Study

S.No	Time	Activity	Participants
1	11:00 - 11:15 am	Registration of the Guests	
2	11:15 - 11:30 am	Welcome address	**Shri Gaurav Upadhyay, IPS** State Project Director, AIWTDS
4	11:30 - 12:15 pm	Presentation on the Cumulative Impact Assessment (CIA) Study for the Assam Inland Water Transport Project	**Shri. Salil Das/ Shri.Debanjan** Sustainability Intelligence LLP
5	12:15 - 12:45 pm	Open for the dialogue with the Public and concerned departmental officials	
6	12:45 - 12:55 pm	Closing remarks	**Shri Hanif Noorani, ACS** Additional State Project Director, AIWTDS.
7	12:55 - 01:00 pm	Vote of thanks	Project Officer, AIWTDS
Lunch Follows			

Contact details of AIWTDS Safeguards team:

Shri. G.Mahesh Babu, Environmental Specialist (**M: +91 8919265886**)

Smt. Meghali Sarma Basak, Social Development Specialist (**M: +91 7005130031**)

Smt. Mousami duwarah, Social Development Expert (**M: +91 8822377513**)

CIA Final Workshop Attendance Sheet

Final Stakeholders Consultation Workshop on the Draft Cumulartive Impact Assessment (CIA) Study for the Assam Inland Water Transport Project

Registration Form:

Sl No.	Name of the Participant	Designation	Organization	Contact number	E-mail Address	Remarks
1	Ditemoni Gogoami	ACP Tr Dispur	Assam police	6001899338	ditemonigogoi2[illegible]@gmail.	
2	Dr. Bhagaban Kalita	Marketing Officer cum I/c PM Hall	Dept. of Fishery	9435555460	bhagabank@yahoo.com	
3	Gokul Bhuyan.	Addl. Chief Env. Engr	Pollution Control Board, Assam	9435343530	gbhuyan@pcbassam.org	
4	Sumit Choudhury	JM, Civil	GSCL	7399368714	Sumitchoudhury9@gmail.com	
5	Raktim Kalita	VM, Archi	GSCL	7906967662	raktimkalita2777@gmail.c	
6	Manish Kumar Mapa	Env.	L & T	9101508704	Mapakumarmanish97@gmail.	
7	Achintya Prom Hazarika	"	"	7002746657	achintyaprom11@gmail.ca	
8	Priyanku Borah	Env	L&T	9101228229	priyankuborah320@gmail.a	
9	Dipima Sarma	Environmental Officer	WRD, GoA	8402846586	do.eo.eapwrd@gmail.com	
10	Jayanta Gogoi	EE (i/c) DIWT	Directorate IWT	8638255835	jayantagogoi1993@gmail.com	
11	Rizwan Uz Zaman	Tech. Consultant	ACCMS, GoA	9099109757	manirizwan@gmail.com	
12	DR. BHRIGU PRASAD SAIKIA	Teacher (Retired)	Gauhati University	9678525445	bpsaikia@gmail.com	
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Final Stakeholders Consultation Workshop on the Draft Cumulartive Impact Assessment (CIA) Study for the Assam Inland Water Transport Project

Registration Form:

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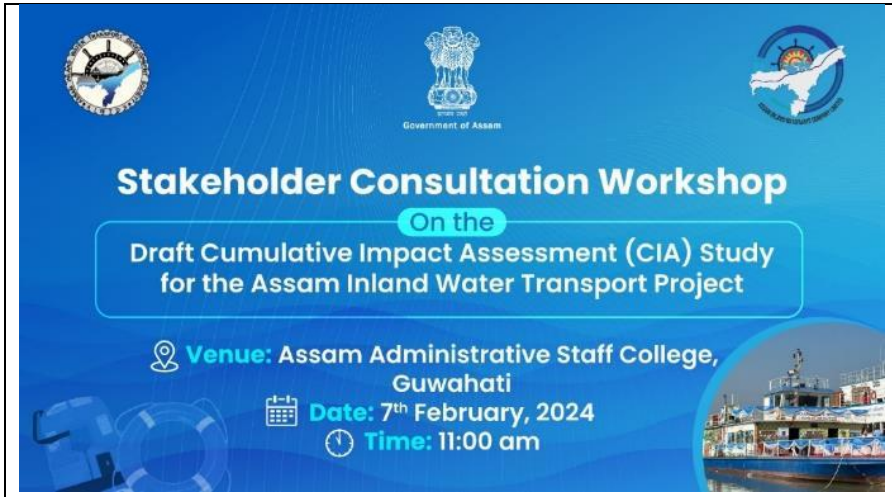
CIA Final Disclosure Photographs



Stakeholder Consultation Banner

Welcome address to the Partcipants

CIA Presentation

Section of Participants

	
Section of Participants	Section of Participants
	
Vote of Thanks	Photo of Participants