ENVIRONMENTAL IMPACT ASSESSMENT REPORT

GUWAHATI ROPEWAY PROJECT, ASSAM

Submitted to:

State Pollution Control Board, Assam

Submitted by:

Guwahati Metropolitan Development Authority

Government of Assam

Prepared by:

SENES Consultants India Pvt. Ltd.

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EXECUTIVE SUMMARY

1.0 INTRODUCTION

Guwahati is the gateway to the northeastern region. Due to its excellent connectivity and unique geographical location, this region is experiencing rapid growth of trade and commerce and it has the potential to become the hinterland for the entire northeastern region. The major growth of the city is now aimed at north Guwahati due to shortage of land at the southern part. The two banks of the river are connected through road and water transport. However, the means of transportation between the two banks needs to be improved to support growth of the city along the north bank.

The Government of Assam has thus taken initiative for the development of ropeway project across Brahmaputra river to connect Guwahati city situated on the south bank to the north bank. The Government of Assam has subsequently designated Guwahati Metropolitan Development Authority (GMDA) to execute the project. The detailed project report for the proposed project has been prepared by M/s RITES Limited.

The proposed project falls under Item 7 (g) (Aerial Ropeways) and is a designated project under Schedule and falls under category B of the Environment Impact Assessment (EIA) Notification dated 14th September, 2006 and requires clearance from Ministry of Environment and Forests in the absence of State Environment Impact Assessment Authority. The EIA study has been done as per the TOR provided by MoEF vide letter No.10-119/2007-IA.III dated 2nd September, 2008.

A Rapid Environment Impact Assessment (REIA) study report has been prepared for this project based on baseline environmental quality data collected for winter season'08 for the study area. Identification and prediction of significant environmental impacts due to the proposed ropeway with an Environmental Impact Statement followed by delineation of appropriate impact mitigation measures in an Environmental Management Plan (EMP) are included in the REIA Report.

M/s Guwahati Metropolitan Development Authority has retained the services of SENES Consultants India Private Limited (SENES) for carrying out Environmental Impact Assessment (EIA) study and preparation of an EIA report and Disaster Management Plan (DMP) for the proposed project. The purpose of this Environmental Impact Assessment (EIA) study is to provide information on the nature and extent of environmental impacts arising from the construction and operation of the proposed project and related activities taking place concurrently.

2.0 SALIENT FEATURES OF PROJECT

The salient features of the project are discussed below:

- Size of the Project: 1820 m length
- Carrying capacity 250 persons per hour (PPH)
- Expected cost of the project: Rs. 28.76 Crores
- No. of towers: 5
- Source of power supply: State Electricity Board
- Power requirement: 200 KW
- Water Requirement: 15.61 m^3/day (municipal supply)
- Waste water generation: 11.61 m^3/day
- Solid Waste generation: 0.55 MT/day
- No. of trees to be cut: Nil

3.0 PROJECT NEED AND ADVANTAGES

The population of Guwahati city is expanding at a high rate. The substantial growth in the region is characterized by densification of the center core and ribbon development along the main transportation corridor. The situation has further deteriorated due to a limited road network and carriageway resulting in perpetual congestion on the main as well as arterial roads within the city.

Looking into these aspects, the future growth of the city is planned along the north bank. At present, the connectivity of the banks of the river is through private and state owned transport buses and ferry services operated by Department of Inland Water Transport, Assam. There is a road bridge across the river, which leads to NH – 31 and connects the north and south bank. The NH-31 and the road in the main city are quite congested and during peak hours it takes about one to two hours to cross the river. The ferries used for carrying passengers are old and inadequate and is therefore not an effective system of transportation.

The existing transportation infrastructure connecting the two banks is evidently inadequate. Considering the proposed future growth pattern of the city, it is imperative to have a reliable transport system in place and thus an aerial ropeway is proposed to provide connectivity between the two banks.

4.0 ALTERNATE SITES

Two alignments were considered for the proposed alignment:

- Ropeway between south bank and north bank via Urbashi island and Umananda island.
- Ropeway between south bank and north bank of Guwahati via Umananda island.

The first alignment passes through Urbashi Island, which is protected by the Archaeology Department and therefore the second alignment has been selected.

5.0 PROPOSED ROPEWAY

The alignment for the proposed ropeway has been considered between south bank and north bank of Brahmaputra river via Umananda island. The length of the proposed ropeway will be 1820 m. The proposed alignment will involve construction of five trestles in addition to two terminal stations. The entire alignment will pass through Brahmaputra river. The maximum depth in the southern channel is in the range of 10 to 14 m whereas the maximum depth in the northern channel ranges between 23 to 27 m. The major navigation activities take place in the northern channel whereas the southern channel is used for navigating of country boats and double decker systems.

6.0 FINANCIAL VIABILITY OF THE PROJECT

The total cost for the project has been worked out to be Rs. 28.67 Crores. The charges for ferryboats for one way trip are about Rs. 5.0 per person. It is proposed to charge a fees of Rs. 25.0 for a round trip for the proposed ropeway. Based on the estimated project cost, annual recurring cost and earnings, the project yields a Financial Internal Rate of Return (FIRR) of 3.96 % .Although the FIRR for the project is less, the proposed ropeway will provide an alternative safe mode of transport compared to the boat services and the alternate road route. In addition, the future growth of the city is planned along the north bank and the proposed ropeway will become the focal point of attraction of north bank. The proposed project has been granted administrative approval for an amount of Rs. 27.72 crores

7.0 UTILITIES/AMENTITIES

Water

The water demand for the proposed project has been estimated as 15.6 m^3/day. The water requirements for the proposed project will be met through the municipal source. It is expected that about 11.7 m^3/day of wastewater will be generated and will be discharged into the municipal sewer in the area.

Power

The total power demand for the project has been estimated as 200 KW. The power supply will be made available from the state electricity board.

Waste

Approximately 0.52 MT/day of waste will be generated during the operation phase of the project. Two set of Twin bins of 200 l capacity each will be provided at the lower terminal station along the South bank and one set will be provided at the upper terminal station along the north bank. The waste collection frequency will be daily and the waste will be handed over to the Guwahati Municipal Corporation.

Manpower

The operation of the proposed project will involve employment of about 40 skilled and semi skilled staff.

Parking

Parking facilities will be provided at the lower terminal station. An area of 1850 sq.m has been designated for parking and will accommodate about 100 Cars and 80 two wheelers.

7.0 ENVIRONMENTAL SETTING OF THE STUDY AREA

The baseline environmental status was assessed based on primary and secondary data collected either through in-site field observation or obtained from agencies such as IMD, Geological Survey of India, State Ground Water Department, Central Ground Water Board, State Pollution Control Board, Census of India and Local Forest Department.

The baseline status collated from analysis of secondary and primary data is summarized in the **Table E-1** below

TABLE E-1: BASELINE ENVIRONMENTAL STATUS

Attribute	Baseline status
Meteorology	A meteorological station was set up on site. The minimum temperature recorded was 12.6 °C and maximum temperature was found to be 31.2 °C during the study period (Winter season'08). The average wind speed was observed to be 1.22 m/s and the predominant wind direction was observed to be northeasterly
Ambient Air Quality	Ambient air quality was monitored at 5 locations. The observed SPM levels were in range of 89 to 265.0 μg/m^3, while RSPM was in range of 41 to 123 μg/m^3. The range of SO_2 and NO_X was 5-11.0 μg/m^3 and 5 to 23 μg/m^3 respectively. Observed SPM levels exceeded NAAQS at three locations and RSPM levels at two locations whereas concentrations of SO_2, NOx were well within the prescribed limits. CO levels were well within prescribed limits at project site.
Noise Levels	Noise monitoring was carried out at seven locations. The results of the monitoring program indicated that both the daytime and night time levels of noise exceeded the ambient noise standards at two locations and one location respectively.
Water Quality	4 Groundwater samples were analyzed. Total Dissolved Solids (TDS) in groundwater samples exceeded the permissible limit as per IS: 10500 at three locations (Uluburi, Paltan bazaar and Rajadwar village). Calcium levels exceeded at two locations, Magnesium at all the four locations, Iron at three locations ,total alkalinity at two locations and total coliform levels exceeded the permissible limits at two locations Surface water samples from Brahmaputra river were analyzed at four locations. The BOD value was observed to be slightly high at three

Attribute	Baseline status
	locations. Rest all parameters were within limits as per Class C standards for water quality.
Soil Quality	The proposed site is characterized by clayey soils. The results show that the moisture retention capacity of the soil is low. Soil of the area is slightly basic.
Biological Environment	The proposed site falls within the biogeographic Zone - Brahmaputra Valley of India. Reserve forests like Phatasil Reserve forest, Sila Reserve Forest Agyathuri Reserve Forest ,South Kalapahar and Dirgheshwari pahar are located at a distance of 4.4 km, 5.5 km, 7.2 km, 3.9 km and 4.5 km away Brahmaputra river is famous for fresh water dolphin that is Ganges river dolphin (Platanista gangetica) which is commonly known as Susus. It has been declared as an endangered mammal by IUCN Red List-2008.
Socio-economy	The proposed sit will link Guwahati and north Guwahati are the two circles. Work participation rate is 35.1 % and proportion of category of "other workers" is 96.8%.

8.0 IMPACT ASSESSMENT AND MANAGEMENT PLAN

Environmental impact due to the construction and operation stages of the project were predicted quantitatively using models such as ISCST3 for air dispersion calculations, noise propagation equations for noise impacts. Impacts were also evaluated qualitatively using engineering judgment and best management practices.

Adequate environmental management measures will be incorporated during planning, construction and operating stages of the project to minimize any adverse environmental impact and assure sustainable development of the area. The impacts during construction phase will be temporal in nature. The summary details the pollution sources, mitigation measures for operation phase for different components.

8.1 WATER ENVIRONMENT

The major impact on the water environment during the construction phase of the project will be the impact on water quality due to introduction of construction materials in the river system and deposition of materials. Temporary barriers of GI sheets will be constructed along the construction area to contain the impacts. The navigational activities will also get slightly disrupted but the impact will be mitigated by phasing the construction activities.

During operation phase, the navigational activities will not be impacted as necessary horizontal and vertical clearances have been provided. The water demand for the project has been estimated as 15.61 m^3/day and will be sourced through municipal supply. About 11.7 m^3/day of wastewater will be generated and will be discharged to the municipal sewer.

8.2 LAND ENVIRONMENT

The construction activities for the proposed project will involve construction of terminal stations. No impact on the land use is expected as the areas of the terminals comprise of abandoned land. The waste generated during the construction will be effectively managed. During operation phase the proposed project will generate about 0.52 MT/day of waste. Adequate number of collection points will be provided and the waste will be handed over to the Guwahati Municipal Corporation.

8.3 ECOLOGICAL ENVIRONMENT

The proposed project will have a minor impact on the terrestrial and aquatic ecology during construction and operation phase. During construction phase, there will a minor impact due to pollution and disturbance caused. No tree cutting is involved in the project. The proposed alignment does not coincide with the route of migratory birds and thus will not have any impact. No impact on the river dolphins is expected.

8.4 SOCIO ECONOMIC ENVIRONMENT

The proposed project will not have any impact on the archaeological sites as no activity is proposed at the Urbashi Island which is protected by the Archaeology Department . The Umananda Island comprises of a temple and no impact is expected as no boarding/deboarding operations are expected. The services of ferryboat operators will continue to be used as the ropeway only targets office goers and businessmen and the villagers and fishermen will continue to avail their services.

8.5 AIR ENVIRONMENT

The construction activities for the proposed terminal stations will be of small scale and thus the particulate emissions will be minimal and short term in nature. The dust generated during the construction phase on the river bed and island will be considerably reduced due to localized meteorological conditions.

During operation phase, the project will involve operation of one DG set of 300 kVA and 10 KVA only for emergency evacuation during power failure. The predicted incremental concentrations have been estimated to be negligible. The DG set will be provided with adequate stack height of 7 m and 4 m.

8.6 NOISE ENVIRONMENT

The use of construction equipments will lead to increased sound pressure levels. It is proposed to implement job rotation and to limit the time of operation along with providing earplugs in areas of high noise exposure.

The operation of the cable car system will lead to noise emissions due to movement of cable car. The impact due to movement of cable car will be minor and short term in nature. Thus, no impact is envisaged on the noise environment.

8.0 ENVIRONMENTAL MANAGEMENT SYSTEM

For the effective implementation of the EMP, an Environmental Management System (EMS) will be established at the proposed project. The EMS will include the following:

1. An Environmental Management cell
2. Environmental Monitoring Program
3. Personnel Training
4. Regular Environmental Audits and Corrective Action
5. Documentation – Standard operating procedures Environmental Management Plans and other records.

9.0 CONCLUSION:

The proposed project is aimed at the infrastructural development of the area. The project will provide impetus to the growth of north Guwahati. The project will provide a safer means of transportation to the residents of Guwahati city.

All possible environment aspects have been adequately assessed and necessary control measures have been formulated to meet with statutory requirements, in the preparation of this EIA-EMP report. Thus implementing this project will not have any appreciable negative impacts. Thus, the proposed project is a welcome development and may be accorded environmental clearance.

EIA Report

1.0 Introduction

Guwahati is often considered as the gateway to the North-East Region (NER) of the country and is the largest city within the region. During the past few decades it has experienced unprecedented spatial expansion and a steep rise in population. The city is spread between the Lokpriya Gopinath Bordoloi (LGB) International Airport in the West and Narengi in the East for almost 45 km and between the southern bank of the Brahmaputra river and the foothills of the Shillong plateau for around 15 km. The city is gradually expanding to the northern bank of Brahmaputra.

The Guwahati city is a major hub of commercial, industrial and educational activities and a large number of people travel from north Guwahati to the city. Most of the commuters cross the Brahmaputra river through government and private ferry boats. The government operated boats are very less in number and cannot cater to the need of the commuters. There is a road bridge across the river which takes a detour of 20 km to travel from north Guwahati to south Guwahati. Since the city's expansion is envisaged on the northern bank of the river, an efficient transport system is imperative to connect the two banks.

The Government of Assam has taken initiative for the development of ropeway project across Brahmaputra river to connect Guwahati city situated on the south bank to the north bank. The Government of Assam has subsequently designated Guwahati Metropolitan Development Authority (GMDA) to execute the project. The detailed project report for the proposed project has been prepared by M/s RITES Limited.

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M/s Guwahati Metropolitan Development Authority has retained the services of SENES Consultants India Private Limited (SENES) for carrying out Environmental Impact Assessment (EIA) study and preparation of an EIA report and Disaster Management Plan (DMP) for the proposed project. The purpose of this Environmental Impact Assessment (EIA) study is to provide information on the nature and extent of environmental impacts arising from the construction and operation of the proposed project and related activities taking place concurrently.

1.1 OBJECTIVES AND SCOPE OF STUDY

The objectives of the EIA study are as follows:

i) To describe the proposed project and associated works together with the requirements for carrying out the proposed development;
ii) To establish the baseline environmental and social scenario of the project surroundings;
iii) To identify and describe the elements of the community and environment likely to be affected by the proposed developments;
iv) To identify, predict and evaluate environmental and social impacts expected to raise during the construction and operation phase of the project in relation to the sensitive receptors;
v) To develop mitigation measures so as to minimize pollution, environmental disturbance and nuisance during construction and operations of the development; and
vi) To design and specify the monitoring and auditing requirements necessary to ensure the implementation and the effectiveness of the mitigation measures adopted.
vii) To prepare disaster management plan to deal with emergency situations.

1.2 EIA METHODOLOGY

The EIA study has been carried out as per the MoEF guidelines. The EIA methodology for the proposed project has been described in **Figure 1.1.**

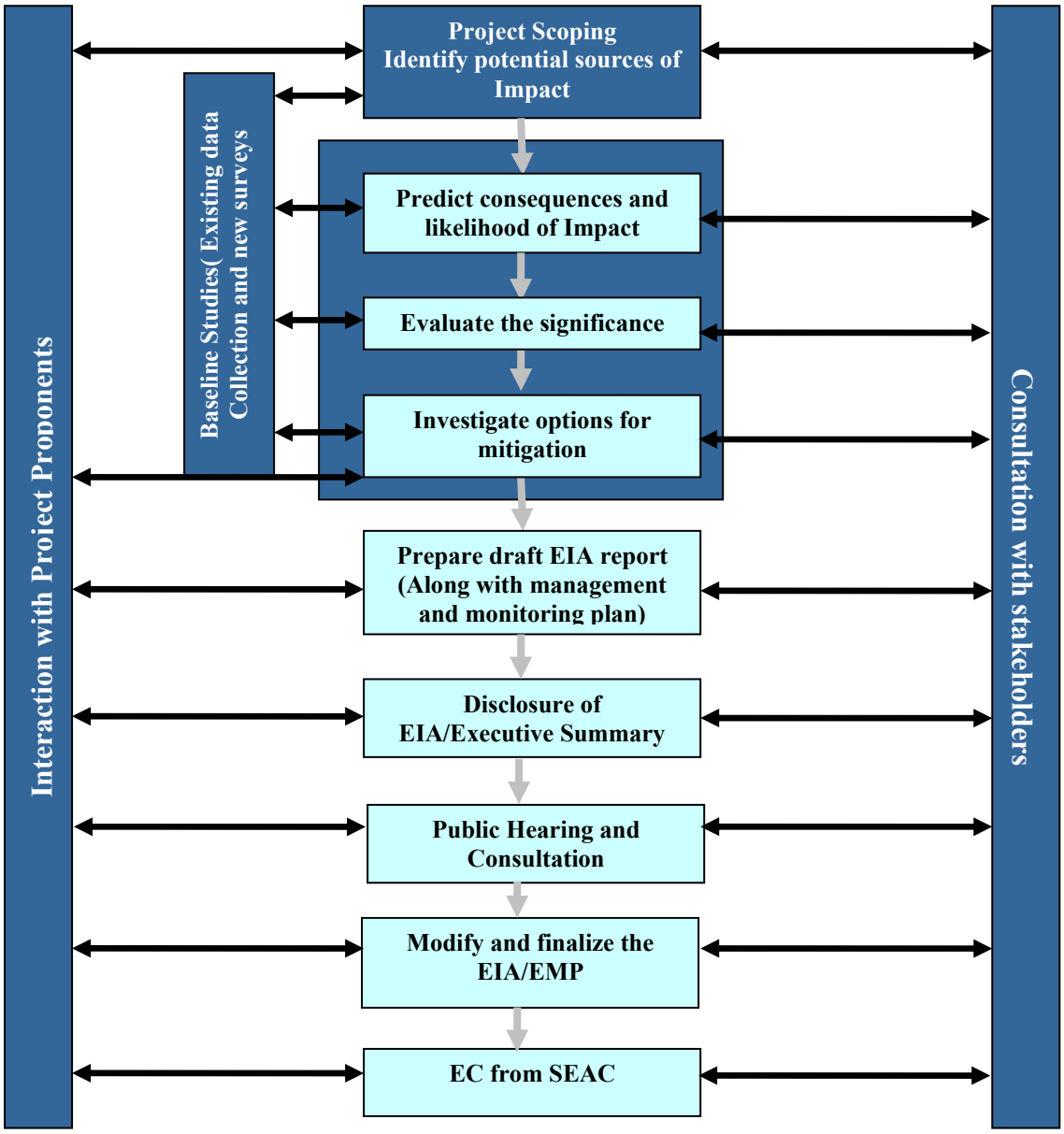
1.3 STRUCTURE OF THE EIA REPORT

This EIA report presents the existing baseline scenario and the results from the assessment and evaluation of the environmental impacts that may arise during the construction and operation of the proposed development. Following impact prediction, the requirement for mitigative measures to minimize any unacceptable environmental impacts is presented. This report also highlights the post project environmental monitoring plan and environment management system considered to be necessary during the construction and operation.

This EIA report comprises of six chapters as follows:

- ***Chapter 1*** discusses the introduction and scope of study.
- ***Chapter 2*** outlines the detailed project description
- ***Chapter 3*** documents the baseline environmental status of the project site.
- ***Chapter 4*** deals with environmental impacts associated with the project and proposed mitigation measures
- ***Chapter 5*** presents the Environmental Management Plan (EMP) both during construction and operational phases of the proposed project.
- ***Chapter 6*** deals with Disaster Management Plan for the proposed project.
- ***Chapter 7*** presents the summary and conclusions of the EIA study.

FIGURE 1.1: EIA METHODOLOGY



1.4 ADDRESSAL OF TOR

The salient points discussed during the Expert Appraisal Committee (EAC) meeting and provided in Terms of Reference (TOR) given by MoEF vide File no No.10-119/2007-IA.III dated September 2 , 2008 have been duly addressed. The terms of reference approved by MoEF is attached as **Appendix I.** The summary is given below:

SN	TOR Recommendation	Compliance
1	Details of feasibility study. The proponent shall examine alternative route also.	The feasibility study for the proposed project has been carried out by M/s Rites Limited. The project has an Internal rate of return of 3.96% but considering the socio economic benefits and the impetus it will provide to the growth of north Guwahati, the project has been found feasible. Two alternative routes were evaluated and the route via Umananda island was selected. The details are presented in Section 2.4.
2	Details of funds available for the project and the recurring expenditure.	The proposed project has been granted administrative approval for an amount of Rs. 27.72 crores and the Government of Assam has disbursed a fund of Rs. 11.47 Crores to GMDA for the proposed project . The details have been presented in Section 2.8.
3	Details of the parking on both sides of the project area.	Adequate parking facilities will be provided . An area of 1850 sq.m has been designated for parking facilities along the south bank and will accommodate about 100 cars and 80 two wheelers.
4	Details of the safety incorporated in the project.	Adequate safety measures will be adopted such as door lock and safety devices at stations. A minimum of three sets of diesel engine operated both directional self driven rescue carriage will be provided for rescue of stranded passengers. The rescue carriage will be such that once it is docked before the stranded cabin, passengers can be shifted to the rescue cabin easily. The details of safety measures have been provided in Section 6.1.3
5	Details of landuse plan on either ends of the project.	The landuse on either ends of the project has been designated as recreational areas. The landuse plan for Guwahati city is provided in Figure 5.1
6	Details of solid waste management.	Measures will be taken to minimize the construction waste generation. The waste material will be segregated at source and recycling of waste will be done to the extent possible. The responsibility of transporting and disposing construction and demolition waste will be of the contractor and will be transported to an authorised site.

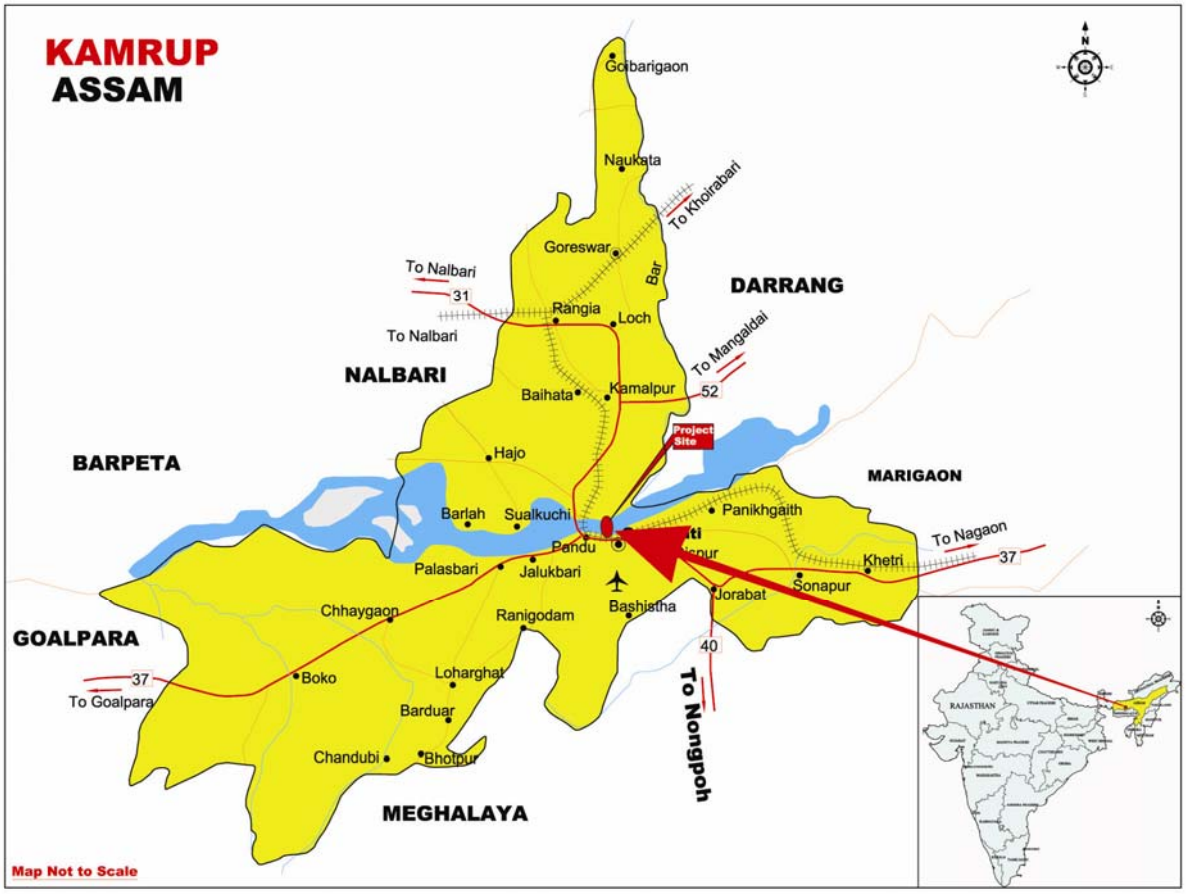
		Twin bins of 200 l capacity will be provided to collect the waste generated during operation phase of the proposed project. The waste will be handed over to the Guwahati Municipal Corporation.
7	Public Hearing shall be conducted in accordance with Environmental Impact Assessment Notification, 2006 and the issues raised by the public shall be incorporated in the Environment Impact Assessment / Environmental Management Plan and submitted to the Ministry with all requisite data/ information.	The proposed EIA report is being submitted for conduct of Public Hearing.

2.0 Project Description

Guwahati is the gateway to the northeastern region. Due to its excellent connectivity and unique geographical location, this region is experiencing rapid growth of trade and commerce and it has the potential to become the hinterland for the entire northeastern region. The major growth of the city is now aimed at north Guwahati due to shortage of land at the southern part. The two banks of the river are connected through road and water transport. The road bridge takes a detour of 20 km and the travel time is about 1 hour. The ferry boats are very less in number and cannot cater to the needs of the future population. Considering the expansion of the city on the north bank, an efficient transport system is required to connect the two banks.

The Government of Assam thus intends to develop an aerial ropeway across Brahmaputra river to connect Guwahati city situated on the south bank to the north bank. Guwahati Metropolitan Development Authority (GMDA) has been designated by Govt. of Assam to execute the project. The location of the proposed project is shown in **Figure 2.1.**

FIGURE 2.1: PROJECT LOCATION



2.1 NEED AND JUSTIFICATION FOR PROJECT

The population of Guwahati city is expanding at a high rate. The region also experiences flow of large volume of goods pertaining not only to the state of Assam but also to the other parts of the northeastern region. Additionally, substantial number of students and workers from the rest of the state and rest of the NE region come to Guwahati on regular basis. The substantial growth in the region is characterized by densification of the center core and ribbon development along the main transportation corridor. The situation has further deteriorated due to a limited road network and carriageway resulting in perpetual congestion on the main as well as arterial roads within the city.

Looking into these aspects, the future growth of the city is planned along the north bank. At present, the connectivity of the banks of the river is through private and state owned transport buses and ferry services operated by Department of Inland Water Transport, Assam. There is a road bridge across the river, which leads to NH – 31 and connects the north and south bank. The NH-31 and the road in the main city are quite congested and during peak hours it takes about one to two hours to cross the river. The road connectivity of the two banks is shown in **Figure 2.2.**

The Department of Inland Water Transport, Assam operates 61 numbers of ferry services for the purpose of public utility connecting the south bank of the river with north bank. However, the ferries used for carrying passengers are old and do not have the capacity to carry vehicles thereby reducing the effectiveness of the entire system.

The existing transportation infrastructure connecting the two banks is evidently inadequate. Considering the proposed future growth pattern of the city, it is imperative to have a reliable transport system in place and thus an aerial ropeway is proposed to provide connectivity between the two banks. The detailed project report for the proposed ropeway has been carried out by M/s Rites Limited.

2.2 TRAFFIC PROJECTION AND SYSTEM CAPACITY

Traffic data was collected from secondary sources to estimate the system capacity for the proposed ropeway. The details of passengers commuting through ferry boats were collected from the major ferry ghats in the area. The details of secondary data collected are provided in **Appendix II (Table 1).** The average daily number of commuters crossing the river was estimated as 2896 with the weekday average being 2988 and the weekend average being 2297.

FIGURE 2.2: ROAD CONNECTIVITY OF NORTH BANK AND SOUTH BANK

Considering a growth rate of 3 % and assuming that the ropeway will be used by 30% of the commuters, the ropeway capacity works out to be 162 PPH (passengers per hour) in 2026 and 256 in the year 2043 **(Appendix II, Table 2).** Hourly traffic data was also collected for Panbazar and Machhkaua ghats. The peak hourly traffic was estimated to be 425 and projections were made considering 3 % growth rate. The ropeway capacity was worked out as 223 PPH for 2026 and 370 PPH for 2043**(Appendix II, Table 3).** Thus, the proposed ropeway has been designed for a carrying capacity of 250 PPH. The proposed ropeway will meet the traffic needs for 2043 for average traffic flow and 2026 for peak hourly traffic.

2.3 SITE SELECTION CRITERIA

The site selection criteria for the terminal stations included the following:

- Availability of adequate space for proposed terminal points
- Ease of land acquisition
- Minimum possible infringement
- Feasibility to cater to the required traffic projection
- Connectivity of stations
- Power availability

2.4 ALTERNATE SITES

Two alignments were studied and their benefits and drawbacks were examined in detail in terms of engineering feasibility, practicality of construction and operational requirements, costs, landscape, visual and environmental impact. The following alignments were considered:

- Ropeway between south bank and north bank via Urbashi island and Umananda island.
- Ropeway between south bank and north bank of Guwahati via Umananda island.

Alignment 1: The alignment passes through Umananda and Urbashi island, which is located at a distance of 441 m from the south bank and is protected by the Archaeology Department.

Alignment 2: The alignment passes through Umananda island only. This alignment has been selected because of no involvement of protected archaeological areas and shorter length.

Two alternatives were evaluated for the location of the terminal station at south bank of the river. The alternatives were as follows:

- Nehru Park
- Forest Office

The site at Nehru Park comprises of a children's park and therefore it was ruled out. The other site comprises of area available in the Forest Office and is located adjacent to the main road. Thus, this site was selected for the location of the terminal station.

2.5 PROPOSED ALIGNMENT

The alignment for the proposed ropeway has been considered between south bank and north bank of Brahmaputra river via Umananda island. The length of the proposed ropeway will be 1820 m. The proposed alignment will involve construction of five trestles in addition to two terminal stations. The entire alignment will pass through Brahmaputra river. The maximum depth in the southern channel is in the range of 10 to 14 m whereas the maximum depth in the northern channel ranges between 23 to 27 m. The major navigation activities take place in the northern channel whereas the southern channel is used for navigating of country boats and double decker systems. The proposed ropeway alignment is shown in **Figure 2.3**

FIGURE 2.3: PROPOSED ALIGNMENT

The detailed L section and the plan for the proposed ropeway has been provided in **Appendix III**. The depth of the river bed as observed through echo sounding process has been enclosed as **Appendix IV.**

Lower Terminal Station – Forest Compound, south bank

The proposed site for the terminal station is the Forest Compound, along the south bank of the river, which in under the possession of GMDA. The site is connected through a two lane undivided road which leads to NH- 37 and NH- 31. The coordinates of the terminal station are as follows:

Latitude: N 26°11'24.40"
Longitude: E 91°44'47.90"

The terminal station will be will comprise of passenger handling area, ticket counter and parking facilities. The layout plan for the proposed terminal station is provided in **Appendix V.** An area of 1850 sq.m has been designated for parking purposes and will accommodate about 140 Cars.

Upper Terminal Station – Rajadwar village, north bank of Guwahati

The proposed site for the terminal station is located at Rajadwar village along the north bank of the river. The station is at a distance of 300 m from Machkhao ferry ghat and is located near the unmetalled road, which leads to Amingaon. The road will have to be developed for about 300 m length. The coordinates of the terminal station are as follows:

Latitude: N 26°11'47.30"
Longitude: E 91°44'41.97"

Apart from this, passenger-handling area, public conveniences, parking will be provided at the upper terminal station. The layout plan for the upper terminal station is provided as **Appendix VI.**

2.6 SELECTION OF ROPEWAY SYSTEM

The following ropeway systems were evaluated for the proposed ropeway:

- Fixed grip gondola system
- Pulsated gondola system
- Jig Back system
- Mono cable detachable Gondola system

Fixed Grip Gondola system (continuous movement) is ruled out because boarding/de-boarding needs to be carried out when the system is on and being fixed grip system, the ropeway speed will be less. Therefore considering the length of the ropeway and the recommended capacity, a large number of cabins will need to be installed.

Pulsated Gondola system is ruled out because this system is ideally not suitable when the length of the ropeway is long. Therefore the effectiveness of this system becomes meaningless.

Detachable Gondola System is ruled out because the capacity of the system is low and requires greater station area.

Jig Back system offers advantages such as ease in boarding/de-boarding operations and the capacity can be met with a reasonable system speed. Further, no station mechanisms are required for locking, unlocking and grip testing as the cabin does not have to take a round turn and thus requires less length. Thus, it is proposed to provide a mono cable detachable gondola system.

2.7 DESCRIPTION OF ROPEWAY SYSTEM

It is proposed to provide a Twin track Single haul Bi Cable double reversible Jig Back system. In Jig Back cable system, the vehicle oscillates 'To and Fro' between stations on the same track by inverting the hauling ropes direction of motion. There will be one cabin on two track ropes on both sides. The hauling rope will be an endless rope which can move in both the directions. Both the cabins will be attached to the hauling rope in such a way that while one cabin is at one station the other is at the other station. The details of the ropeway system are provided in **Table 2.1** and the details of the system operation are provided in **Appendix VII.**

TABLE 2.1: ROPEWAY CHARACTERISTICS

SN	Particular	Proposed Alignment
1	System	Twin track Single haul Bi Cable double reversible Jig Back system
2	Total Length (m)	1820
3	Capacity , PPH	250
4	Line Speed (m/s)	0-6
5	Maximum Lift (m)	19
6	Cabin capacity , persons	30+1 (Passengers + Operator)
7	Number of cabin sets	2
8	Rescue System	Self driven carriage and cabin
9	Travel time (s)	406

2.8 FINANCIAL VIABILITY OF PROJECT

The total cost for the project has been worked out to be Rs. 28.67 Crores. The charges for ferryboats for one way trip are about Rs. 5.0 per person. Considering the target population, which comprises office goers and businessmen, it is suggested that a fare of Rs. 25.0 per head be charged for a round fare for the initial period. Based on the estimated project cost, annual

recurring cost and earnings, the project yields a Financial Internal Rate of Return (FIRR) of 3.96 % (Refer **Appendix VIII** for the cash flow statement). Although the FIRR for the project is less, the proposed ropeway will provide an alternative safe mode of transport compared to the boat services and the alternate road route. In addition, the future growth of the city is planned along the north bank and the proposed ropeway will become the focal point of attraction of north bank.

The proposed project has been granted administrative approval for an amount of Rs. 27.72 crores and has been attached as **Appendix IX**. The Government of Assam has also disbursed a fund of Rs. 11.47 Crores to GMDA for the proposed project and the documents have been attached as **Appendix IX.**

2.9 UTILITIES AND INFRASTRUCTURAL FACILITIES

Water

The water demand for the proposed project has been estimated as 15.6 m^3/day. The water requirements for the proposed project will be met through the municipal source. It is expected that about 11.7 m^3/day of wastewater will be generated and will be discharged into the municipal sewer in the area.

Power

The total power demand for the project has been estimated as 200 KW. The power supply will be made available from the state electricity board.

Waste

Approximately 0.52 MT/day of waste will be generated during the operation phase of the project. Two set of Twin bins of 200 l capacity each will be provided at the lower terminal station along the south bank and one set will be provided at the upper terminal station along the north bank. The waste collection frequency will be daily and the waste will be handed over to the Guwahati Municipal Corporation.

Manpower

The operation of the proposed project will involve employment of about 40 skilled and semi skilled staff.

3.0 Baseline Environmental Status of the Area

This chapter describes the existing environmental settings in the study area. In order to identify any potential impact on and changes to the natural and socioeconomic environments, it is essential to have a thorough understanding of the nature of those existing environments prior to commencement of the proposed activities. This translates as a need to characterize the existing baseline environmental and socio-economic conditions including establishing the prevailing conditions for a range of media through primary monitoring, undertaking focused surveys, and the collection of secondary information from various published sources. This includes the physical environment comprising air, water and land components, the biological environment, and socio-economic environment. The major purposes of describing the environmental settings of the study area are:

- To understand the environmental characteristics of the area;
- To assess the existing environmental quality, as well as the environmental impacts of the future developments being studied;
- To identify environmentally significant factors or geographical areas that could influence any decision about future development.

The following section describes the methodology for the baseline studies in detail.

3.1 METHODOLOGY OF CONDUCTING BASELINE STUDY

Attributes of the physical environment like air, water, soil, and noise quality in the surrounding area were assessed, primarily through field studies, and by undertaking monitoring and analysis of samples collected from field. Information about geology, hydrology, prevailing natural hazards like earthquakes, etc have been collected from literature reviews and authenticated information made available by government departments. Extensive surveys were carried out to understand and record the biological environment prevailing in the area and the same was verified against published information and literature. The socioeconomic environment has been studied through extensive consultations with various stakeholders with a strong focus on the neighbouring villages. Additionally, socioeconomic data has been obtained from the Census and various government departments.

The scoping and the extent of data generation were formulated with interdisciplinary team discussions, criteria questions and professional judgment. The study area for undertaking baseline studies has been taken as 5 km on either side of the alignment. However, based on the initial survey, the understanding of the project, and professional judgment, the study area for the primary baseline studies and intensive data collection was taken as 2 km on either side of the alignment.

3.2 AIR ENVIRONMENT

The existing quality of the air environment serves as an index for assessing the pollution load and the assimilative capacity of any region and forms an important tool for planning project activity in the area. Primary ambient air quality data was collected for winter season (December 2008) to understand the air quality in the region and to assess the impacts on air environment.

3.2.1 Climate and Meteorology

Climate and meteorology of a place can play an important role in the implementation of any developmental project. Meteorology is also the key to understand local air quality as there is an essential relationship between meteorology and atmospheric dispersion involving wind in the broadest sense of the term.

Guwahati's climate is mildly sub-tropical with warm, dry summers from April to late May, a strong monsoon from June to September and cool, dry winters from late October to March. December, January and February are the coldest and June, July, August and September are the hottest. Extreme high level of humidity is observed in summers leading to discomfort.

Secondary data has been collected from various sources including data from Guwahati station of the Indian Meteorological Department (IMD). Guwahati experiences a mild sub tropical climate.

A) Meteorological Data

Meteorological information is important for devising baseline ambient air quality monitoring plans and for the prediction of impacts from air quality modeling. At Guwahati, a meteorological station was installed to monitor parameters of wind speed and direction and temperature. Hourly meteorological data was collected for one season (winter, December 2008). Monitoring was done as per IS: 8829: Micro-meteorological Techniques in Air Pollution.

Long-term climate trend data was obtained from Guwahati, IMD meteorological station located at the Bhorjar airfield. The area around the station is plain, surrounded by hills, about 9 km from the Bramhaputra. Wind instruments were located on the roof of the Radio – sonde building at a height of 7 m, with satisfactory exposure (IMD, 1951 - 1980). The observatory was shifted from old site at Kaikuchi to Bhorjar airfield, new ATC building on 1st Jan.1953. Another part time observatory was functional at the Central Telegraph office from 1902 to Sept.1965.

B) Long Term Climate Trends

The following section discusses the long-term climate trend of secondary data collected for the station located at the Bhorjar airfield in Guwahati over the period of 1951-1980. This data, along with the data obtained from onsite has been used in air dispersion modeling. The climatological summary for Guwahati is provided in **Table 3.1.**

TABLE 3.1: CLIMATOLOGCIAL SUMMARY FOR IMD STATION AT GUWAHATI (1951-1980)

Month	Mean Max. Temp (°C)	Mean Min. Temp (°C)	Total Rainfall (mm)	Mean Wind Speed (m/s)	Predominant Wind direction
January	23.6	9.8	11.4	0.7	NE
February	26.4	11.5	12.8	1.0	NE
March	30.2	15.5	57.7	1.4	NE
April	31.5	20.0	142.3	1.8	NE
May	31.0	22.5	248.0	1.6	NE
June	31.4	24.7	350.1	1.3	NE
July	31.8	25.5	353.6	1.2	NE
August	32.1	25.5	269.9	1.2	NE
September	31.7	24.6	166.2	1.0	NE
October	30.1	21.8	79.2	0.9	NE
November	27.4	16.4	19.4	0.8	NE
December	24.6	11.5	5.1	0.6	NE
Average/ Total	**29.3**	**19.1**	**1717.7**	**1.1**	**-**

Source: Climatological Table, IMD

Precipitation: The onset of monsoon in Guwahati district takes place by mid April and lasts up to September. The majority of rainfall in Guwahati (about 71 %) takes place during the period of May – August and the average annual precipitation for the region is 1717.7 mm. The maximum mean monthly rainfall is 353.6 mm, which occurs in July; with mean minimum monthly rainfall is 5.1 mm, which occurs in the month of December.

Near Surface Temperature: Guwahati has mild sub tropical weather conditions. Summers are warm and dry whereas winters exhibit cool and dry conditions. The mean daily minimum temperature at Guwahati occurs in January (9.8 °C) and the mean daily maximum temperature occurs in August (32.1°C).

Wind Direction: Wind direction is reported as the direction from which the wind blows and is based on surface observations. Over the course of a year, wind usually blows in all directions,

with varying frequencies. Certain directions occur more frequently than others – these are known as the prevailing wind directions. On an average, over the course of a year, the prevailing winds are from the northeast direction approximately 21 percent of the time. Calms (i.e. wind speed less than 1 knot or 0.51444 m/s) are reported 41 percent of the time.

C) Meteorological Station Data

Table 3.2 provides averages of temperature, rainfall, and wind speed over the winter season during which monitoring was done. **Figure 3.1** presents a wind rose over the monitoring period.

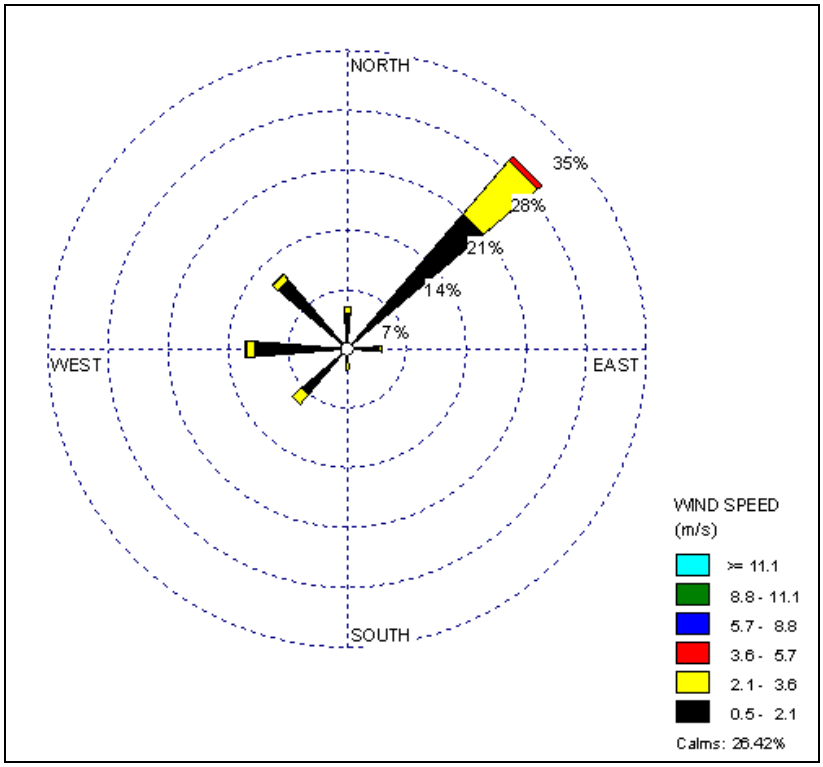
TABLE 3.2: METEOROLOGICAL MONITORING DATA

Season	Maximum Temp (°C)	Minimum Temp (°C)	Average Wind speed (m/sec)	Rainfall (mm)
Winter	31.2	12.6	1.22	Nil

D) Wind Rose

The wind rose denotes a class of diagrams designed to display the distribution of wind direction experienced at a given location over a period of time - long for a climatological record of prevailing winds or short to show wind character for a particular event or purpose. Wind roses summarize a considerable amount of wind frequency information into a single graphic and shown in **Figure 3.1** below during the monitoring period at the proposed site.

FIGURE 3.1: WIND ROSE FOR METEOROLOGICAL MONITORING DATA



The wind rose diagram reveals that wind was blowing predominantly from the northeast direction with frequency of approximately 30% having speed in the range of 0.5-5.7 m s^{-1} during the monitoring period. Wind speed, however, in the range of 3.6-5.7 m s^{-1} was observed with very low frequency of about 1%. The onsite average wind speed was observed 1.22 m s^{-1} with frequency of calm winds 26.42% during the monitoring period. The wind rose diagram shows that during the monitoring period predominant wind direction was observed concurrent with climatological prevailing wind direction (northeasterly).

TABLE 3.3: FREQUENCY OF STABILITY CLASSES OVER MONITORING PERIOD

Stability Class	Frequency (%)
A – Extremely Unstable	16.1
B – Unstable	16
C – Slightly Unstable	1.2
D – Neutral	Nil
E – Slightly Stable	3.0
F – Stable to Extremely Stable	63.7

This data indicates that over the monitoring period, the site exhibits trends of primarily stable to extremely stable conditions. Stable conditions exhibit poor vertical mixing, and low levels of contaminant dispersion. Use of this stability data for modeling purposes will produce higher concentrations of pollutants at a given receptor (i.e. more conservative results).

3.2.2 Ambient Air Quality in Study area

An assessment of baseline air quality was undertaken to establish the status of exposure of the receptors. This assessment was accomplished by examining sources of air emissions within the study area, and by conducting a site–specific background–sampling program.

Site–specific Background Air Quality Monitoring

A site–specific background air quality monitoring program was conducted for one season (pre-monsoon season). Background data was collected for SPM, RSPM, SO2, NOx and CO.

Four sampling stations were located in the study area to provide the surrounding baseline air quality. The details of monitoring locations are specified in **Table 3.4.**

TABLE 3.4: AIR QUALITY MONITORING LOCATIONS

Monitor	Description	Distance from centre of site (km)	Upwind/ Downwind from Site
AQ1	Forest Office, LTP	0.0 km from LTP	Project Site
AQ2	Umananda	0.7 km from LTP	Upwind
AQ3	Rajadwar Village	0.2 km from UTP	Upwind
AQ4	Ulubari	2.5 km from LTP	Downwind
AQ5	AT Road (Near Vishal Mega Mart)	0.8 km from LTP	Downwind

The background-monitoring program was carried out as per standard methodologies and accepted protocols as detailed by the MoEF. Air quality was monitored with four high volume samplers, for 24 hours, twice a week. Each sampler maintained a volumetric flow rate between 1-1.2 m3/min. In this manner, 24 hourly values for all pollutants were collected at each of the four locations. Analysis of pollutants was done as per standard IS codes.

Monitoring results (observed levels and ranges) of SPM, RSPM, SO2, NOx and CO are presented in the **Table 3.5A** to **Table 3.5E.**

TABLE 3.5A: MONITORING PROGRAM RESULTS – AQ1

Units: $\mu g/m^3$

Parameter	Monitoring Results			NAAQS (Residential, Rural and other areas)
	Maximum	Average	Minimum	
SPM	**229**	**208**	183	200
RSPM	**103**	90	78	100
SO_2	8	7	6	80
NO_x	18	16	11	80
CO	820	650	500	2000

TABLE 3.5 B: MONITORING PROGRAM RESULTS – AQ2

Units: $\mu g/m^3$

Parameter	Monitoring Results			NAAQS (Residential, Rural and other areas)
	Maximum	Average	Minimum	
SPM	119	102	89	200
RSPM	54	48	41	100
SO_2	5	4	2	80
NO_x	7	6	5	80
CO	485	470	450	2000

FIGURE 3.2: AIR MONITORING LOCATIONS

TABLE 3.5C: MONITORING PROGRAM RESULTS – AQ3

Units: μg/m^3

Parameter	Monitoring Results			NAAQS (Residential, Rural and other areas)
	Maximum	Average	Minimum	
SPM	155	133	113	200
RSPM	90	64	49	100
SO_2	5	3	4	80
NO_x	7	6	6	80
CO	690	536	410	2000

TABLE 3.5 D: MONITORING PROGRAM RESULTS – AQ4

Units: μg/m^3

Parameter	Monitoring Results			NAAQS (Residential, Rural and other areas)
	Maximum	Average	Minimum	
SPM	**219**	196	177	200
RSPM	99	85	75	100
SO_2	11	8	6	80
NO_x	22	18	9	80
CO	730	586	500	2000

TABLE 3.5E: MONITORING PROGRAM RESULTS – AQ5

Units: μg/m^3

Parameter	Monitoring Results			NAAQS (Residential, Rural and other areas)
	Maximum	Average	Minimum	
SPM	**265**	**206**	178	200
RSPM	**123**	95	77	100
SO_2	11	8	7	80
NO_x	23	17	10	80
CO	840	678	550	2000

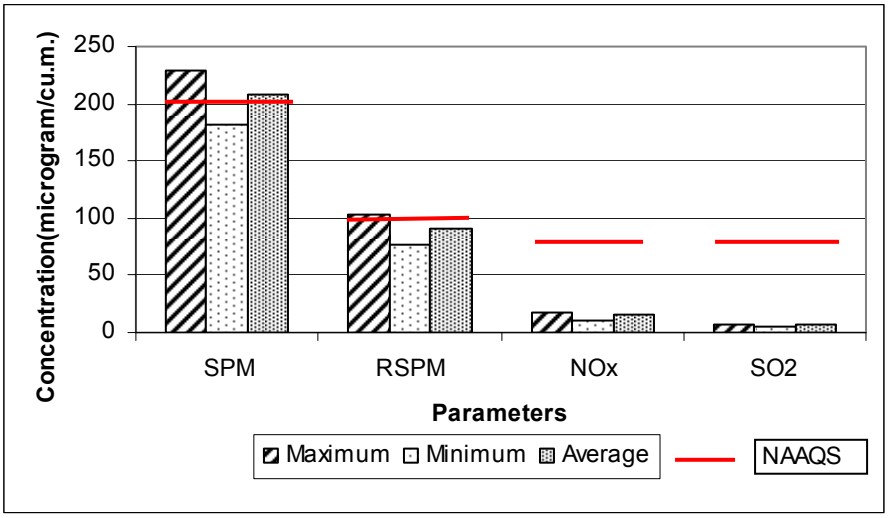
With respect to pollutants, the results of the monitoring program indicate the following:

- The observed SPM levels obtained at three locations are beyond permissible limits
- Monitored values of RSPM are beyond permissible limits at two locations
- NO_X and SO_2 level observations are well within the specified standards at all the monitored locations.
- CO levels observations are also well within the specified standards at all the monitored locations

The baseline conditions at each of the air quality monitors are described below, with NAAQS standards indicated on each graph.

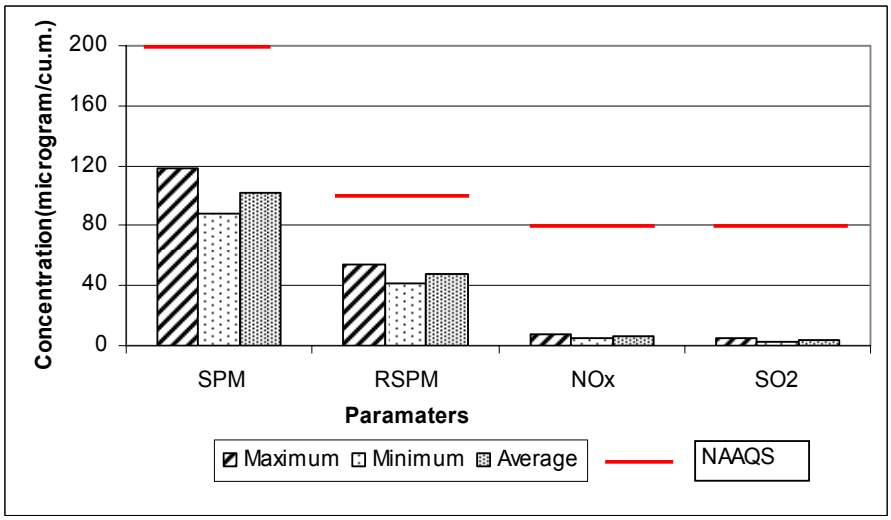
AQ-1: The monitor was placed at the lower terminal station. Observed SPM and RSPM levels were observed to be high at this location with maximum concentration of SPM and RSPM being 229 µg/m^3 and 103 µg/m^3 respectively. All the other parameters (SO_2 and NO_x) were observed to be well within the prescribed standards (Refer **Figure 3.3**).

FIGURE 3.3: BASELINE AIR QUALITY - AQ1 (FOREST COMPOUND)



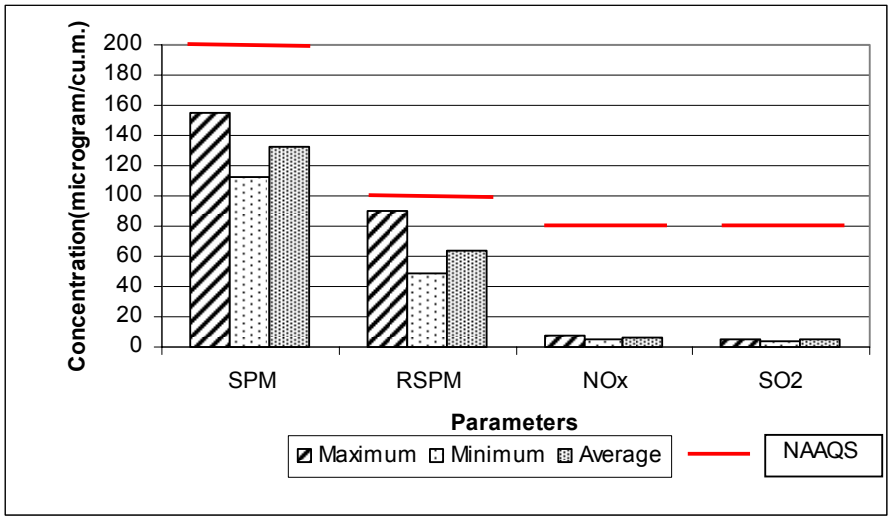
AQ-2: The monitor was placed at Umananda, upwind to the project site. All the parameters are well within the limits (Refer **Figure 3.4**).

FIGURE 3.4: BASELINE AIR QUALITY - AQ2 (UMANANDA ISLAND)



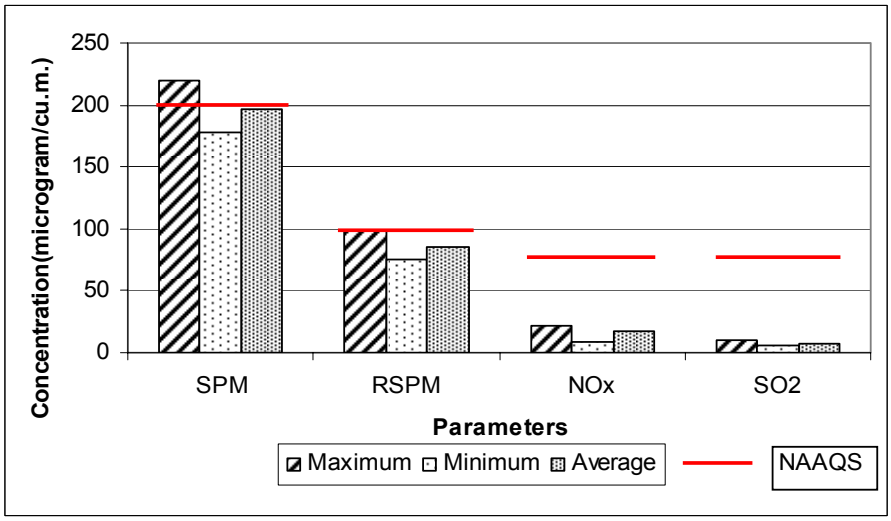
AQ- 3: This monitor was placed in Rajadwar village, upwind to the project site. All the parameters i.e. SPM, RSPM, SO_2 and NO_x are well within the prescribed limits (Refer **Figure 3.5**).

FIGURE 3.5: BASELINE AIR QUALITY - AQ3 (RAJADWAR VILLAGE)



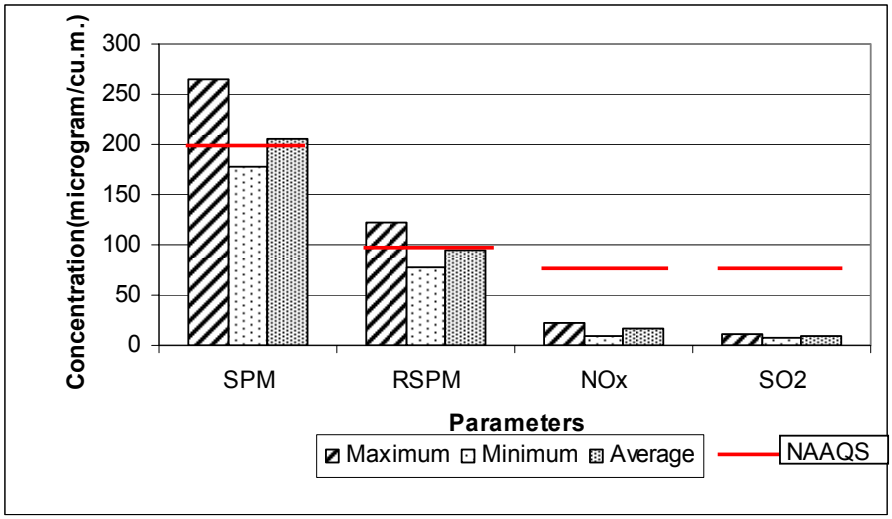
AQ- 4: This monitor was placed on a building in Ulubari, downwind to the project site. All the pollutants are within the prescribed limit except for SPM which exceeded NAAQS. Maximum value of SPM observed at this location is 219 μg/m^3. (Refer **Figure 3.6**).

FIGURE 3.6: BASELINE AIR QUALITY - AQ4 (ULUBARI)



AQ- 5: This monitor was placed on a building on AT road, near Vishal Mega Mart, downwind to the project site. All the pollutants are within the prescribed limit except for SPM and RSPM which exceeded NAAQS. Maximum value of SPM and RSPM observed at this location was 265 μg/m^3 and 123 μg/m^3 respectively. (Refer **Figure 3.7**)

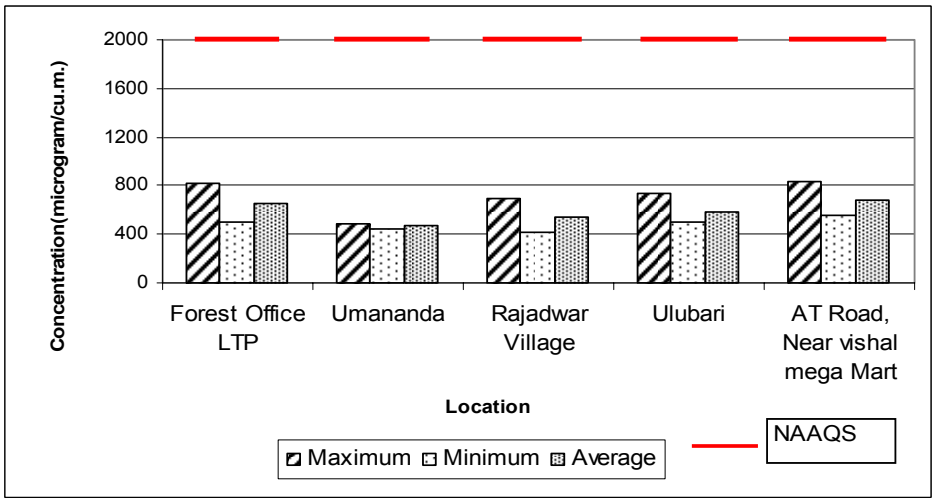
FIGURE 3.7: BASELINE AIR QUALITY - AQ5 (NEAR VISHAL MEGA MART)



CO CONCENTRATION:

The CO concentration is well below the prescribed NAAQS limits at all the 5 monitoring locations.

FIGURE 3.8: CONCENTRATION OF CO AT DIFFERENT LOCATIONS



3.3 NOISE ENVIRONMENT

Unwanted noise and unpleasant sounds are generally classified as noise pollution. It is measured in decibels (dB). Normally a person begins to identify sounds when a level of 10 to 15 dB is reached. The other end of the scale is known as the threshold of pain (140 dB), or the point at which the average person experiences pain. Noise is generally measured in frequency weighted scales and noise quality measurements are generally measured in the 'A' level and reported as db (A). To be able to make an assessment of noise impacts, a noise monitoring study has been carried out to establish existing ambient noise quality in the study area.

A) Ambient Noise Quality

An assessment of baseline noise quality was undertaken to establish the status of exposure of the major sensitive receptors.

This assessment was accomplished by conducting a site–specific background–monitoring program and where appropriate, drawing comparisons to the applicable Ambient Air Quality Standards in Respect of Noise (AAQSRN).

B) Site-Specific Background Noise Quality Monitoring

Noise monitoring was conducted at seven locations within the study area. The background-monitoring program was done in accordance with the requirements of an EIA study. Sound pressure level (SPL) measurements were automatically recorded to give the noise level for every hour continuously for 24 hours in a day.

Accordingly, three full days (i.e. 24 hourly values) of data was collected at each of the seven locations. These monitoring locations are provided in **Table 3.6.**

TABLE 3.6: NOISE MONITORING LOCATIONS

Monitoring Station	Description of Location	Distance from the nearest point
N1	Forest Office, LTP	0.0 km from LTP
N2	Umananda	0.7 km from LTP
N3	Rajadwar, UTP	0.0 km from UTP
N4	Rajadwar village	0.7 km from UTP
N5	Pan Bazaar	0.4 km from LTP
N6	Kacchahari Chowk	0.2 km from LTP
N7	Nehru Park	0.2 km from LTP

Table 3.7 provides equivalent noise levels viz., Leqday and Leqnight, at the noise monitoring locations, alongside noise standards as prescribed by the CPCB. Leq was calculated using the following equation:

$$L_{eq,T} = 10\log\left(1/n\sum_{i=1}^{n}10^{\frac{L_i}{10}}\right)$$

Where Li = levels observed at n equally spaced times during interval T.

TABLE 3.7: MONITORING PROGRAM RESULTS – NOISE

Location	Day Time			Night Time		
	Date	Leq (dB (A)	Limit Leq (dB (A))	Date	Leq (dB (A)	Limit Leq (dB (A)
N1	05-12-08	54.3	55	05-12-08	45.0	45
	12-12-08	54.3	55	12-12-08	43.4	45
	19-12-08	52.5	55	19-12-08	42.1	45
N2	06-12-08	51.8	55	06-12-08	39.5	45
	13-12-08	52.1	55	13-12-08	39.6	45
	20-12-08	**55.8**	55	20-12-08	39.5	45
N3	03-12-08	43.4	55	03-12-08	37.7	45
	10-12-08	43.6	55	10-12-08	37.8	45
	17-12-08	43.0	55	17-12-08	37.6	45
N4	03-12-08	49.8	55	03-12-08	40.6	45
	10-12-08	50.1	55	10-12-08	40.1	45
	17-12-08	50.7	55	17-12-08	40.4	45
N5	04-12-08	**55.3**	55	04-12-08	43.5	45
	11-12-08	**56.5**	55	11-12-08	42.6	45
	18-12-08	**56.1**	55	18-12-08	43.4	45
N6	03-12-08	**58.0**	55	03-12-08	**47.6**	45
	10-12-08	***60.1***	55	10-12-08	***47.9***	45
	17-12-08	***59.8***	55	17-12-08	***47.5***	45
N7	08-12-08	*52.9*	55	08-12-08	*41.6*	45
	15-12-08	*52.0*	55	15-12-08	*42.0*	45
	22-12-08	*52.8*	55	22-12-08	*41.5*	45

TABLE 3.8: AMBIENT AIR QUALITY STANDARDS IN RESPECT OF NOISE

Area Code	Category of Area/Zone	Limits in dB (A) Leq*	
		Day Time	Night Time
(A)	Industrial area	75	70
(B)	Commercial area	65	55
(C)	Residential area	55	45
(D)	Silence Zone	50	40

1. *Daytime shall mean from 6.00 a.m. to 10.00 p.m.*
2. *Night time shall mean from 10.00 p.m. to 6.00 a.m.*
3. *Silence zone is defined as an area comprising not less than 100 meters around hospitals, educational institutions and courts. The silence zones are zones, which are declared as such by the competent authority.*
4. *Mixed categories of areas may be declared as one of the four above-mentioned categories by the competent authority.*

The results of the monitoring program indicated that the daytime levels of noise exceeded N2 (Umananda island) on one out of three days of the monitoring process. The daytime levels of noise exceeded the prescribed standards on all three days of the monitoring at N5 (Pan Bazar). The day time as well as the night time noise levels exceeded the prescribed standards at N6 (Kacchahari Chowk) on all the three days of monitoring.

3.4 TRAFFIC PATTERN & DENSITY

Traffic counts were carried at two locations-a) Kacchahari Chowk (south bank) and b) Hazu Chowk (north bank) to provide background values of traffic density, and correlate such data to the levels of air pollution and noise along the road.

Site-Specific Traffic Monitoring

Site-specific traffic study was conducted along two roads ; a) Kacchahari Chowk (south bank) and b) Hazu Chowk (north bank). In total, these roads were surveyed for 2 days each including weekday and weekend. Total number of vehicles passing on a weekday and weekend are presented in **Table 3.9** and **Table 310**. Vehicular traffic included heavy motor vehicles (truck, buses, and matadors), light motor vehicle / cars, three wheelers, two wheelers and bi/ tricycles.

TABLE 3.9: TOTAL NUMBER OF VEHICLES - KACCHAHARI CHOWK

SN	Vehicle	Total Traffic Count	
		Weekday	Weekend
1	Heavy Motor Vehicles	6233	3469
2	Light Motor Vehicles / Cars	13430	7072
3	Three wheelers	4190	1616
4	Two Wheelers	13698	6406
5	Bicycle / Tricycle	1565	1334

TABLE 3.10: TOTAL NUMBER OF VEHICLES - HAZU CHOWK

SN	Vehicle	Total Traffic Count	
		Weekday	Weekend
1	Heavy Motor Vehicles	1326	1205
2	Light Motor Vehicles / Cars	1589	1277
3	Three wheelers	843	705
4	Two Wheelers	1614	1238
5	Bicycle / Tricycle	1436	1102

FIGURE 3.9: TRAFFIC COUNT (TO & FRO) PERFORMED ON KACCAHARI CHOWK ON WEEKDAY

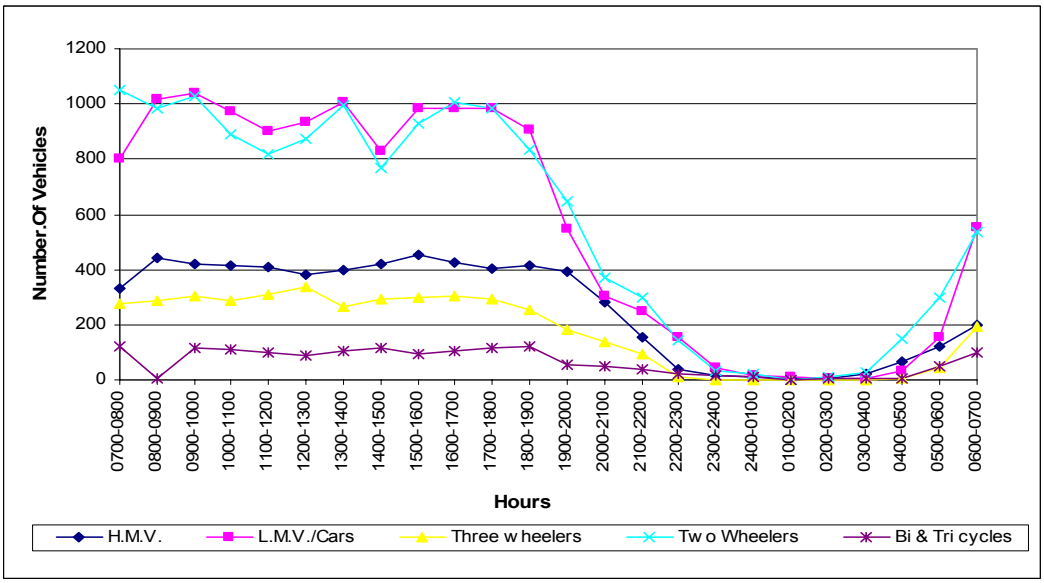


FIGURE 3.10: TRAFFIC COUNT (TO & FRO) PERFORMED ON KACCAHARI CHOWK ON WEEKEND

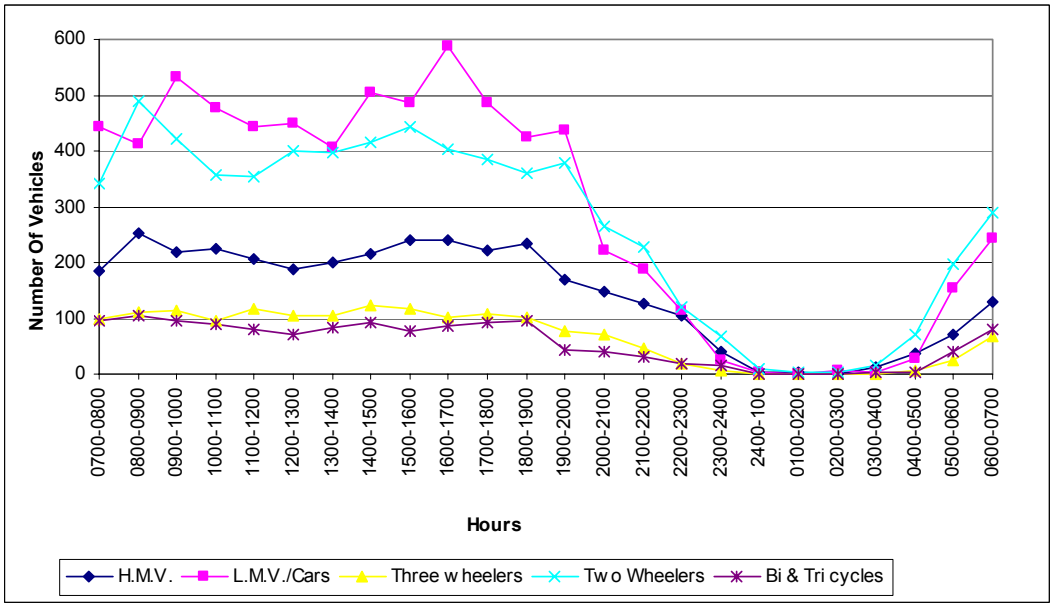


FIGURE 3.11: TRAFFIC COUNT (TO & FRO) PERFORMED ON HAZU CHOWK ON WEEKDAY

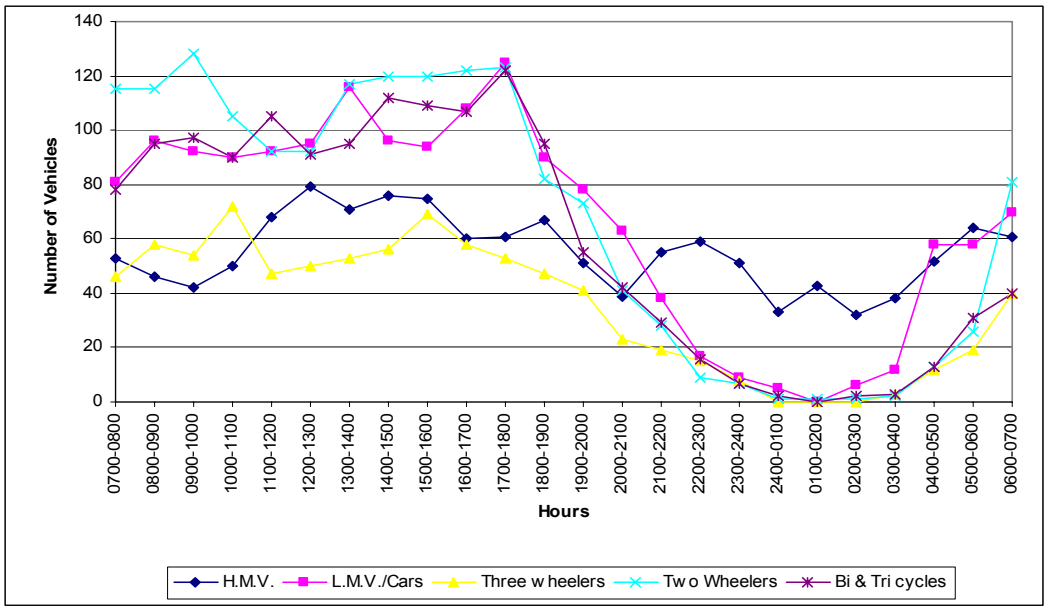
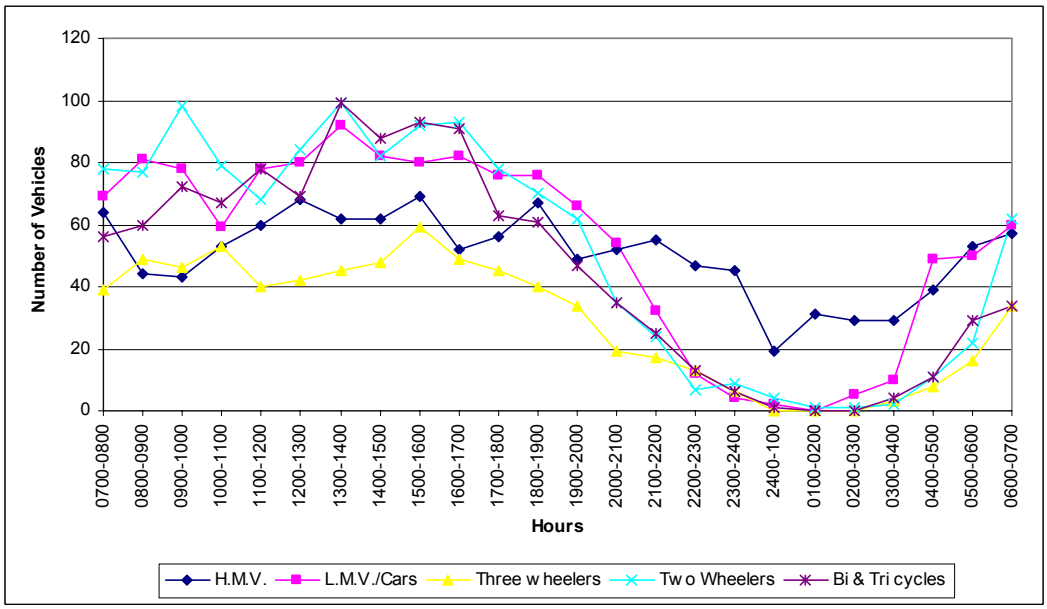


FIGURE 3.12: TRAFFIC COUNT (TO & FRO) PERFORMED ON HAZU CHOWK ON WEEKEND



The results of the monitoring program indicate the following:

- The traffic along Kacchahari Chowk was observed to be more than along Hazu Chowk. This can be attributed to he fact that the south bank is more developed and has a higher density of population as compared to the north bank.
- During weekday frequency of vehicles were observed to be more as compared to weekend at both the locations.
- At Kacchahari Chowk, maximum volume of traffic comprised of two wheelers followed by LMV's on a weekday whereas on a weekend maximum number of vehicles comprised of LMV's followed by two wheelers on. The rest of the vehicles showed

similar movement in terms of volume on a weekday as well as a weekend (HMV's followed by three wheelers and bi/tricycles).

- At Hazu Chowk, maximum volume of traffic comprised of two wheelers followed by LMV's, bi/tricycle, HMV's and three wheelers on a weekday. On a weekend, the maximum volume of traffic comprised of LMV's followed by two wheelers, HMV's, bi/tricycles and three wheelers.

3.5 WATER ENVIRONMENT

This section documents the baseline scenario of the water environment in the study area and discusses both water resources and quality. The data has been collected from various secondary sources and primary survey carried out in the study area.

3.5.1 Hydro-geological Settings

Geologically, Guwahati city is characterized by mostly Precambrian granite gneisses, quartzite forming residual hills and occupying a major part of the landscape. Small, elongated intermontane valleys with various thicknesses of sediment fill and alluvium form the rest of the areas.

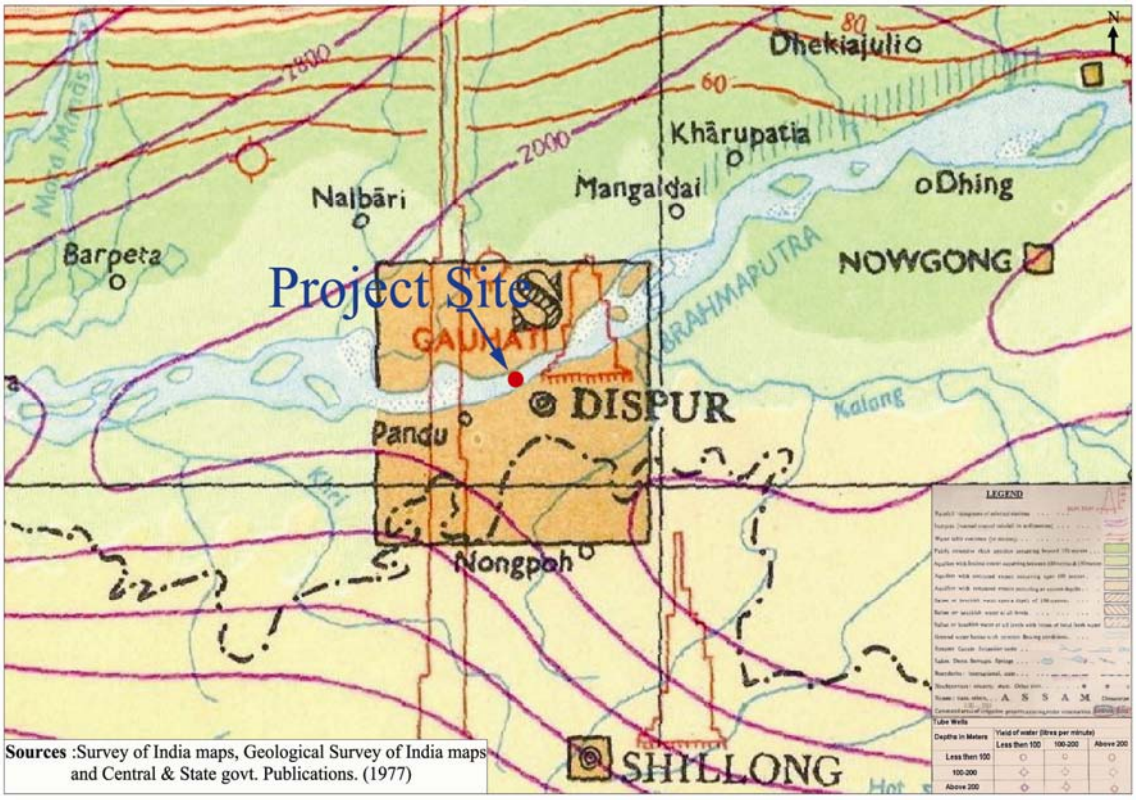
Study of satellite data, supplemented by field checks over Guwahati, show that a characteristic feature of the terrain is the presence of a number of paleochannels which are perceived to be old channel ways linked to the river Brahmaputra towards north.

Apart from the rainfall, tanks, and surface reservoirs along with return seepage from the canals and irrigation are the important sources of ground water recharge. Largely, the hydrogeological framework of the district is controlled by geological structures, morphological configuration and distribution of precipitation.

Hard rocks like gneiss and schist occurs in hilly regions and alluvium in the plains of Guwahati. Gneiss and schist are hard, compact and devoid of primary porosity. However, due to weathering and tectonic movements these rocks have developed a weathered zone of 5 - 15 m thickness and fractures zones of considerable depth and extent. These zones have developed secondary porosity and permeability and form aquifers of minor to medium potential. Ground water occurs in these zones and moves along hydraulic highs towards hydraulic lows.

In alluvial deposits, several thick beds of sand/gravel and boulders are present which form aquifers of excellent hydraulic parameters and of great potential. At places, thick and impervious clay beds confine aquifers when saturated aquifers develop confined or artesian condition. Such condition is found near Dumunichowki over an area of about 150 - 200 sq.km. Ground water is developed by means of dug wells, bore wells, and occurs under semi confined to unconfined conditions. The saturated thickness of these aquifers ranges from 50 m to 150 m.

FIGURE 3.13: HYDROGEOLOGICAL MAP



3.5.2 Baseline Water Quality & Sampling Locations

Water sampling and analysis has been conducted to establish baseline water quality in the area. Sampling has been done following standard guidelines for physical, chemical and bacteriological parameters. Water analysis was done as per the methods prescribed in "Standard Methods for the Examination of Water and Wastewater (American Public Health Association)".

Four ground water and four surface water samples evaluated in the study area. **Table 3.11A** and **Table 3.11B** give details of the ground water and surface water sampling stations.

TABLE 3.11 A: GROUNDWATER QUALITY MONITORING LOCATIONS

Station No.	Description	Distance from the nearest point on the route (km)
GW – 1	Ulubari	2.5 km from LTP
GW – 2	Paltan Bazar	1.1 km from LTP
GW – 3	Rajadwar	0.7 km from UTP
GW – 4	Forest Office	0.0 km from LTP

TABLE 3.11 B: SURFACE WATER QUALITY MONITORING LOCATIONS

Station No.	Description	Distance from the nearest point on the route (km)
SW-1	Brahmaputra river near Forest Office Bank	0.5 km from Umananda Island
SW-2	Rajadwar Bank	0.8 km from Umananda Island
SW-3	Downstream of Brahmaputra	0.7 km from Umananda Island
SW-4	Upstream of Brahmaputra	0.6 km from Umananda Island

Table 3.12 A shows the physicochemical characteristics of composite ground water sampling in the selected areas as compared with the standard (IS 10500: Indian Standards/Specifications for Drinking Water) reference values. **Table 3.12 B** shows the physicochemical characteristics of surface water samples as compared to CPCB Standards for Class "C" water i.e. water to be used for drinking after conventional treatment followed by disinfections.

TABLE 3.12A: GROUND WATER QUALITY IN THE STUDY AREA

S. N	Test Parameters	Unit	Results				Desired limit as per IS: 10500	Permissible limit (IS: 10500)
			GW1 (OW)	GW2 (OW)	GW3 (OW)	GW4 (BW)		
1	pH	-	7.12	7.10	6.98	7.08	6.5-8.5	6.5-8.5
2	Colour	Hazen	<5	<5	<5	<5	5	25
3	Odour	-	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
4	Turbidity	NTU	2.0	3.12	4.12	3.6	5	10
5	Taste	-	Agreeable	Agreeable	Agreeable	Agreeable	N.S.	N.S.
6	Conductivity	µmhos/cm	1352	1176	1098	510	N.S.	N.S.
7	Total Dissolved Solids	mg/L	**752**	**650**	**592**	266	500	2000
8	Chloride as Cl^-	mg/L	189.04	150.37	154.67	30.07	250	1000
9	Sulphate as SO_4^{2-}	mg/L	103.02	59.69	65.45	15.45	200	400
10	Calcium as Ca	mg/L	**92.98**	**78.55**	72.14	52.40	75	200
11	Magnesium as Mg	mg/L	**52.90**	**48.09**	**46.49**	**41.68**	30	100
12	Iron as Fe	mg/L	0.30	**2.68**	**1.48**	**0.35**	0.3	1.0
13	Nitrate	mg/L	9.51	1.43	41.12	1.08	45	100
14	Fluoride	mg/L	0.46	0.40	0.35	0.37	1.0	1.5
15	Total Alkalinity	mg/L	**269.50**	**291.50**	121.0	176	200	600
16	Total Hardness as Carbonates	mg/L	6.21	2.53	6.13	6.26	300	600
17	Cyanide as CN	mg/L	ND	ND	ND	ND	0.05	No relaxation
18	Zinc as Zn	mg/L	0.02	0.02	0.02	0.028	5	15
19	Lead as Pb	mg/L	0.001	0.005	0.003	0.005	0.05	No relaxation
20	Residual free Chlorine	mg/L	N.D.	N.D.	N.D.	N.D.	0.2	No relaxation

21	Selenium as Se	mg/L	N.D.	N.D.	N.D.	N.D.	0.01	No relaxation
22	Cadmium as Cd	mg/L	<0.01	N.D.	N.D.	0.0014	0.01	No relaxation
23	Chromium as Cr+6	mg/L	N.D.	N.D.	N.D.	N.D.	0.05	No relaxation
24	Copper as Cu	mg/L	0.018	0.017	0.015	0.018	0.05	No relaxation
25	Arsenic as As	mg/L	<0.02	N.D.	N.D.	N.D.	0.05	No relaxation
26	Aluminium as Al	mg/L	0.003	0.006	0.004	0.003	0.03	0.2
27	Manganese as Mn	mg/L	0.016	0.018	0.017	0.016	0.1	0.3
28	Boron as B	mg/L	N.D.	0.003	0.003	0.002	1.0	5.0
29	Mercury as Hg	mg/L	N.D.	N.D.	N.D.	N.D.	0.001	No relaxation
30	Total Coliform	MPN/100ml	<2.0	348.0	418	<2.0	10	No relaxation
31	E.coli	/100 ml	Absent	Absent	Absent	Absent	Nil	No relaxation
32	Fecal Coliform	/100ml	Absent	Absent	Absent	Absent	Nil	No relaxation

ND: Not Detectable, OW: Open Well, BW: Bore well
GW-1: Water sample from Ulubari; GW-2: Water sample from Paltan Bazar ; GW-3: Water sample from Rajadwar ; GW – 4: Water sample from Forest Office

TABLE 3.12 B: SURFACE WATER QUALITY IN THE STUDY AREA

S. N	Test parameters	Unit	Result				CPCB standards for class "C" water
			SW-1	SW-2	SW-3	SW-4	
1	pH	-	7.28	6.98	7.29	7.76	6.5-8.5
2	Conductivity at 20 ^{o}C	S/cm	0.123	0.123	0.127	0.126	-
3	Colour	Hazen	18	12	11	15	300
4	Free Ammonia as NH_4^+	mg/L	Nil	Nil	Nil	Nil	N.S.
5	Boron as B		0.07	0.02	0.07	0.03	N.S.
6	Iron as Fe	mg/L	0.106	0.11	0.12	0.11	50
7	Chloride as Cl^-	mg/L	8	10	12	12	600
8	Dissolved Oxygen	mg/L	7.0	7.1	7.2	7.0	Min 4.0
9	COD	mg/L	28.44	12.19	12.19	16.25	-
10	BOD,3 days at 27 ^{o}C	mg/L	**10**	**4.0**	**4.0**	**6.0**	Max. 3
11	Nitrates as NO_3^-	mg/L	2.6	2.4	2.4	2.7	50
12	Total Suspended Solids	mg/L	35	38	46	42	N.S.
13	Sulphate as SO_4^-	mg/L	10	12	**7**	**8**	400
14	Total Coliform	MPN/100 ml	<2.0	5.0	80	82	5000
15	E.coli	/ 100ml	Absent	Absent	Absent	Absent	Nil

N.S: Not specified, N.D.: Not Detected

SW-1: Brahmaputra river near forest office bank, *SW-2: Brahmaputra river near Rajadwar bank;*

SW-3: Brahmaputra river, downstream of LTP, *SW-2: Brahmaputra river , upstream. of LTP*

Above table indicates that the groundwater quality exceeded desirable limits for drinking water with respect to Total dissolved solids at three locations (i.e. GW - 1, GW - 2 & GW - 3), Calcium at two locations (i.e. GW-1 & GW - 2), Magnesium at all the four locations (i.e. GW1, GW2, GW3 & GW4), Iron at three locations (i.e. GW - 2, GW - 3 & GW - 4), total alkalinity at two locations (i.e. GW-1 & GW- 2) and total coliform levels exceeded the permissible limits at two locations (i.e.GW-2 & GW-3). All the other parameters were within the prescribed limits as per IS: 10500 (Specifications for drinking water).

Surface water samples on analysis and comparison with CPCB class "C" water showed that BOD is relatively high at all the four locations as compared to the maximum allowable limit. This may be due to the discharge of untreated effluents into the river water. Surface water sample also shows the presence of Total Coliform. Rest all the parameters are within the limits of Class "C" water i.e. water to be used for drinking after conventional treatment followed by disinfections.

3.6 LAND ENVIRONMENT

3.6.1 Geology of the Area

Geologically, the Guwahati city represents a Precambrian terrain that is an extension of the Shillong plateau. Physiographically the area can be divided into three units-

- The hilly region in the south,
- The alluvial plains in central part and
- The western parts and the swamps along Brahmaputra flood plains.

Geologically, the city is made up of the Precambrian gneissic complex, which is, directly overlain by Pleistocene-Holocene sediments. The hills are made up of the gneisses and granite bodies with quartzites, amphibolites and biotite schists; with the intermontane valleys are filled with Pleistocene-Holocene sediments. The rocks are affected by two dominant sets of joints, intruded by quartz veins, aplite and pegmatite.

The Shillong Group of rocks occurs as inselbergs in alluvium and hill ranges in southern boundary of the district with Meghalaya. These rocks occupy about 1500 sq. km, area south out of Brahmaputra river and 100 sq.km (ten percent) in north bank. They constitute mainly of schists and gneisses of varied nature and composition. Migmatites, basic rocks, granites and veins of different composition are embedded in these schists and gneisses.

The basement is overlain by a cover of Quaternary deposits of variable thickness composed of unconsolidated sand, silt and clay. Along many tracts occupied by paleo channels, the typical Brahmaputra sand with abundant biotite and mostly silt are encountered. Thin layers of residual clays, which are the weathered product of feldspar, are found intertwined with the alluvium at places.

3.6.2 Sub Surface Geology

The lithological logs of boreholes drilled by Central Ground Water Board, Directorate of Geology and Mining, Assam State Minor Irrigation Department, Public Health Department and Private Sectors show that granular zones start right from surface to 250 m.b.g.l in the north bank of river Brahmaputra.

The alluvium comprise mainly of sand, gravel and boulders with intercalations of thin beds of clay. The coarseness of aquifer material increases towards north and ultimately becomes bouldery in the foothills of the Himalayan range. A thin cover of discontinuous clay beds occur at surface allover the alluvial deposit ranging in thickness of 5 to 10 m.

Sub-surface geology differs near inselbergs where piedmont formation of good thickness serves as aquifer. In the southern bank of river Brahmaputra the sub-surface geology is of non-uniform

nature in lateral as well as vertical extensions. The area dominated by alluvium is composed of sand, sandy clay, pebbles and gravels. In the piedmont formation coarse sand and pebbles act as aquifer.

3.6.3 Geomorphology of the project area

Geomorphologically, Guwahati city is located in an area, where the Shillong Plateau and the Floodplains of the Brahmaputra confront each other. Landforms within the city are therefore unique with dissected hills (originally part of the Shillong Plateau), plain areas and natural lakes (the beels), swamps and the mighty river Brahmaputra. Precambrian residual hills dotting all around interspersed with elongated low-lying plains. Broadly, the area is categorized into three geomorphic units:-

i) The denudo structural hills (residual hills),
ii) The alluvial plains and
iii) The marshy lands including the static water bodies (Water bodies with paleochannels) have
iv) been identified from satellite images and topomaps.

A unique feature of the landscape of Guwahati is the presence of numerous partially silted water bodies locally known as beels, the largest of which is the Deepar Beel, a Ramsar Convention list wetland of international importance presently covering about 5.7 sq. km. in the western fringe of the city, the only large water reserve of Guwahati. Other water bodies/wetlands within the city are Soru Sola Beel and Bor Sola Beel. Most of the earlier water bodies however, have been converted into built up land during last couple of decades.

The main city is situated on the southern banks of the Brahmaputra. At places the width of the river is 6 to 8 km, while its narrowest portion (1.8 km) is in the location of the famous bridge of Saraighat. Apart from the Brahmaputra towards northern extremity, two other rivers viz., the Basistha and Bharalu form the main drainage within the city. Water bodies along with paleochannels occupy only 7.82% of the total area, while the alluvial plain occupies 31.51% and residual hills occupy 68.49% of the total study area (Table 3; Fig. 2 and 3).

There are many permanent and temporary islands and beaches in the river. Umananda a permanent island situated close to the proposed site provides a unique picturesque environment. The project site is located over this island.

There are several hills of different sizes and shapes. The hills in the northern areas (Nilachal or Kamakhya Hill in the north-west, Chitrasala or Kharghuli Hill in the north) close to the bank of Brahmaputra, south-central areas (Narakasur Hill, Kalapahar and Fatasil Hill) and eastern areas (Narengi, Hengerabari, etc). Many of these hills such as the Nilachal, Chitrachal, Narakasur, etc. are famous of their legendary, religious and historic importance.

3.6.4 Relief and Drainage

The proposed project site lies in a flat area with a slope of less than 10 meters per kilometer and an elevation of less than 100 meters above sea level. The natural drainage system of Guwahati consists of the Bharalu river (a tributary of the Brahmaputra) and its inter-linkages to the beels and to the Brahmaputra river. Apart from Bharalu, many small rivers Morabharalu, Bahini, and Basista flow within the city interconnected with the feeder drains of the city. **Figure 3.14** and **Figure 3.15** show the slope and drainage map of Assam respectively.

FIGURE 3.14: SLOPE MAP

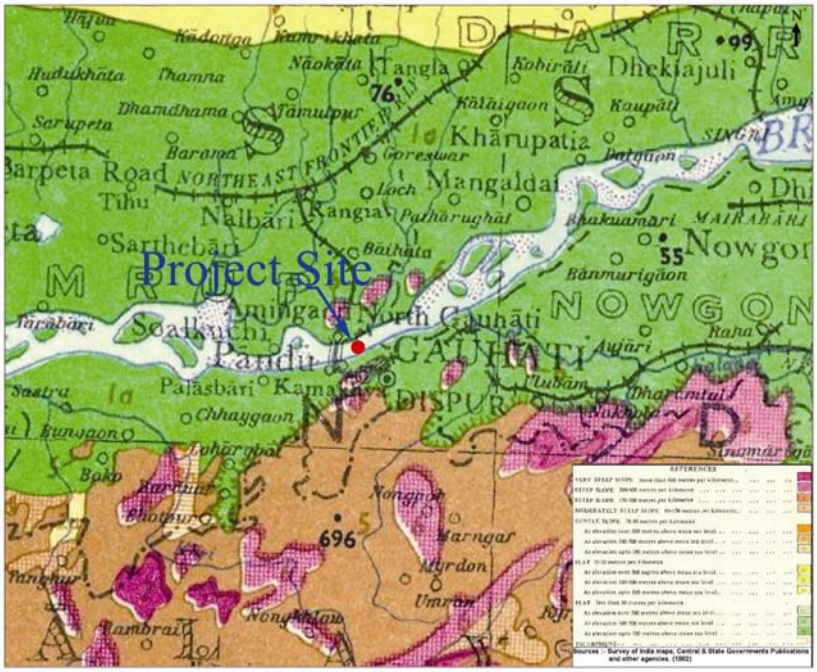
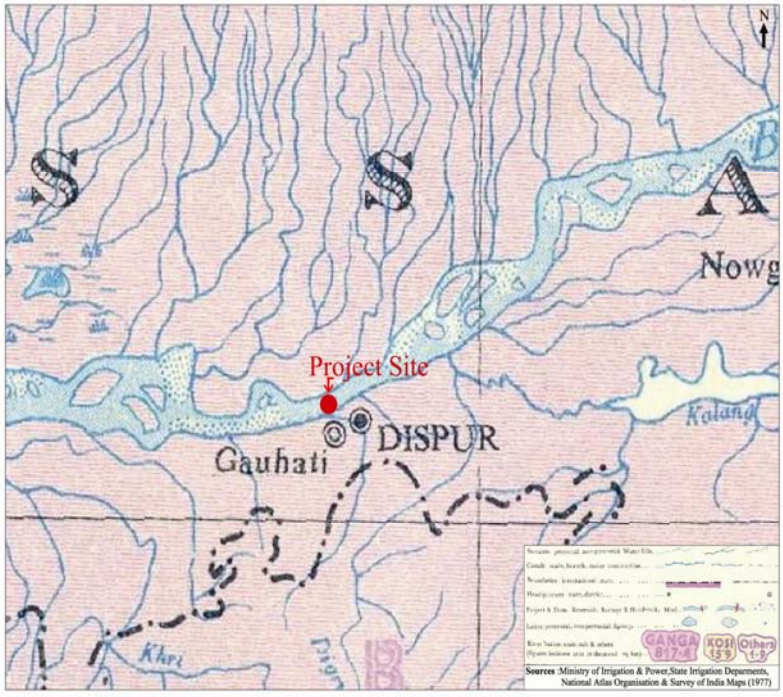


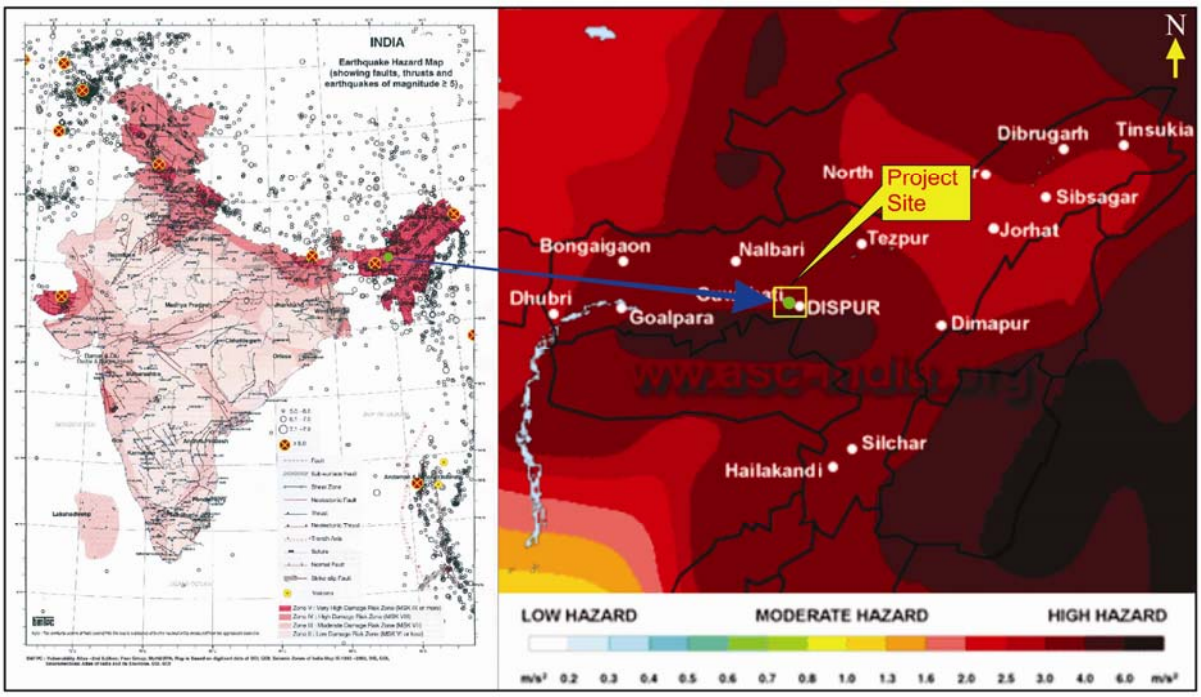
FIGURE 3.15: DRAINAGE MAP



3.6.5 Seismo-Tectonic Appraisal of the Area

Assam is among the most seismically active parts of India. Geomorphologically, northeast India is located in an earthquake prone zone (zone V) of the Indian subcontinent. In this region earthquakes come with land slides, floods along with series of earthquakes of smaller magnitude. Here earthquakes of up to MM intensity IX can be expected. According to a hazard map by the Global Seismic Hazard Assessment Program, the state can expect to have a peak gravitational acceleration (PGA) of 0.24g to 0.48g.

FIGURE 3.16: EARTHQUAKE HAZARD MAP OF ASSAM



3.6.6 Soil

The soil type found in Guwahati is mainly of sandy, silty and clay type. Soil sampling was done to establish the baseline characteristics and to assess the anticipated impacts due to proposed project. Soil samples thus collected were mixed to make composite sample that were analyzed. Details of the soil sampling location are shown in **Table 3.13.**

TABLE 3.13: SOIL SAMPLING LOCATIONS

Station No.	Description	Distance from the nearest point on the route (km)
S – 1	Forest office	0.0 km from LTP
S – 2	Umananda	0.8 km from LTP
S – 3	Rajadwar	0.0 km from UTP
S – 4	Rajadwar village	0.7 km from UTP

A quantitative assessment of the particle size distribution in the soil was made by wet sieve analysis and sedimentation analysis using hydrometer, as per procedures laid down in IS: 2720 Part IV. The particle sizes were designated according to the scale given in IS: 1498, which is given in **Table 3.14.**

TABLE 3.14: PARTICLE SIZE SCALE (IS: 1498)

Soil Type	Texture	Particle Size
Gravel	Coarse	20 – 80 mm
	Fine	4.75 – 20 mm
Sand	Coarse	2.0 – 4.75 mm
	Medium	0.425 – 2.0 mm
	Fine	0.075 – 0.425 mm
Silt & Clay	-	Less than 0.075 mm

The three major type of soil are – (a) sands, which have at least 70% sand and less than 15 % clay (b) clay, which have more than 40 % clay content (c) loam, which is a mixture of sand silt and clay. The physical and chemical characteristics of the soil samples collected are shown in the **Table 3.15.**

TABLE 3.15: SOIL CHARACTERISTICS IN THE STUDY AREA

S. N	Parameters	Unit	Results			
			S1	S2	S3	S4
1	Texture	---	Clay	Clay	Clay	Sandy Clay
2	pH Value(10% slurry)	---	8.10	8.12	7.08	7.85
3	Electrical Conductivity	µmhos/cm	125	104	84	62
4	Bulk Density	g/cc	1.29	1.16	1.16	1.15
5	Specific Gravity	---	1.75	1.92	1.84	1.95
6	Organic Matter	% w/w	0.02	0.03	0.03	0.08
7	Alkalinity	mg/kg	325.18	252.87	150.33	104.32
8	Acidity	mg/kg	Nil	Nil	Nil	Nil
9	Porosity	%	2.19	1.51	1.14	1.25
10	Sodium as Na	mg/kg	229.79	60.83	299.60	122.82
11	Potassium as K	mg/kg	303.13	632.51	57.98	54.03
12	Sodium Absorption Ratio	---	4.25	1.40	6.19	3.21
13	Copper as Cu	mg/kg	38.75	56.40	15.26	28.75
14	Zinc as Zn	mg/kg	146.03	345.63	60.58	71.66
15	Boron as B	mg/kg	46.02	32.94	21.95	24.19
16	Total Iron as Fe	mg/kg	97.29	45.20	45.90	97.26

17	Moisture Content	% by wt.	1.60	0.56	0.87	0.78
18	Permeability	cm/min	0.072	0.08	0.061	0.064
19	Sand	%	43.69	42.89	42.95	45.45
20	Silt Clay Content	%	56.31	57.11	57.05	54.55
21	Void Ratio	---	2.01	2.12	2.02	1.98
22	Infiltration Capacity	mm/h	35	38	41	37
23	Carbonates	mg/kg	Nil	Nil	Nil	Nil
24	Phosphorous as P	mg/kg	2.82	2.41	2.46	2.50
25	Chloride as Cl^-	mg/kg	81.90	165.37	124.38	81.62
26	Nitrogen	%	0.08	0.09	0.03	0.04
27	Sulphate as SO_4^{2-}	mg/kg	294.85	27.46	35.02	31.92
28	Manganese as Mn	mg/kg	2.64	2.62	2.63	2.58
29	CEC meq / 100g	---	8.65	8.42	8.21	8.36
30	Water Holding Capacity	%	35.25	35.21	35.62	35.30
31	Phosphates	mg/kg	9.67	10.95	1.05	5.17

S-1: Soil sample from Forest office, S-2: Soil sample from Umananda, S-3: Soil sample from Rajadwar project site, S-4: Soil sample from Rajadwar village

Above table indicate that the soil in the region is slightly basic with a pH of 8.10, 8.12 and 7.08 and 7.85. Most crops grow best if the soil pH range is 6.0 to 7.5. Conductivity of the soil is 125, 104, 84 and 62 µmhos/cm .

Texture of the soil sample is clayey at three locations and sandy clayey at one location. Bulk density of the soil sample is 1.29, 1.16, 1.16 and 1.15 g/cc at the four locations.

Soil permeability is the property of the soil pore system that allows fluid to flow. Water will flow easily through soil with large pores with good connectivity between them. Analysis of the soil sample shows that permeability of the soil sample is 0.072, 0.08, 0.061 and 0.064 cm/min.

Soil porosity includes both: - the total amount of pore space and the distribution of sizes of pores. It controls soil water content, air movement, and water movement. The rates of air exchange and water movement depend on both the volume and continuity of pore spaces within the soil. Analysis of soil sample shows that the soil has porosity of 2.19, 1.51, 1.14 and 1.25 %.

The Sodium Absorption Ratio (SAR) measures the relative proportion of sodium ions in a water sample to those of calcium and magnesium. The SAR is used to predict the sodium hazard of high carbonate waters especially if they contain no residual alkali. High concentration of sodium disperses soil colloidal particles, rendering the soil hard and resistant to water penetration. The potential of sodium hazards increases in soil with higher SAR values. The

analysis of the sample shows SAR for the project site is 4.25, 1.40, 6.19 and 3.19 which indicates that the soil is not sodic in nature.

3.7 ECOLOGICAL ENVIRONMENT

The ecological survey has been done to establish the baseline ecological conditions of the buffer zone (area within 10 km radius of the project site), to assess the potential ecological impacts of the proposed project on ecology, to develop adequate and feasible mitigation measures (via inputs to project design and layout, working practices, or compensate where appropriate) to keep ecological impacts within acceptable limits, and to prepare comprehensive management plan. This section of report renders ecological baseline of the area.

3.7.1 Habitat Assessment

Assessments that determine the suitability of ecosystem as habitat for a species are termed as habitat assessment. Habitat assessment provides border contexts for estimation of resources lost (flora and fauna) and also provides a means for resource management to incorporate alteration effect into their management models. Within a defined geographical area, an ecosystem health is often assessed by determining plant and animal habitat conditions. Habitat analysis defines the set of physical and biological locations and the environmental factors required by the animal or plant population to survive and reproduce. Habitat means the place where an organism dwells.

The information on a habitat provides baseline for proposed project site because the project activities might lead to loss of the ecological resources, if existing. The information will further enable to evaluate the feasibility and efficacy of the mitigation options that are being proposed by environmentalist and conservationist to incorporate conservation concerns in mitigating the impacts of developmental project.

Assam state is part of the transition zone between the Indo-Malayan and Indo-Chinese biogeographical regions. Favorable climate, topographic and edaphic factors support luxuriant growth of diverse plant communities and create varied habitats. The wet Evergreen, semi Evergreen, moist Deciduous, wet Savannah and Riparian forests as well as extensive network of river systems and swamps, marshes and wetlands provide ideal conditions and suitable habitats for subsistence of a wide variety of fauna be it mammals, primates, reptiles, amphibians, fish, molluscs, birds, butterflies, moths, that is, they support the existence of one of the most diverse faunal population.

The project site is located in Guwahati city in Kamrup district of Assam. The alignment for the ropeway project is such that it would pass through Brahmaputra river, connecting north and south Guwahati along the two banks of river. The total alignment is 1.8 km long comprising of five towers and two terminals.

The acquired land for the ropeway development does not come under forest area nor does the alignment coincide with the migratory routes of birds. Rich vegetation is absent, abundant growth of weeds and grass was noticed at project site. Reserve forests like Phatasil Reserve forest, Sila Reserve Forest Agyathuri Reserve Forest ,South Kalapahar and Dirgheshwari pahar are located at a distance of 4.4 km, 5.5 km, 7.2 km, 3.9 km and 4.5 km away . Deepor Beel Bird sanctuary is about 12 km away from the project site.

The Brahmaputra river flows in east to west direction. Water bodies like Dighali beel, Soru sola beel, Bor Sola Beel and Jorpukhuri lie in the buffer zone. The river Brahmaputra is present in the core zone and others like Kulsi river and Bharalu river lie at a distance of about 20 km and 2.9 km respectively from project site.

3.7.2 Terrestrial Ecology

Floral Diversity

Guwahati falls within the biogeographic Zone - Brahmaputra Valley of India. Guwahati is situated in district Kamrup which has 1432 sq. km of forest area, comprises of

- 69 sq.km of very dense forest,
- 609 sq.km of moderately dense forest and
- 754 sq. km of open forest.

The forest in this region comprises of Tropical Moist Deciduous type forests. This forest is further divided into Sal forest and mixed deciduous forest. In these forests, Sal grows in association with Ajar (*Lagerstoemia species*), Ghugra (*Schima wallichii*), Paruli (*Stereospermum prsonatum*), Haldu (*Adina cordifolia*), Sam (*Artocarpus sp.*), Bor (*Ficus sp.*), Uraim (*Bischofia javanica*), Gomari (*Gmelina arborea*), Teeta champa (*Michelia champa*), Poma (*Toona ciliate).* Efforts were focused on intensive studies of the ecological habitat, vegetation composition and the presence of faunal groups specifically around theareas where impact may occur, both during the constructional as well as the operational phase.

Floral Characteristics

Upper Terminal point (Rajadwar) North Guwahati


Existing Vegetation at Site

The upper terminal station is located atop a hillock in Rajadwar village. The site is devoid of trees. Abundant growth of shrubs and weeds was noticed. Among the weeds, excessive growth of lantana (*Lantana camara*) was recorded, followed by the climber Gall berry (*Mikenia scandens)* which trailed along the bushes and trees. Other weeds like *Eupatorium adoratum, Achyranthus aspera, Amaranthus spinosus, Ambrosia artemisiifolia,*

Chenopodium alba were recorded at site and in its vicinity. The photographs given below show weeds recorded at the site

Lantana camara

Cassia alata

Ageratum conyzoides

On the hillock near Rajadwar (UTP) dense growths of trees, shrubs, herbs, weeds and grasses was noticed. Abundant growth of bamboos was recorded atop the hillock near Rajadwar. Some of the most dominant species with extensive growth were *Dendrocalamus giganteus, Bambusa tulda, Bambusa balcooa* and *Dendrocalamus hemiltonii. Bamboosua vulgaris* was the exotic species introduced and now cultivated throughout Guwahati and Assam as ornamental plants. Trees like *Tectona grandis, Shorea robusta, Shorea assamica, Artocarpus integrifola, Tamarindus indica, Cocos nucifera, Ficus elastica, Ficus benghalensis* were the dominant species. The flora covering the lower strata were *Pragmites karka, Lantana camara, Ageratum conyzoides, Blumeria sp., Amaranthus sp* and *Echinochloa sp.*

The photograph shows Rajadwar village, which is adjacent to the site. The village shows abundant growth of betel nut (*Areca catechu),* followed by *Cocos nucifera, Ficus elastica, Artocarpus integrifola, Plumeria rubra, Plumeria alba, Hibiscus sp.* Majority of the plants recorded in village were those used in horticulture. Along the road and streets a green carpet of dub grass (*Cynodon dactylon*) was noticed.

Umananda Island

Umananda Island is situated in the river basin of Brahmaputra and supports dense vegetation. There is no evolutionary difference in the flora and fauna between south and north Guwahati. Limited diversity in birds was recorded at the time of survey. This may be due to lack of fruit and seed bearing trees or due to human disturbance created during the visits to Umananda temple, situated on this island.

The site selected for installation and development of supporting tower is devoid of trees and thus no tree cutting would be involved. Grass cover and weed growth was noticed. Weeds recorded at site were *Ageratum conyzoides, Apluda mutica, Euphorbia hirta* and *Achyranthus aspera.* Grasses like *Cynodon dactylon, Heteropogon contortus* and *Eleusina indica.* A dense canopy of bail (*Aegle marmelose*), siris (*Albizia sp*.), amaltas (*Cassia fistula*), semal (*Bombax sp*.), Gulmohar (*Delonix regia*), *Plumeria sp, Melia azedarach, Terminalia sp., Tamarindus indica, Cocos nucifera, Dendrocalamus giganteus,* were recorded at a distance from the proposed site. A dense growth of *Lantana camara* followed by *Achyranthus aspera*, *Sida acuta, Leucas aspera* was reported on this Island, covering its rocky surface.

The fauna recorded on this island were mostly birds, which were common to the main land. During the time of survey, species of birds recorded were common myna (*Acridotheres tristis*), blue rock pigeon (*Columba livia),* white breasted kingfisher (*Haleyon smyrensis*) and house crow (*Corvus splendens).* Small mammals like the Indian mongoose and field mouse were reported.

Lower terminal point (LTP) south Guwahati

Lower terminal point is located near district court (Kacchahari) on south bank of river Brahmaputra. The site has disturbed ecology due to human interference.Extensive growth of weeds like lantana (*Lantana camera*), Pragmites (*Pragmites karkar*), congress grass (*Parthenium hysterophorus*), dub grass (*Cynodon dactylon),* jimson weed (*Datura stramonium*), barnyard grass (*Echinochloa crus galli*), Johnson grass (*Sorghum halepense*), *Echinochloa colona,* chick weeds (*Ageratum conyzoides*), and green giant (*Alocasia sp*.) was reported. The site was devoid of trees; therefore no tree cutting would be involved.

In the core zone, trees recorded were bail (*Aegle marmelos)* , imli *(Tamarindus indica)* , mango (*Mangifera indica)*, gulmohar (*Delonix regia*), teak (*Tectona grandis)*, coconut (*Cocos nucifera)* , banana (*Musa acuminate*) and gular (*Ficus glomerata)*.

Aegle marmelos

Cocos nucifera

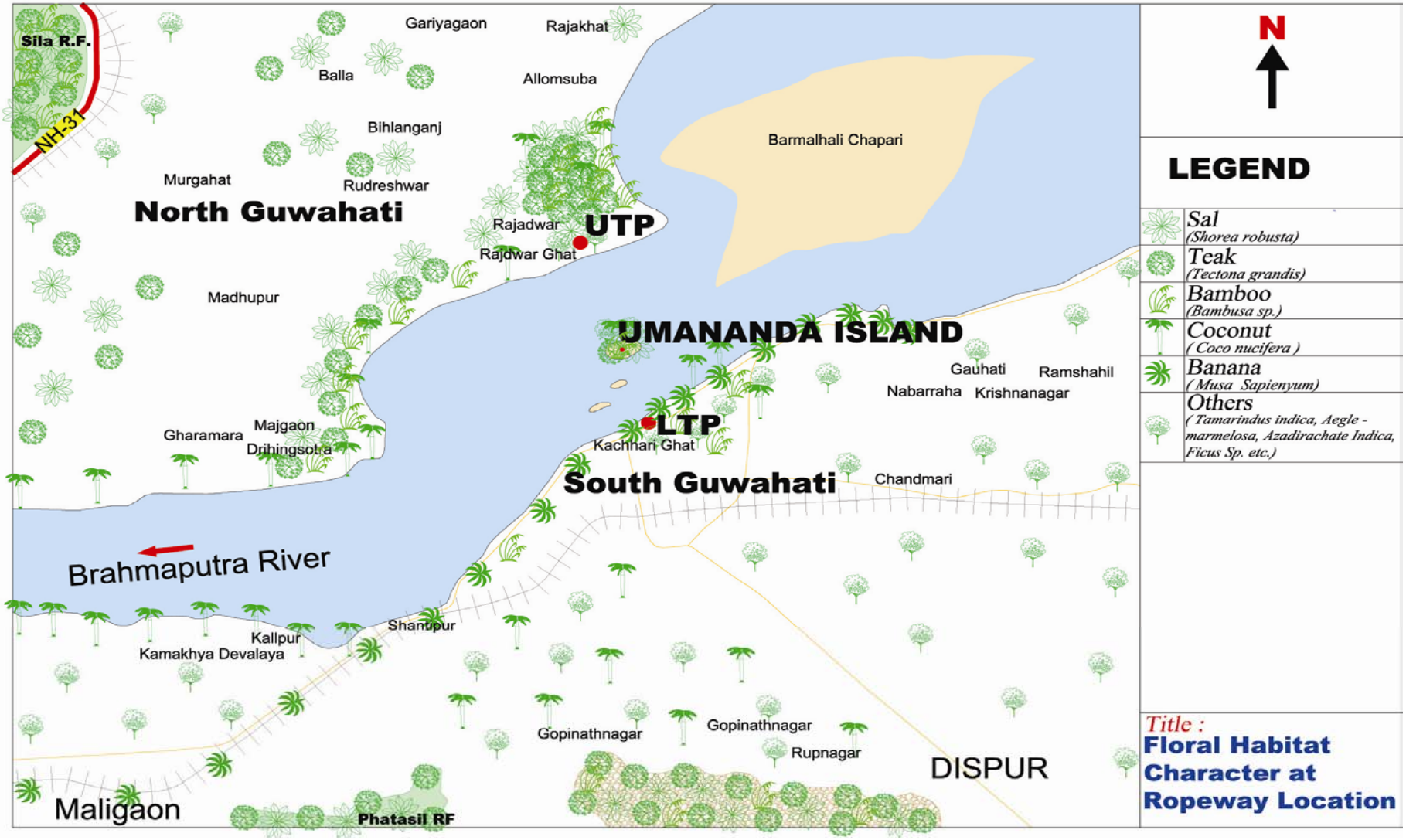
Mangifera indica

Tree species reported along the roadside, garden and parks were gulmohar (*Delonix regia)*, banyan tree (*Ficus benghalensis)*, siris (*Albizzia sp*.), bakain (*Melia azedarach)*, royal palm (*Oreodoxa regia)*, kadamba (*Bauhinia malabarica*), bakain (*Melia azedarach)*, sissoo (*Dalbergia sissoo)*, imli (*Tamarindus indica)*, rubber tree (*Ficus elastica)*, amaltas (*Crassia fistula)*, semal (*Bombax ceiba)*, Jamun (*Eugenia jambolana),* coconut *(Cocos nucifera)*. They harbour birds and small arboreal mammals. The habitat characteristics at towers and supporting platforms are provided in **Table: 3.16.**

TABLE -3.16: HABITAT CHARACTERISTICS

Location	Vegetation Cover%	Non-Vegetation Cover%	Habitat Type	Vegetation Type	Flora reported in the core zone
(UTP) at north Guwahati Rajadwar village	60	40	Terrestrial	Mixed scrub, with abundant growth of weeds	*Lantana camaraDatura sp.* at the site. *Dendrocalamus sp.,Albizia sp.Artocarpus sp.Tectona sp.Shorea robusta*
Brahmaputra river basin	--	--	Aquatic	Absent	Absent
Umananda Island	70	30	Terrestrial	Mixed type of vegetation common to main land. Scrub vegetation at site	Site was covered by grasses and weeds like *Lantana sp. Parthenium sp. Datura sp*. Trees like *Tamarindus indica, Plumeria, Albizia, Bombax, Ficus sp.*
South Guwahati	30	70	Terrestrial	Mostly planted, Climbers and weed growth.	*Mikenia scandens, Lantana sp.Archyranthus sp. Phroguites karka, Saccharum sp. Musa acuminate, Carica papaya, Tectona grandis, Bombax sp.*

FIGURE 3.17: MAP SHOWING VEGETATION DISTRIBUTION AND ITS COMPOSITION IN THE PROJECT AREA



3.7.3 Faunal Diversity

Assam state supports rich biodiversity. It supports rich faunal biodiversity ranging from Indo-Chinese species to peninsular Indian species. Diverse types of fauna ranging from mammals, avian species to reptiles were recorded. The existing aquatic ecology supports rich diversity due to existence of lotic and lentic water bodies. During the time of survey 11 mammalian species, 48 avian, 4 reptile and 19 species of butterflies were recorded. Some of the identification was based on secondary data like specific tasks performed by the animals, casts, trails and tracks they leave behind. The over all account of species recorded is given in **Table 3.17**

TABLE 3.17: NUMBER OF FAUNAL SPECIES RECORDED DURING SURVEY

Faunal Groups	No. of species
Mammals	11(4^{+} + $7^{\#}$)
Birds	48(29^{L} + 19^{M})
Reptiles	4
Butterflies	19

+Direct sightings, # indirect evidences and secondary information , **L-** *Local or common bird recorded,* **M** *-Migratory bird recorded*

Mammals

Macaca (Rhesus macaque), Golden langur (Trachypithecus geei), Bay bamboo rat (Connomys badius), Spotted Deer (Curvus axis), Otter (Aonyx congica), Indian Mongoose (Herpestes javanicus), Clouded leopard (Neofelis nebulosa) were reported in the forests of Guwahati. List of mammals is given in **Table 3.18**. Only four mammalian species were directly sighted, and rest was based on secondary information and information procured from the forest department. Their distribution in Guwahati is given in **Table 3.19.**

TABLE 3.18: MAMMALS RECORDED IN GUWAHATI CITY AND FOREST AREA

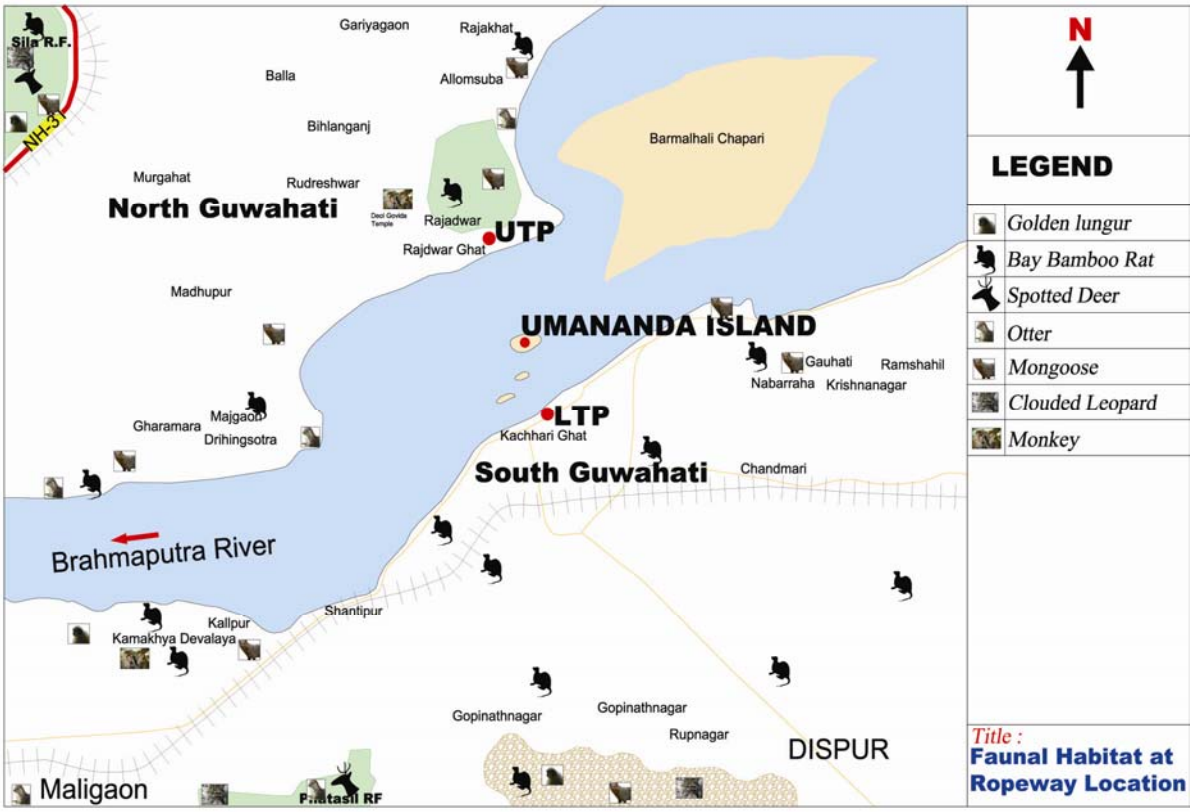
S.N	Common Name	Scientific Name	Red Data Status -2008
1.	Spotted deer	*Axis axis*	Least concern
2.	Swamp deer	*Rucervus duvaucelii*	Vulnerable
3.	Clouded leopard	*Neofelis nebulosa*	Vulnerable
4.	Golden langur	*Trachypithecus geei*	Endangered
5.	Indian mongoose	*Herpestes javanicus*	Least concern
6.	Bay bamboo rat	*Cannomys badius*	Least concern
7.	Hog badger	*Arctonyx collaris*	Least concern
8.	Rhesus macaque	*Macaca mulatta*	Least concern
9.	Hoary bamboo rat	*Rhizomys pruinosus*	Least concern
10.	Otter	*Lutra perspicillata*	Vulnerable
11	Ganges river dolphin	*Platanista gangetica*	Endangered

TABLE 3.19: DISTRIBUTION OF MAMMALS

S.N.	Common Name	Scientific Name	Local Name	Area	Evidence	Remarks
1.	Rhesus macaque	*Macaca mulatta*	Bandar	UTP	Direct sightings	Seen in countable numbers at Doul Govinda temple (Introduced by people)
2.	Golden Langur	*Trachypithecus geei*	langur	UTP	Direct sightings	Seen in three to four pairs near Kamakhya temple (Introduced by people)
3.	Mongoose	*Herpestes javanicus*	Nevla	LTP, UTP, Umananda Island	Direct sightings	Present in large number near the banks of the river and dense bushy areas
4.	Bay bamboo rat	*Cannomys badius*		LTP ,UTP Umananda Island	Direct evidence	Near bamboo plants and garbage dumped at the district court
5.	Hoary bamboo rat	*Rhizomys pruinosus*	-	LTP, UTP Umananda Island	Dialogue with local people/not reported at the time of survey.	Reported in wild, along the river banks, amongst dense growth of bamboos trees, villages and Guwahati city.
6.	Otter	*Lutra perspicillata*	Otter	UTP	Dialogue with local people / no direct evidence	Reported to inhabit relatively undisturbed areas on steep slopes along Brahmaputra river bank.

**LTP- South bank near district court;; UTP- North bank at Rajadwar village and near Doul Govinda temple.*

FIGURE 3.18: MAP SHOWING FAUNAL DISTRIBUTION IN THE SURVEYED AREA



Map (Based on secondary information and information obtained from the Forest Department)

Avifauna

Assam state supports rich avifauna, due to abundance of feeding, breeding and roosting places. In this state both endemic and exotic species were reported. Mainly endemic species were confined to upper Assam and exotic species were mainly migratory birds which arrive in winter for roosting. Birds reported during the time of survey in Guwahati were cosmopolitan in distribution. No endangered species were noticed. Due to high abundance of avifauna, they were noticed along the roadside, in market places, along the banks of river, lakes and in human settlement areas. Majority of the birds recorded in core and buffer zone show short distance and local migration during the day time (diurnal migration). Their migrations were mainly in search food and new feeding ground.

Birds recorded in large number were rock pigeon (*Columba livia),* house crow (*Corvus splendens),* cattle egret (*Bubulcus ibis),* House sparrow, Myna. Three subspecies of myna like pied myna, common myna and bank myna were commonly noticed. They represent species diversity. **Table: 3.20** gives the list of avifauna recorded during survey.

TABLE 3.20: COMMON AVIFAUNA RECORDED DURING SURVEY

S. N	Scientific Name	Common Name	Local Status	Project Site	Study Area	Red List IUCN
1.	*Acridotheres tristis*	Common myna	A	+	+	LC
2.	*Columba livia*	Blue rock pigeon	A		+	LC
3.	*Corvus splendens*	House crow	A	+	+	LC
4.	*Dicrurus adsimilis*	Black drango	S		+	LC
5.	*Haleyon smyrensis*	White breasted kingfisher	S		+	LC
6.	*Milvus migrans*	Pariah kite	C		+	LC
7.	*Passer domesticus*	House sparrow	A	+	+	LC
8.	*Streptopelia chinensis*	Spotted dove	L		+	LC
9.	*Apus affinis*	House swift	L		+	LC
10.	*Tringa hypoleucos*	Common sandpiper	L		+	LC
11.	*Mirafra assamica*	Lark	C		+	IV
12.	*Corvus macrorhynchos*	Jungle Crow	C		+	LC
13.	*Ocyceros birostris*	Indian Grey hornbill	L		+	LC
14.	*Dicrurus hottentottus*	Hair-crested Drongo	S		+	LC
15.	*Anthus rufulus*	Paddyfield pipit	L		+	LC
16.	*Cercomela fusca*	Indian Chat	L		+	LC
17.	*Coracias benghalensis*	Indian Roller	L		+	LC
18.	*Merops orientalis*	Green Bee Eater	S		+	LC
19.	*Ardeola gravii*	Pond heron	C	+	+	LC
20.	*Turdoides striata*	Red vented bulbul	L		+	LC
21.	*Vanellus indicus*	Red wattled lapwing	L		+	LC
22.	*Egretta garzetta*	Little egret	C		+	LC
23.	*Ardeola grayigrayi*	Indian pond heron	C		+	LC
24.	*Bubulcus ibis*	Cattle egret	C	+	+	LC
25.	*Turdoides striata*	Jungle babbler	L		+	LC
26.	*Acridotheres ginginianus*	Bank myna	C		+	LC
27.	*Gracupica contra*	Pied myna	A	+	+	LC
28.	*Psittacula kramen*	Rose ring parakeet	C	+	+	LC
29.	*Upupa epops*	Hoopoe	S		+	LC

[A= Abundant, C = Common, S = Sporadic, L= Less, LC=Least Concern]

Migratory birds:

Migratory birds from Siberia visit during winter season (winter migration) and once in a year (annual migration). They arrive at Deepor Beel, which is twelve kilometers (outside buffer zone) away towards the south west direction. The route of migration is north-south direction. These birds arrive in large numbers due to suitable temperature and abundant availability of

snails, slugs and fish on which they feed. Local migratory birds from upper Assam migrate to Deepor Beel for feeding, breeding purposes and to escape freezing winter.

Deepor Beel (Bird sanctuary)

The Deepor Beel covers an area of 414 hectare. It shows abundant growth of hydrophytes like *Eichhornia crassipes*, followed by *Pistia stratiotes*, *Ottelia alismoides, Lemna minor, Azolla pinnata.* Small water birds lay eggs either on large floating leaves or built nests among closely aggregated *Eichhornia sp.* Birds like cattle egret, pond heron and white breasted king fisher were noticed setting at the edge of water bodies to hunt fish and water insects. **Table 3.21** gives the list of birds reported in Deepor Beel.

TABLE 3.21: MIGRATORY AVIFAUNA ARRIVING ANNUALLY IN DEEPOR BEEL

S.No	Common Name	Scientific Name
19.	Black tailed godwit	*Limosa limosa*
1.	Spot billed pelican	*Pelecanthus philippensis*
2.	Lesser adjutant stork	*Leptoptilos javanicus*
3.	Baer's pochard	*Aythya baeri*
4.	Palas Sea Eagle	*Haliaeetus leucogaster*
5.	Greater adjutant Stork	*Leptoptilos dubius*
6.	Siberian crane	*Grus leucogeranus*
7.	Greater flamingo	*Phoenicopterus rosens*
8.	Northern pintail	*Anas acuta*
9.	Ruff	*Philomachus pugnax*
10.	Yellow wagtail	*Motacilla flava*
11.	Godwall	*Anas atrepera*
12.	White wagtail	*Motacilla alba*
13.	Northern shoveler	*Anas clypeata*
14.	Rosy pelican	*Pelecanus onocrotalus*
15.	Spotted billed pelican	*Pelecanus philippensis*
16.	Eurasian wigeon	*Anas Penelope*
17.	Spotted sandpiper	*Actitis macularia*
18.	Blue throat	*Luscinia svecica*

Route of migration:

The Siberian bird (winter migrant) migrates in a north-south direction. There is no correlation with the route of migration and ropeway alignment. Even the height of towers and the altitude of flight varies. Mainly the Siberian Crane migrates at an altitude of 1000 to 2000 feet above the mean sea level. Some even migrate at above 16,000 feet. Thus the chance of collision with the tower is absent. Secondly, the ropeway is far off, about 12 kilometers away from the route of migration. Diurnal migratory birds (which migrate from north to south Guwahati or vice versa), easily adapt to the various changes occurring daily.

Butterflies

The Assam region bears rich biodiversity of flora and fauna. The floral richness of this area comprises of varieties of shrubs, herbs and grasses bearing attractive coloured flowers laden with scented nectar to attract and support butterflies. Each butterfly is plant specific and visits specific species of plants for nectar. The floral biodiversity itself indicates the species of butterflies that can be predicated in that area. During the survey total of 19 species of butterflies belonging to 4 families were recorded and listed in **Table 3.22.** All the species were common and none of them are listed as 'endangered" (IWPA, 1972). **Table: 3.21** given below shows the list of Butterfly species.

TABLE 3.22: BUTTERFLIES RECORDED DURING THE SURVEY

S.N	Common Name	Scientific Name
	PAPILIONIDAE	
1.	Glassy bluebottle	*Graphium cloanthus*
2.	Lime	*Papilio demoleus*
3.	Common Mormon	*Papilio polytes*
	PIERIDAE	
4.	Indian Cabbage White	*Pieris canidia*
5.	Common Albatross	*Appias albina*
6.	Small Grass Yellow	*Eurema libythea*
7.	Common Brimstone	*Goneoteryx rhamni*
	LYCAENIDAE	
8.	Sorrel Sapphire	*Heliophorus sena*
9.	Pale Grass Blue	*Pseudozizeeria maha*
	NYPHALDAE	
10.	Common Wall	*Pararge schakra*
11.	Common Leopard	*Phalanta phalantha*
12.	Blue Pansy	*Junonia orithya*
13.	Lemon pansy	*Junonia lemonias*
14.	Chocolate Pansy	*Junonia iphita*
15.	Indian Red Admiral	*Vanessa indica*
16.	Painted Lady	*Cynthia cardui*
17.	Yellow Coster	*Pareba vesta*
18.	Plain Tiger	*Danaus chrysippus*
19.	Common Sergeant	*Pantoporia perius*

Herpetofauna

Reptilian species such as common house gecko (*Hemidactylus gleadoviimaculatus*) were commonly noticed in shops, houses and other places close to human habitation. Agama (*Agama tuberculata*), Common garden lizard (*Calotes versicolor*) and skink (*Scincilla sp*.) were recorded on Umananda Island, garden of parks and underneath dense ground cover in core zone. During the survey no snake was noticed. Also, no secondary information of trails marks and moulting of skin of snakes was discovered in the core zone.

3.7.4 Aquatic Ecology

Aquatic ecosystem in Guwahati city comprises of fresh water ecosystem. Marine water ecosystems were absent. The freshwater ecosystems in Guwahati are running water bodies (lotic) and still water bodies (lentic) type. The lotic water bodies comprise of Brahamaputra, Kulsi and Bharalu river and the lentic water bodies comprise of Dighali (0.4 km from LTP), Jorpukhuri (0.7 km from LTP) and Deepor Bil (about 12 km away from UTP).

Dighali Pukhuri:

Dighali Pukhuri is about 0.4 km away from the LTP. This lake shows abundant growth of *Eichhornia crassipes, Spirodela polyrhiza, Azolla.* The lake water appears polluted due to presence of polythene bags and discarded material. Water appears green due to excessive growth of blue green algae or cyanobacteria (Algal bloom), making the water toxic due to release of neurotoxins and also increases BOD, hampering the growth and health of fish.

Jorpukhuri:

Jorpukhuri is about 0.7 km away from LTP. It is rain fed water body. This pond is shallow and devoid of water weeds. Small size hydrophytes were noticed. No fish and amphibians were noticed during the time of survey. Discarded paper, plastic bags, and other articles were noticed floating on the surface. Algal growth was also noticed at the edge of pond. **Table 3.23** gives the list of fish and **Table 3.24** give the list of Macrophytes reported in lotic and lentic water bodies.

TABLE 3.23: FISH REPORTED IN BRAHMAPUTRA RIVER AND OTHER WATER BODIES

S.N	Scientific Name	Common Name
1.	*Channa punctatus*	Lata
2.	*Channa striatus*	Sole
3.	*Channa gachua*	Chang
4.	*Labeo rohita*	Rohu
5.	*Catla catla*	Catla
6.	*Cirrhinus mrigala*	Mrigal
7.	*Hypophthalmichthys molitrix*	Silver carp
8.	*Cyprinus carpio*	Common carp
9.	*Tilapia mozambica*	Tilapia
10.	*Liza parsia*	Parse
11.	*Clarias batrachus*	Magur
12.	*Heteropneustes fossillis*	Singi
13.	*Mystas gulio*	Tangra
14.	*Anabas testudineus*	Koi

TABLE 3.24: MACROPHYTES AND OTHER MARSHY PLANTS IN LOTIC AND LENTIC WATER

S.N	Scientific name	Family
1.	*Ottelia alismoides*	Alismataceae
2.	*Lemna purpusila*	Lemnaceae
3.	*Eichhornia crassipes*	Hydrocharitaceae
4.	*Nymphaea noncheli*	Nympheaceae
5.	*Spirodela polyrhiza*	Lemnaceae
6.	*Vallisneria spiralis*	Hydrocharitaceae
7.	*Ipomea aquatica*	Convolvulaceae
8.	*Pristia stratiotes*	Hydrocharitaceae
9.	*Salvinea natans*	Salviniaceae
10.	*Azolla pinnata*	Salviniaceae
11.	*Phargmites karkar*	Graminae
12.	*Sagittaria sagififolia*	Alismataceae
13.	*Marsilea minuta*	Marseliaceae
14.	*Scirpus articulatus*	Cypherceae
15.	*Nymphoides speltatum*	Gentianaceae
16.	*Limnophila indica*	Scrophulariaceae

17.	*Trapa bispinosa*	Trapaceae
18.	*Trapa natans*	Trapaceae
19.	*Marsilea minuta*	Marseliaceae
20.	*Ipomea aquatica*	Convolvulaceae
21.	*Typha domingensis*	Typhaceae
22.	*Eclipta prostrate*	Compositae

Brahmaputra river:

It originates in southwestern Tibet, flows down from upper Assam and finally drains into Bay of Bengal forming a delta (Sunderban Delta) with the Ganga river. At the time of survey in core zone (pre and post monsoon), it was noticed that the water recedes nearly 200 m from the south bank and more than 100 m from the north bank during post monsoon. During the pre monsoon season, water was noticed only in the centre of river bed, where the water has maximum depth. Heavy siltation was noticed along the two banks of the river.

In the core zone of the project site private and government ferries was noticed plying regularly. Oil spillages commonly occur from these ferries during their operation resulting in water pollution. In the core zone, which is prone to disturbances due to ferries, no fish species or their surfacing behavior was noticed. Brahmaputra river is famous for fresh water dolphin that is Ganges river dolphin *(Platanista gangetica)*. It is commonly known as Susus. It was declared as an endangered mammal by IUCN Red List-2008.

Habitat:

Primary habitats are characterized by an eddy counter-current system in the main river flow caused by a fine sand / silt point bar formed from sediment deposits of a convergent stream branch or a tributary. At this point, there is a reduced flow of the waters in the surrounding areas thus abundant prey is available for the Dolphins. Dolphins feed on several species of fishes, invertebrates and possibly turtles (the Dolphins are primarily carnivorous and especially picivorous). They do most of the feeding at the bottom of the river. They love to live in deep water or beels (large holes in river basin). Their presence in a river system signals a healthy ecosystem, since they are at the apex of the aquatic food chain. The presence of Dolphins in adequate numbers symbolizes greater biodiversity in the river system and helps keep the ecosystem in balance.

Behaviour:

Being mammals, the Ganges river dolphin cannot breathe in water and must surface every 30-120 seconds. Their marked seasonal change in their distribution depends on the depth of water and the availability of food. Observations by (Reeves and Brownell, 1989) shows that the Dolphins migrate out of the Gandaki, Koshi and Karnali systems during the high water season, probably spending lower water seasons in deep pools of the tributaries. In the main rivers, a

decrease in their numbers during the summer season would confirm a seasonal pattern of migration. Dolphins navigate and hunt by means of echo location. They are so sensitive in echo location that they can locate a wire thin as a hair floating in the river water. The list of major invertebrates present in Brahamaputra river are given in **Table 3.25**

TABLE: 3.25 MAJOR INVERTEBRATE FAUNA PRESENT IN BRAHMAPUTRA RIVER

Groups Scientific Name		
A.	**Zooplanktons**	
	a] Copepoda	*Diaptomus sp.* *Cyclopina sp.* *Prendodiaptomus sp.*
	b] Cladocera	*Daphnia sp.* *Moina dubia* *Cesiodaphnia sp.*
	c] Rotifiers	*Brachionus sp.* *Asplanchana sp.*
	d] Mysis	*Mesopodopsis sp.*
	e] Protozoa	*Diffugia sp.*
B.	**Sponges**	**Absent**
C.	**Molluscs**	*Bellamya bengalensis* *Pila globosa* *Thiara tuberculata* *Thiara lineata* *Gyraulus convexiculus*
D.	**Crustaceans**	*Macrobrachium rude* *M. maicomerii* *Peneaus monodon* *P. indica* *Acetus indicus*
E.	**Crabs**	*Paratelphusa spinigera* *P. hydrodronus*
F.	**Insects (Coleoptera)**	*Haliptus angustifrons* *Dineutus unidentatus* *Amphiops mirabillis*
G.	**Hemipterans**	*Corika sp.* *Micronecta albifrons*
H.	**Dipterans**	*Culex sp.* *Chironomus sp* *Mansonia sp.*

3.8 SOCIO ECONOMIC ENVIRONMENT

This section discusses the baseline scenario of the socio-economic environment in the study area and the anticipated impacts of the proposed project on the socio-economic environment. The areas of discussion in this chapter are demographic structure, economic activity, education,

literacy profile, land use and infrastructure resources. The assessment attempts to predict and evaluate the anticipated impacts of project upon people, their physical, psychological health and well being, their economic facilities, cultural heritage, lifestyle and their value system.

3.8.1 Socio-Economic Profile

The proposed ropeway is located in Guwahati city over Brahmaputra river in the state of Assam. Assam falls in northeastern region of India and has a distinct geographical topography and Socio cultural milieu.

Assam state is administratively divided into 27 districts with its capital in Dispur .Its population is 26,655,528 spread over 78,438 sq km as per 2001 census. Boundaries of the state are shared with seven northeastern states and also with Bhutan and Bangladesh.

Guwahati is the largest city within the region. Dispur, the capital of Assam is situated within the city. It falls in Kamrup district that is spread over 4345 sq. km. with a population of 25, 22,224. It consists of Guwahati and Rangia, its two subdivisions, and 14 revenue circles.

Out of these Guwahati and north Guwahati are the two circles, which are going to be connected by the proposed ropeway. Guwahati city is the metropolitan city with population of 809,895 and north Guwahati has a population of 65813 as per 2001 census.

The major economic activities are trade and commerce, transport and services. It is centre of commercial activities in northeastern region.

3.8.2 Project Location and study area

The study area for assessment was defined as an area within ten km radius around the proposed project site. Designation of impact zone is based on the EIA guidelines considering the size and operation of the project. Since this project intends to develop a ropeway between Kacchari Ghat (south Guwahati) and Rajadwar (north Guwahati), the baseline study focuses on the community around the project site where people's lives are going to change.

The study area is listed below in **Table 3.26**

TABLE 3.26: STUDY AREA DETAILS

S.N	Study Area	Circle	District
1	Ward No. 31, Guwahati Municipal Corporation	Guwahati	Kamrup
2	Ward No 4, North Guwahati	North Guwahati	Kamrup

S.N	Study Area	Circle	District
3	North Guwahati (TC)	North Guwahati	Kamrup
4	Guwahati (M Corp.)	Guwahati	Kamrup

Source: Census of India 2001

3.8.3 Demographic structure

The population of Guwahati city has increased at a fast rate with the 1991-2001 decadal growth rate being 38.6 %. The population of Guwahati city has been projected to grow to 1.19 million by 2011. **Table 3.27** provides the number of households and population as per the census 2001.

TABLE 3.27: STUDY AREA, NUMBER OF HOUSEHOLDS AND POPULATION

Study Area	Number of households	Population 2001
Ward No. 31, Guwahati Municipal Corporation	643	3314
Ward No 4, North Guwahati	1040	5616
North Guwahati (TC)	3179	16286
Guwahati (M Corp.)	184454	809895

Source: Census of India 2001

The sex ratio of the Guwahati city is 839 and that of the district is 901 as per 2001 census. These figures point towards the imbalance in the male and female population.

Table 3.28 gives a break-up of population and sex ratio in the study area.

TABLE 3.28: POPULATION – MALE, FEMALE AND SEX RATIO

Study Area	Male	Female	SC	ST	Sex Ratio*
Ward No. 31, Guwahati Municipal Corporation	1699	1615	1428	54	951
Ward No 4, North Guwahati	3424	2192	333	94	640
North Guwahati (TC)	8750	7536	5229	384	861
Guwahati (M Corp.)	440288	369607	40197	30519	839

Source: Census of India 2001

* *No. of females against 1000 males*

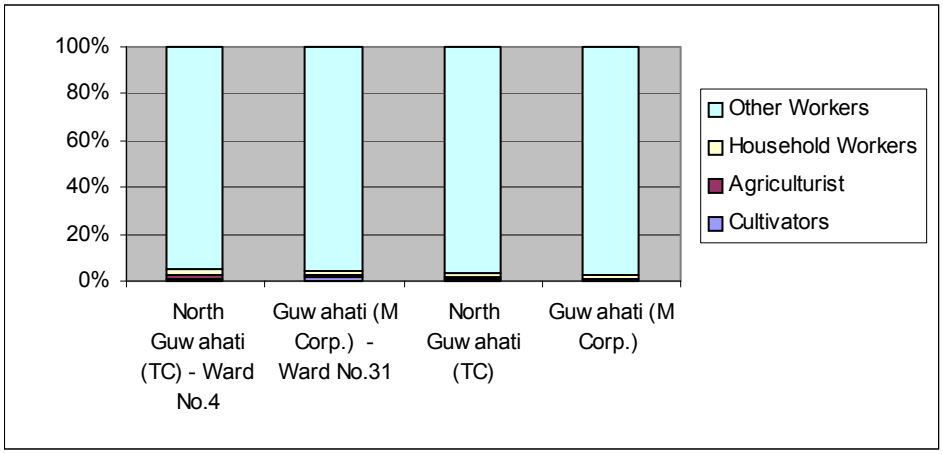
The figures clearly indicate the presence of sizable SC and ST population in the proposed project area and alarming figures of sex ratio.

3.8.4 Economic Activity and Livelihood Pattern

Guwahati city is the centre of economic activity in the northeast region. It's a major trade centre with Asia's biggest tea market. Work participation rate is 35.1 % and proportion of category of "other workers" is 96.8%. Employment and business sectors are government agencies, industries, transport, trade, household industries, tourism etc.

As seen in **Figure 3.19**, the category of other workers is the only employment and income generation sector in the study area.

FIGURE 3.19: WORKFORCE ENGAGEMENT IN DIFFERENT SECTORS



Source: Census of India 2001

3.8.5 Education and literacy profile

Literacy is an important indicator to assess the Human Development Index of the area. Literacy rate of Guwahati city is 86.5 % as per census 2001.There are number of educational institutions like Cotton College, Guwahati Medical College Guwahati University, and IIT Guwahati etc. Apart from these there are numbers of institutions providing education in varied subjects and streams. Area wise literacy rate is tabulated in **Table 3.29**

TABLE 3.29: AREA WISE LITERACY RATE

Study Area	Literacy Rate (%)
Ward No. 31, Guwahati Municipal Corporation	85.3
Ward No 4, North Guwahati	79.9
North Guwahati (TC)	84.1
Guwahati (M Corp.)	86.5

Source: Census of India 2001

3.8.6 Land use

The area under the Guwahati Municipal Development Authority comprises of Guwahati Municipal Corporation Area (GMCA), North Guwahati Town Committee area, Amingaon and some revenue villages. The area is known as the Guwahati metropolitan area (GMA) and covers an area of 264 sq km. According to the Town and Country Planning department land use pattern of Guwahati in 2001 is given in **Table 3.30**

TABLE 3.30: LAND USE PATTERN

Land Use	Percentage
Residential	25.1
Commercial	2.5
Industry	5.2
Special category Government	6.2
Recreational and Parks	5.4
Public and Semi – Public	9.4
Transport	12.9
Green Belt	15.4
Water bodies, hills	17.7
Total	**100.00**

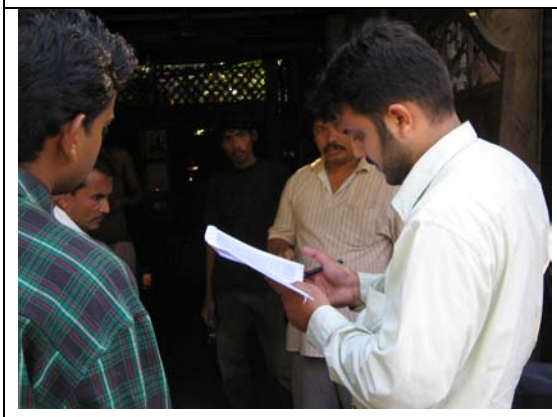
Source: CDP Guwahati

3.8.7 Primary Assessment of Proposed Project Area

Primary assessment was carried out for stakeholder analysis by means of consultations and small group discussions in order to analyze social factors that are to be taken into consideration for project planning. This exercise is carried out to identify ways to mitigate any adverse social impacts and enhance positive ones.

Discussion with Ferry operators

Discussion with passengers and Boat operators

	
Discussion with passengers and Boat operators	***Youth Club members***
	
Residents of north Guwahati	***Residents of north Guwahati***

3.8.8 Perception of The Proposed Project by the people

Consultations were held in the study area to understand the perception and concerns of the locals with regard to the proposed ropeway project. Developmental needs and aspirations of the people were understood in order to identify potential need based areas that could be addressed through the project's socially responsible proactive initiatives and interventions. The locals were of the general view that proposed project will benefit them and expressed the following views about the project:

- Development of project will provide a facility that will decrease travelling time between north and south Guwahati.
- The scope for development in the south Guwahati is very limited due to high density of population, which is why expansion of the city will take place towards north Guwahati.
- Economic activity will increase in the north Guwahati area.
- Movement of vehicles between south and north Guwahati will decrease due to which traffic congestion on the road would decrease.
- Ferryboat operators expressed concerns regarding their business potential
- Operations of ferries and boats operations are for limited time in the evening till 5 pm and completely closed during rainy season. Therefore, the ropeway facility will be of great help to locals during the non-operation period of the boats.

4.0 Environmental Impacts and Mitigation Measures

This chapter focuses on identification of pollution sources due to the proposed project activity. The pollutants generated during the construction and operation phase have been assessed and quantified to estimate the level of impact and thus formulate environment management measures to mitigate theses impacts.

Chapter 3 provided the information on the baseline environmental conditions at the project site for various parameters. This chapter discusses the various pollution loads and stressors that could impact the environment and the incremental environmental impacts on the environmental parameters during the operation phase of the project.

4.1 CONSTRUCTION PHASE

The proposed ropeway will involve site clearance, construction on riverbed and construction of line towers and terminal stations on the banks of Brahmaputra river. The impacts associated with the construction phase of the proposed aerial ropeway for different environmental components are discussed below:

4.1.1 Water Environment

Impacts on Water Quality

The proposed ropeway will involve development of well foundations for two line towers which are to be constructed on the riverbed. For the line tower to be located on Umananda Island, a cofferdam will be constructed. During construction, the inorganic loading of the river may increase slightly on account of introduction construction material to the river system. Substantial amount of deposition of construction material such as cement could also take place during construction activities. The construction activities will also involve disposal of slurry resulting due to excavation activities. However, the impact will be short term in nature and will be compensated due to increased desiltation process resulting from increased flow because of construction of cofferdam.

Impacts on Navigational activities

The Brahmaputra river between Dhubri and Sadiya has been declared as National Waterway -2 (NW-2) and the stretch from Bangladesh border to Dibrugarh of NW-2 has been classified under ‘Class VII’ of National Waterway. Approval from Inland Waterways Authority of India has been granted for the construction of ropeway with vertical clearance of 17.60 m between HFL and the bottom of the carrier and horizontal clearance of 915 m between any two piers

within the river portion for navigational purposes. The approval from Inland Waterways Authority of India is attached as **Appendix X.**

The design of the ropeway has taken into consideration the necessary clearances. The HFL of the river is 51.46 m and a vertical clearance of 17.60 m has been provided. The detailed section has been presented in **Appendix III.** Thus, there will be no impact on the navigational activities as necessary horizontal and vertical clearances will be provided.

Construction and Development of site

The development of the terminal stations could lead to stockpiling and excavation activity on site, thereby causing erosion of base soil. The run off from the site may contain high quantity of suspended solids (SS). The impact of runoff may not be very significant except during rainy season. Further construction of garland drains will reduce the runoff from the stockpiles.

Labour Activities

During construction phase, wastewater shall be generated from labour activities on site. Wastewater generated would be characterized by high levels of BOD, SS, Nitrogen and E. Coli. Significant water quality impact may occur if the sewage is disposed off on land or any water body. Since most of the people would be deployed locally, impact from temporary make shift labour tents is not anticipated to be very high and the wastewater generated during this phase will be diverted to the sewer line.

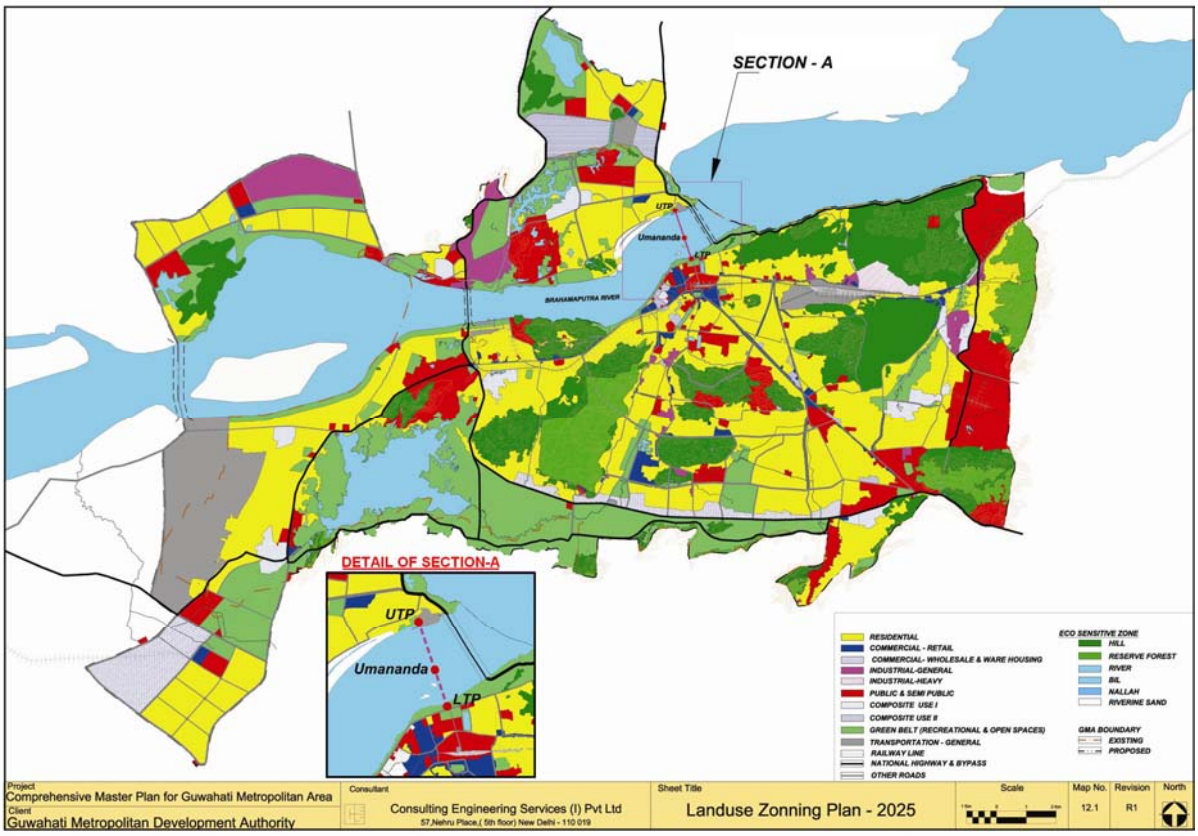
The impact on the quality and quantity of water resources is not going to be significant as proper storage facilities will be maintained for construction materials, construction waste and oil and grease.

4.1.2 Land Environment

IMPACTS ON LAND USE AND AESTHETICS

The proposed terminal stations will be developed on the south and the north bank of the river. The station at south bank will be developed in an area of 1260 sq.m and is proposed in Guwahati city which is the hub of industrial, commercial and educational activities and there are no major visual receptors in this area. No major change in land use is envisaged. The station at north bank is situated in a developing area and will be developed in an area of 180 sq.m and will not alter the land use pattern as proposed in the landuse zoning plan for 2025. The land use zoning plan is attached as **Figure 4.1.**

FIGURE 4.1: LAND USE AS PER MASTER PLAN



Five line towers are proposed to be constructed. One line tower is proposed at the Umananda Island which is at a distance of 661 m from the south bank and comprises of a centurion old temple of Lord Shiva. The location of the line tower will be such that it will not impact the aesthetics of the area. Two line towers each are located on either side of the Umananda Island. The Brahmaputra river is a declared Waterway and supports major navigational activities and therefore no major impacts are envisaged on the aesthetics of the area. The location of the line towers is attached as **Appendix III.**

IMPACTS ON TOPOGRAPHY, DRAINAGE AND SOIL QUALITY

The terminal stations are proposed along the riverbank. The sites for the terminal stations will be leveled in accordance with the topography of the region and thus there will be no significant impact on the topography and drainage of the area. Impact on soil owing to the construction of terminals includes soil erosion, compaction, physical and chemical desegregations and pollution of soil in case of waste discharge on land. The impact will be however short term in duration and will be not significant in nature.

SOLID WASTE

Wastes which are likely to be generated during the construction of towers and terminals include the following:

- Site clearance;
- Construction and demolition material;
- Excavated materials;
- Chemical waste material; and
- Municipal wastes.

Construction and Demolition Waste: Construction and demolition material may contain a mixture of inert and non-inert material. Construction and demolition materials arising from the construction may include waste timber formwork, spent concrete and cement screening, and material and equipment wrappings.

Excavated materials: The excavated overburden will be used for filling and will be compacted.

Chemical Wastes: Plant and vehicle servicing will likely be the primary source of chemical wastes during the construction period. The majority of chemical waste produced is therefore expected to consist of waste oils and solvents. However volumes are expected to be less than approximately 10 litres a month.

Municipal Waste: Workers engaged during construction phase will generate municipal wastes such as food wastes, packaging and wastepaper. The waste from labour tents would be mainly household domestic waste.

Waste materials have the potential to cause adverse environmental impacts during generation, storage, transport and disposal. The principal adverse effects relate to dust, water quality, general health and safety and visual impacts. The recommended waste management plan is based upon the principle to reduce the amount of waste for disposal through the development of outline plans for waste avoidance, material re-use and recycling and is discussed in the Environment Management Plan.

4.1.3 Ecological Environment

Impacts on terrestrial Ecology

All development activities lead to impact on the existing flora and fauna. For the proposed ropeway project, construction activities will involve site clearance for construction of terminals. The area for the terminal stations comprise mainly of common shrubs, weeds and grasses and

do not support any ecologically sensitive flora and fauna. The impact of construction on terrestrial ecology have been summarized in **Table 4.1.**

TABLE 4.1: IMPACTS ON TERRESTRIAL ECOLOGY

S.N	Parameter	Magnitude	Duration
1	Habitat Loss	Absent	--
2	Habitat fragmentation	Absent	--
3	Reduction of Habitat quality	Absent	--
4	Impact due to pollution	Minor	Short term
5	Impact due to disturbance	Minor	Short term

The proposed project may result in air, noise and water pollution, which may have an impact on the terrestrial ecology. However, the impact will last for small duration and will be minor in nature. No sensitive species for flora and fauna were recorded within the core zone during the survey. The proposed alignment does not coincide with the migratory route of birds. The noise emissions during construction phase may have a minor impact on the fauna in the surrounding areas.

Impacts on Aquatic Ecology

The impact of construction activities on aquatic ecology has been summarized in **Table 4.2.**

TABLE 4.2: IMPACT OF CONSTRUCTION ON AQUATIC ECOLOGY

S.N	Impact of Construction	Type of Impact	Extent of Impact
1	Benthic Habitat	Minor	Short term
2	Impact due to change in flow regime	Minor	Short term
3	Impact due to pollution	Minor	Short term

Benthic habitat: Due to the existing pollution of Brahmaputra river, the river bed does not support major benthic flora. The construction of line towers on the riverbed will entail displacement of benthic fauna. However, the construction activities will be limited to a small area and thus the impact will be minor.

Impact due to change in flow regime: The flow of water is one of the main factors that determine characteristics of freshwater ecosystems, and is critical to both their functioning and ecology. Changing the flow rate of a water body, be it an increase or decrease, can indirectly damage community adapted to the prevailing flow, and may irreversibly modify the physical and biological environment. The construction of cofferdam along Umananda Island will slightly increase the flow of water during construction phase and will have a minor negative impact on the aquatic fauna.

Impact due to Pollution: Damage to a freshwater community is most likely to occur when human activities modify the chemical environment to the extent that it is beyond the natural range for that water body. Physical pollution resulting due to construction activities may include sand removal and drilling and may affect small areas affecting limited aquatic fauna and will be compensated due to the flow of water. Hence, the impact can be ranked as minor.

4.1.4 Socio Economic Environment

The construction activities at site will lead to temporary disruption in movement of ferries and boats. The likely impacts on the socio economic environment have been discussed below:

Impact on ferryboats and navigational activities: During construction phase, the movement of country boats and steamers will get affected. However, the construction will be carried out in a phased manner so that minimum disturbance is caused to the navigational activties taking place along the river. The movement of ferry boats may also get disrupted for a short duration of time but will be suitably addressed by devising an alternate temporary route for the ferry boats.

Impact on Historical, Archaeological and Architectural Sites*:* One line tower is proposed at Umananda Island, which comprises of a centurial old temple of Lord Shiva. The construction activities will be carried out in such a way that the impact on the historical site is minimal. The Urbashi Island located at a distance of 441 m away from the south bank comprises of sculptures of the East India Company and the Island is protected by the Archaeological Department, Government of India. The proposed alignment does noyt involve any construction on the Urbashi island and thus no impact I envisaged on the archaelogical site.

Displacement: The proposed terminal stations will not involve any displacement of population and hence no resettlement and rehabilitation issues are involved.

4.1.5 Air Environment

The construction activities for the proposed terminal stations will be of small scale and thus the particulate emissions will be minimal and short term in nature. For the construction of line towers the generation of the dust will be low as compared to the construction of terminal stations. Moreover, the dust generated during the construction phase on the river bed and island will be considerably reduced due to localized meteorological conditions. The impact of other pollutants such as SO_2, NOx and CO will be caused due to diesel-operated mechanical equipment and their impact is expected to be negligible and of short term duration. As the impact during construction phase is expected to be minimal and of short-term duration, the air quality modelling exercise has not been performed for the quantitative impact assessment during this phase.

4.1.6 Noise Environment

The noise emission sources during construction phase will include construction machineries/equipments to be employed at site. The expected noise levels from the operation of equipment and machinery are provided in **Table 4.3** below:

TABLE 4.3: NOISE LEVELS GENERATED FROM CONSTRUCTION EQUIPMENT

Name of Source	Noise Level at 16 m (50 ft) from Source in dB (A)	Noise Level at 1m from source (calculated) in dB (A)
Back Hoe/Loader	81	105
Concrete Mixer Truck	85	109
Cranes - mobile	81	105
Dump Truck	83	107
Generator	Not considered	75 (as prescribed by CPCB)
Hammering	86	110
Jackhammer	88	112

Source: www.gvrd.bc.ca/education/pdf04/ColumbiaWorkshop1-ConstructionNoise.pdf

Since the proposed plant does not involve extensive construction works, the noise levels during this phase are not expected to be significant. The mitigation measures will include job rotation and provision of earmuffs in high noise areas.

4.2 OPERATIONAL PHASE

The operation phase of the proposed project will involve passenger movement and ropeway operation. The impacts associated with the operation phase of the project have been discussed in the following sections.

4.2.1 Water Environment

WATER REQUIREMENT

Water demand during the operational phases has been estimated on the basis of various activities proposed as per project master plan and associated consumption pattern. The details are presented in **Table 4. 4**

TABLE 4. 4: WATER REQUIREMENTS FOR PROPOSED PROJECT

S.N	Particular	Water Requirement	Water Consumption (m^3/day)
1	Visitors	5 lpcd	12.8
2	Staff	45 lpcd	1.8
3	Miscellaneous (Equipment washing and Machine room cleaning)	4l/sq.m/day	1.0
Total water requirement			**15.6**

The total water requirement for the proposed project has been estimated to be 15.6 m^3/day and will be sourced from municipal water supply and therefore will not have any impact on the water resources of the area.

WASTEWATER QUANTIFICATION AND CHARACTERISTICS

During operation phase, it is assumed that 80 % of the water supplied will be discharged as wastewater (Source: Manual on Sewerage and Sewage treatment, published by Government of India). Approximately 11.61 m^3/day of wastewater will be generated. The wastewater generation has been categorized under two sources:

- Gray water (wastewater generated from various activities, except for the wastewater produced from the toilet flushing)
- Black water (wastewater generated from the toilet)

Wastewater generated is expected to have characteristics and pollution load as shown in **Table 4.5.**

TABLE 4.5: EXPECTED WASTEWATER CHARACTERISTICS

S.N	Parameter	Concentration in wastewater mg/l
1	PH	7.15-7.65
2	Total Solids	500-800
3	Suspended solids	150-250
4	Biochemical Oxygen Demand (BOD_3 days @ 27^0 C)	200-250
5	Chemical Oxygen Demand	250-350
6	Phosphates	8.5
7	Nitrates	1-3
8	Alkalinity	125-200

Source: Manual on Sewerage and Sewage Treatment, Govt. of India

The wastewater with the foresaid characteristics can neither be discharged into inland surface water nor reused or recycled. The wastewater generated will be diverted to the municipal sewer and no major impact is expected on the water quality in the region.

4.2.2 Land Environment

During operation phase, solid waste will be generated by ropeway users. The solid waste generated from the proposed project has been estimated as shown in **Table 4.6.**

TABLE 4.6: SOLID WASTE GENERATION FROM PROPOSED PROJECT

S.N	Particular	Generation Criteria	Waste Generation (MT/Day)
1	Visitors	0.2 kg/cap/day	0.51
2	Staff	0.2 kg/cap/day	0.01
Total waste generation			**0.52**

The above table indicates that a total of 0.52 MT/day of waste will be generated due to the proposed development. The waste generated will be handed over to Guwahati Municipal Corporation.

4.2.3 Ecological Environment

Potential impacts of project operation on terrestrial and aquatic ecology include increased noise and disturbance from the operation of the cable car including maintenance, glare/lighting impact of structures (towers and cables) on bird species and positive impact to aquatic flora and fauna due to reduction in passenger ferry boats. This section of the report considers the potential impact of project on terrestrial and aquatic ecology during the operation phase of ropeway.

Terrestrial Ecology

The potential impact of project during the operation phase on terrestrial ecology include disturbance generated by aerial lighting in project area during working hour at night. No impact is expected on the migratory birds as the ropeway alignment does not interfere with the migratory route of birds. The major impact will be on mammals and birds whose breeding cycle depends upon light period. Their breeding cycle will get altered due to change in light period. Sound and air pollution produced by D.G set will cause unrest to mammals, birds and insect whose breeding and mating depends upon mating call. Frogs and reptiles having niches near the machine room will be permanently disturbed, unless they establish new habitats.

The construction of the ropeway will also reduce the number of vehicles travelling between north and south Guwahati, resulting in decrease in air pollution and will thus have a minor positive impact ion the terrestrial ecology.

Aquatic Ecology

The impact on aquatic ecology will be positive impact resulting from reduction in transportation of ferries, plying along the banks of the river. The ferry boats add pollutants in the form of oil and grease spillage from engines. The ropeway operation will reduce the pressure on water bodies. It will also have positive impact on river dolphins which surfaces every 30- 120 second for breathing. Thus the over all impact on aquatic ecology will be significantly positive.

4.2.4 Socio Economic Environment

The potential impacts envisaged due to the project activities have been detailed below:

Ferry operations: It is expected that only 30 % of the commuters will use the ropeway as the terminal station for the proposed ropeway along the south bank is near Kacharighat, which is away from the major markets. In addition, the ferryboats allow passengers to carry their vehicles and goods which will not be allowed in the ropeway.

Devotees visiting the Shiva Temple at Umananda Island will also be using the services of the ferryboats as no boarding/deboarding facility is proposed along the Island. Thus, a considerable amount of population will continue to avail the facilities of the ferryboats and hence no major impact is envisaged.

Growth pattern of north Guwahati: The proposed ropeway will improve the connectivity of north bank and will help in the growth of the city along north bank.

Culture and Heritage: No boarding/ deboarding activities have been planned at Umananda island keeping in view the heritage of the area. The ropeway project is conceived keeping in mind the convenience of people commuting between south and north Guwahati on regular basis and devotees visiting Doul Govinda temple in north Guwahati. Therefore it will in fact augment the available mode of transportation for the tourist and devotees interested in visiting the temple.

Additional Revenues for Government: Proper connectivity by ropeway will lead to new establishments and business avenues in north Guwahati and will create more jobs for the local community.

Demography: Proposed project does not envisage in any permanent residential facility so there will be no change in demographic structure of the area.

Impact on accessing utilities: The resources available to locals will not be affected in any way as there is no provision of residential facility.

4.2.5 Air Environment

The operation of the proposed ropeway will not involve major air emissions. Ropeway operation is an environmentally efficient non-polluting transport system. Two DG sets of capacity 300 KVA and 10 KVA are proposed at the lower and upper terminal stations for back up power supply. The DG set will be installed, which will be the major source of pollution for the proposed project. The proposed ropeway operation will not cause any significant effect on the ambient air environment.

In order to assess the impact on the air environment due to the DG sets, air quality modelling exercise has been carried out using USEPA(United State Environmental Protection Agency) and MoEF approved model ISCST (Industrial Source Complex Short Term) version 3. The ISCST3 model is a Gaussian plume model and is widely used to assess pollution concentration and/or deposition flux on receptors from a wide variety of sources. The air quality model has been used to predict concentrations of specific pollutants (SPM , SO_2, NOx and CO).

As a worst-case scenario, emissions have been predicted assuming an operation time of 24 hours. The characteristics of DG sets and the emission rates are given in **Appendix XI**. **Tables 4.7** provide the predicted concentrations of pollutants. The spatial distribution of the incremental pollutant levels is given in **Appendix XI (Figure 1 to Figure 4)**

TABLE 4.7: PREDICTED INCREMENTAL AND RESULTANT GROUND LEVEL CONCENTRATIONS IN μg/m^3

Concentration (μg/m^3)	Maximum 24 Hour GLC	AQ1	AQ2	AQ3	AQ4	AQ5
	(-200,-200)	(97,23)	(-236,700)	(-433,1828)	(1489,1960)	(-137,-1012)
Predicted SPM	0.77	0.40	0.003	0.01	0.02	0.11
SPM Baseline (Maximum)	229	229	119	155	219	265
Resultant SPM	229.77	229.4	119.00	155.01	219.02	265.11
NAAQS	**200 μg/m^3**					
Predicted NO_x	23.4	12.04	0.07	0.13	0.69	3.48
NOx Baseline (Maximum)	18	18	7	7	22	23

Resultant NOx	41.4	30.04	7.07	7.13	22.69	26.48
NAAQS	**80 μg/m^3**					
Predicted SO_2	3.45	1.78	0.01	0.03	0.10	0.51
SO_2 Baseline (Maximum)	8	8	5	5	11	11
Resultant SO_2	11.45	9.78	5.01	5.03	11.1	11.51
NAAQS	**80 μg/m^3**					
Concentration (μg/m^3)	**Maximum 8 Hour GLC**	**AQ1**	**AQ2**	**AQ3**	**AQ4**	**AQ5**
	(100,0)	**(97,23)**	**(-236, 700)**	**(-433,1828)**	**(1489,1960)**	**(-137,-1012)**
Predicted CO	18.2	15.1	0.10	0.12	0.74	2.52
CO Baseline (Maximum)	820	820	485	690	730	840
Resultant CO	838.2	835.1	485.1	690.12	730.74	842.52
NAAQS	**2000 μg/m^3**					

Based on the modelling exercise under observed meteorological condition, maximum predicted concentrations of SPM, NOx and SO_2 averaged over 24 hours are predicted 0.77, 23.4 and 3.5 μg/m^3 respectively and occurred in the southwest direction from the DG set located at the lower terminal station at a distance of about 283 m. However, maximum CO concentration averaged over 8 hours is predicted to be 18.2 μg/m^3 and occurred at a distance 100 m in the east direction of the 300 KVA DG set location. The maximum resultant concentrations for NOx, SO_2, and CO are well within the prescribed norm, but the maximum resultant concentration for SPM exceeds the prescribed limit. The exceedance of the SPM limit is attributed to the very high observed background concentration of the SPM. The impact on the air quality due to DG set operations is expected to be negligible.

The proposed ropeway operation will always lead to reduction in traffic between north and south guwahati and will have a minor positive impact on the air environment. The overall impact due to the proposed ropeway will be minor positive.

4.2.6 Noise Environment

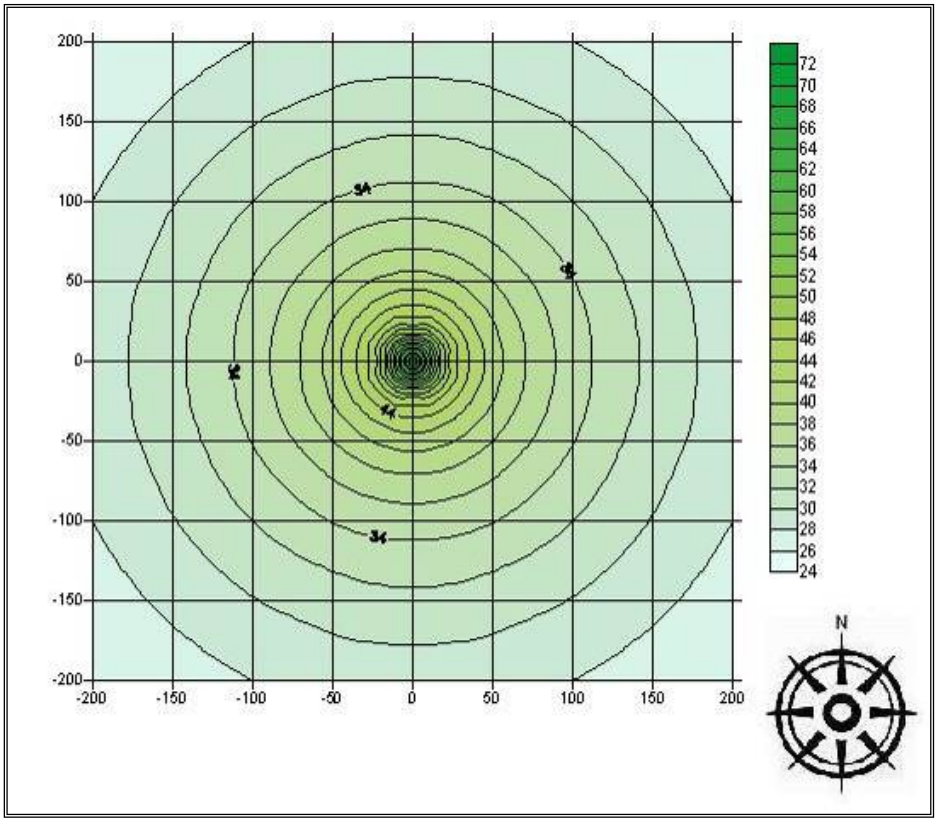
During operation phase, the major sources of noise generation will be:

- Mechanical equipment for ropeway operation
- Movement of ropeway
- DG set to be used in case of emergency

As the continuous noise source will be expected from the movement of ropeway, hence the noise impact assessment is carried out for this source only. A noise assessment has been undertaken to define the nature and scale of potential environmental impacts associated with the implementation of the proposed ropeway specifically in terms of the effects in the vicinity

of receivers. To assess the noise impact, noise modelling has been carried with the DHAWANI model. The modelling exercise has been performed with the unmitigated noise level of 75 dB (A) at 1m distance from the ropeway at landing points. The model results predicted the variation of the noise level with distance from the source as shown in the **Figure.4.2**

FIGURE 4.2: VARIATION NOISE LEVELS AROUND CABLE CAR WITHOUT CONTROL



The modelling results reveals that noise level would be 44 dB (A) at a distance of about 25 m from the source and keep on decreasing with the distance. The noise level reduced to 34 dBA at about 125 m from the source that is less than the ambient noise quality standard for residential area (55 dB (A) in day time and 45 dB (A) in night time). Based on the noise modelling study, it may be concluded that the waiting room for the passenger should be located at a minimum distance of 125 m from the cable car.

4.3 SUMMARY OF IMPACTS

The potential impacts arising due to construction and operational activities of proposed facility have been summarised in **Table 4.8**.

TABLE 4.8: SUMMARY OF IMPACTS DURING CONSTRUCTION AND OPERATION PHASE

S. N	Components	Aspect	Potential Impact
CONSTRUCTION PHASE			
1.	Water quality	• Deposition of construction material along riverbed • Disposal of slurry • Disposal of wastewater generated from temporary labour tents	• No significant negative impact • Short term negative impact • No significant impact
2.	Navigational Activities	• Impact on steamers and double deckers • Impact on ferry boats	• Short term negative impact • Short term negative impact
3.	Land use and Aesthetics	• Land development	• No significant impact
4.	Topography, drainage and soil quality	• Site development • Solid waste	• No significant impact
5.	Ecological Environment	• Impact on benthic fauna • Impact due to pollution and disturbance	• Minor negative impact • Short term negative impact
6.	Socio Economic Environment	• Impact on ferry boats and navigational activities • Impact on archaeological and cultural sites	• Short term negative impact • No significant impact
7.	Air Quality	• Emissions from construction equipments and transportation of constriction materials	• Minor negative impact
8.	Noise Environment	• Noise Emissions from construction equipments and activities and DG sets	• Minor negative impact • Short term negative impact
OPERATIONAL PHASE			
1.	Water Quality	• Use of water resources • Wastewater generation	• Minor negative impact • Negative impact
2.	Solid waste	• Generation of 0.51 MT/day of solid waste	• Negative impact
3.	Ecological Environment	• Bird Collision with towers and cable • Impact due to reduced oil spillages on aquatic ecology	• Minor negative • Minor positive impact
4.	Socio Economic Environment	• Increased development along north bank • Impact on ferry boats • Impact on archaeological sites	• Major Positive impact • Minor negative impact • No significant impact
5.	Air environment	• Emissions from DG sets (emergency use)	• Minor negative impact

S. N	Components	Aspect	Potential Impact
		• Improvement in air quality due to reduced number of vehicles	• Significant positive impact
6.	Noise environment	• Noise emissions from machinery and movement of cable car	• Minor negative impact

5.0 Environment Management Plan

The Environmental Management Plan (EMP) is a site specific plan developed to ensure that the project is implemented in an environmental sustainable manner where all contractors and subcontractors, including consultants, understand the potential environmental risks arising from the proposed project and take appropriate actions to properly manage that risk. EMP also ensures that the project implementation is carried out in accordance with the design by taking appropriate mitigative actions to reduce adverse environmental impacts during its life cycle. The plan outlines existing and potential problems that may adversely impact the environment and recommends corrective measures where required. Also, the plan outlines roles and responsibility of the key personnel and contractors who are charged with the responsibility to manage the proposed project site.

The EMP is generally:

- Prepared in accordance with rules and requirements of the MoEF/SEIAA and the State Pollution Control Board;
- To ensure that the component of facility are operated in accordance with the design;
- A process that confirms proper operation through supervision and monitoring;
- A system that addresses public complaints during construction and operation of the facility; and
- A plan that ensures remedial measures are implemented immediately.

The key benefits of the EMP are that it provides the organization with means of managing its environmental performance thereby allowing it to contribute to improved environmental quality. The other benefits include cost control and improved relations with the stakeholders.

EMP includes four major elements;

- Commitment & Policy: The proposed project management will strive to provide and implement the Environmental Management Plan that incorporates all issues related to air, land and water.
- Planning: This includes identification of environmental impacts, legal requirements and setting environmental objectives. The various potential impacts are discussed under Section 4.0.
- Implementation: This comprises of resources available to the developers, accountability of contractors, training of operational staff associated with environmental control facilities and documentation of measures to be taken.
- Measurement & Evaluation: This includes monitoring, corrective actions, and record keeping.

It is suggested that as part of the EMP, a monitoring committee should be formed comprising of the site in-charge/coordinator and project implementation team representative. This committee's role would be to ensure proper operation and management of the EMP including the regulatory compliance.

5.1 CONSTRUCTION PHASE

5.1.1 Water Environment

The construction activities along the riverbed will be carried out in a phased manner and will last only for a short duration. The following measures will be implemented to mitigate the impacts of construction activities on the water quality:

- The construction activities shall be carried out in the dry season
- Care shall be taking during the drilling activities to ensure that the construction materials are not introduced in the river system.
- Preventing spread of contaminated water by installing temporary barriers of G.I sheets.
- The slurry resulting from drilling activities shall be disposed off in the downstream portion of the river along the section having maximum flow to make use of dilution effect.
- The deposition of construction materials along the riverbed shall be compensated by the increased flow resulting due to the construction of cofferdam during this phase.

For construction of terminal stations, adequate control measures have been proposed to prevent degradation and maintain the quality of the water source, to check the surface run-off. Following management measures are suggested to protect the water quality during the construction phase.

- Avoid excavation during monsoon season
- Check dams will be provided to prevent construction runoff from the site
- Wastewater generated from temporary leabour tents will be diverted to the sewer network in the area
- To prevent surface and ground water contamination by oil/grease, leak proof containers will be used for storage and transportation of oil/grease. The floors of oil/grease handling area will be kept effectively impervious.

5.1.2 Land Environment

The waste generated from construction activity includes construction debris, biomass from land clearing activities and waste from the labour camp. Following section discusses the management of each type of waste.

Construction Waste Management: The recommended waste management plan is based upon the waste management principle to reduce the amount of waste for disposal through the development of outline plans for waste avoidance, material re-use and recycling. Mitigation measures are proposed to alleviate the impacts caused by the excavated materials and residual wastes during their handling, temporary storage on site, transportation and final disposal.

Waste management procedures will be implemented to minimise potential impacts to the environment. This may be achieved by consideration and application of the following:

- avoid and/or minimise waste generation wherever practical by changing its quality or site procedures (allow excavated material for backfilling in other locations simultaneously);
- maximise the opportunity for reusing/recycling/recovering materials and thereby negate/minimise the disposal requirements (e.g. by waste segregation according to type, separation of recyclable materials such as metal, maximise reuse of timber formwork wherever possible, utilisation of excavated material for filling or landscaping); and
- Ensure that all treatment and disposal options comply with all relevant guidelines and legislation.

Construction and Demolition Waste: The following practices will be followed to minimise the construction and demolition waste:

- Segregate waste materials according to types to facilitate re-use and recycling;
- Separate inert construction and demolition materials;
- Segregate different materials at source as far as practical;
- Co-ordinate material deliveries to minimise storage times on site to avoid damage and producing waste material; and
- Provide training to site staff in waste minimisation practices

The responsibility of transporting and disposing construction and demolition waste will be of the contractor and will be transported to an authorised site.

Excavated Material: The following measures will be implemented to mitigate against the likely adverse impacts to the environment:

- excavated material and sites will be covered to prevent washout and erosion during heavy rainfall;
- dust suppression techniques will be adopted ;
- silt traps will be provided in the surface drainage system in the stockpile area;
- designated areas for stockpiling will be fenced

The excavated material will be used for filling and will be compacted.

Municipal Waste: A temporary refuse collection facility will be set-up by the contractor and wastes will be stored in appropriate containers prior to collection and disposal.

The waste management plan for construction phase has been summarised in **Table 5.1.**

TABLE 5.1: WASTE MANAGEMENT PLAN – CONSTRUCTION PHASE

Waste Management Plan
Detailed Design Stage ▪ maximising the re-use of excavated materials; ▪ Reuse of excavated materials, topsoil, vegetation etc; ▪ Providing an area within the construction site to allow for sorting and segregation of materials.
Construction Stage ▪ minimisation of waste generation for disposal (via reduction/recycling/re-use); ▪ segregating waste materials according to type to facilitate re-use and recycling; ▪ separation of inert construction and demolition materials for r re-use on-site or to be dumped in authorised site; ▪ during demolition works, segregating materials at source as far as practical; ▪ co-ordinate material deliveries to site in order to minimise storage times on site and the likelihood of causing damage; ▪ training site staff in waste minimisation practices; ▪ transport of wastes off site as soon as possible; ▪ maintenance of comprehensive accurate waste records; ▪ use of re-useable metal boarding / signboards; ▪ no on-site burning will be permitted

5.1.3 Ecological Environment

Terrestrial Ecology

The following measures are suggested to mitigate the impacts o construction phase on the aquatic ecology:

- Construction of temporary barriers using GI sheets around the construction area (LTP and UTP).
- Construction should be avoided during night time. Aerial lighting should be avoided overnight.
- During construction on Umananda Island, care should be taken that no unnecessary removals of vegetation, tree chopping and cutting are involved.

Aquatic Ecology

Following management measures are recommended:

- Avoid major construction during monsoon, because fishes migrate and breed during monsoon season.
- Barrier should be constructed in river by using G I sheet prier to construction. This will avoid mortality of aquatic fauna during drilling operation and other construction activities
- Barrier should encompass small area of river bed so that major flow of river is not altered.

5.1.4 Socio Economic Environment

Income Generation Opportunity for Local Community

The proposed project would provide employment opportunities to the local community during construction phase. Specific consideration would be given for the employment of locals. Requirement of construction material and services will be sourced from local dealers and traders.

Safety and Health Safeguards for the workers

Considering the nature of work, proper equipments and safety gears will be provided to the workers. Occupational health and safety standards will be followed as per guidelines of Factories Act 1948.

Barricading and signboards

Construction area will be barricaded and signboards will be displayed which will provide requisite information to the neighboring communities about the construction activity and vehicle movement for transportation of construction material.

5.1.5 Air Environment

The main source of air emissions during this phase is anticipated is dust emissions from material loading and unloading, site development activities and vehicular movement. However the dust generated during the construction phase will be considerably reduced by localised meteorological conditions. The impact of other pollutants such as SO_2, NO_x and CO due to operation of mechanical equipments are expected to be negligible and thus no major control measures are required. The following procedural changes to construction activities are suggested to reduce vehicular emissions :

Idling Time Reduction - Construction equipment is commonly left idling while the operators are on break or waiting for the completion of another task. Emissions from idling equipment tend to be high, since catalytic converters cool down, thus reducing the efficiency of hydrocarbon and carbon monoxide oxidation. Existing idling control technologies, which automatically shut the engine off after a preset time can reduce emissions, without intervention from the operators.

Improved Maintenance - Recognizing that significant emission reductions can be achieved through regular equipment maintenance, contractors will be asked to provide maintenance records for their fleet as part of the contract bid and at regular intervals throughout the life of the contract.

5.1.6 Noise Environment

To mitigate the impact of noise from construction equipments during the construction phase the following measures are recommended for implementation:

Noise Shields - Equipments generating noise levels greater than the prescribed standards will be provided with noise shields to bring down the noise levels to permissible standards.

Time of Operation **-** The construction activities will be limited to the daytime only and will not be permitted during night hours.

Job Rotation and Hearing Protection **-** Workers employed in high noise areas will be rotated. Earplugs/muffs, or other hearing protective wear will be provided to those working very close to the noise generating machinery.

5.2 OPERATION PHASE

5.2.1 Water Environment

Water Requirement

The water requirements for the project will be met through municipal supply and the proposed project will not utilise any ground or surface water resources.

Navigational Activities

Appropriate horizontal and vertical clearances have been provided so that the navigational activities are not hindered along the river.

***Storm Water Management*:**

The quantity of storm water generated from the terminal stations is expected to be negligible and will constitute runoff from buildings, roads and paved areas. Contamination of storm water is possible from the following sources:

- Diesel and oil spills in the diesel power generator & fuel storage area.
- Oil spills and leaks in vehicle parking lots and washing area.
- Leachate generated from the waste.

A detailed "Storm Water Management Plan" has been developed after considering the above sources. The plan incorporates best management practices, which includes the following:

- Regular inspection and cleaning of storm drains.
- Cover waste storage areas.
- Secondary containment and dykes in fuel/oil storage facilities.
- Conducting routine inspections to ensure cleanliness.
- Preparation of spill response plans, particularly for fuel and oil storage areas.
- Good housekeeping in the above areas.

Wastewater Management

The wastewater generated from the temporary labor tents will be diverted to the sewer network in the area.

5.2.2 Land Environment

The solid waste generated due to the proposed project will be negligible. Two set of Twin bins of 200 l capacity each will be provided at the lower terminal station along the south bank and one set will be provided at the upper terminal station along the north bank. The waste collection frequency will be daily and the waste will be handed over to the Guwahati Municipal Corporation.

5.2.3 Ecological Environment

Terrestrial Ecology

Following Measures have been recommended:

- The aerial lighting should be limited to UTP and LTP. Lighting along the tower should be avoided.

Aquatic Ecology

- Minimum aerial lighting to be provided
- Care should be taken that no waste material or used oil and grease of D.G set are discharge into river beds

5.2.4 Socio Economic Environment

Infrastructure Development

The proposed ropeway is an infrastructure development project for the traffic movement between the two banks Brahmaputra river. In addition to ropeway other facilities like approach road, parking etc will also be developed.Due to the the proposed facility , the development along north bank will get an impetus, and will help in reducing congestion along the south bank.

Ferry and boat operators

The business of ferryboat operators will not be impacted significantly as their services will continue to be availed by villagers and vendors who also carry their vehicles and their goods. In addition, the increase in traffic over the period of time, the business of boat operators would coexist with the ropeway facility.

5.2.5 Air Environment

To mitigate the impact of pollutants from diesel generator sets and vehicular traffic during the operational phase of the site the following measures are recommended for implementation:

- Diesel generator set emission control measures;
- Greenbelt development.

Diesel Generator Set Emission Control Measures: Adequate stack height of 7 m and 4 m will be provided to keep the air pollutants well within the prescribed limits; hence no additional emission control measures have been suggested.

Greenbelt Development: Increasing vegetation in the form of greenbelt is one of the preferred methods to mitigate air pollution. Plants serve as a sink for pollutants, act as a barrier to break the wind speed as well as allow the dust and other particulates to settle out there. It also helps to reduce the noise level to some extent. Dense plantations will be developed along the terminal stations.

5.2.6 Noise Environment

The mechanical equipments for the ropeway operation will be provided with acoustic enclosures to meet the noise levels recommended by OSHA.

5.3 ENVIRONMENTAL MANAGEMENT SYSTEM AND MONITORING PLAN

For the effective and consistent functioning of the project, an Environmental Management System (EMS) should be established at the site. The EMS should include the following:

- An Environmental management cell
- Environmental Monitoring
- Personnel Training
- Regular Environmental Audits and Corrective Action
- Documentation – Standard operating procedures Environmental Management Plans and other records

5.3.1 Environmental Management Cell

Apart from having an Environmental Management Plan, it is also necessary to have a permanent organizational set up charged with the task of ensuring its effective implementation of mitigation measures and to conduct environmental monitoring. The major duties and responsibilities of Environmental Management Cell shall be as given below:

- To implement the environmental management plan,
- To assure regulatory compliance with all relevant rules and regulations,
- To ensure regular operation and maintenance of pollution control devices,
- To minimize environmental impacts of operations as by strict adherence to the EMP,
- To initiate environmental monitoring as per approved schedule.
- Review and interpretation of monitored results and corrective measures in case monitored results are above the specified limit.
- Maintain documentation of good environmental practices and applicable environmental laws as ready reference.
- Maintain environmental related records.
- Coordination with regulatory agencies, external consultants, monitoring laboratories.
- Maintain of log of public complaints and the action taken

6.0 Disaster Management Plan

Emergency prevention through good design, operation, maintenance and inspection are essential to reduce the probability of occurrence and consequential effect of any eventualities. However, it is not possible to totally eliminate eventualities and random failure of equipment or human errors, omissions and unsafe acts cannot be ruled out. An essential part of disaster management is therefore concerned with mitigating the effects of such Emergency and restoration of normalcy at the earliest.

The overall objective of the Disaster Management Plan (DMP) is to make use of the combined resources at the site and outside services to achieve the following:

1. To localize the emergency and if possible eliminate it;
2. To minimize the effects of the accident on people and property;
3. Expedite the rescue and medical treatment of casualties;
4. Safeguard other people;
5. Evacuate people to safe areas;
6. Informing and collaborating with statutory authorities;
7. Initially contain and ultimately bring the incident under control;
8. Preserve relevant records and equipment for the subsequent enquiry into the cause and circumstances of the emergency;
9. Investigating and taking steps to prevent reoccurrence

The DMP has therefore to be related to the identification of potential disasters/accidents. The plan will help develop actions that will be able to successfully mitigate the effects of losses/ emergency with minimum requirement of resources to control and terminate emergencies, should the same occur.

The main risks identified for the project include hazards pertaining to ropeway severance, earthquake and landslides. An emergency prevention plan and disaster management plan has been developed to identify the precautionary measures such as design overview, measures to be taken during erection and commissioning of ropeway, maintenance and inspection to be carried out for control and safety of passengers. The details are presented below:

6.1 EMERGENCY PREVENTION

6.1.1 Design Stage

INFORMATION

The operator of the ropeway will:

a) obtain from the manufacturer, supplier or assembly contractor any drawings, manuals, other data and design verification, inspection and test certificates that are necessary to establish that the passenger ropeway has been designed, manufactured and installed in accordance with the relevant IS codes ;
b) obtain from the manufacturer, supplier or assembly contractor catalogues, drawings, manuals, specifications or other information required to ensure that all relevant in-service activities can be carried out safely;
c) store this data at the place of work where the passenger ropeway is situated so that it is secure and readily available to all persons in that place of work and to any other person requiring access including equipment inspectors. This data shall be kept available for reference until disposal of the equipment.

SUPERVISION

The ropeway operator will:

a) personally supervise the passenger ropeway and every specified activity or appoint a competent person to carry out this supervision;
b) ensure that persons appointed are competent to carry out duties allocated to them;
c) delegate to competent persons, appointed to supervise passenger ropeway, powers required to exercise supervision;
d) Ensure that the names of persons appointed to supervise a passenger ropeway are made known to any persons who carry out a specified activity or any other significant activity associated with that passenger ropeway.

6.1.2 Erection And Commissioning Stage

Assembly contractors of a passenger ropeway will ensure that it is erected, commissioned, tested and inspected in accordance with information which is complete and appropriate for safe erection, testing, inspection and commissioning.

Assembly contractors of ropeway will record every critical safety stage in the erection and commissioning of passenger ropeways.

6.1.3 Operation Stage

GENERAL

The operator of the ropeway will ensure that:

a) a display is placed in a conspicuous location for the operator at the main drive stating the approved limiting conditions such as total number of cabins, capacity of each cabin , minimum spacing between cables, maximum line speed and operating limiting wind velocities;
b) the ropeway has a valid certificate of inspection;
c) the ropeway is operated safely and within their design limits;
d) all safety devices are in working condition;
e) the operation is in accordance with relevant operating manuals/procedures
f) all operating procedures relating to ropeway are kept under regular review, improved and updated whenever possible, and implemented by competent persons.

SAFETY MEASURES

The ropeway will be provided with the following safety measures:

a) The cabins will be provided with door lock, which cannot be opened by the passengers.
b) Carriage of each cabin will be provided with track rope brake.
c) Two separate brakes will be provided in the drive of ropeway system. One spring/weight operated and actuator/thruster released brake will be provided on brake ring fitted on drive sheave as normal and emergency brake. A second weight operated thruster released brake is provided on high speed brake drum coupling which will act as service brake.
d) In the event of main supply power failure, full capacity D.G. sets will be provided to supply power to run drive motors.
e) Self-driven rescue carriage and cabin to effect evacuation of stranded passenger from cabins on line.
f) Standby Diesel Engines are to be provided to run ropeway at slow speed to rescue passengers from line in case of failure of drive motor.
g) Line safety devices will be installed on each trestle to immediately stop the ropeway in the unlikely event of rope derailment.
h) Emergency push buttons will be provided at all stations to stop the ropeway
i) The Ropeway Main Drive Motors will be tripped if :
    - Set rope speed exceeds by 5%
    - Wind speed exceeds the set limit

Safety Devices at Stations

All safety devices as per the ropeway system chosen will be provided. In addition, emergency stop buttons shall be provided at convenient points to stop the cabin lift in the event of any emergency.

Line Security Devices

Line safety devices will be installed on each trestle, hold downs and pressure frames to immediately stop the ropeway in the unlikely event of rope derailment. This comprises of electrical trip limit switch with attachment mounted on line sheave mount. In an accidental case, if the hauling rope comes out of line sheave it automatically trips the ropeway by the actuation of limit switch through the attachment. Rope catcher will be provided on the incoming side of mount beams on line trestles, hold down, P.F. and stations to arrest / support the hauling rope in case of de ropement.

Rescue Arrangement

Since the ropeway needs to fly over Brahmaputra river, it will be provided with an independent rescue arrangement to facilitate the rescue of passengers(bringing back to the station) who might remain trapped along the line on account of unforeseen stopping in a reasonable short time and in the easiest and safest manner. A minimum of three sets of diesel engine operated both directional self driven rescue carriage will be provided . The rescue carriage will be such that once it is docked before the stranded cabin, passengers can be shifted to the rescue cabin easily.

Miscellaneous, Communication and Fire Precautions

- Anemometers shall be provided to monitor the wind speed and to provide trip signal to main drive in case wind speeds exceeds a pre-determined set speed.
- Communication System:
    - Communication system shall be available at both the terminal stations and should be interlinked.
- The Public Address system, provided as part of Communication system, shall be available at both the stations and will be able to operate during power failure.
- The wireless system will be provided to communicate while maintenance / rescue operation on line and for other reasons, when communication through telephone system will not be possible.
- Fire Precautions:
    - Special precautions shall be taken to protect any part of the ropeway from fire.
    - Provisions for arresting and mitigating fire hazards due to the storage of fuel for DG sets should be as per practices for such fuel storage.

MAINTAINING RECORDS

The ropeway operator will ensure that:

a) written procedures are developed for operating the equipment under all reasonably foreseeable conditions, and that all safety requirements are incorporated into these procedures;
b) records are kept of every critical safety stage in the operation of ropeway;
c) operating procedures and all other relevant operating records are freely available to any person who operates the equipment; and
d) all operational data are available for inspection by any authorised person who is involved with the ropeway, including equipment inspectors.

DAILY OPERATIONAL REQUIREMENTS

Starting of ropeway: Only competent persons authorised by the ropeway management will start the ropeway.

Daily inspections: Prior to transporting passengers, a daily inspection will be conducted by a competent person. As a minimum, the inspection will consist of the following:

a) inspect visually each terminal, station, and the entire length of the ropeway, including grips, hangers and carriers;
b) note the position of tension carriages and counterweights, and ensure that the tensioning system is free to move in both directions;
c) test the operation of all manual and automatic switches in terminals, stations, and loading and unloading areas, as per the manufacturer's specifications;
d) test the operation of main drive and all braking systems;
e) test the operation of communication systems;
f) note the general condition of the hauling rope

Termination of Daily Operations: Procedures will be established for terminating daily operations to ensure that passengers shall not be left on the ropeway after it has been shut down.

The log book shall be a record of the daily operation of the lift and it will include the following:

a) names and positions of operating personnel;
b) weather conditions: temperature, wind and visibility;
c) operating hours;
d) time, duration, and cause of abnormal interruptions; and
e) Unusual occurrences involving passengers and equipment.

MAINTENANCE OF ROPEWAY

The maintenance program will comprise of procedures for addressing all components subject to load, wear, corrosion or fatigue. This would include:

a) the types of lubricants required and frequency of application;
b) the types of testing required and frequency of testing;
c) the definitions and measurements to determine excessive wear and replacement criteria;
d) the recommended frequency of service to specific parts and details of the service required; and
e) Identification of other areas that might require specific attention.

The ropeway management shall ensure that:

a) The ropeway including all safety devices, is maintained in accordance with the maintenance and inspection schedules and are kept in safe working condition at all times;
b) a procedure is in place which requires any faults found in the ropeway to be reported immediately by the person who finds the fault, investigated and, where necessary, maintained, adjusted, repaired or altered;
c) ropeway that has been subject to maintenance, whether routine maintenance or maintenance in response to a fault found, shall be appropriately tested before re-entering service, to ensure their design compliance; and
d) all maintenance procedures relating to the ropeway shall be kept in controlled status, regularly updated and continually improved and shall be executed by competent persons.

The operator of the ropeway will:

a) the date, time and full details of any maintenance work undertaken and the results of any maintenance procedure carried out;
b) ensure that maintenance records are available for examination by all persons concerned, including equipment inspectors; and
c) keep record of running hours and/or number of loading cycles operated by a passenger ropeway and its condition, where a passenger ropeway, or any of its components, is subject to condition monitoring.

INSPECTION OF ROPEWAY

The owner /operator of the ropeway shall ensure that

a) commissioning inspection has been carried out by an equipment inspector, who shall also witness all relevant tests;
b) formal pre season inspections are carried out
c) the ropeway is inspected in-service at least annually for issue of certificate of

inspection

d) daily and periodic maintenance inspections are carried out

Inspection Intervals: The operator will ensure that the ropeway is inspected in-service and is:

a) inspected at commissioning, after the first year of service and thereafter at least annually;
b) inspected after their re-erection or re-commissioning;
c) inspected after major repairs or alterations; and
d) inspected in the event that they are seriously damaged.

Records: A list of parts to be inspected will be maintained. The operator of the ropeway will maintain records of the date, time, time and results of any inspection carried out and the name of the inspection body engaged.

TESTS OF ROPEWAY OPERATION

The ropeway operator will ensure that:

a) all routine tests of emergency procedures, and of alarms, and safety devices, relating to the ropeway, are carried out at appropriate intervals ;
b) every overload test is carried out under strict conditions, is monitored at all times and does not exceed the limits specified in the relevant design or operating standard; and
c) the ropeway is not loaded above its safe working load, except for the purposes of an overload test.

The records of the following will be maintained:

a) the date, time, details and results of any tests carried out are recorded;
b) comments on the performance of ropeway in any test, and on any maintenance done or any adjustment, alteration, or repair made as a result of any test are recorded; and
c) any data arising from testing are readily available for inspection by authorised persons including equipment inspectors.

6.2 DISASTER MANAGEMENT PLAN

A definite plan will be made for marshalling passengers for safe loading and unloading. The ropeway manager will establish and draw up any special instructions necessary to be observed by staff to ensure the safety of children and elderly persons riding the ropeway, and shall ensure that such instructions are implemented and enforced by the staff.

Loading attendants are to ensure that passengers do not embark on chairs, or in cars or cabins, with equipment which will in any way be a hazard to the safety of themselves or other passengers.

6.2.1 Communication

Both an audible signal system and a two-way voice communication system shall be maintained between the drive station and all loading and unloading stations. If only one system fails to operate, the ropeway may continue to run, provided the remote attendant stop system is fully operational. In the event of the failure of both communication systems, the ropeway shall not be operated. In the latter event, provided that adequate special precautions are taken, the ropeway may be run for the purpose of evacuation only.

6.2.2 Wind Speed Indicators

When wind conditions are sufficiently severe to make operation hazardous to passengers or equipment, based on operational experience on a particular site, the ropeway shall be shut down. The ropeway shall be closed down when the wind velocity reaches the design limit values. For this purpose, suitable wind gauges will be installed at appropriate locations to ascertain wind velocity.

6.2.3 Evacuation Procedure

Procedures for evacuation of passengers, dealing with all emergencies (will be developed and incorporated in the evacuation plan. The plan will include:

a) the definition of the line of authority in the event of an evacuation, including:
    - the individuals or positions responsible for ordering an evacuation; and
    - the individuals or positions responsible for performing the evacuation, first-aid, and ground care of evacuated passengers;
    - a description of the equipment necessary for evacuation, the standard which it has been designed and manufactured to, and where it is stored;
b) an estimate of the time necessary for the complete evacuation of the ropeway. As a guideline, an evacuation plan that takes longer than one hour should be reviewed and all implications of adverse weather conditions considered;
c) a description of unusual terrain conditions and how each of these conditions shall be dealt with during an evacuation;
d) a policy of when an evacuation should begin in the event that the ropeway becomes inoperable;
e) provision for communication with passengers of an inoperable ropeway, when communication shall start, and how often subsequent communication shall be repeated;
f) the method of evacuation to be used for a typical passenger and the method to be used for an incapacitated passenger;
g) provision for communication with the evacuation teams;
h) provision for suspending the evacuation in the event ropeway is made operable during

the evacuation;

i) provision for control and assistance of evacuated persons until released; and
j) provision for a post-evacuation report.

6.2.4 Evacuation Equipment

There shall be sufficient equipment available that the ropeway may be evacuated in a reasonable amount of time. Devices shall be capable of lowering passengers to the ground or rescuing passengers from the locations at which the devices are to be used.

Consideration shall be given to the following in determining the equipment required:

a) probable operating and evacuation conditions;
b) storage locations;
c) periods of operation which may influence evacuation

The following shall apply to the equipment that is provided and maintained for the purpose of emergency evacuation:

a) when not in use, equipment shall be carefully stored in such a location that it is readily available for use;
b) each device shall be completely inspected annually and after each use, by a competent person and any worn or damaged components shall be replaced or repaired, as appropriate;
c) all carabiners, if used, shall be of the locking type and manufactured to an acceptable standard; and
d) this equipment shall be designated for evacuation use only.

7.0 Summary and Conclusion

The proposed project is aimed at the infrastructural development of the area. The project will provide impetus to the growth of north Guwahati. The project will provide a safer means of transportation to the residents of Guwahati city.

All possible environment aspects have been adequately assessed and necessary control measures have been formulated to meet with statutory requirements, in the preparation of this EIA-EMP report. Thus implementing this project will not have any appreciable negative impacts. Thus, the proposed project is a welcome development and may be accorded environmental clearance.

APPENDICES

Appendix I
Terms of Reference

No.10-119/2007–IA-III
Government of India
Ministry of Environment & Forests
(IA-III Division)

Paryavaran Bhawan,
C.G.O. Complex, Lodi Road,
New Delhi – 110 003

Dated the 2nd September, 2008

To,

Chief Executive Officer,
Guwahati Metropolitan Development Authority,
Bhangagarh, Guwahati-5.

Sub: Ropeway project between Guwahati and North Guwahati by M/s Guwahati Metropolitan Development Authority – TOR – regarding.

****

Sir,

This has reference to your letter No.GMDA/GEN/2007/Part-II/16, dated 29.7.2008 regarding the subject mentioned above.

2. The proposal is to facilitate the daily commuters and seasonal tourists, Govt. of Assam proposes to develop a passenger ropeway across the river Brahmaputra connecting South Guwahati to North Guwahati. The length of the ropeway is 1820 m with 2 terminals and 5 trestles. Capacity of the ropeway is 250PPH. The ropeway will have two cabins supported on two track ropes and firmly attached to an endless haulage rope and one cabin will be placed at each terminal station, travel in opposite directions simultaneously and stopping at opposite terminals. Power requirement for the project is 200 KW which will be sourced from State Electricity Board. 2 DG set (One of 300 KVA and other of 10 KVA) for back up power supply are proposed for the project.

3. The Expert Appraisal Committee for environmental appraisal of Infrastructure Development and Miscellaneous Projects considered the project during its meeting held on 21st and 22nd August, 2008 and the Committee categorized the project as B-1. Based on the consideration of the documents submitted and the presentation made by the project proponent, the Committee prescribed the following additional Terms of Reference for preparing Environment Impact Assessment report for the above mentioned project:-

(i) Details of feasibility study. The proponent shall examine alternative routes also.
(ii) Details of funds available for the project and the recurring expenditure.
(iii) Details of the parking on both the sides of the project area.
(iv) Details of the safety incorporated in the project.
(v) Details of landuse plan on either ends of the project.
(vi) Details of Solid waste management.
(vii) Public Hearing shall be conducted in accordance with Environment Impact Assessment Notification, 2006 and the issues raised by the Public shall be incorporated in the Environment Impact Assessment/ Environmental Management Plan and submitted to the Ministry with all requisite data/information.

4. The draft Environment Impact Assessment report may be prepared in accordance with the above-mentioned TORs.

5. The draft Environmental Impact Assessment report should be submitted to the State Pollution Control Board for Public hearing as stipulated in the Environmental Impact Assessment Notification, 2006.

6. Public hearing should be conducted for the project as per provisions of Environmental Impact Assessment Notification, 2006 and the issues raised by the public shall be addressed in the Environmental Management Plan.

7. After compilation of Public hearing the final Environmental Impact Assessment report, which shall address all the material environmental concerns expressed concerns during the process and appropriate changes should be made in the Environmental Impact Assessment and EMP and submitted to the Ministry for environmental appraisal.

8. Besides the above, the following general points will be followed:-

a) All documents to be properly referenced with index, page numbers and continuous page numbering.
b) Where data are presented in the report especially in table, the period in which the data were collected and the source should be indicated.
c) Where the documents provided in a language other than English, an English translation should be provided.

Yours faithfully,

(Dr. A. Senthil Vel)
Additional Director

Copy to:-

Member Secretary, Assam State Pollution Control Board, Bamunimaidam, Guwahati-781021. Assam.

(Dr. A. Senthil Vel)
Additional Director

Appendix II
Traffic Projection and System Capacity

TABLE 1: TRAFFIC DATA OF MAJOR FERRY GHATS

S.N	Panbazar/Rajdwar		Machhkaua		S. Guwahati	
	Date	Persons	Date	Persons	Date	Persons
1	11th Aug	1311	14th Aug	798	8th Aug	233
2	12th Aug	1222	15th Aug	1434	9th Aug	170
3	13th Aug	845	16th Aug	1352	10th Aug	137
4	14th Aug	1300	17th Aug	1785	11th Aug	212
5	15th Aug	0	18th Aug	2043	12th Aug	129
6	16th Aug	1697	19th Aug	1600	13th Aug	295
7	17th Aug	1630	20th Aug	1609	14th Aug	98
8	18th Aug	1260	21th Aug	1820	15th Aug	0
9	19th Aug	1456	22nd Aug	1736	16th Aug	248
10	20th Aug	968	23rd Aug	1492	17th Aug	113
11	21st Aug	1703	24th Aug	1429	18th Aug	209
12	22nd Aug	1547	25th Aug	1426	19th Aug	207
13	23rd Aug	1450	26th Aug	1432	20th Aug	370
14	24th Aug	1367	27th Aug	1148	21st Aug	252
15	25th Aug	1303	28th Aug	1682	22nd Aug	191
16	26th Aug	1315	29th Aug	1411	23rd Aug	148
17	27th Aug	868			24th Aug	222
18	28th Aug	1618			25th Aug	325
19	29th Aug	1198				
Total Persons		**24058**		**24197**		**3559**
Persons per day		**1266**		**1512**		**198**

TABLE 2: AVERAGE DAILY TRAFFIC DATA

S.N	Year	Potential Traffic	Potential Ropeway Users	Ropeway Capacity (PPH)
1	2009	3265	980	98
2	2026	5396	1619	162
3	2043	8537	2561	256

TABLE 3: PEAK HOURLY TRAFFIC DATA

S.N	Year	Potential Traffic	Ropeway capacity (PPH)/ Potential Ropeway Users
1	2009	464	139
2	2026	745	223
3	2043	1232	370

Appendix III
L-Section of the Proposed Ropeway

Appendix IV
Hydragraphic Survey – Brahmaputra River

Appendix IV
Hydrographic Survey – Brahmaputra River

Appendix V
Layout Plan – Lower Terminal Station

Appendix VI
Layout Plan – Upper Terminal Station

Appendix VII
System Operation Details

Operational cycle of Jig Back system in the proposed ropeway is described below:

- The Lower Terminal Point (LTP) will be located an area near forest compound at south bank and the Upper Terminal Point (UTP) will be located at north bank. An endless haulage rope through drive connects the ropeway stations i.e. LTP & UTP followed by different rocker sheaves placed on the trestles.
- One cabin will be fixed with rope at LTP and another one cabin will be fixed with rope at UTP.
- Starting of the system from dead stop both at LTP and UTP, where boarding /de boarding takes place.
- System speed is uniformly accelerated. This gives a forward movement of the cabins placed at LTP and a reverse movement of the cabins placed at UTP.
- System moves uniformly in line.
- System starts de-accelerating as it approaches the UTP for forward movement and LTP for reverse movement.
- Before entering to the station cabin decelerates and comes to a crawling speed of maximum 0.75 m/sec and finally comes to a halt .
- System comes to a dead stop when forward cabin reaches at UTP and the reverse cabin reaches at LTP.
- After some time gap for allowing boarding/de boarding, similar process will continue

Appendix VIII
Cash Flow and FIRR

TABLE 1 : CASH FLOW STATEMENT FOR PROPOSED ROPEWAY

(All figures in lakhs)

Year	Capital Cost	Annual Recurring Cost	Gross Revenue	Net Inflow	Cumulative Net Inflow
1	920	0	0	-920	-920
2	1380	0	0	-1380	-2300
3	0	68	123.75	55.75	-2244.25
4	0	68	123.75	55.75	-2188.5
5	0	68	123.75	55.75	-2132.75
6	0	74.8	161.7	86.9	-2045.85
7	0	74.8	161.7	86.9	-1958.95
8	0	74.8	161.7	86.9	-1872.05
9	0	82.28	211.2	128.92	-1743.13
10	0	82.28	211.2	128.92	-1614.21
11	0	82.28	211.2	128.92	-1485.29
12	0	90.51	259.88	169.37	-1315.92
13	0	90.51	259.88	169.37	-1146.55
14	0	90.51	259.88	169.37	-977.18
15	0	99.56	330	230.44	-746.74
16	0	99.56	330	230.44	-516.3
17	0	99.56	330	230.44	-285.86
18	22.16	109.51	330	198.33	-87.53
19	0	109.51	330	220.49	132.96
20	0	109.51	330	220.49	353.45
21	0	120.47	330	209.53	562.98
22	0	120.47	330	209.53	772.51
23	-747.98	120.47	330	957.51	1730.02
Internal Rate of return					**3.96%**

Appendix IX
Administrative Approval

GOVERNMENT OF ASSAM
GUWAHATI DEVELOPMENT DEPARTMENT
DISPUR::GUWAHATI-6.

NO.GDD.118/2001/Pt/158 Dated Dispur, the 10th March, 2006.

From : Shri D. R. Rajbongshi, ACS,
Deputy Secy. to the Govt.of Assam.

To : The Cief Executive Officer,
Guwahati Metropolitan Dev. Authority,
Bhangagarh, Guwahati-5.

Sub : CONSTRUCTION OF ROPE WAY FROM GUWAHATI-UMANANDA-NORTH GUWAHATI.

Reff : This Deptt's letter NO.GDD.118/2001/Pt/157, Dated 1-3-2006.

Sir,

In inviting a reference to the Administrative Approval issued vide letter stated above,
I am directed to say that the above Administrative Approval is accorded subject to observance of the following conditions :-

1. G.M.D.A. would be the executing agency of the project instead of Deputy Commissioner, Kamrup(Metro),Guwahati.
2. The project and any part(s) of this are not to be taken up in any other schemes like NLCPR/NEC/State Plan etc.
3. G.M.D.A. will identify the works for Rs.8.00 Crore(Rupees eight Crores)only out of the total project cost of Rs.27.72 Crores for releasing fund in this financial year.
4. G.M.D.A.to follow all procedures/rules etc. of the Government, during implementation of the project including preparation of estimate and technical sanction.
5. Engagement of a reputed technical authority like IIT or NERIST for preparing D.P.R. is to be done by G.M.D.A.
6. If the DPR, reveals that the cost of the proct is below Rs.27. Crores then GMDA, will call for fresh BID and will settle the same through a transparent Bid Process. However if the DPR, so prepared reveal that the cost of the project is more than Rs. Rs.27.72 Crores or same then GMDA,will allot work in pursuant to the present process and as per recommendation of Bid Negotiation Committee.
7. The entire process indicated above should be completed within a period of two months.
8. G.M.D.A. will reimburse the cost already incurred by D. C. Kamrup(Metro) in preparing the Bid Document, procurement of consultancy, advertisement in the National Newspapers etc.

You are, therefore requested kindly to identify the item of works for making expenditure for an amount of Rs.8.00 Crores (Rupees eight Crores)only to be made available during current financial year,2005-2006 and submit the same within 19-3-2006 for onward submission to Planning & Development Department.
Please treat it as TOP MOST URGENT.

Yours faithfully,
10/3/06
Deputy Secy. to the Govt.of Assam,
Guwahati Development Department.

- 2 -

Memo No.GDD.118/2001/Pt./158-A, Dated Dispur, the 10th March, 2

Copy to :-

1. The Deputy Commissioner, Kamrup (Metro) Guwahati. He is reques to handover the papers/documents of the project to G.M.D.A. and to submit the Bills for the expenditure already incurre to G.M.D.A. for payment.

By Order etc...,

Deputy Secy. to the Govt.of Assam,
Guwahati Development Department

....

GOVERNMENT OF ASSAM
GUWAHATI DEVELOPMENT DEPARTMENT
DISPUR::GUWAHATI-6.

No.GDD.118/2001/Pt/157, Dated Dispur the 1st March, 2006.

From : Shri D.R. Rajbangshi, ACS,
Deputy Secy. to the Govt.of Assam.

To The Accountant General (A&E)Assam,
Maidamgaon Beltola, Guwahati-29.

Sub : Administrative Approval for Construction of Rope way from Guwahati-Umananda-North Guwahati.

Sir,

I am directed to say that the Governor of Assam is pleased to accord Administrative Approval for an amount of Rs.27.72 Crore (Rupees twenty seven crore seventy two lakhs)only for construction of Rope Way from Guwahati-Umananda-North Guwahati limiting the expenditure to the extent of Rs.8.00 crore(Rupees eight crore)only during the year-2005-2006.

The Deputy Secy. to the Govt.of Assam, Secretariat Admn. (Accounts)Deptt, Dispur will draw the amount and disburse the same to Chief Executive Officer, Guwahati Metropolitan Development Authority on receipt of declaration of D.D.O , FOC, and budget allotment from this Department in due course.

The expenditure is debitable to the head of Account "2217-Urban Dev.-II-Other State Plan & Non-Plan Schemes-800-Other Expenditure-09-Grants-in-aid one time Addl. Central Asstt.-General (Plan) for the year 2005-2006.

This has the concurrence of Finance(EC-III)Deptt. Vide U.O.NO.FEC(III),2002/2006,dtd. 1-3-2006.

Yours faithfully,

Deputy Secy.to the Govt.of Assam,
Guwahati Development Department.

Memo No.GDD.118/2001/pt/157-A, Dated Dispur the 1st March, 2006.

Copy to :- 1. The Treasury Officer, Dispur Treasury, Dispur, Ghy-6.
2. The Deputy Secy. to the Govt.of Assam, Secretariat Admn. (Accounts) Deptt., Dispur for information and necessary action.
3. Finance (EC-III)/Finance(Estt.-B)/Finance(Budget)Deptt, Dispur.
4. Planning & Development Department, Dispur, for information.
5. The Chief Executive Officer, G.M.D.A., Bhangagarh, Guwahati-5 for information and necessary action.

By order etc.,

Deputy Secy.to the Govt.of Assam,
Guwahati Development Department.

Memo No.GDD.118/2001/pt/157-B, Dated Dispur the 1st March, 2006.

Copy to : 1. The Treasury Officer, Dispur Treasury, Dispur, Guwahati-6.
2. The Accountant General (A&E) Assam, Maidamgaon, Beltola, Guwahati-29.

Financial Adviser,
Guwahati Development Department.

SH(3) B

GOVERNMENT OF ASSAM
GUWAHATI DEVELOPMENT DEPARTMENT
DISPUR,GUWAHATI-6

NO.GDD.118/2001/Pt.I/32 Dated Dispur,the 29th March,2008.

From : Shri D.R.Rajbangshi,ACS,
Deputy Secy.to the Govt.of Assam,
Guwahati Development Department.

TO : The Principal Accountant General (Audit),Assam,
Maidamgaon, Beltola, Guwahati-29.

Sub : Declaration of Drawing and Disbursing Officer.

Sir,

I am directed to say that the Governor of Assam is pleased to declare the Deputy Secy.to the Govt.of Assam, Sectt. Admn.(Account Deptt., Dispur as Drawing and Disbursing Officer for drawal of an amount of Rs. 1147.00 lakhs (Rupees One thousand one hundred forty seven lakhs) only made available by Finance (Budget) Department vide their letter NO.BB. 161/2007/415, Dated- 27/3/2008 subject to observance of the provisions under rules S.O. 213 (b) and S.O. 214 of T.Rs and S.Os.

The Administrative Approval for an amount of Rs. 27.72 Crore (Rupees twenty seven crores seventy two lakhs) only has been issued vide NO. GDD. 118/2001/Pt/157, dated- 1-3-2006.

There is budget provision of Rs. 1147.00 lakhs under the head of Account " 2217-Urban Dev.-II-Other State Plan & Non-Plan Scheme-80-General-800-Other expenditure-09-Grants-in-aid-to GMDA-one time ACA-General (Plan) for the year 2007-08 under Grant NO.73 .

This is issued with the approval of Finance (Estt.B) Deptt vide their U.O.NO.FEB. 95/2008 dated- 28-3-2008 .

Yours faithfully,

Deputy Secy.to the Govt.of Assam.
Guwahati Development Department.

Memo NO.GDD. 118/2001/Pt-I/32-A, Dated Dispur,the 29th March,2008.
Copy to :-
1. The Treasury Officer, Dispur Treasury, Dispur,Guwahati-6. for information &necessary action.
2. Finance (Budget)/(Estt-B)/(E.A.) /(EC-III) Deptt. Dispur.
3. The Deputy Secy.to the Govt.of Assam, S.A.(Accounts),Deptt. Dispur,for information and necessary action.
4. The Chief Executive Officer,Guwahati Metropolitan Development Authority,Bhangagarh,Ghy-5 for information.
5. Planning and Development Department,Dispur, Guwahati-6.

By order etc. ,

Deputy Secy.to the Govt.of Assam.
Guwahati Development Department.

Memo NO. GDD. 118/2001/Pt-I/32-B, Dated Dispur,the 29th March,08.
Copy to :-
1. The Principal Accountant General (Audit), Assam, Maidamgaon, Beltola, Guwahati-29.
2. The Treasury Officer, Dispur Treasury, Dispur , Guwahati-6.

Financial Adviser.
Guwahati Development Department

Appendix X
Approval from Inland Waterway authority of India

03 Jul 08 18:10 P.1

0124-2571627 By Speed Post

भारतीय अन्तर्देशीय जलमार्ग प्राधिकरण
(पोत परिवहन मंत्रालय, भारत सरकार)
मुख्यालय : ए–13, सैक्टर–1, नौएडा–201 301 (उ.प्र.)

INLAND WATERWAYS AUTHORITY OF INDIA
(Ministry of Shipping, Govt. of India)
Head Office : A-13, Sector-1, Noida-201 301 (U.P.)

Tele. : Code-95120 - 2544036, 2521684, 2522798, 2521724 Fax : 2544009, 2544041, 2543973

No. IWAI/PR/2/Nav Cl./2007 Date : 2.7.2008

To
The Chief Executive Officer,
Guwahati Metropolitan Development Authority,
Bhangagarh,
Guwahati

Sub: Construction of ropeway between Guwahati – Umananda - North Guwahati across river Brahmaputra on NW-2.

Sir,

Please refer to your letter no GMDA/GEN/7//2007/119 dated 6.6.08 forwarding an application for getting clearance for the construction of ropeway between Guwahati – Umananda - North Guwahati across river Brahmaputra. In this regard it is to inform that river Brahmaputra between Dhubri and Sadiya has been declared as National Waterway no. 2 (NW-2) and stretch from Bangladesh border to Dibrugarh of NW-2 has been classified under 'Class VII' of National Waterway as per Gazette "Inland Waterways Authority of India (Classification of Inland Waterways in India) Regulation, 2006". A copy of OM No. IWAI/PL-NW-3/9/98-Vol-I dated 27.8.07 issued by IWAI is enclosed for your reference and necessary action please.

With reference to your application seeking clearance for the construction of ropeway between Guwahati – Umananda - North Guwahati across river Brahmaputra on NW-2, I am directed to inform you that this Authority has no objection for construction of the ropeway with vertical clearances of 17.60 m between HFL and the bottom of the carrier and a horizontal clearance of 915 m, between any two piers within the river portion for navigation purpose.

Yours faithfully

(S.S. PANDIAN)
Chief Engineer

Encl : As above.

Appendix XI
Air Quality Modelling Results

TABLE 1: DG SET DETAILS

Sr. No.	Particulars	DG set Capacity	
		300 KVA	10 KVA
1	No of DG sets	1	1
2	No of stacks	1	1
3	Height of stack (m)	7	4
4	Diameter of stack (m)	0.25	0.05
5	Exit velocity of gas (m/s)	20.6	17.3
6	Exit temperature of gas (^{0}C)	532	400
7	Oil consumption (L/hr)	72	3
8	Density of oil (kg/m^3)	850	850
9	Sulphur content (%)	0.25	0.25

TABLE 2: EMISSION RATE OF DIESEL GENERATOR SET

Pollutant	Emission Rate (g/s)	
	300 kVA	10 kVA
Particulate Matter (SPM)	0.02	0.001
Sulphur Dioxide (SO_2)	0.09	0.004
Nitrogen Dioxide (NO_x)	0.61	0.02
Carbon monoxide (CO)	0.23	0.01

FIGURE 1: PREDICTED MAXIMUM 24 HOUR GLC(μ/gm^3) OF PM

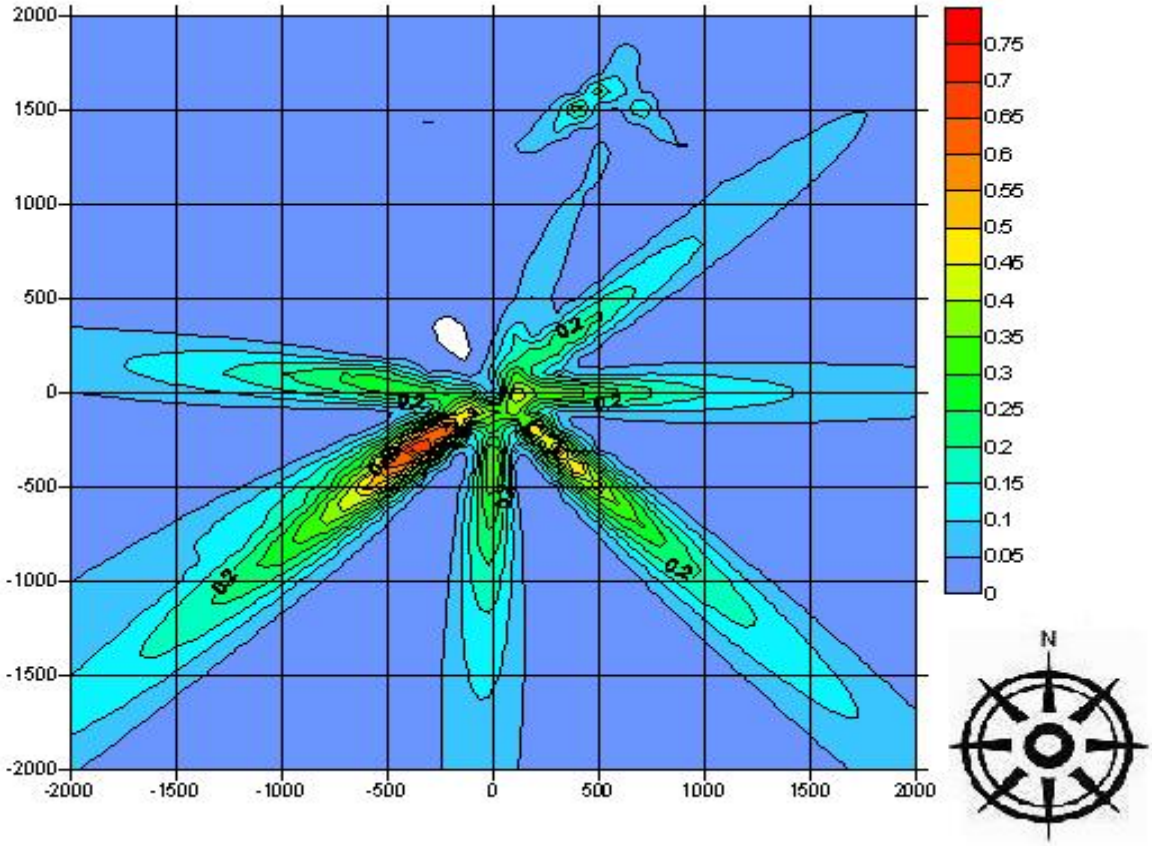


FIGURE 2: PREDICTED MAXIMUM 24 HOUR GLC(μ/gm^3) OF NOX

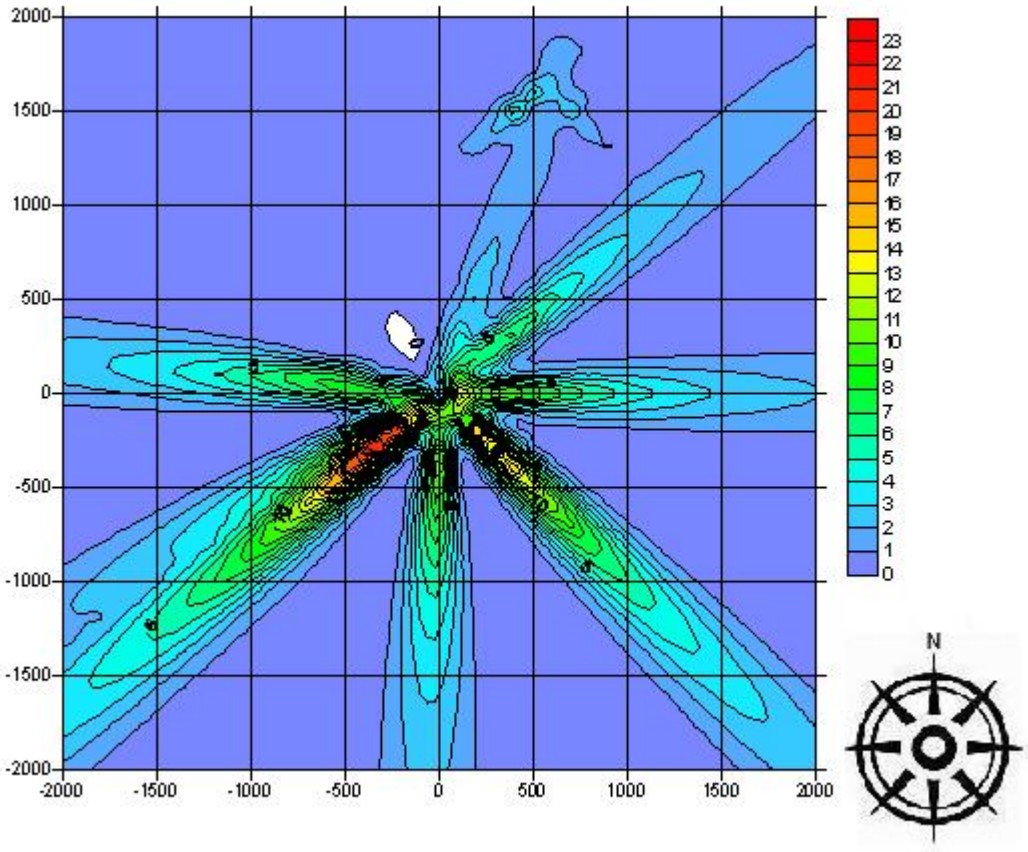


FIGURE 3: PREDICTED MAXIMUM 24 HOUR GLC(μ/gm^3) OF SO_2

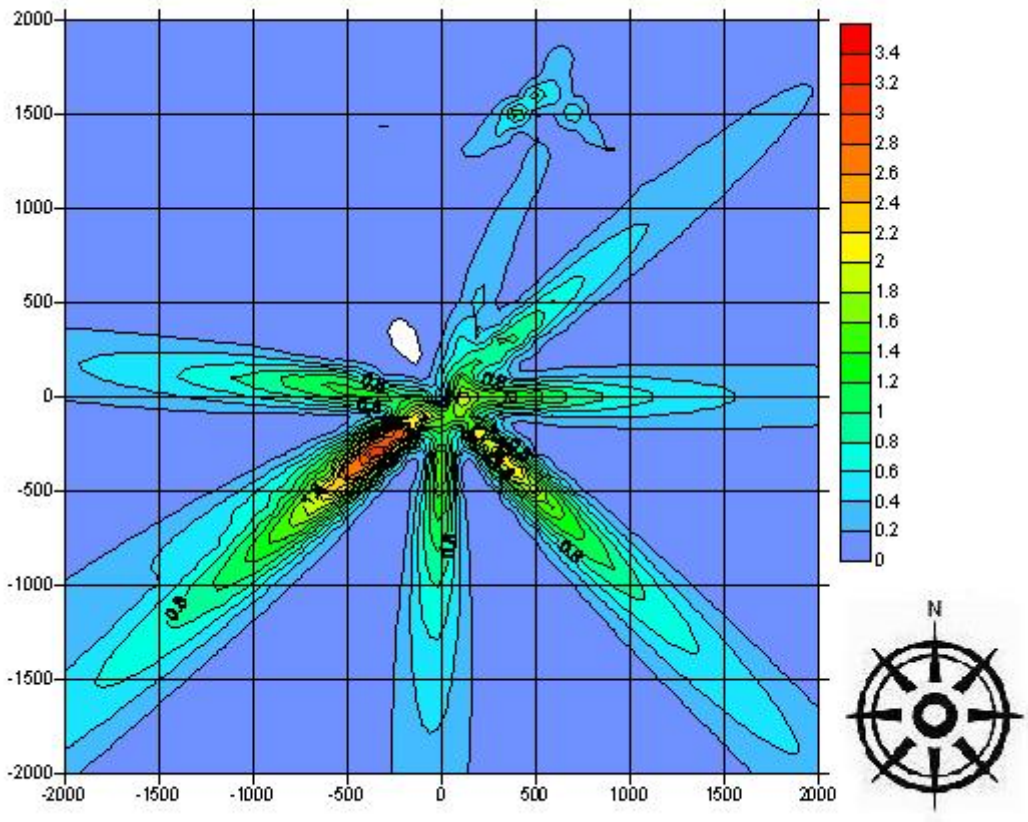


FIGURE 4: PREDICTED MAXIMUM 24 HOUR GLC(μ/gm^3) OF CO