adani

Ports and Logistics

Ref:GPL/ENV/ 2025-26/03

April 7, 2025

To,

The Director
Ministry of Environment, Forest & Climate Change
INDIRA PARYAVARAN
JOR BAGH ROAD,
NEW DELHI – 110 003.

Subject : Development of Gopalpur Ports Ltd." : Env. Compliance.

Ref. : No.10-12/2009-IA.III dt. 30th Mar, 2011, 14th Aug.2018

Dear Sir,

With reference to the above, we are submitting herewith our compliance of the conditions as laid down in different permissions and clearances. The Compliance report till end of March 2025 is being enclosed for your kind consideration.

Yours faithfully,

For Gopalpur Ports Limited,

Authorized signatory

GOPALPUR PORTS LIMITED ODISHA - INDIA

Copy to:

1. Additional Chief Secretary, Department of Forest & Wildlife, Govt. of Odisha, Secretariat, ,hubaneswar – 751 001.
2. The Chairman, Central Pollution Control Board, Parivesh Bhavan, CBD-Cum-Office Complex, East Arjun Nagar, Delhi – 110 032.
3. Addl. Principal Chief Conservator of Forests (Central), Ministry of Environment, Forest and Climate Change, Regional Office (EZ), A/3, Chandersekharpur, Bhubaneswar – 751 023.
4. The Member Secretary,Odisha State Pollution Control Board, Paribesh Bhavan, A/118, Nilakantha Nagar, Unit – VIII, Bhubaneswar - 751 012.Regional Officer, Odisha State Pollution Control Board Bharampur, Ganjam

Gopalpur Ports Limited
At/Po. Arjeepalli, Via- Chatrapur,
Dist- Ganjam, Odisha, PIN- 761045
CIN: U63032OR2006PLC008831

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Website : www.gopalpurports.in

Compliance Report for Environmental Clearance No.10-12/2009-IA-III Dated 30th March 2011

Sl. No.	Conditions	Compliance Status
6.		
(i)	"Consent for Establishment" shall be obtained from State Pollution Control Board under Air and Water Act and a copy shall be submitted to the Ministry before start of any construction work at the site.	Complied
(ii)	No construction work other than those permitted in Coastal Regulation Zone Notification, 2011 shall be carried out in Coastal Regulation Zone area.	Being complied with.
(iii)	The shore line map prepared by Institute for Ocean Management, Chennai with regard to the stretch at Gopalpur Port has been examined and it is observed that on the southern side of the port, the area is shown as high to medium accretion while, on the northern side the area is shown as low to medium erosion. This is because the net littoral drift is towards the northern side and due to the break water at the southern port there seems to be accretion at the southern breakwater and low to medium erosion on the northern side. This has to be ratified by adopting suitable sand bypass system from south break water to the northern side of the north break water.	Beach nourishment undertaken for 4 MCM in the groin field to address the erosional aspect Environmental monitoring report (From Oct .2024 to April 2025) attached.
(iv)	Controlled and proper methods of dredging including state of the art equipment and planning the dredging operation and disposal shall be employed.	Dredging carried out by use of controlled cutter suction. Other mitigation measures implemented to curtail the turbidity.

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(v)	Technically qualified institution shall be engaged to monitor the impact right from the beginning to suggest scientifically accepted mitigation measures as and when required on annual basis at least for first 3 years, shall be obtained.	Department of Marine Sciences, Berhampur University engaged to carry out the environmental monitoring of project work of Gopalpur port.
(vi)	A high level expert committee shall be constituted including the experts for Monitoring the population of benthic life during and after the construction phase and also to ensure the compliance of other conditions stipulated in the clearance.	High level expert committee has been constituted and periodically reviews the compliance conditions stipulated in the clearance.
(vii)	An additional substratum shall be provided with the breakwaters, thereby adding to the habitat of benthic community especially flora which is very low due to the present geo physical characteristics of the area.	Additional substratum provided during construction of break water and from the studies being carried out by department of Marine Science dept., Berhampur University there is increase in habitat of benthic community.
(viii)	Oil spills if any shall be properly collected and disposed as per the Rules.	Oil Spill Contingency Plan (OSCP) is in place.
(ix)	There shall be no drawl of ground water in CRZ area.	Complied with.
(x)	Environment Management Plan as suggested shall be strictly complied with.	Complied with.
(xi)	There shall be no disposal of solid and liquid wastes into the Coastal areas.	Being complied with and taken care off.
(xii)	Sewage Treatment facility should be provided in accordance with the CRZ notification, 2011. Treated sewage shall be reused for flushing of toilets and horticulture purposes.	Sewage Treatment facility provided and the treated sewage water used for plantation.
(xiii)	The solid waste shall be properly collected, segregated, and disposed as per the provision of solid Waste (Management and Handling) Rules, 2000.	Waste management Plan is in place.

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(xiv)	Installation and operation of DG set if any shall comply with the guidelines of CPCB.	CPCB approved DG sets are installed.
(xv)	The approach channel shall be properly demarcated with lighted buoys for safe navigation and adequate traffic control guidelines shall be framed. The fishermen shall be suitably educated and informed about the traffic guidelines.	Channel Marker Buoys have been installed for safe navigation. Fishermen Sensitization is being done regularly for harmony with port operation.
(xvi)	The project proponent shall set up separate environmental management cell for effective implementation of the stipulated environmental safeguards under the supervision of a Senior Executive.	Environment Management Cell has been created Headed by DGM Environment
(xvii)	The project proponent shall take up mangrove plantation/green belt in the project area, wherever possible. Adequate budget shall be provided in the Environment Management Plan for such mangrove development.	Green Belt development work is in progress following land shaping and plantation work.
(xviii)	The funds earmarked for environment management plan shall be included in the budget and this shall not be diverted for any other purposes.	Adequate fund is ear-marked and available.
(xix)	Under the provisions of Environment (Protection) Act, 1986, legal action shall be initiated against the project proponent if it was found that the construction of the project has been started without obtaining environmental clearance.	Construction of the project commenced after obtaining the Environmental Clearance. Date of project commencement is 10th Nov. 2011.
7.		
(I)	Adequate provision for infrastructure facilities including water supply, fuel and sanitation must be ensured for construction workers during the construction phase of the project to avoid any damage to the environment.	Being complied with.
(ii)	Appropriate measures must be taken while undertaking digging activities to avoid any likely degradation of water quality.	Being complied with.

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(iii)	Borrow sites for each quarry sites for road construction material and dump sites must be identified keeping in view the following: a) No excavation or dumping on private property is carried out without written consent of the owner. b) No excavation or dumping shall be allowed on wetlands, forest areas or other ecologically valuable or sensitive locations. c) Excavation work shall be done in close consultation with the soil Conservation and Watershed Development Agencies working in the area, and d) Construction spoils including bituminous material and other hazardous materials must not be allowed to contaminate water courses and the dump sites for such materials must be secured so that they shall not leach into the ground water.	Being complied with.
(iv)	The construction material shall be obtained only from approved quarries. In case new quarries are to be opened, specific approvals from the competent authority shall be obtained in this regard.	Being complied with.
(v)	Adequate precautions shall be taken during transportation of the construction material so that it does not affect the environment adversely.	Being complied with.
(vi)	Full support shall be extended to the officers of this Ministry/Regional Office at Bhubaneswar by the project proponent during inspection of the project for monitoring purposes by furnishing full details and action plan including action taken reports in respect of mitigation measures and other environmental protection activities.	GPL is committed to provide necessary support.

(vii)	A Six-monthly monitoring report shall need to be submitted by the project proponents to the Regional Office of this Ministry at Bhubaneswar regarding the implementation of the stipulated conditions.	Being complied with.
(viii)	Ministry of Environment and Forests or any other competent authority may stipulate any additional conditions or modify the existing ones, if necessary in the interest of environment and the same shall be complied with.	GPL is committed to comply with such condition, if any.
(ix)	The Ministry reserves the right to revoke this clearance if any of the conditions stipulated are not complied with the satisfaction of the Ministry.	Taken note of.
(x)	In the event of a change in project profile or change in the implementation agency, a fresh reference shall be made to the Ministry of Environment and Forests.	Will be complied, if any.
(xi)	The project proponents shall inform the Regional Office as well as the Ministry, the date of financial closure and final approval of the project by the concerned authorities and the date of start of land development work.	Complied The Land development work commenced on 10th November 2011 after approval of the project.
(xii)	A copy of the clearance letter shall be marked to concern Panchayat / local NGO, if any, from whom any suggestion / representation have been made, received while processing the proposal.	Noted and complied.
(xiii)	Orissa Pollution control Board shall display a copy of the clearance letter at the Regional Office, District Industries Centre and Collector's Office/Tahasildar's office for 30 days.	Noted
8.	These stipulations would be enforced among others under the provisions of Water (Prevention and Control of Pollution) Act 1974, the Air (Prevention and Control of Pollution) Act 1981, the Environment (Protection) Act, 1986, the	Noted

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	Public Liability (Insurance) Act, 1991 and EIA Notification 1994, including the amendments and rules made thereafter.	
9.	All other statutory clearances such as the approvals for storage of diesel from Chief Controller of Explosives, Fire Department, Civil Aviation Department, Forest Conservation act, 1980 and Wildlife (Protection) Act, 1972 etc. shall be obtained, as applicable by project proponents from the respective competent authorities.	Agreed
10.	The project proponent shall advertise in at least two local Newspapers widely circulated in the region, one of which shall be in the vernacular language informing that the project has been accorded Environmental Clearance and copies of clearance are available with the State Pollution Control Board and may also be seen on the website of the Ministry of Environment and forests at http://www.envfor.nic.in. The advertisement should be made within 10 days from the date of receipt of the Clearance letter and a copy of the same should be forwarded to the Regional Office of this Ministry at Bhubaneswar.	Complied, Vide letter No. GPL/2011/59, dated 11/04/2011
11.	Environmental clearance is subject to final order of the Hon'ble Supreme court of India in the matter of Goa Foundation vs. Union of India in Writ Petition (Civil) No.460 of 2004 as may be applicable to this Project.	Agreed
12.	Status of compliance to the various stipulated environmental conditions and environmental safeguards will be uploaded by the project proponent in its website.	Complied

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13.	The project proponent shall also submit six monthly reports on the status of compliance of the stipulated EC conditions including results of monitoring data (both in hard copies as well as by e-mail) to the respective Regional Office of MoEF, the respective Zonal Office of CPCB and the SPCB.	Complied
14.	The environmental statement for each financial year ending 31st March in Form-V as is mandated to be submitted by the project proponent to the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently, shall be put on the website of the company along with the status of compliance of EC conditions and shall also be sent to the respective Regional Offices of MoEF& CC by e-mail.	Complied
Additional Conditions of the EC Validity Extension Order dated 14th August 2018		
1.	The Project Proponent will submit a Certified Compliance Report within 03 months issued by the MoEF& CC, Regional Office or concerned Regional Office of the Central Pollution Control Board or the Member Secretary of the respective State Pollution Control Board for the conditions stipulated in the Environmental and CRZ Clearance issued earlier	Being Complied
2.	The development plan shall be implemented strictly in accordance to the Coastal Zone Management Plan as drawn up in compliance to the orders of the NGT in this regards. A copy of the compliance report shall be submitted within 30 days to the MoEF& CC.	Being Complied
3.	As per the Ministry's Office Memorandum F.No22-65/2017-Ia.III dated 1st May 2018, the	As per the Para 6 (IX) of the said notification which states

	project proponent is required to prepare and implement Corporate Environment Responsibility (CER) Plan. As per the para 6(II) of the said O.M appropriate funds shall be earmarked for the activities such as infrastructure creation for drinking water supply, sanitation, health, education, skill development, roads, cross drains, electrification including solar power, solid waste management facilities, scientific support and awareness to local farmers to increase yield of crop and fodder, rain water harvesting, soil moisture conservation works, avenue plantation, plantation in community areas etc. The activities proposed under CER shall be restricted to the affected area around the project. The entire activities proposed under the CER shall be treated as project and shall be monitored. The monitoring report shall be submitted to the regional office as a part of half yearly compliance report, and to the District Collector. It should be posted on the website of the Project Proponent.	that *the CER is not applicable in name change, transfer, amendment involving no additional project investment*; this is not applicable to us, as there is no additional project investment.



ENVIRONMENTAL MONITORING OF GOPALPUR PORT

Report
October,2024 to March, 2025

Submitted to

Gopalpur Ports Limited
Arjeepalli, Via- Chhatrapur
PIN-761020, Ganjam, Odisha, India

Visiontek Consultancy Services Pvt .Ltd
(An Enviro Engineering Consulting Cell,)

Prepared by

VISIONTEK Consultancy Services Pvt. Ltd.,
Nodal Expert, GPL Env. Monitoring Project
Plot No- M22 23, Chandaka Industrial Estate, Patia,
Bhubaneswar-751024

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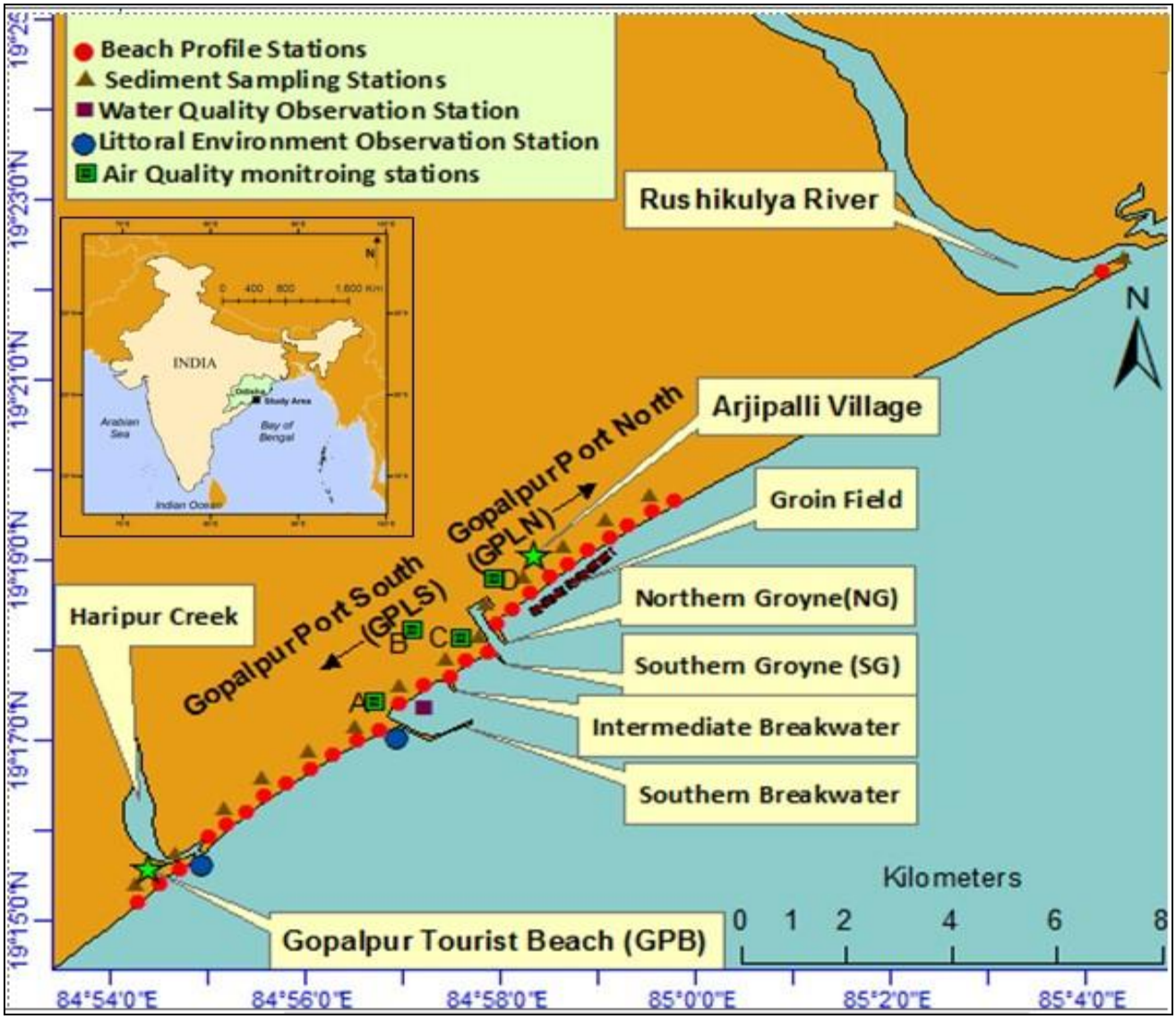


Figure 1: Sampling locations of different parameters near Gopalpur coast

OBJECTIVES:

1. Shoreline Monitoring

Monitoring the beach profile, erosion/accretion environment, shoreline change along a stretch of approximately 13km (from Gopalpur light house to Arjipalli village), which lies within the Port limit, on monthly basis.

Monitoring the sediment characteristics, littoral environment observations (LEO) were carried out along 13km stretch on monthly basis (Fig.1).

2. Monitoring of Ambient Air Quality

Monitoring of Ambient Air Quality were carried out at 4 stations; two in the windward side and two in the leeward side within the port premises for PM_{10}, $PM_{2.5}$, SO_2, NO_2 to measure the maximum ground level concentration (Fig.1).

3. Noise level monitoring

The noise level monitoring was carried out at 4 stations; two in the windward side and two in the leeward side within the port premises.

4. DG stack monitoring

DG stack monitoring was carried out on monthly basis from six DGs available in the port premises.

5. Domestic effluent

The Domestic effluent water was collected from the outlet of the sewage treatment plant available in the port for analysis of different parameters such as pH, BOD, COD, Suspended solid, Oil and grease.

6. Marine Water Sample

Chemical and microbial parameters

Coastal water samples were collected monthly from the harbor area for analysis of different parameters like pH, DO, Colour, Odour, Fecal Coliform, BOD, Salinity, EC, TDS, TSM, Phosphate, Nitrate, Chlorides, Sulphate, PHC, Lead, Hexavalent Chromium &Mercury were analyzed soon after the collection.

7. Sediment Sample

Chemical Parameters

Sediment samples were collected every month at same location near berth area and analyzed for the parameters like texture, pH, Sodium, Potassium, Phosphate, Chlorides, Sulphate, PHC, Lead, Mercury, Hexavalent Chromium and Organic Carbon etc.

8. Potable water analysis

Potable water samples were collected from the port premises every month and analyzed for color, order, turbidity, pH, Total hardness, Iron, Chloride, TDS, Calcium, Magnesium, Sulphate, Fluoride, Alkalinity, Salinity, Zinc, Lead and E.Coil.

9. Coal Stack yard

The water samples from the coal stack yard were collected monthly basis from coal stack yard available inside the port premises for analysis of different parameters such as pH, Electrical Conductivity and Total Dissolved Solid.

10. Biological Parameters

Biological parameters such as light penetration, chlorophyll, primary productivity, phytoplankton, zooplankton, benthic meio fauna and benthic macro fauna within the harbour were analyzed at every three month interval.



Figure 2: Sampling activities and field observation

Observation Schedule

Table 1: Types and frequency of Observations

Types of Observation	Schedule of Observation	Spatial variability of observation
Shoreline (ARCPAD_DGPS)	Monthly	Mapping the berm line, representing the shoreline, within the port limit covering13 km stretch
Beach Profile (RTK_GPS/TOTAL STATION)	Monthly	30 transects covering about 13 km stretch of the coast line (Fig. 1). Within 4.5km north and south of the port, the distance between two successive transects is maintained at 500m while for other locations, the distance is maintained at 1km.
Littoral Environmental Observations (LEO)	Monthly	At three points; Gopalpur port South, Gopalpur port North near and tourist beach (Fig. 1).
Sediment	Monthly	Sediment samples are collected for grain size analysis at backshore, midshore and foreshore of a transect at every 1km interval covering the 26 km stretch of the coast.
Ambient air quality (PM_{10}, $PM_{2.5}$, SO_2, O_2)	Twice in a Week	From the four sampling stations within the port environment (Fig. 2.1)
Noise level	Monthly	Within the port environment as per the guidelines of Central Pollution Control Board (CPCB)
DG stack monitoring	Monthly	Monitoring was carried out for the six DGs available inside the port premises.
Domestic effluents	Monthly	pH,BOD,COD,SuspendedSolids,oil&Grease
Coastal Water sample	Monthly	pH, DO, Colour, Odour, Fecal Coliform, BOD, Salinity, EC, TDS, TSM, Phosphate, Nitrate, sulphates, Chlorides, PHC, Lead, Mercury, Hexavalent Chromium,
Sediment sample a. Chemical parameters	Monthly	Texture, pH, Sodium, Potassium, Phosphate, Chlorides, Sulphates, PHC, Lead, Mercury, Hexavalent Chromium and Organic Carbon
Potable water	Monthly	Color, odour,Turbidity, pH, Total Hardness
Effluent from Coal Stack Yard	Monthly	pH, EC,TDS
b. Biological parameters	Quarterly	Light penetration. Chlorophyll, Primary productivity, phytoplankton, zooplankton within the harbor Benthic Meio-Fauna, Benthic Macro-Fauna

1. Shoreline monitoring

Table 1.1 and Figure 3 present monthly measurements of shoreline distances (in meters) between the berm line and a reference line along Gopalpur Port South from October 2024 to March 2025. Measurements were taken at 0 km, 0.5 km, 1.0 km, 2.5 km, 3.0 km, 3.5 km, 4.0 km, and 4.5 km intervals. In October 2024, shoreline length ranged from 719.6 meters at 0 km to 730.8 meters at 4.5 km, peaking at 1145.9 meters at 2.5 km. At 0 km, the values remain relatively stable, ranging from 703.3 (Feb 25) to 720.5 (Nov 24).At 0.5 km, a decrease is observed from 707.6 (Oct 24) to 658.9 (Feb 25), followed by a slight increase in March 2025.At 1.0 km, values peak in January2025 (851.3) and remain consistently high across months.The highest variations occur at 2.5 km, where values fluctuate between 1125.9 (January2025) and 1165.2 (February 25).Beyond 3.0 km, values show some fluctuations but remain relatively higher in Feb 2025 and Mar 2025 compared to earlier months.These monthly fluctuations, particularly at the 2.5 km mark, reflect dynamic coastal processes influenced by seasonal changes and geomorphological factors.

Table 1.2 and Figure 4 illustrate shoreline distances along Gopalpur Port North from the dataset represents monthly variations in shoreline characteristics from October 2024 to March 2025 across different distances (0 km to 4.5 km). At the Northern Groin (0 km) a fluctuating trend is observed, with values declining from 319.9 (October2024) to 277.8 (March2025).The lowest value occurs in March 2025, suggesting gradual sediment reduction or possible erosion at the groin location. At0.5 km to 1.5 km North a significant decrease in values is seen from October 2024 to February 2025, particularly at 0.5 km, where values drop from 247.2 (Oct 24) to 183.66 (Feb 25).A minor recovery is noticed in March 2025 (202.1 at 0.5 km), indicating possible seasonal sediment fluctuations.The relatively stable values at 1.0 km (219.7 – 225.8) and 1.5 km (172.4 – 211.7) experiencing alternating sediment deposition and erosion. At2.0 km to 3.5 km North, it exhibits moderate fluctuations, with values generally stabilizing around 230–300 m. At 4.0 km to 4.5 km North a consistent increase in values is observed, with a peak in February 2025 (426.1 at 4.5 km), suggesting significant sediment build-up further north of the groin.This pattern indicates that sediment is being transported northward and deposited at greater distances from the groin.

Table1.3 and Figure 5 provide shoreline distances from October 2024 to March 2025 along Gopalpur Tourist Beach, measured from 0 km to 3.0 km. The shoreline observations at Gopalpur Tourist Beach (GPB) from October 2024 to March 2025 reveal seasonal variations in shoreline distribution. In October 2024, shoreline levels were relatively low near the beach (0 km – 1.5 km),

while higher values at 2.0 km (682.8 m) and 3.0 km (685.5 m). From February 2025, a slight decline was observed in nearshore areas, possibly due to seasonal erosion or sediment redistribution, while the 2.0 km – 3.0 km section remained consistently high (~731–744 m), confirming it as a stable sediment deposition zone. By March 2025, nearshore values stabilized, and maximum sediment accumulation was recorded at 2.0 km (744.6) and 3.0 km (741.9 m). These trends suggest that Gopalpur Tourist Beach experiences dynamic shoreline changes influenced by wave actionand monsoonal effects.

Table 1.4 summarizes the beach width and volume observations from October 2024 to March 2025 at various locations around Gopalpur indicate significant seasonal variations in Beach width and volume. At Tourist Beach, width varied from 52.5 m (Oct) to a peak of 73.4 m (Feb) before decreasing to 56.0 m (Mar), with corresponding beach volume changes peaking at 133.1 m^3/m (Feb). Haripur Creek experienced a steady increase in width, reaching 137.7 m (Feb), while its beach volume peaked dramatically at 305.0 m^3/m (Mar), suggesting substantial sediment accumulation. Southern Breakwater maintained a wide and stable shoreline (~490 m), except in March (350.7 m), likely due to erosion, while its beach volume remained consistently high (~900–999 m^3/m). Intermediate Breakwater and Southern Groin followed similar trends, with Southern Groin showing a peak width of 391.6 m (Feb) and beach volume of 1124.7 m^3/m (Jan) before a decline. Northern Groin showed a notable increase in both width (63.7 m in Oct to 103.8 m in Feb) and volume (268.7 m^3/m in Oct to 428.1 m^3/m in Feb), indicating sediment accumulation. Marine Thana displayed a continuous increase, peaking at 148.4 m width and 993.4 m^3/m volume in Feb, before a slight decline in March. Arjipalli Beach showed the least variation, with width fluctuating between 47.0 m (Oct) and 79.2 m (Jan) and volume peaking at 380.4 m^3/m (Feb). Overall, the general trend suggests peak sediment deposition in February, followed by slight erosion in March, influenced by monsoonal wave action and sediment transport processes along the shoreline.

Table 1.5 details sediment grain size characteristics at Gopalpur Port South, Port North, Tourist Beach, and Rushikulya Spit from October 2024 to March 2025 at various locations in Gopalpur indicates seasonal variability in grain size and sorting patterns. Tourist Beach predominantly consists of medium sand, moderately sorted, maintaining consistency across all months. Haripur Creek shows a transition from fine sand in November to medium sand in the following months. Southern Breakwater and Intermediate Breakwater primarily consist of fine to medium sand, moderately well sorted, but notable deviations are observed in February and March, where sorting quality decreases (poorly sorted sediments at Intermediate Breakwater), likely due to monsoonal influences. Southern Groin remains relatively stable with fine sand, moderately well sorted, while Northern Groin exhibits some

variability, transitioning from medium to coarse sand (March). Marine Thana shows the most significant shift, with a transition from medium to coarse sand (January), suggesting increased wave activity or changes in sediment supply.Arjipalli Beach remains consistent with fine sand and moderate sorting throughout.

Littoral environmental conditions at Gopalpur Tourist Beach and Gopalpur Port from October 2024 to March 2025 show a transition from spilling to plunging breakers, indicating seasonal changes in wave energy and coastal processes. At Gopalpur Tourist Beach, breaker height varied between 1.13 m (Jan) and 1.70 m (Mar), with plunging waves dominating from December onward. Wave period ranged from 10.22 sec (Feb) to 14.53 sec (Jan), with consistent SSE wave direction. The surf zone width gradually increased from 85 m (Oct) to 110 m (Mar), indicating a widening active zone. At Gopalpur Port, spilling breakers dominated until January, transitioning to plunging waves in February and March, with wave height peaking at 1.56 m (Oct) and 1.43 m (Mar). Wave period showed variability, dropping to 8.74 sec (Feb), indicating higher energy dissipation. The surf zone remained relatively stable (100–115 m). Overall, plunging breakers in later months indicate higher wave energy, contributing to increased erosion and sediment movement.

Shoreline monitoring

Table 1.1: Shoreline (m) analysis along Gopalpur Port South (Shoreline represents the distance in meter between berm line and the reference line in Fig. 1)from October, 2024 to March, 2025.

GPLS	SG 0km	0.5 km	1.0 km	2.5 km	3.0 km	3.5 km	4.0 km	4.5 km
Oct_24	719.6	707.6	825.8	1145.9	904.4	809.6	737.5	730.8
Nov_24	720.5	659.5	846.9	1145.4	992.3	903.1	826.2	764.1
Dec_24	711.8	658.2	847.3	1138.0	1015.0	905.8	819.8	766.4
Jan_25	707.4	659.2	851.3	1125.9	1002.5	910.6	828	762.18
Feb_25	703.3	658.9	846.7	1165.2	1031.1	918.2	836.8	773.1
Mar_25	717.8	674.3	850.2	1150.6	1029.9	922.5	839.4	769.1

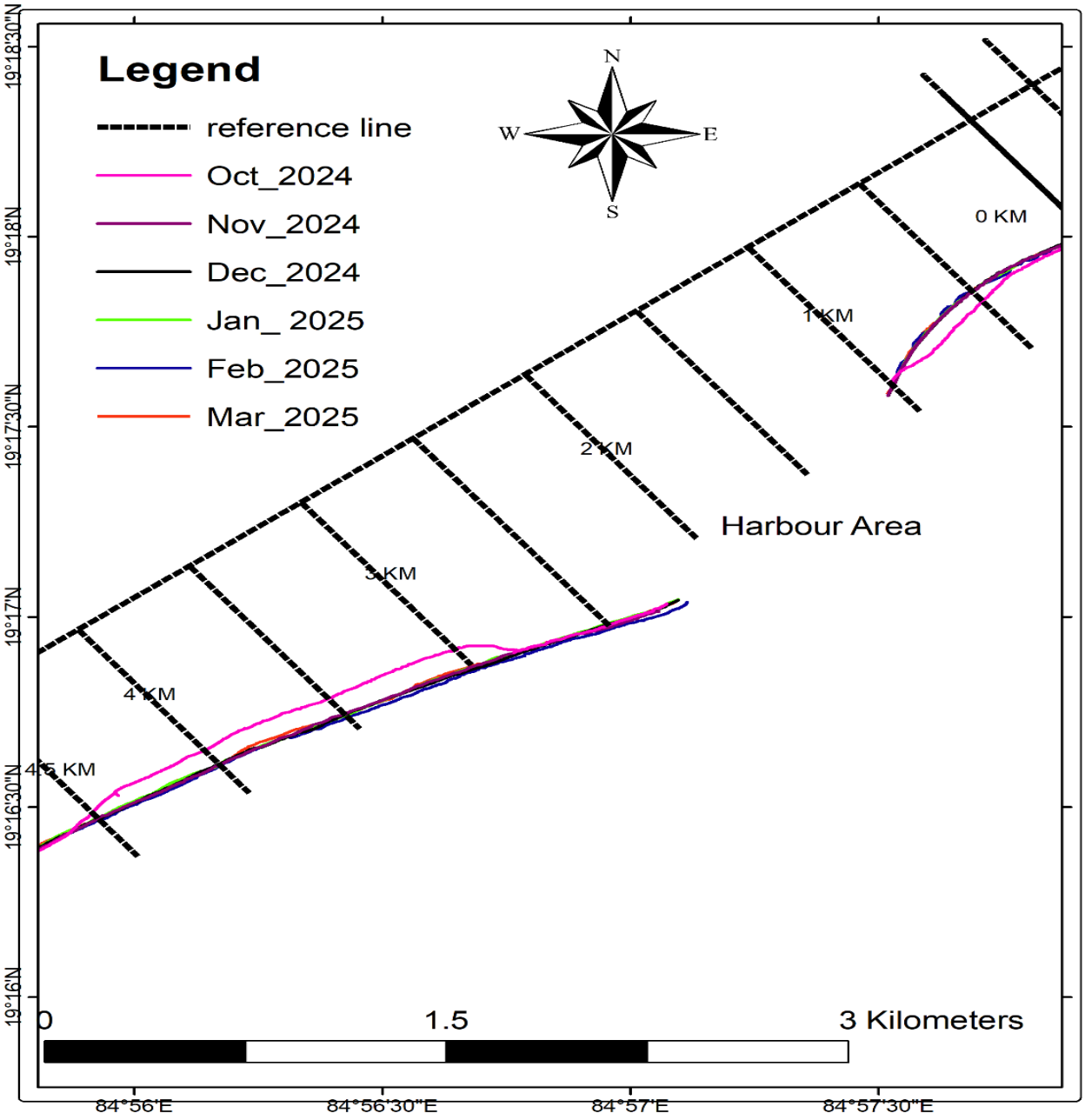


Figure 3: Shoreline change at south of Gopalpur port from October, 2024 to March, 2025.

Table 1.2: Shoreline (m) analysis along Gopalpur Port north (Shoreline represents the distance in meter between berm line and the reference line in Fig. 2) from October, 2024 to March, 2025.

GPLN	NG 0km	0.5 km	1.0 km	1.5 km	2.0 km	2.5 km	3.0 km	3.5 km	4.0 km	4.5 km
Oct_24	319.9	247.2	225.8	172.4	208.8	196.7	139.8	222.6	274.1	308.1
Nov_24	281.3	191.9	221.9	211.7	236.1	226.5	212.2	276.6	343.1	399.6
Dec_24	311.2	192.6	224.1	210.2	238.7	227.7	215.4	284.3	350.5	409.6
Jan_25	294.1	185.7	221.9	208.8	234.4	223.2	211.2	283.6	349.9	410.7
Feb_25	305.1	183.66	219.7	206.6	227.3	229.9	229.4	301.2	374.5	426.1
Mar_25	277.8	202.1	223.4	195.1	238.4	222.9	231.8	304.6	368.6	422.7

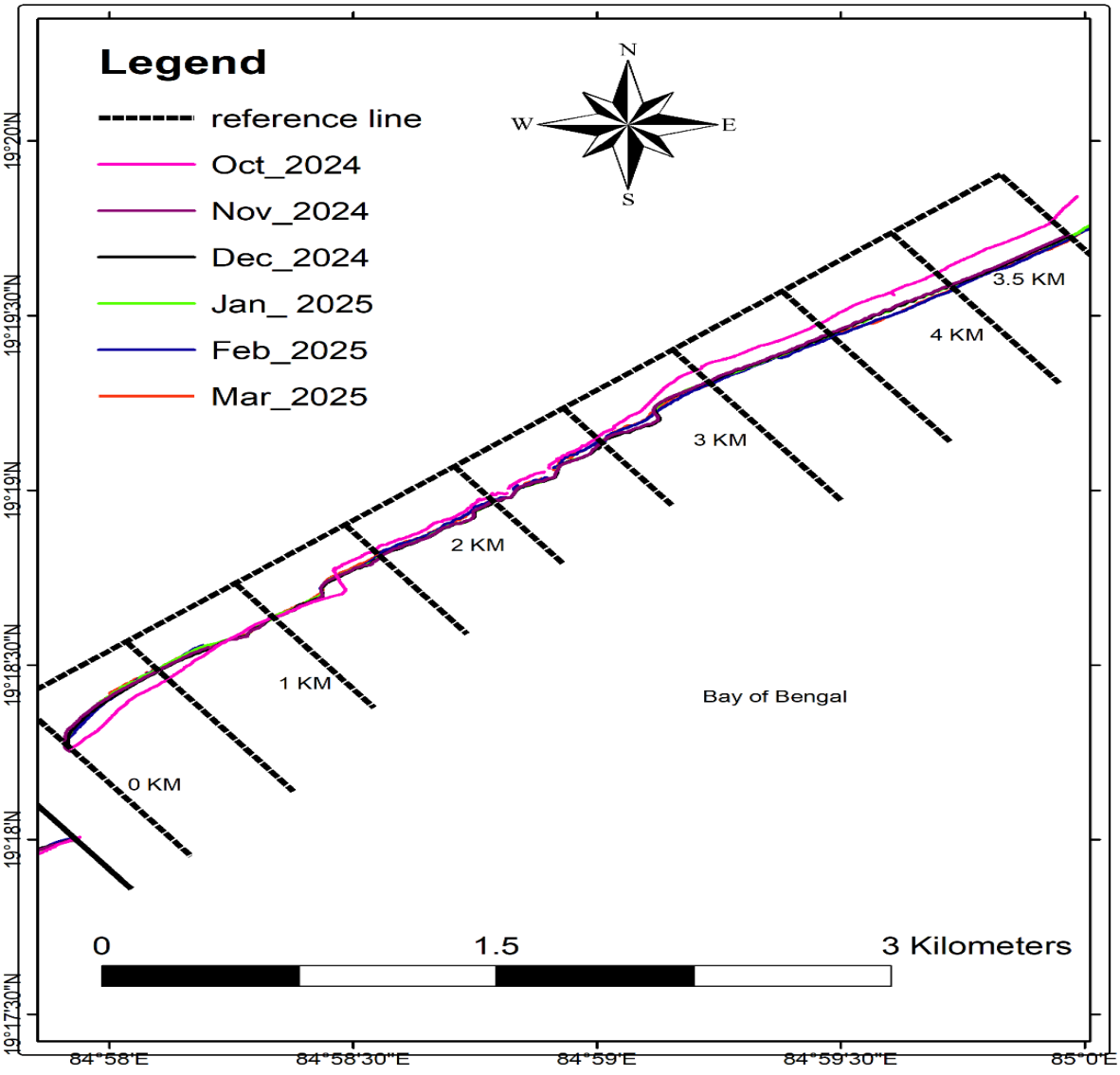


Figure 4: Shoreline changes at north of Gopalpur port from October, 2024 to March, 2025.

Table 1.3: Shoreline (m) analysis along Gopalpur tourist beach (Shoreline represents the distance in meter between berm line and the reference line in Fig. 3) from October, 2024 to March, 2025.

GPB	LH 0km	0.5 km	1.0 km	1.5 km	2.0 km	2.5 km	3.0 km
Oct_24	60.9	71.4	87.1	93.5	682.8	615.2	685.5
Nov_24	77.5	99.6	113.4	102.6	729.5	724.4	730.7
Dec_24	78.8	98.4	110.9	107.1	740.6	731.7	729.7
Jan_25	83.3	97.4	126.3	108.8	736.1	730.3	723.9
Feb_25	80.8	107.3	108.9	95.6	740.4	731.2	736.4
Mar_25	77.9	92.7	119.8	109.9	744.6	740.6	741.9

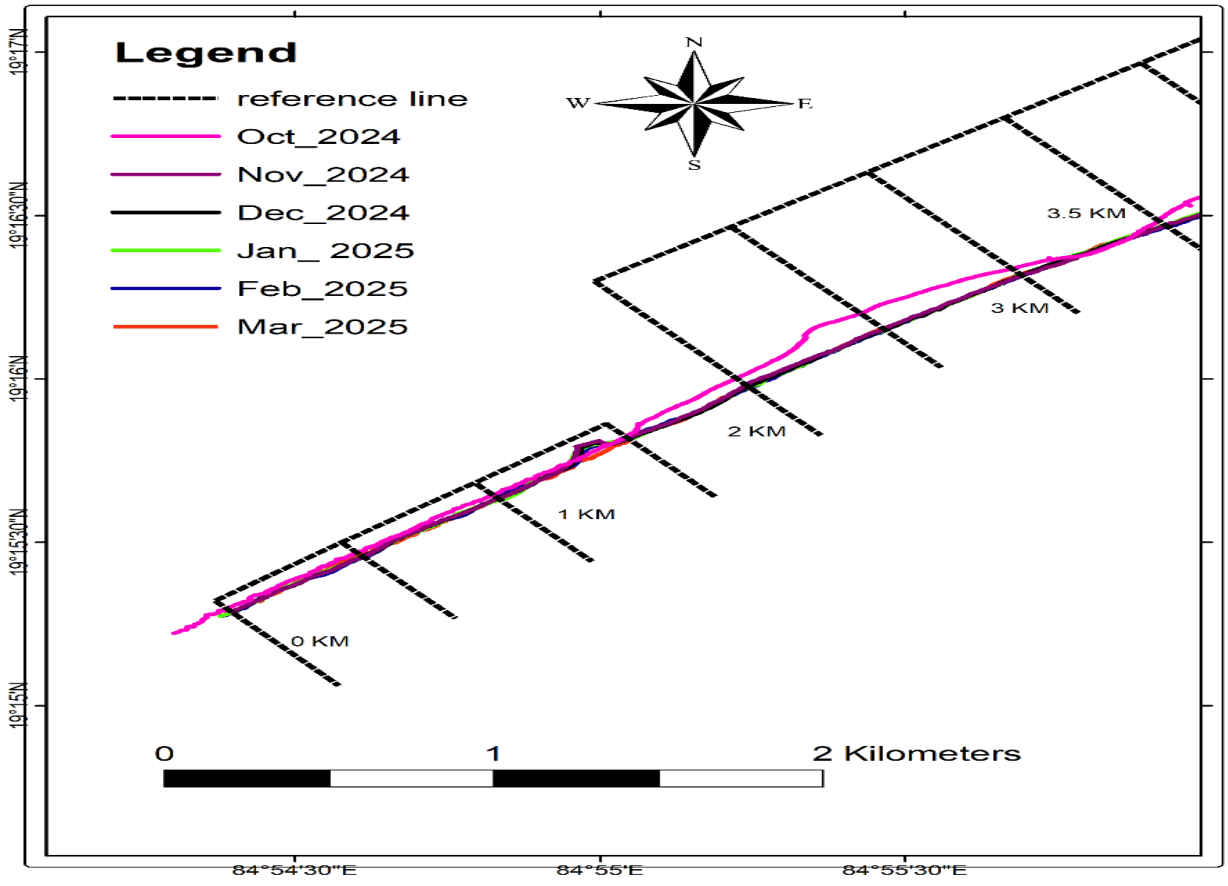


Figure 5: Shoreline change at tourist beach of Gopalpur beach from October, 2024 to March, 2025.

Table 1.4: Beach width and volume along Gopalpur port Southduring October, 2024 to March, 2025.

Beach Width (m)						
	Oct_24	Nov_24	Dec_24	Jan_25	Feb_25	Mar_25
Tourist beach	52.5	58.8	66.4	59.6	73.4	56.0
Haripur creek	122.8	134.2	126.3	119.4	137.7	137.1
Southern breakwater	443.8	484.7	505.0	490.2	491.7	350.7
Intermediate breakwater	351.0	377.0	340.3	322.6	354.1	343.1
Southern groin	372.6	386.1	389.8	362.7	391.6	315.4
Northern groin	63.7	93.5	100.2	90.5	103.8	86.1
Marine Thana	97.7	123.0	136.5	139.7	148.4	120.8
Arjipalli	47.0	75.5	75.5	79.2	78.1	67.8
Beach Volume (m^3/m)						
	Oct_24	Nov_24	Dec_24	Jan_25	Feb_25	Mar_25
Tourist beach	115.9	110.2	127.4	112.8	133.1	114.7
Haripur creek	114.6	142.5	103.9	94.2	110.5	305.0
Southern breakwater	959.0	863.1	869.5	961.6	901.4	999.4
Intermediate breakwater	639.1	650.7	603.1	711.4	591.8	657.6
Southern groin	1040.0	1082.3	1026.3	1124.7	951.0	919.2
Northern groin	268.7	374.5	390.9	362.8	428.1	356.5
Marine Thana	342.3	689.6	862.3	971.4	993.4	851.7
Arjipalli	271.8	348.8	369.2	358.7	380.4	324.5

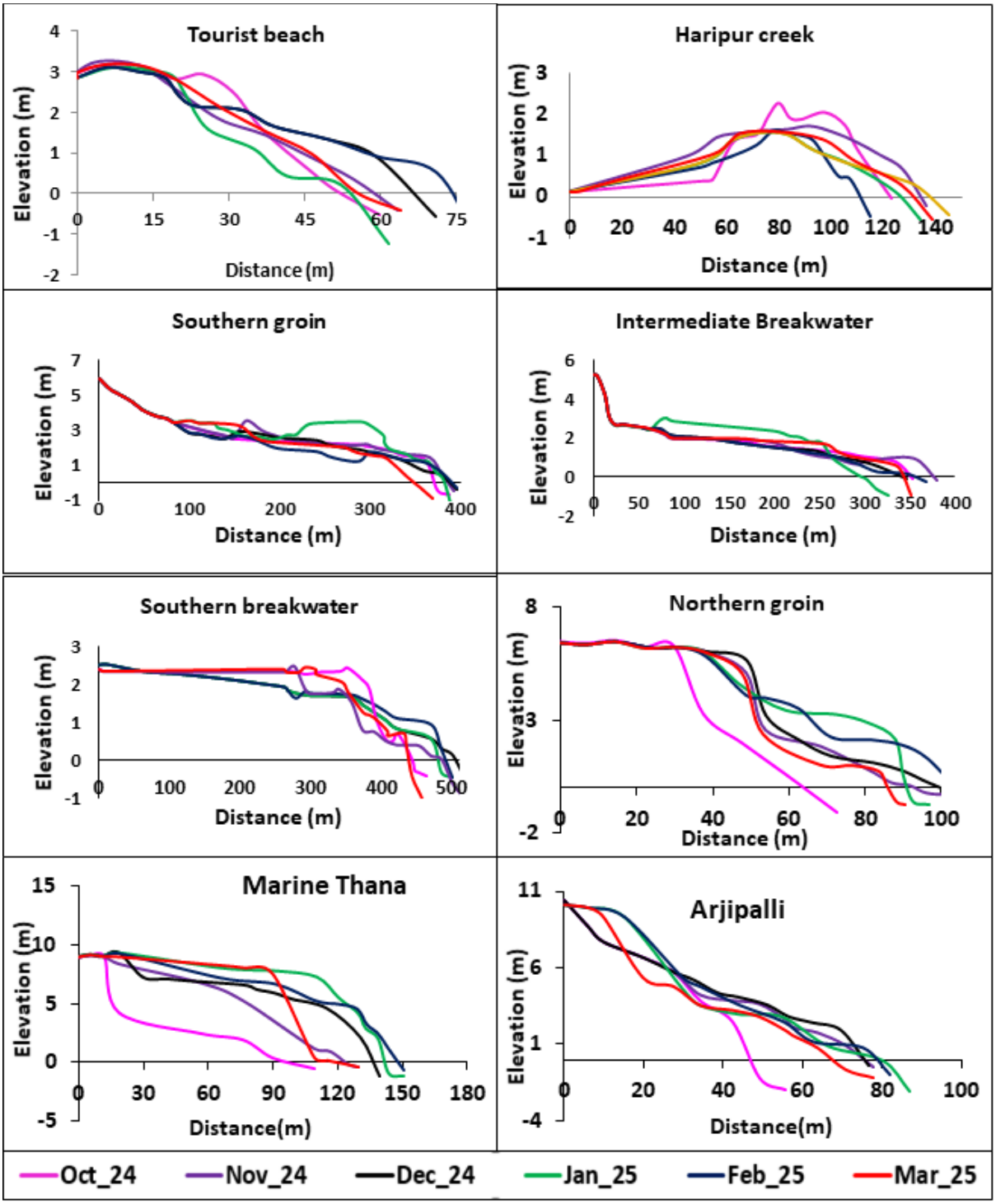


Figure 6: Beach profile at different stretches of Gopalpur port from October, 2024 to March, 2025.

Sediment Grain size

Table 1.5: Sediment grain size (Mean, Sorting) at Gopalpur port south, port north and tourist beach from October, 2024 to March, 2025.

	Oct_24	Nov_24	Dec_24	Jan_25	Feb_25	Mar_25
Tourist beach	Medium Sand/Moderately Sorted	Medium Sand/Moderately Sorted	Medium Sand/Moderately Sorted	Medium Sand/Moderately well Sorted	Medium Sand/Moderately Sorted	Fine Sand/Moderately Sorted
Haripur creek	Medium Sand/Moderately well Sorted	Fine Sand/Moderately well Sorted	Medium Sand/Moderately Sorted	Medium Sand/Moderately Sorted	Medium Sand/Moderately Sorted	Medium Sand/Moderately Sorted
Southern break water	Medium Sand/ Moderately well Sorted	Fine Sand/ Moderately well Sorted	Fine Sand/ Moderately Sorted	Fine Sand/ Moderately Sorted	Fine Sand/ Moderately well Sorted	Medium Sand/ Moderately well Sorted
Intermediate breakwater	Medium Sand/Moderately Sorted	Medium Sand/Moderately Sorted	Medium Sand/Moderately Sorted	Fine Sand/well Sorted	Fine Sand/Modrately Sorted	Medium Sand/Modrately Sorted
Southern groin	Medium Sand/Moderately Sorted	Medium Sand/Moderately well Sorted	Fine Sand/Moderately Sorted	Medium Sand/Moderately well Sorted	Fine Sand/ well Sorted	Medium Sand/ well Sorted
Northern groin	Coarse Sand/ Moderately well Sorted	Medium Sand/ Moderately well Sorted	Medium Sand/ Moderately well Sorted	Medium Sand/ Moderately Sorted	Medium Sand/ Moderately well Sorted	Coarse Sand/ Moderately well Sorted
Marine Thana	MediumSand/ Moderately well Sorted	MediumSand/ Moderately Sorted	FineSand/ Moderately Well Sorted	CoarseSand/ Poorly Sorted	FineSand/ Moderately well Sorted	MediumSand/ Moderately well Sorted
Arjipalli	MediumSand/ Moderately well Sorted	FineSand/ Moderately well Sorted	MediumSand / Moderately Sorted	MediumSand/ Moderately Sorted	FineSand/ well Sorted	FineSand/ well Sorted

Littoral Environment Observation

Table 1.6: Littoral Environmental Conditions along Gopalpur Coast from October, 2024 to March, 2025.

Month	Breaker type	Breaker height (m)	Breaker angle (deg)	Wave period (sec)	Wave direction	Uprush (m/s)	Backwash (m/s)	Surf zone width(m)
Gopalpur Tourist Beach								
Oct_24	Spilling	1.50	15	11.82	SSE	1.12	0.94	85
Nov_24	Spilling	1.56	10	11.30	SSE	1.11	1.04	90
Dec_24	Plunging	1.40	12	11.26	SSE	1.14	1.12	95
Jan_25	Plunging	1.13	13	14.53	SSE	1.14	1.07	105
Feb_25	Plunging	1.24	10	10.22	SSE	1.11	0.98	110
Mar_25	Plunging	1.70	10	12.14	SSE	1.44	0.99	110
Gopalpur Port								
Oct_24	Spilling	1.56	5	11.37	SE	1.20	1.0	110
Nov_24	Spilling	1.15	10	11.82	SSE	0.96	0.89	100
Dec_24	Spilling	1.50	09	11.68	SSE	1.15	1.10	115
Jan_25	Spilling	1.33	09	10.61	SSE	1.15	1.1	120
Feb_25	Plunging	1.26	10	8.74	SSE	1.08	0.89	130
Mar_25	Plunging	1.43	15	9.35	SE	1.19	0.98	115

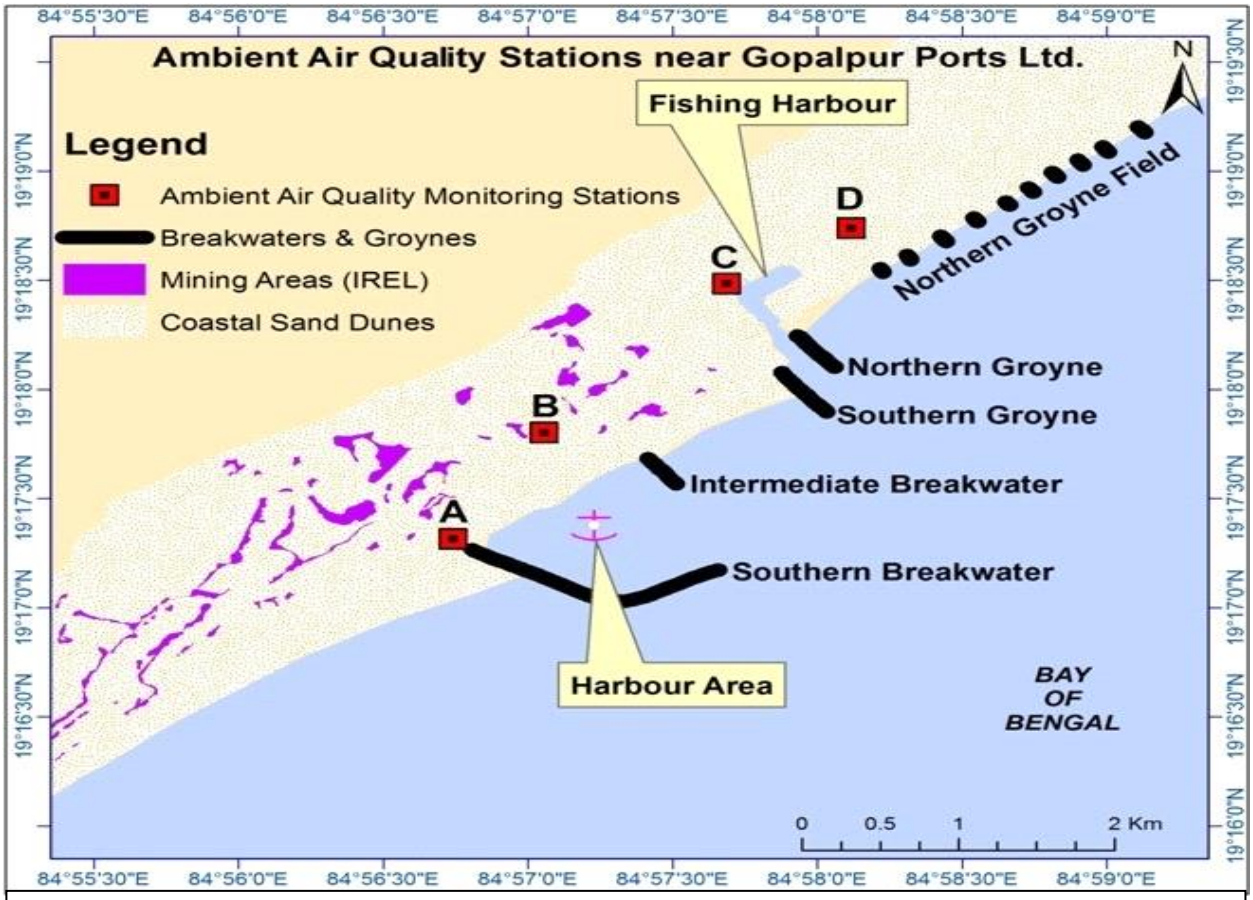
2. Ambient air quality

Ambient air quality (PM_{10}, $PM_{2.5}$, SO_2 andNO_2) was monitored around the Port premises at four points, two in the windward and two in the leeward sides (Figure 2.1) from October, 2024 to March, 2025. The coordinates of the four stations of air quality monitoring are; A-19^0 17' 17.72''N, 84^0 56' 51.72''E (At Substation-4) B-19^0 17 '45.03''N, 84^0 57'19.79''E (At Substation-2) C-19^0 18' 29.18''N, 84^0 57' 40.84''E (At Signal Station) D-19^0 18' 51.59''N, $84^0$58' 06.88''E (Near Entrance Gate) (Figure 1).The four points of monitoring are fixed in such a way that the impact of the port on air quality can be assessed up to a distance in down wind direction (both during strong sea breeze and land breeze time) where maximum ground level concentration is anticipated. Table-2.1, 2.2, 2.3 and 2.4 depict the air quality values for the study period at the four points within the port premises along with the national ambient air quality standard (NAAQS) norms stipulated by MoEFCC.

The maximum PM_{10} (88.46µg/m^3) and $PM_{2.5}$ value (39.82 µg/m^3) were recorded during the month of November-2024 and during the month of October, 2024 at station 'C' due to large number of vehicular emission and road dust whereas the minimum PM_{10} (49.38 µg/m^3) and $PM_{2.5}$ (15.86 µg/m^3) were recorded during the month of December,2024 and February,2025 at station 'A'. The maximum SO_2 (7.28 µg/m^3) and NO_2 (7.38 µg/m^3) were recorded during the month of November, 2024 and October,2024 at station 'C' and at station 'A' respectively due to high vehicular emission. Whereas the minimum SO_2 (2.68) was recorded and NO2 (2.53) was recorded at station 'B' during the month of March, 2025.

The average value of Pm_{10} was recorded at station A,B,C and D are 64.04,64.82,67.66 and 65.23 respectively where as the average $PM_{2.5}$ at station was A,B,C and D are 23.61,24.41,25.66 and 24.23 respectively The average value of SO_2 was recorded at station A,B,C and D are 4.18,4.28,5.06 and 5.54 respectively where as the average value of NO_2 at station A,B,C and D are 4.44,4.61,5.34,6.06 respectively

The ambient air quality monitored parameters at the four points within the port premises from October, 2024 to March, 2025 are well within the NAAQ threshold limit stipulated by CPCB. Thus, the ongoing port operational activities are not detrimental to the air quality in the terrestrial environment.



A-19^0 17' 17.72''N, 84^0 56' 51.72''E (At Substation-4)
B-19^0 17 '45.03''N, 84^0 57'19.79''E (At Substation-2)
C-19^0 18' 29.18''N, 84^0 57' 40.84''E (At Signal Station)
D-19^0 18' 51.59''N, 84^0 58' 06.88''E (Near Entrance Gate)

Figure 7: Location of air quality monitoring stations within the Gopalpur Port area

Table 2.1: Ambient Air Quality within Gopalpur Port premises (Station-A) (PM- Particulate matter, SO_2-Sulphur dioxide, NO_2-Oxides of nitrogen

Station_A					
	Date	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)
Oct_24	04.10.2024	67.43	29.34	4.28	4.62
	05.10.2024	69.27	30.18	4.62	5.17
	08.10.2024	71.62	32.42	4.92	5.67
	09.10.2024	68.57	31.64	5.17	6.27
	15.10.2024	74.61	33.57	4.46	4.83
	19.10.2024	77.38	36.72	4.91	4.23
	22.10.2024	69.54	29.57	4.73	4.17
	26.10.2024	72.38	32.84	4.28	4.85
Nov_24	05.11.2024	69.43	27.46	4.63	4.82
	06.11.2024	67.24	25.38	4.27	4.73
	20.11.2024	71.58	29.61	5.13	6.13
	22.11.2024	72.64	29.84	4.92	5.84
	25.11.2024	68.56	26.43	5.34	5.76
	27.11.2024	74.28	30.17	4.91	5.14
Dec_24	04.12.2024	58.63	22.57	3.92	4.38
	06.12.2024	54.27	20.61	4.18	4.92
	12.12.2024	59.43	23.49	4.65	5.13
	14.12.2024	61.37	24.57	3.67	4.61
	19.12.2024	60.46	23.92	4.94	5.34
	27.12.2024	57.34	21.67	3.83	3.92
	28.12.2024	52.64	19.62	4.31	4.52
	30.12.2024	62.94	24.73	4.54	4.61
Jan_25	03.01.2025	61.43	19.64	4.15	4.63
	04.01.2025	59.27	20.18	3.92	4.28
	08.01.2025	63.28	23.38	3.84	4.39
	11.01.2025	62.46	20.62	4.68	5.16
	16.01.2025	58.94	20.57	2.92	3.43
	17.01.2025	56.24	20.38	4.22	4.76
	20.01.2025	57.83	18.94	3.67	4.27
	21.01.2025	60.76	21.62	3.86	4.75
Feb_25	04.02.2025	62.49	18.37	4.23	3.86
	05.02.2025	66.37	20.43	3.64	3.57
	12.02.2025	59.76	17.95	3.92	4.27
	14.02.2025	61.35	18.84	4.71	3.94
	20.02.2025	57.38	17.62	3.64	3.58
	21.02.2025	59.24	17.83	3.76	2.83
	24.02.2025	63.17	19.64	3.68	3.94
	28.02.2025	71.95	19.87	3.62	4.37
Mar_25	06.03.2024	64.32	22.61	3.27	3.64
	07.03.2024	62.43	21.62	4.28	2.89
	13.03.2024	58.73	18.37	3.64	3.51
	14.03.2024	54.27	17.38	4.29	3.67
	19.03.2024	64.18	21.96	3.82	4.29
	20.03.2024	59.27	19.67	3.57	3.46
	24.03.2024	68.73	18.83	2.96	2.82
	25.03.2024	70.28	23.47	3.27	4.37
	mean (range)	64.04 (52.64-77.38)	23.61(17.38-36.72)	4.18(2.92-5.34)	4.44(2.82-6.27)
Reference value (NAAQS, 2009)		100	60	80	80

Table 2.2: Ambient Air Quality within Gopalpur Port premises (Station-B) (PM- Particulate matter, SO_2-Sulphur dioxide, NO_2-Oxides of nitrogen

Station_B					
	Date	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)
Oct_24	04.10.2024	69.43	29.89	4.94	4.62
	05.10.2024	76.27	32.64	4.15	4.91
	08.10.2024	74.38	33.49	4.38	5.37
	09.10.2024	69.57	29.84	5.17	4.86
	15.10.2024	76.18	34.87	5.67	6.97
	19.10.2024	75.14	33.64	5.28	6.29
	22.10.2024	65.28	28.49	5.63	5.67
	26.10.2024	64.92	26.78	6.92	6.28
Nov_24	05.11.2024	63.27	26.42	4.35	4.57
	06.11.2024	69.45	28.76	4.92	5.13
	20.11.2024	72.49	30.43	5.37	5.68
	22.11.2024	76.38	31.94	4.28	4.83
	25.11.2024	82.57	33.27	5.33	4.92
	27.11.2024	86.34	34.62	6.14	5.64
Dec_24	04.12.2024	63.57	25.37	3.28	4.29
	06.12.2024	57.28	21.68	4.62	3.86
	12.12.2024	59.46	23.52	4.97	4.73
	14.12.2024	64.91	25.83	4.37	4.84
	19.12.2024	53.46	20.64	3.83	4.62
	27.12.2024	57.52	21.37	4.15	5.27
	28.12.2024	60.82	23.82	4.61	3.84
	30.12.2024	63.76	25.94	3.92	4.16
Jan_25	03.01.2025	54.68	20.38	3.27	3.91
	04.01.2025	62.57	21.35	3.68	4.13
	08.01.2025	64	23.57	3.67	3.75
	11.01.2025	58.49	21.08	4.1	5.27
	16.01.2025	53.27	19.37	3.95	4.68
	17.01.2025	61.94	22.67	4.68	5.38
	20.01.2025	64.38	24.62	3.96	4.27
	21.01.2025	54.18	20.68	3.82	4.62
Feb_25	04.02.2025	56.36	16.83	3.28	3.85
	05.02.2025	57.92	16.94	3.61	3.42
	12.02.2025	62.46	18.86	3.92	4.15
	14.02.2025	68.25	19.76	2.86	3.86
	20.02.2025	58.46	17.16	3.57	4.67
	21.02.2025	67.38	18.89	3.18	4.91
	24.02.2025	59.42	18.34	4.27	5.27
	28.02.2025	68.91	19.24	3.64	4.82
Mar_25	06.03.2024	61.83	20.46	3.82	3.64
	07.03.2024	56.27	17.38	2.68	2.53
	13.03.2024	62.79	22.83	4.19	3.94
	14.03.2024	68.94	26.48	4.38	3.76
	19.03.2024	71.92	27.38	3.94	4.24
	20.03.2024	67.92	25.92	4.65	4.39
	24.03.2024	64.28	22.83	3.93	3.62
	25.03.2024	53.51	16.73	3.67	3.76
	mean (range)	64.83(53.27-86.34)	24.41(16.73-34.87)	4.28 (2.68-6.92)	4.61 (2.53-6.97)
Reference value (NAAQS, 2009)		100	60	80	80

Table 2.3: Ambient Air Quality within Gopalpur Port premises (Station-C) (PM- Particulate matter, SO_2-Sulphur dioxide, NO_2-Oxides of nitrogen

Station_C					
	Date	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)
Oct_24	04.10.2024	63.48	27.64	5.27	6.84
	05.10.2024	79.27	36.58	4.62	5.37
	08.10.2024	76.17	33.64	5.76	4.92
	09.10.2024	78.32	37.82	5.57	5.13
	15.10.2024	81.28	38.61	4.18	4.91
	19.10.2024	69.57	30.43	6.49	6.87
	22.10.2024	73.49	33.46	5.73	5.73
	26.10.2024	82.61	39.82	4.86	4.92
Nov_24	05.11.2024	78.26	31.64	6.37	6.24
	06.11.2024	82.61	33.48	7.28	6.82
	19.11.2024	88.43	36.43	6.24	6.54
	21.11.2024	71.39	29.61	5.83	6.28
	26.11.2024	81.66	32.84	6.57	6.37
	28.11.2024	88.46	35.94	6.28	6.18
Dec_24	05.12.2024	54.62	21.67	5.38	5.67
	07.12.2024	49.38	19.37	4.92	5.91
	11.12.2024	57.64	21.59	3.84	6.17
	13.12.2024	60.92	24.38	5.67	4.97
	17.12.2024	62.75	24.96	4.28	5.34
	20.12.2024	54.91	20.96	4.93	5.73
	26.12.2024	63.34	25.84	4.86	5.87
	30.12.2024	59.83	23.86	5.17	6.39
Jan_25	03.01.2025	64.28	23.89	4.26	4.79
	04.01.2025	59.37	20.64	3.92	4.94
	08.01.2025	61.52	21.83	4.67	5.27
	11.01.2025	62.48	22.67	4.52	5.62
	16.01.2025	53.17	19.67	3.86	4.88
	17.01.2025	59.84	20.97	3.76	4.67
	20.01.2025	58.34	20.38	4.28	5.46
	21.01.2025	61.95	22.86	5.13	5.94
Feb_25	04.02.2025	63.28	19.12	4.83	4.46
	05.02.2025	67.86	19.67	5.24	3.82
	12.02.2025	58.46	17.38	5.37	4.16
	14.02.2025	66.24	18.76	5.64	3.92
	20.02.2025	68.64	19.96	4.92	3.57
	21.02.2025	70.28	19.37	4.76	3.64
	24.02.2025	69.54	19.25	4.82	4.99
	28.02.2025	72.64	20.48	5.27	4.38
Mar_25	06.03.2024	70.62	26.84	4.92	5.37
	07.03.2024	68.54	24.39	3.86	4.63
	13.03.2024	71.38	26.48	4.68	5.28
	14.03.2024	62.43	21.86	5.27	6.79
	19.03.2024	57.61	19.64	4.73	4.59
	20.03.2024	68.95	23.97	3.94	4.18
	24.03.2024	63.49	21.86	5.27	6.76
	25.03.2024	73.27	27.86	4.76	4.79
	mean (range)	67.66 (49.38-88.46)	25.66 (17.38-39.82)	5.06 (3.76-7.28)	5.34 (3.57-6.87)
Reference value (NAAQS, 2009)		100	60	80	80

Table 2.4: Ambient Air Quality within Gopalpur Port premises (Station-D) (PM- Particulate matter, SO_2-Sulphur dioxide, NO_2-Oxides of nitrogen

Station_D					
	Date	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)
Oct_24	04.10.2024	73.64	31.27	6.84	4.92
	05.10.2024	68.49	29.84	4.67	5.83
	08.10.2024	81.95	37.91	5.18	6.91
	09.10.2024	75.64	34.62	6.76	7.38
	15.10.2024	69.27	29.67	5.84	6.94
	19.10.2024	72.18	32.59	4.96	5.73
	22.10.2024	77.64	34.57	5.17	7.16
	26.10.2024	81.94	38.92	5.83	6.27
Nov_24	05.11.2024	68.27	27.51	6.37	6.79
	06.11.2024	76.18	29.64	5.84	6.35
	19.11.2024	86.43	33.28	6.73	6.92
	21.11.2024	81.37	31.94	6.94	7.16
	26.11.2024	75.61	30.98	5.83	5.37
	28.11.2024	76.49	31.27	5.43	5.84
Dec_24	05.12.2024	64.38	23.86	5.38	5.98
	07.12.2024	57.29	21.93	6.17	6.37
	11.12.2024	57.94	20.97	5.94	6.84
	13.12.2024	65.27	26.37	4.83	5.69
	17.12.2024	53.48	19.67	6.27	6.37
	20.12.2024	57.92	20.61	5.68	7.34
	26.12.2024	54.63	20.91	6.27	6.27
	30.12.2024	61.47	24.83	4.96	6.89
Jan_25	03.01.2025	54.38	20.64	4.95	5.67
	04.01.2025	53.17	19.97	5.16	6.13
	08.01.2025	63.27	23.68	5.83	6.37
	11.01.2025	58.43	21.38	6.37	7.18
	16.01.2025	56.27	19.73	5.93	6.94
	17.01.2025	68.19	25.64	6.57	7.38
	20.01.2025	62.37	21.96	6.18	6.63
	21.01.2025	54.19	19.37	5.37	6.46
Feb_25	04.02.2025	57.24	16.83	5.34	6.14
	05.02.2025	59.38	17.62	4.62	5.83
	12.02.2025	54.18	16.37	4.39	5.94
	14.02.2025	62.57	18.79	5.62	6.37
	20.02.2025	63.94	19.25	4.28	5.73
	21.02.2025	68.42	21.57	3.94	4.72
	24.02.2025	54.67	15.86	5.83	6.91
	28.02.2025	60.92	17.69	6.27	7.21
Mar_25	06.03.2024	65.37	21.86	4.92	5.27
	07.03.2024	62.49	19.64	5.37	4.93
	13.03.2024	68.72	22.92	4.68	4.69
	14.03.2024	71.92	24.83	4.92	4.28
	19.03.2024	65.49	20.79	5.37	3.76
	20.03.2024	59.37	20.63	4.83	4.37
	24.03.2024	60.82	18.15	4.37	3.58
	25.03.2024	57.39	16.34	5.73	4.94
	mean (range)	65.23 (53.17-86.43)	24.23 (15.86-38.92)	5.54 (3.94-6.94)	6.06 (3.58-7.38)
Reference value (NAAQS, 2009)		100	60	80	80

3. Noise level monitoring:

The noise level monitoring was carried out at different selected locations according to its importance. The highest average noise level was recorded at station "D" (Near entrance gate) due to high vehicular movement and the lowest value was recorded at station "A". The average day and night noise level monitoring values at station A-19^0 17' 17.72''N, 84^0 56' 51.72''E B-19^0 17 '45.03''N, 84^0 57'19.79''E C-19^0 18' 29.18''N, 84^0 57' 40.84''E D-19^0 18' 51.59''N, $84^0$58' 06.88''E from October,2024 to March,2025 are presented in Table 3.1.

The noise level monitored during the day and night time is also well within the NAAQ thresholds stipulated by MoEFCC for industrial 75dB in day time and 70dB during night time zones

Table 3.1: Noise level (dB) within Gopalpur Port premises at station A, B, C, and D during Day Time

Day time					
	Time	Station A	Station B	Station C	Station D
Oct_24	6.00AM	66.5	66.6	59.8	66.3
	8.00AM	61.2	67.5	54.6	64.2
	10.00AM	64.3	68.2	68.6	65.5
	12.00 Noon	61.5	67.3	54.2	66.2
	2.00PM	61.8	72.4	69.5	68.6
	4.00PM	69.2	69.9	71	66.3
	6.00PM	62.6	70.2	66.3	68.9
Nov_24	6.00AM	60.2	66	61.4	63.4
	8.00AM	59.3	63.2	69.8	61.3
	10.00AM	61.4	59.9	63.3	69.3
	12.00 Noon	60.9	68	70.5	63
	2.00PM	63.4	67.2	71.3	66.7
	4.00PM	62.8	64.8	64.4	68.5
	6.00PM	66.4	69.7	68.2	64.1
Dec_24	6.00AM	56.34	61.38	61.53	62.86
	8.00AM	57.62	60.57	65.37	60.57
	10.00AM	60.38	58.46	62.83	68.37
	12.00 Noon	56.83	63.75	67.83	65.28
	2.00PM	60.38	65.43	71.68	70.39
	4.00PM	61.28	62.87	64.92	70.59
	6.00PM	63.54	65.39	61.83	62.94
Jan_25	6.00AM	56.34	61.38	61.53	62.86
	8.00AM	57.62	60.57	65.37	60.57
	10.00AM	60.38	58.46	62.83	68.37
	12.00 Noon	56.83	63.75	67.83	65.28
	2.00PM	60.38	65.43	71.68	70.39
	4.00PM	61.28	62.87	64.92	70.59
	6.00PM	63.54	65.39	61.83	62.94
Feb_25	6.00AM	57.64	59.37	60.57	65.83
	8.00AM	61.38	61.28	63.49	69.27
	10.00AM	59.43	60.46	61.37	62.73
	12.00 Noon	60.42	62.37	68.27	67.43
	2.00PM	59.34	65.43	64.38	66.43
	4.00PM	62.57	67.29	60.43	68.86
	6.00PM	65.83	68.47	65.73	70.27
Mar_25	6.00AM	58.37	59.37	61.38	64.83
	8.00AM	62.94	57.18	60.46	66.79
	10.00AM	58.37	62.39	62.94	68.43
	12.00 Noon	61.83	64.18	65.86	69.73
	2.00PM	63.76	63.72	67.19	62.46
	4.00PM	59.73	64.94	62.83	71.62
	6.00PM	67.37	67.38	64.37	70.38
Avg		61.27	64.30	64.62	66.41

Table 3.2: Noise level (dB)within Gopalpur Port premises at station A, B, C, and D during Night Time

Night Time					
	Time	Station A	Station B	Station C	Station D
Oct_24	7.00 PM	54.3	59.4	53.7	64.2
	9.00PM	61.7	65.2	61.3	60.1
	11.00PM	57.4	61.6	62.4	57.6
	1.00AM	59.3	58.4	60.1	54.9
	3.00AM	54.6	57.6	59.2	62.8
	5.00AM	61.4	54.8	56.7	60
Nov_25	7.00 PM	58.6	67.4	60.8	67.6
	9.00PM	61.2	62.3	62.7	65.8
	11.00PM	63.7	66.7	66.9	59.7
	1.00AM	59.4	59.3	68	63.4
	3.00AM	64.8	61.8	59.8	65.2
	5.00AM	56.3	67.3	65.1	61.6
Dec_25	7.00 PM	61.83	59.92	62.93	68.37
	9.00PM	59.48	59.37	61.38	69.27
	11.00PM	62.83	67.38	68.64	70.38
	1.00AM	61.37	60.27	66.72	69.82
	3.00AM	58.92	66.73	60.18	58.34
	5.00AM	54.26	62.84	64.83	67.64
Jan_25	7.00 PM	62.38	60.58	66.27	68.37
	9.00PM	65.73	64.38	63.79	67.27
	11.00PM	63.94	56.27	64.28	63.75
	1.00AM	60.48	54.39	66.94	54.28
	3.00AM	64.39	50.76	60.18	61.83
	5.00AM	51.64	58.64	64.83	52.73
Feb_25	7.00 PM	59.37	58.42	59.61	66.37
	9.00PM	61.29	57.34	63.43	68.49
	11.00PM	62.37	61.29	62.84	57.64
	1.00AM	60.49	60.73	58.47	59.17
	3.00AM	57.92	52.17	54.94	60.76
	5.00AM	64.25	54.39	63.72	62.48
Mar_25	7.00 PM	57.38	59.37	64.95	65.18
	9.00PM	56.18	51.86	62.76	62.48
	11.00PM	61.95	54.92	58.73	60.73
	1.00AM	57.38	62.76	67.18	62.49
	3.00AM	62.76	63.48	62.49	61.76
	5.00AM	64.86	61.72	54.93	59.43
Avg		60.17	60.05	62.27	62.83

4. The DG Stack monitoring:

DG stack available inside the port premises and their observed values from October, 2024 to March,2025 are presented In Table 4.1and Table 4.2

Table 4.1: DG stack parameters with in Gopalpur Port (DG-1, DG-2, DG-3)

DG-1 (250KVA)							
	Oct,24	Nov,24	Dec,24	Jan,25	Feb,25	Mar,25	Average
Flue Gas Temperature (k)	389	395	383	395	399	398	393.17
Flue Gas Velocity (m/s)	8.26	11.14	6.81	7.44	7.50	11.72	8.81
Quantity of emission (m^3/hr)	198	173	120.5	127.78	127.37	199.65	157.72
PM (g/kwh)	0.11	0.12	0.13	0.17	0.14	0.13	0.13
SO_2(g/kwh)	0.11	0.1	0.14	0.13	0.16	0.14	0.13
NO_x + HC (g/kwh)	0.12	0.11	0.18	0.15	0.18	0.21	0.16
Co(g/kwh)	0.16	0.13	0.17	0.21	0.23	0.19	0.18
DG-2(250KVA)							
	Oct,24	Nov,24	Dec,24	Jan,25	Feb,25	Mar,25	Average
Flue Gas Temperature (k)	397	391	303	380	408	411	381.67
Flue Gas Velocity (m/s)	7.1	6.28	6.3	6.61	6.76	7.59	6.77
Quantity of emission (m3/hr)	179	154	140.9	117.94	112.12	125.18	138.19
PM (g/kwh)	0.09	0.09	0.1	0.12	0.16	0.09	0.11
SO2(g/kwh)	0.1	0.13	0.15	0.14	0.13	0.17	0.14
NOx + HC (g/kwh)	0.13	0.14	0.21	0.19	0.24	0.26	0.20
Co(g/kwh)	0.21	0.19	0.2	0.24	0.21	0.18	0.21
DG-3 (250KVA)							
	Oct,24	Nov,24	Dec,24	Jan,25	Feb,25	Mar,25	Average
Flue Gas Temperature (k)	425	435	397	302	397	427	397.17
Flue Gas Velocity (m/s)	10.48	9.52	10.76	9.09	9.27	12.35	10.25
Quantity of emission (m3/hr)	216	165	183.8	204.13	158.27	196.12	187.22
PM (g/kwh)	0.14	0.11	0.13	0.11	0.12	0.13	0.12
SO2(g/kwh)	0.12	0.11	0.13	0.12	0.14	0.16	0.13
NOx + HC (g/kwh)	0.14	0.12	0.26	0.24	0.26	0.24	0.21
Co(g/kwh)	0.19	0.21	0.18	0.16	0.19	0.16	0.18

Table 4.2: DG stack parameters with in Gopalpur Port (DG-4, DG-5, DG-6)

DG-4 (100KVA)							
	Oct,24	**Nov,24**	**Dec,24**	**Jan,25**	**Feb,25**	**Mar,25**	**Average**
Flue Gas Temperature (k)	366	392	376	377	384	379	**379.00**
Flue Gas Velocity (m/s)	10.35	6.86	9.2	11.43	11.61	11.02	**10.08**
Quantity of emission (m^3/hr)	236	159	165.9	205.51	205.08	197.09	**194.76**
PM (g/kwh)	0.15	0.16	0.15	0.16	0.17	0.14	**0.16**
SO_2(g/kwh)	0.14	0.15	0.17	0.14	0.12	0.19	**0.15**
NO_x + HC (g/kwh)	0.12	0.16	0.19	0.26	0.23	0.22	**0.20**
Co(g/kwh)	0.24	0.26	0.21	0.19	0.15	0.14	**0.20**
DG-5 (100KVA)							
	Oct,24	Nov,24	Dec,24	Jan,25	Feb,25	Mar,25	**Average**
Flue Gas Temperature (k)	378	389	367	385	389	371	**379.83**
Flue Gas Velocity (m/s)	7.46	9.5	9.31	8.39	8.44	10.84	**8.99**
Quantity of emission (m3/hr)	184	154	172.06	147.84	148.04	198.11	**167.34**
PM (g/kwh)	0.1	0.11	0.12	0.16	0.13	0.12	**0.12**
SO2(g/kwh)	0.11	0.12	0.14	0.17	0.18	0.16	**0.15**
NOx + HC (g/kwh)	0.14	0.13	0.16	0.18	0.28	0.29	**0.20**
Co(g/kwh)	0.2	0.21	0.24	0.27	0.26	0.23	**0.24**
DG-6 (100KVA)							
	Oct,24	Nov,24	Dec,24	Jan,25	Feb,25	Mar,25	**Average**
Flue Gas Temperature (k)	374	375	359	368	372	368	**369.33**
Flue Gas Velocity (m/s)	9.84	11.17	9.97	11.99	12.5	11.87	**11.22**
Quantity of emission (m3/hr)	234	178	188.2	220.88	219.69	218.69	**209.91**
PM (g/kwh)	0.14	0.15	0.14	0.17	0.14	0.15	**0.15**
SO2(g/kwh)	0.13	0.14	0.16	0.15	0.15	0.18	**0.15**
NOx + HC (g/kwh)	0.15	0.14	0.17	0.23	0.19	0.17	**0.18**
Co(g/kwh)	0.25	0.23	0.22	0.29	0.27	0.16	**0.24**

5. Domestic effluent water

The domestic effluent water sample was collected from the outlet of the sewage treatment plant inside the Gopalpur port. Different water quality parameters were analyzed to understand the water quality of the domestic effluent discharge. The average value of the different parameters like pH (7.0), BOD (16.32), COD (128.77), Suspended solid (53.06) and oil and grease (3.28) during the last six months (October,2024 to March,2025) and the monthly analyzed values are depicted in table 5.1

Table 5.1 Domestic effluent parameters of the Gopalpur port

Parameter	Oct,24	Nov,24	Dec,24	Jan,25	Feb,25	Mar,25	Average
pH (mg/L)	6.9	7.1	7.4	6.9	6.9	6.8	7.00
BOD (mg/L)	13.82	14.46	15.24	16.6	18.34	19.46	16.32
COD (mg/L)	114.6	108.89	111.25	124.16	165.76	147.93	128.77
Suspended Solids (mg/L)	46.27	44.8	42.37	51.8	68.83	64.28	53.06
Oil & grease (mg/L)	1.49	2.64	3.18	3.42	4.73	4.23	3.28

6. Marine Water quality

Water samples were collected from port berth area (19^0 17' 21" N, 84^0 56' 55" E) for determination of their physico-chemical and biological properties. The samples were taken to the laboratory soon after the collection. Due care was taken to avoid contamination during sampling. The chemical and biological properties of water and sediment samples were measured following prescribed methods by Indian Standards. The detail observed/analyzed parameters and their threshold values are provided below.

Water quality parameters such as pH, dissolved oxygen (DO), color and odour, fecal coliform, biological oxygen demand (BOD), salinity, electrical conductivity (EC), Total dissolved solids (TDS), total suspended matter (TSM), phosphate, nitrate, chloride, Sulphate, lead, mercury, hexavalent chromium and petroleum hydrocarbon for the period from October,2024 to March,2025 of Gopalpur port (harbour area) are presented in Table 6.1. It is evident that most of the parameters are well within the permissible limit/standard. During the observation period it is noticed that pH of water ranged from 7.12-7.28 with mean value of 7.2. representing alkaline nature of the harbour area. The maximum and minimum vales were recorded during October, 2024 and March, 2025 respectively The Dissolved Oxygen ranges from 6.92-7.16 with average value of 7.04 mg/l for last six month.

The maximum Dissolved Oxygen was recorded during February,2025 and the minimum value was recorded during November, 2024. The Fecal coliform values ranged from 970-2200 CFU/ml with average value of 1673 CFU/ml. The maximum value was recorded during February,2025. and the minimum value was recorded during October, 2024.The BOD value ranged from 3.18-3.59 with average value of 3.33 mg/l. The maximum value was recorded during February, 2025 and the minimum value was recorded during November, 2024.The Salinity value is ranged from 30.13-31.73PSU with average value of 30.96. The minimum value was recorded during October, 2024 due to the post monsoonal effect and the maximum values was recorded during March, 2025. The Electrical Conductivity ranged from 40.56-45.28ms/cm with average value of 42.84ms/cm. The TDS and TSM value ranged from 24.90-28.70-and 0.582-0.734gm/l with average value of 26.59 and 0.65 gm/l respectively. The Sulphate value was ranged between 816.3-912.6 mg/l with average value of 863.78 mg/l for last six month. The Phosphate concentration was ranged between 0.072 to 0.137 with average value of 0.11 mg/l during last six months. Nitrate concentration ranged between 0.346 to 0.728 mg/l with average value of 0.57mg/l. the maximum value recorded during the month of November, 2024 due to the post monsoonal effect while the minimum value recorded during the month of March,2025.Chloride level of sea water varied from 10438-13864 mg/l with mean value of 12048 mg/l. The level of petroleum hydrocarbon was ranged between 0.21-2.68 mg/l. with average value of 1.24 mg/l The level of lead varied from .BDL-0.006 mg/l. The mercury value ranged fron BDL to 0.001 over the last six months. The Hexavalent chromium varied from BDL to 0.0027 mg/l with average value of 0.002 mg/l.

From the analysis of water quality parameters, it can be stated that the water quality of harbour area is good as almost all parameters are well within the permissible limits.

Table 6.1: Marine Water Quality parameters during October, 2024, to March, 2025 from Gopalpur port, harbor area.

Water parameters	Oct,24	Nov,24	Dec,24	Jan,25	Feb,25	Mar,25	Avgerage	Standard	Methods
pH	7.28	7.24	7.18	7.24	7.16	7.12	7.20	6.5-9[1]	Microprocessor based pH system
DO (mg/l)	6.96	6.92	7.12	6.97	7.13	7.16	7.04	> 3mg/L [1]	Winkler's Titration method following Grasshoff et al (1999)
Fecal coliform	970	1280	1790	2000	2200	1800	1673.33		APHA, 1999
BOD (mg/L)	3.26	3.18	3.24	3.43	3.59	3.28	3.33	--	Winkler's Titration method following grasshoff et al. (1999)
Salinity (PSU)	30.13	31.2	30.62	30.48	31.62	31.73	30.96	< 5 [1]	Mohr-Knudsen Argentometric titration method
EC (mS/Cm)	44.8	42.6	41.67	40.56	45.28	42.13	42.84	--	YSI portable multi parameter water quality meter
TDS (PPT)	28.7	26.4	24.9	25.53	27.64	26.38	26.59	--	multi parameter water quality meter
TSM($g.l^{-1}$)	0.638	0.582	0.634	0.629	0.734	0.694	0.65	--	Filtration method using Vacuum pump and filtration unit
Sulphate	912.7	821.4	834.8	884.9	912.6	816.3	863.78	--	APHA 4500 PD
Phosphate (mg/L)	0.137	0.148	0.137	0.086	0.072	0.076	0.11	0.1 mg/L	APHA 4500 NO_2 E
Nitrate (mg/L)	0.648	0.728	0.682	0.562	0.438	0.346	0.57	1.0 mg/L[m]	APHA 4500 SO_4^{2-}E
Chloride (mg/L)	13864.7	12786	11638	10438	11216	12349	12048.62	--	APHA 4500 CL^- B
PHC (mg/L)	0.38	0.21	0.24	1.62	2.68	2.31	1.24	--	EPA 3510
Lead(mg/L)	0.006	0.001	0.001	BDL	BDL	BDL	0.00	10 mg/L[1]	APHA 311 B.C
Mercury (mg/L)	0.001	0.001	0.001	BDL	BDL	BDL	0.001	0.1 mg/L[3]	APHA 5500 Hg
Hexavalent Chromium(mg/L)	0.002	0.0025	0.0023	0.0027	BDL	BDL	0.002	0.01 mg/L[3]	APHA 3500 Cr B

Sources:

1. **Primary water quality criteria for class SW-IV waters (Harbour) as per EPA, 1986**
2. **Guidelines for coastal water quality, Dept. of Environment, Govt. of India, General notice no 620 of 1999.**
3. **Central Pollution Control Board, PollutionControl Acts, Rules and Notifications, Fourth Edition, Ministry of Environment and Forests, 2001, 897pp.**

7. Sediment Quality

Sediment samples were collected from port berth area (19^0 17' 21" N, 84^0 56' 55" E) for determination of their physico-chemical properties. The sediment pH varied from 6.59-6.92 with mean value of 6.76 indicating prevalence of alkali medium within the sedimentary environment (Table 7.1). Sodium level in sediment varied from 632.48-738.5 mg/kg with mean value of 672.05 mg/kg. Maximum values were observed during February,2025 and minimum during January,2025.. Potassium values are varied from 11.64-12.94 mg/kg with mean value of 12.24 mg/kg. The sediment phosphate value is ranged from 23.81-30.95 mg/kg with average value of 26.96 mg/kg. The maximum value recorded during the month of March,2025 where as the minimum value recorded during the month of November, 2024. The sediment chloride value is varied from 2890.6-3285.9 mg/kg with average value of 3043.25 mg/kg. The maximum value was recorded during October, 2024 whereas the minimum value recorded during March,2025. The maximum Sulphate value (286.3) was observed during October 2024 while it was minimum (239.48) in the month of March,2025. The value of petroleum hydro carbon (PHC) was ranged from 0.003-0.004 µg/L with mean value of 0.003 during the sampling period. The value of lead varied from 0.015-0.023 gm/kg during the entire sampling period. The mercury value was varied from 0.003-0.006 with average value of 0.004.

The Levels of hexavalent chromium value is varied from 18.86-27.64.with average value of 24.58. The Percentage of organic carbon varied from 0.09 -0.24% . With average value of 0.17.

From the analysis of Sediment quality parameters of the harbor area from October,2024 to March,2025, it can be stated that the Sediment quality of harbour area is good as almost all parameters and parameters are well within the permissible limits.

Table 7.1 Sediment parameters during October, 2024 to March, 2025

	Oct,24	Nov,24	Dec,24	Jan,25	Feb,25	Mar,25	range	Average	Methods
pH	**6.92**	**6.84**	**6.81**	**6.78**	**6.59**	**6.63**	**6.59-6.92**	**6.76**	**Potentiometric method**
Sodium (mg/kg)	**653.8**	**642.6**	**638.4**	**632.48**	**738.5**	**726.54**	**632.48-738.5**	**672.05**	**Flame photometry**
Potassium (mg/kg)	**12.94**	**11.64**	**12.1**	**11.94**	**12.48**	**12.35**	**11.64-12.94**	**12.24**	**Flame photometry**
Phosphate (mg/kg)	**24.62**	**23.81**	**26.37**	**27.38**	**28.64**	**30.95**	**23.81-30.95**	**26.96**	
Chloride (mg/kg)	**3285.9**	**2964.3**	**3027.6**	**3120.5**	**2970.6**	**2890.6**	**2890.6-3285.9**	**3043.25**	**USDA:1954 US - affirmed 2010**
Sulphate (mg/kg)	**286.3**	**273.4**	**269.8**	**258.9**	**247.8**	**239.48**	**239.48-286.3**	**262.61**	**Methods of analysis of soil by HLS Tandon***
PHC (µg/L)	**0.003**	**0.003**	**0.004**	**0.003**	**0.004**	**0.0035**	**0.003-0.004**	**0.003**	**UNEP 1992**
Lead (gm/kg)	**0.021**	**0.023**	**0.019**	**0.021**	**0.018**	**0.015**	**0.015-0.023**	**0.020**	**EPA 3050 B**
Mercury (mg/kg)	**0.006**	**0.005**	**0.004**	**0.003**	**0.004**	**0.004**	**0.003-0.006**	**0.004**	**EPA 3050 B**
Hexavalent chromium(mg/kg)	**18.86**	**27.64**	**26.92**	**25.61**	**24.79**	**23.67**	**18.86-27.64**	**24.58**	**Methods of analysis of soil by HLS Tandon***
Organic carbon (%)	**0.29**	**0.26**	**0.32**	**0.36**	**0.46**	**0.42**	**0.26-0.46**	**0.35**	**Methods of analysis of soil by HLS Tandon***

8. Potable Water

The potable water was collected from the drinking water available inside the port and analyzed for different water quality parameters like, Turbidity, pH, Total Hardness**,** Iron, Chloride, Total Dissolved Solid (TDS), Calcium, magnesium, Sulphate, Flouride, Alkalinity, salinity, Zinc and lead and the values are within the permissible limit. The monthly values and the average values are depicted in Table 7.1

Table 8.1 Potable Water parameters during October, 2024 to March, 2025

Potable Water parameters	Oct,24	Nov,24	Dec,24	Jan,25	Feb,25	Mar,25	Mean
Turbidity (ntu)	0.63	0.59	0.59	0.62	0.68	0.71	0.64
pH	7.18	7.13	7.28	7.32	7.29	7.31	7.25
Total Hardness (mg/l)	183.5	135.89	133.52	140.92	156.23	173.16	153.87
Iron(mg/l)	0.18	0.16	0.14	0.11	0.19	0.21	0.17
Chloride (mg/L)	52.46	57.3	54.8	57.4	64.29	64.29	58.42
TDS (mg/l)	314.83	309.46	304.8	290.6	264.37	276.8	293.48
Calcium(mg/l)	31.48	22.48	23.37	24.6	26.37	28.9	26.20
Magnesium(mg/l)	25.48	19.37	18.42	19.4	21.83	24.7	21.53
Sulphate(mg/L)	12.82	11.34	13.27	13.8	19.76	24.6	15.93
Flouride(mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Alakalinity(mg/l)	179.4	172.4	168.7	159.7	147.62	138.9	161.12
Salinity(ppt)	0.24	0.22	0.19	0.16	0.19	0.14	0.19
Zinc(mg/l)	0.0005	0.0003	0.0002	0.0001	0.0002	0.0001	0.00
Lead(mg/L)	BDL	BDL	BDL	BDL	BDL	BDL	BDL
E. Coli (MPN/100 ml)	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8

9. Effluent from coal stack yard:

The water from the coal stack yard was collected from coal stack yard available inside the port premises for analysis of different parameters such as pH, Electrical Conductivity and Total Dissolved Solid. The monthly average value of the parameters are depicted in table 9.1

Table 9.1 Coal stack yard parameters during October, 2024 to March, 2025

Stackyard-1							
	Oct,24	Nov,24	Dec,24	Jan,25	Feb,25	Mar,25	Average
pH	7.7	7.6	7.4	7.2	6.9	7	7.30
EC (µS/Cm)	411.7	407.3	417.5	461.3	449.68	435.27	430.46
TDS (mg/l)	263.5	259.8	268.48	293.32	286.41	278.39	274.98
Stackyard-2							
	Oct,24	Nov,24	Dec,24	Jan,25	Feb,25	Mar,25	Average
pH	8	7.9	7.8	7.4	7.2	6.8	7.52
EC (µS/Cm)	424.8	464.8	488.6	494.2	462.76	452.03	464.53
TDS (mg/l)	271.9	298.7	312.8	317.16	294..83	289.43	298.00
Stackyard-3							
	Oct,24	Nov,24	Dec,24	Jan,25	Feb,25	Mar,25	Average
pH	7.9	7.4	7.6	7.1	7	7.1	7.35
EC (µS/Cm)	554.6	476.6	425.8	447.9	438.26	438.26	463.57
TDS (mg/l)	291.4	306.4	274.3	285.08	279.61	447.19	314.00

10. Biological Parameters

Biological samples (water and sediment) were collected from port berth area (19^0 17' 21" N, 84^0 56' 55" E) for determination of their biological properties. Due care was taken to avoid contamination during sampling. The biological properties of the samples were measured adopting prescribed methods by Indian Standards. Biological parameters such as chlorophyll, primary productivity, phytoplankton and zooplankton, macrobenthos and meiobenthos samples were collected and analysed on quarterly basis from October, 2024 to March,2025 and are depicted in Table 9.1. Quarter 3 (Q3) represents for months October, 2024 to December, 2024 and Quarter 4 (Q4) represents for January, 2025 to March, 2025.

Table10.1. Biological parameters of Gopalpur Port during quarter 3 (October, 2024 to December, 2024) and quarter 4 (January, 2025 to March, 2025)

Station	Sample	Parameters	Results Q-3	Results Q-4
Harbour Area Latitude- 19^0 17' 21" N Longitude- 84^0 56'55"E	Marine Water	Light penetration (m)	1.7	2.1
		Chlorophyll (mg/m^3)	1.24	1.18
		Primary productivity ($g.C/m^3/hr$)	0.026	0.032
		Phytoplankton (no. of cells/l)	578	684
		Zooplankton (no. of individuals/l)	842	892
	Sediment	Benthic meiofauna (per m^2)	6700	5300
		Benthic macrofauna (per m^2)	7200	6200

Conclusion:

The shoreline, sediment, and wave dynamics at Gopalpur from October 2024 to March 2025 exhibit significant seasonal variations. Shoreline distances show fluctuations, with maximum variations at 2.5 km along Gopalpur Port South, indicating dynamic sediment transport. The northern shoreline experiences erosion at the groin but gains sediment at farther distances, suggesting northward sediment transport. Gopalpur Tourist Beach remains a stable deposition zone beyond 2.0 km, while nearshore areas experience erosion during February 2025.

Beach width and volume peak in February 2025, followed by a decline in March, reflecting monsoonal influences. Haripur Creek and Southern Breakwater accumulate substantial sediment, while Arjipalli Beach shows minimal variation. Sediment grain size remains predominantly medium sand at Tourist Beach, with variations at Haripur Creek, Intermediate Breakwater, and Marine Thana, indicating seasonal hydrodynamic changes.

Littoral conditions transition from spilling to plunging breakers, suggesting increasing wave energy and coastal erosion in later months. Breaker heights fluctuate, with higher energy waves at Gopalpur Tourist Beach and increased surf zone width over time. The plunging breakers in February and March indicate intensified wave forces, which influence sediment redistribution and shoreline changes.

Overall, the coastal processes at Gopalpur are highly dynamic, driven by seasonal monsoonal effects, wave action, and sediment transport, shaping its shoreline evolution.

Ambient air quality such as PM_{10}, $PM_{2.5}$, SO_2, NO_2 were monitored twice in a week at the four points within the port premises from October, 2024 to March, 2025. It is observed that air pollution is mainly due to high particulate matter. The maximum Particulate matter recorded at station 'C' where major port activities are in progress and high vehicular movement. The maximum SO_2 was recorded at station 'C' and NO_x were recorded at station "D" due to high vehicular movement. The values observed are well within the NAAQ norms stipulated by MoEFCC and Environment (protection) Act, 1986. Further, sound level monitored during the day and night time is within the permissible limits stipulated by CPCB for industrial 75dB in day time and 70dB in the night time. Thus, the ongoing port activities at present are not detrimental to the air quality and noise level and indicates a pollution free terrestrial port environment.

Water quality parameters of port harbour area monitored for the period from October, 2024 to March, 2025 include, pH, DO, colour, odour, Fecal Coliform, BOD, Salinity, EC,TDS, TSM, Phosphate, Nitrate, Sulphate, Chloride, PHC, lead, mercury and Hexavalent chromium. All the parameters are well within the standard limit during the sampling period.

Sediment quality of port harbour area was assessed by examining sediment texture (mean grain size, sorting, skewness and kurtosis), pH, sodium, potassium, phosphate, chloride, sulphate, PHC, lead, mercury, organic carbon and hexavalent chromium. Sediment is alkaline in nature while phosphate, PHC, mercury, organic carbon and hexavalent chromium are present in trace amount. The metal concentrations both in water and sediment are within the permissible limit. The biological parameters like Phytoplankton and Zoo plankton were higher in Q4 (January- March, 2025) compared to Q3 (October-December, 2025) Higher value of primary productivity during Q2 can be attributed to the high light penetration. The Macrobenthos and meobenthos abundance were lower during Q4 compared to Q3.

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