DEENDAYAL PORT AUTHORITY
(Erstwhile: DEENDAYAL PORT TRUST)

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EG/WK/5202 (D)/ Part (CRZ 2) /295 Date:05/05/2023

To,
The Deputy Director General of Forests,
Ministry of Environment, Forest & Climate Change
Integrated Regional Office, Gandhinagar,
A wing- 407 & 409, Aryan Bhawan,
Near CH-3 Circle,
Sector 10 A, Gandhinagar – 382 010.

Sub: Creation of water front facilities (Oil Jetties 8, 9, 10 & 11) and development of land of area 554 acres for associated facilities for storage at Old Kandla, Gandhidham, Kutch, Gujarat by M/s Deendayal Port Trust - Environmental & CRZ Clearance – **Submission of Six Monthly Compliance report for the stipulated conditions in EC&CRZ Clearance and Monitoring Report in Data sheet reg.**

Ref.: 1) EC & CRZ Clearance accorded by the MoEF&CC, GoI, New Delhi vide no. 10-1/2017-IA-III dated 20/11/2020.
2) Integrated Regional Office, Gandhinagar, MoEF&CC, GoI, Bhopal letter vide F. No. 6-1/2021 (ENV)/918 dated 10/3/2021 (Received by DPT on 19/3/2021).
3) DPT letter no. EG/WK/5202 (D)/ Part (CRZ 2) Dated 19/04/2021 – Submission of details asked by the R.O., MoEF&CC, GoI, Bhopal reg.
4) DPT letter no. EG/WK/5202 (D)/ Part (CRZ 2)/30 Dated 29/06/2021 – Submission of compliance report (Period upto May, 2021).
5) DPT letter no. EG/WK/5202 (D)/ Part (CRZ 2)/140 Dated 08/02/2022 – Submission of compliance report (Period June to Nov 2021).
6) DPA letter no. EG/WK/5202 (D)/ Part (CRZ 2)/127 dated 30/06/2022- Submission of compliance report (Period December to May, 2022)

Sir,

It is requested to kindly refer above cited references for the said subject.

In this regard, it is to state that, with reference to the Integrated Regional Office, MoEF&CC, GoI, Bhopal letter dated 10/03/2021 (ref. 2), DPA vide above letter dated 19/4/2021 (ref. 3) has submitted details/information asked by the Regional Office, MoEF&CC, GoI, Bhopal in connection with the EC & CRZ Clearance granted by the MoEF&CC, GoI dated 20/11/2020 for the subject mentioned above. Subsequently, DPA vide above cited letters had submitted compliance report of stipulated condition in EC&CRZ Clearances to the Regional Office, MoEF&CC, GoI.

.....cont.....

Now, as directed in the above referred letter dated 10/3/2021 of the Regional Office, MoEF&CC, GoI, Bhopal, kindly find enclosed herewith compliance report of stipulated conditions mentioned in the EC & CRZ Clearance granted by the MoEF&CC, GoI dated 20/11/2020 **(Annexure I)** & Monitoring Report in Data Sheet **(Annexure II) (Period upto November, 2022)** for kind information and record please.

Further, as per the MoEF&CC, Notification S.O.5845 (E) dated 26.11.2018, in which it is mentioned that, "***In the said notification, in paragraph 10, in sub-paragraph (ii), for the words "hard and soft copies" the words "soft copy" shall be substituted***". Accordingly, we are submitting herewith soft copy of the above, in CD as well as through e-mail in ID rowz.bpl-mef@nic.in & eccompliance-guj@gov.in.

This has approval of the Chief Engineer, Deendayal Port Authority.

Yours faithfully,

Manager(Env.)
Deendayal Port Authority

Copy along with point wise compliance of stipulated conditions, to:

1) Shri Amardeep Raju, MoEF&CC,GoI
and Member Secretary (EAC-Infra.1),
Indira Paryavaran Bhavan,
Ministry of Environment, Forest and Climate Change
Jor Bagh Road, Aliganj,
New Delhi-110003.

2) Shri Prasoon Gargav,
Scientist E & Regional Director,
Central Pollution Control Board,
Parivesh Bhawan,
Opp. VMC Ward Office No.10, Subhanpura,
Vadodara – 390 023.
Email: prasoon.cpcb@nic.in

3) Shri T. C. Patel,
Environment Engineer,
Unit Head, Kachchh,
Gujarat Pollution Control Board,
Paryavaran Bhavan,
Sector 10A, Gandhinagar- 382 010.
Email-kut-uh-gpcb@gujarat.gov.in

4) The Regional Officer,
Gujarat Pollution Control Board,
Regional Office (East Kutch),Administrative Office Building,
Deendayal Port Trust, Gandhidham.
Email Id. ro-gpcb-kute@gujarat.gov.in

Annexure -I

CURRENT STATUS OF WORK PROGRESS (Up to November, 2022)

Sr. No.	Name of Project	Status
1	Oil Jetty No. 8 (Jetty & allied facilities)	Deendayal Port Authority issued work order to M/s Kargwal KM Joint Venture; Mumbai vide letter no. CN/WK/1571/Work/243 dated 3/2/2021. Work is in progress.
2	Oil Jetties no. 9, 10 & 11 to be implemented on BOT/PPP Mode.	The SFC recommendation and the MoPSW, GoI approval for Oil Jetties 9, 10 & 11, under PPP mode, has been received on 19/04/2021. a)The RFQ pre-qualification process concluded. Four out of five bidders have been prequalified to participate in the RFP (Bid) Stage. b) Bid due date of RFP extended up to 22/12/2022 • RFQ for OJ-10 shall be initiated only after 4 months of 'award of concession' for Oil Jetty no 9. Same analogy with OJ-11, in context of OJ-10. No construction activity started yet on project site.
3	Development of Land (area 554 acres) for associated facilities for storage.	LOA has been issued to the Contractor, M/s Nilkanth Industries Pvt. Ltd., Gandhidham on 19/10/2022

Annexure 1

COMPLIANCE REPORT (for the period upto November, 2022)

Subject: Point wise compliance of stipulated conditions of EC & CRZ Clearance for ***"Creation of water front facilities (Oil Jetties 8, 9, 10 & 11) and development of land of area 554 acres for associated facilities for storage at Old Kandla, Gandhidham, Kutch, Gujarat by M/s Deendayal Port Authority (Erstwhile Deendayal Port Trust)".***

Reference: Environment and CRZ clearance accorded by the MoEF&CC, GoI vide file no. 10-1/2017-IA-III dated 20/11/2020.

Sr. No.	Stipulated Conditions	Compliance
i	The Environmental and CRZ Clearance to the project is primarily under provisions of EIA Notification, 2006 and CRZ Notification, 2011. It does not tantamount to approvals/ consent/ permissions etc. required to be obtained under any other Act/Rule/regulation. The Project Proponent is under obligation to obtain approvals/ clearances under any other Acts/ Regulations or Statutes as applicable to the project.	The Consent to Establish (CTE) from the GPCB had already been obtained vide CTE No. 94118 granted by the GPCB vide letter no. PC/CCA-KUTCH 1524/GPCB ID 56985 dated 23/7/2018 **(Copy once again attached - Annexure A).**
ii	The project proponent shall abide by all the commitments and recommendations made in the Form-II, EIA and EMP report and also that have been made during their presentation to EAC.	Work is in progress (Oil Jetty No. 8 - Jetty & allied facilities). It is hereby assured that DPA will abide by all the commitments and recommendations made in the Form-II, EIA and EMP report and also that have been made during presentation to EAC.
iii	Construction activity shall be carried out strictly according to the provisions of the CRZ Notification, 2011. No construction works other than those permitted in Coastal Regulation Zone Notification shall be carried out in Coastal Regulation Zone area.	Work is in progress (Oil Jetty No. 8 - Jetty & allied facilities). Construction activity is being carried out strictly as per the provisions of the CRZ notification, 2011. Further, it is also assured that, no activity other than those permissible in Coastal Regulation Notification is being carried out in CRZ area.
iv	All the recommendations and conditions specified by the Gujarat Coastal Zone Management Authority (GCZMA) vide letter No. ENV-I0-2018-24-T cell dated 30th July, 2020 shall be complied with.	The compliance report of CRZ Recommendation issued by the GCZMA dated 30/7/2020 is attached herewith as **Annexure B.**
v	The Project proponent shall ensure that no creeks or rivers are blocked due to any activities at the project site and free flow of water is maintained. Creek water monitoring program shall be implemented during the construction	Work is in progress (Oil Jetty No. 8 - Jetty & allied facilities). It is hereby assured that, no creeks or rivers is being blocked, due to any activities at the project site and free flow of water is maintained.

	phase.	
	Dredging shall not be carried out during the fish breeding season. Dredging, etc. shall be carried out in confined manner to reduce the impacts on marine environment. Silt curtains shall be used to minimize spreading of silt plume during dredging using online monitoring system. Turbidity should be monitored during the dredging. No removal of silt curtain unless baseline values are achieved.	Point noted for compliance. However, No dredging activities have been started yet w.r.t. subject project.
vii	As proposed the dredged material can be used to provide an engineered base for marine terminal i.e., oil jetties 8-11 and construction yard. The impact of dredging on the marine environment should be monitored and necessary measures shall be taken on priority basis if any adverse impact is observed.	Point noted for compliance.
viii	Marine ecological monitoring and its mitigation measures for protection of phytoplankton, zooplanktons, macrobenthos, estuaries, sea-grass, algae, sea weeds, Crustaceans, Fishes, coral reefs and mangroves and migratory birds etc. as given in the EIA-EMP Report shall be complied with in letter and spirit through a reputed university/institute with financial support as desired. Six monthly reports of the studies to be provided to the regional office of MoEFCC.	Work is in progress (Oil Jetty No. 8 - Jetty & allied facilities). DPA assigned work to M/s GUIDE, Bhuj vide work order dated 3/5/2021 for "Regular Monitoring of Marine Ecology in and around the Deendayal Port Authority and Continuous Monitoring Programme covering all seasons on various aspects of the Coastal Environs covering Physico-chemical parameters of marine water and marine sediment samples coupled with biological indices reg. (for three years (2021-2024)). The second year Monsoon season report for the year 2022-2023 submitted is attached herewith as **Annexure C**. DPA has been regularly submitting the reports with the six-monthly compliance report to the regional office of MoEF&CC.
ix	Continuous online monitoring of air and water covering the total area shall be carried out and the compliance report of the same shall be submitted along with the 6 monthly compliance report to the regional office of MoEF&CC.	DPA has been conducting regular Monitoring of environmental parameters since the year 2016 through NABL Accredited laboratories. The latest Environmental Monitoring Report is enclosed herewith as **Annexure D**. DPA already invited the tender for Continous Ambient Air Quality Monitoring System (CAAQMS). However, bidders participated were disqualified as they have not satisfied the tender criteria. Further, it is relevant to mention here that, the process for re-inviting tender has been initiated for which EOIs were invited and scrutinization of the same is under progress.
x	The actions shall be in accordance with	Point Noted.

	proposed landscape planning concepts to minimise major landscape changes. The change in land use pattern shall be limited to the proposed port limits and be carried out in such a way as to ensure proper drainage by providing surface drainage systems including storm water network.	DPA vide EC&CRZ Clearance accorded by MoEF&CC, GoI vide letter dated 20/11/2020 has proposed provision for storm water collection for harvesting the rainwater and using it for irrigation or fire-fighting purpose which will also act as a buffer to cater for the risk for flooding due high intensity rainfall coincident with the high tide.
xi	Suitable preventive measures be taken to trap spillage of fuel / engine oil and lubricants from the construction site. Measures should be taken to contain, control and recover the accidental spills of fuel during cargo handling.	Work is in progress (Oil Jetty No. 8 - Jetty & allied facilities). DPA is already having Oil Spill Contingency Plan to meet with the any accidental oil spill.
xii	All the mitigation measures submitted in the EIA report shall be prepared in a matrix format and the compliance for each mitigation plan shall be submitted to the RO, MoEF&CC along with half yearly compliance report.	The compliance of the mitigation measures submitted in the EIA report prepared in matrix format is attached herewith as **Annexure E.**
xiii	The company shall draw up and implement Corporate Social Responsibility Plan as per the Company's Act of 20l3.	As per the CSR Guidelines issued by the Ministry of Ports, Shipping & Waterways, Government of India, from time to time, DPA have been undertaken CSR activities since the year 2011-12. The details of CSR Activities undertaken & planned is attached herewith as **Annexure F.**
xiv	As per the Ministry's Office Memorandum F. No. 22-65/2017-IA.III dated 30th September, 2020, the project proponent, based on the commitments made during the public hearing, shall include all the activities required to be taken to fulfill these commitments in the Environment Management Plan along with cost estimates of these activities, in addition to the activities proposed as per recommendations of EIA Studies and the same shall be submitted to the ministry as part of the EIA Report. The EMP shall be implemented at the project cost or any other funding source available with the project proponent.	Public Hearing is exempted. However, as specified in the Environmental Management Plan, DPA has been conducting regular Monitoring of environmental parameters since the year 2016 through NABL Accredited laboratories. The latest Environmental Monitoring Report is enclosed herewith as **Annexure D**. DPA issued work order to M/s GUIDE vide its letter no. EG/WK/ 4751 /Part (Marine Ecology Monitoring)/12 dated 03/05/2021 for preparation of Detailed marine biodiversity plan. The second year monsoon season report is attached herewith as **Annexure C.** DPA had already taken up the greenbelt Development activity through Forest Department, GoG, at the cost of 352.32 lakhs (Green Belt development in DPA area in an area of 31.942 Ha.) Further, DPA has appointed the Gujarat Institute of Desert Ecology (GUIDE) for "Green belt development in Deendayal Port Authority and its Surrounding Areas, Charcoal site' (Phase-l)"

		vide Work Order No.EG/WK/4757/Part [Greenbelt GUIDE, dated 31st May 2022 (**Annexure G**). it is relevant to mention here that, DPA already issued Grant of License/Permission to carry out the work of collection and disposal of "Hazardous Waste/Sludge/ Waste Oil" from Vessels calling at Deendayal Port through DPA contractors. Further, it is to state that, all ships are required to follow DG Shipping circulars regarding the reception facilities at Swachch Sagar portal.
xv	In pursuance of Ministry's OM No. stated above the project proponent shall add one annexure in the EIA Report indicating all the commitments made by the PP to the public during public hearing and submit it to the Ministry and the EAC.	Public Hearing is exempted. Hence, Not applicable.
B. STANDARD CONDITIONS: **I. Statutory compliance:**		
i.	Construction activity shall be carried out strictly according to the provisions of CRZ Notification, 2011 and the State Coastal Zone Management Plan as drawn up by the State Government. No construction work other than those permitted in Coastal Regulation Zone Notification shall be carried out in Coastal Regulation Zone area.	Work is in progress (Oil Jetty No. 8 - Jetty & allied facilities). Construction activity is being carried out strictly as per the provisions of the CRZ notification, 2011. Further, it is also assured that, no activity other than those permissible in Coastal Regulation Notification will be carried out in CRZ area.
ii	A certificate of adequacy of available power from the agency supplying power to the project along with the load allowed for the project should be obtained.	Work is in progress (Oil Jetty No. 8 - Jetty & allied facilities). Necessary certificate of adequacy of available power will be provided in due course.
iii	All other statutory clearances such as the approvals for storage of diesel from Chief Controller of Explosives, Fire Department, Coast Guard, Civil Aviation Department shall be obtained, as applicable by project proponents from the respective competent authorities.	Point Noted for compliance.
II. Air quality monitoring and, preservation:		
i.	The project proponent shall install system to carryout Ambient Air Quality monitoring for common/criterion parameters relevant to the main pollutants released (e.g. PM 10 and PM 2.5 in reference to PM emission, and S02 and NOx in reference to S02 and NOx	Work is in progress (Oil Jetty No. 8 - Jetty & allied facilities). However, for DPA area, it is also relevant to mention here that, DPA has been conducting regular Monitoring of environmental parameters since the year 2016 through NABL Accredited

	emissions) within and outside the project area at least at four locations, covering upwind and downwind directions.	laboratories. The work is in progress & DPA submitted monitoring data regularly to all the concerned authorities along with compliance reports submitted. The latest monitoring report are attached herewith as **Annexure D**.
ii.	Appropriate Air Pollution Control (APC) system shall be provided for all the dust generating points including fugitive dust from all vulnerable sources, so as to comply prescribed emission standards.	– DPA has installed Mist Canon at the Port area to minimize the dust. – Further, to control dust pollution in other area, regular sprinkling through tankers on roads and other staking yards is being done. – Further, it is relevant to mention here that, DPA had already issued general circular vide dated 3/9/2019 (Copy – **Annexure H**) regarding Construction and Demolition Waste Management for strict implementation in DPA.
iii.	Shrouding shall be carried out in the work site enclosing the dock/proposed facility area. This will act as dust curtain as well achieving zero dust discharge from the site. These curtain or shroud will be immensely effective in restricting disturbance from wind in affecting the dry dock operations, preventing waste dispersion, improving working conditions through provision of shade for the workers.	DPA has included clause in the tender to take all the necessary measures to reduce dust.
ix.	Dust collectors shall be deployed in all areas where blasting (surface cleaning) and painting operations are to be carried out, supplemented by stacks for effective dispersion.	Point noted for compliance.
x.	The Vessels shall comply the emission norms prescribed from time to time.	Point noted for compliance.
xi	Diesel power generating sets proposed as source of backup power should be of enclosed type and conform to rules made under the Environment (Protection) Act, 1986. The height of stack of DG sets should be equal to the height needed for the combined capacity of all proposed DG sets. Use of low sulphur diesel. The location of the DG sets may be decided with in consultation with State Pollution Control Board.	Point noted for compliance.
xii	A detailed traffic management and traffic decongestion plan shall be drawn up to ensure that the current level of service of the roads within a 05 kms radius of the project is maintained and improved upon after the implementation of the project. This plan should be based on cumulative impact of all development and increased habitation being carried out or proposed to be carried out by the	DPA appointed M/s Tata Consulting Engineers Limited for traffic studies and management as a part of Master Plan preparation for the SIPC Location 1(Adipur) & Location 2(Kandla) in 2016. Further, for diversion of port-related traffic and transportation, DPA has obtained Environmental & CRZ Clearance from SEIAA, GoG vide letter dated 19/06/2020 for construction of

	project or other agencies in this 05 Kms radius of the site in different scenarios of space and time and the traffic management plan shall be duly validated and certified by the State Urban Development department and the P.W.D.! competent authority for road augmentation and shall also have their consent to the implementation of components of the plan which involve the participation of these departments.	Interchange cum Road Over Bridge. The work is currently under progress.
III. Water quality monitoring and preservation:		
i.	The project proponent shall ensure that no creeks or rivers are blocked due to any activities at the project site and free flow of water is maintained.	It is assured that no creeks are blocked due to any activities at the project site and free flow of water is maintained.
ii	Appropriate measures must be taken while undertaking digging activities to avoid any likely degradation of water quality. Silt curtains shall be used to contain the spreading of suspended sediment during dredging within the dredging area.	Point Noted for compliance. Dredging activities not started yet for this project.
iii	No ships docking at the proposed project site will discharge its on-board waste water untreated in to the estuary/ channel. All such wastewater load will be diverted to the proposed Effluent Treatment Plant of the project site.	Point Noted for compliance. Further, it is relevant to mention here that, DPA already issued Grant of License/Permission to carry out the work of collection and disposal of "Hazardous Waste/Sludge/ Waste Oil" from Vessels calling at Deendayal Port through DPA contractors. Further, it is to state that, all ships are required to follow DG Shipping circulars regarding the reception facilities at Swachch Sagar portal.
iv	Measures should be taken to contain, control and recover the accidental spills of fuel and cargo handle.	Point Noted for compliance. It is also relevant to mention here that DPA is already having Oil Spill Contingency Plan.
v	The project proponents will draw up and implement a plan for the management of temperature differences between intake waters and discharge waters.	For construction phase, as per the tender clause, the required water for construction activities will be supplied by the contractor. For operational requirement, required water supply will be purchased from GWSSB. Further, the treated sewage will be utilized for plantation and gardening purposes.
vi	Spillage of fuel/engine oil and lubricants from the construction site are a source of organic pollution which impacts marine life. This shall be prevented by suitable precautions and also by providing necessary mechanisms to trap the spillage.	DPA has included clause in the tender to not let any oil and greasy wastes in the sea water.
vii	Total fresh water use shall not exceed the proposed requirement as provided in the project details. Prior permission	Agreed with the condition.

	from competent authority shall be obtained for use of fresh water.	
viii	Sewage Treatment Plant shall be provided to treat the wastewater generated from the project. Treated water shall be reused for horticulture, flushing, backwash, BVAC purposes and dust suppression.	Waste water will be treated in the existing STP of DPA (1.5 MLD). Treated water is being reused for plantation/gardening.
ix	A certificate from the competent authority for discharging treated effluent/ untreated effluents into the Public sewer/ disposal/drainage systems along with the final disposal point should be obtained.	No effluent will be generated. The sewage generated will be treated in the Sewage treatment plant and the treated water will be reused for plantation/gardening.
x	No diversion of the natural course of the river shall be made without prior permission from the Ministry of Water resources.	Point Noted.
xi	All the erosion control measures shall be taken at water front facilities. Earth protection work shall be carried out to avoid erosion of soil from the shoreline/boundary line from the land area into the marine water body.	Work is in progress (Oil Jetty No. 8 - Jetty & allied facilities). It is relevant to mention here that, for strengthening of coastal resilience as per the directions of the GCZMA and MoEF&CC, GoI, till date, DPA had already undertaken Mangrove Plantation in an area of 1500 Ha. till date since the year 2005. A statement showing details of mangrove plantation at various locations with cost incurred is placed at **Annexure I**. Further, DPA is carrying out an additional mangrove plantation of 100 ha. with the consultation of the Gujarat Ecology Commission vide Work Order No. DD/WK/3050/Pt-I/GIM/PC-44 dated 02/06/2022 (**Annexure J**).
IV. Noise monitoring and prevention:		
i	Noise level survey shall be carried as per the prescribed guidelines and report in this regard shall be submitted to Regional Officer of the Ministry as a part of six-monthly compliance report.	Work is in progress (Oil Jetty No. 8 - Jetty & allied facilities). DPA has been conducting regular Monitoring of environmental parameters including noise level survey since the year 2016 through NABL Accredited laboratories. The work is in progress & DPA submitted monitoring data regularly to all the concerned authorities along with compliance reports submitted. The latest monitoring report are attached herewith as **Annexure D**.
ii	Noise from vehicles, power machinery and equipment on-site should not exceed the prescribed limit. Equipment should be regularly serviced. Attention should also be given to muffler maintenance and enclosure of noisy equipments.	Work is in progress (Oil Jetty No. 8 - Jetty & allied facilities). For DPA area, regular Monitoring of environmental parameters including noise level is being conducted since the year 2016 through NABL Accredited laboratories. The latest monitoring report are attached herewith as **Annexure D**.

iii	Acoustic enclosures for DG sets, noise barriers for ground-run bays, ear plugs for operating personnel shall be implemented as mitigation measures for noise impact due to ground sources.	Work is in progress (Oil Jetty No. 8 - Jetty & allied facilities). DPA has included clause in the tender for the contractor to provide protective clothing or other appliances for security of operating personnel. Further, for development of greenbelt in DPA and surrounding areas, DPA has appointed the Gujarat Institute of Desert Ecology (GUIDE) vide Work Order No.EG/WK/4757/Part [Greenbelt GUIDE, dated 31st May 2022 (**Annexure G**).
iv	The ambient noise levels should conform to the standards prescribed under E(P)A Rules, 1986 viz. 75 dB(A) during day time and 70 dB(A) during night time.	Work is in progress (Oil Jetty No. 8 - Jetty & allied facilities). However, for DPA area, it is also relevant to mention here that, DPA has been conducting regular Monitoring of environmental parameters since the year 2016 through NABL Accredited laboratories. The latest monitoring report are attached herewith as **Annexure D**.
V. Energy Conservation measures:		
i	Provide solar power generation on roof tops of buildings, for solar light system for all common areas, street lights, parking around project area and maintain the same regularly;	Work of Oil Jetty No. 8 - Jetty & allied facilities is in progress. It is assured that, the stipulated condition will be complied with. Further, it is relevant to mention here that, DPA has commissioned a 45 kWP Solar Plant at Gandhidham on 7th July, 2022. DPA has installed 400 KWP solar plant and 600 KWP to be installed this year by PPP operator. 4000 Acres of land has been identified for developing 150 MW Hybrid (Solar Cum Wind) Energy Park.
ii	Provide LED lights in their offices and port areas.	In this regard, it is to state that, 1500 LED has been installed in port area.
VI. Waste management:		
i.	Dredged material shall be disposed safely in the designated areas.	The dredged material will be disposed at designated dumping ground (Latitude 22°51'00" N & Longitude 70°10'00" E).
ii	Shoreline should not be disturbed due to dumping. Periodical study on shore line changes shall be conducted and mitigation carried out, if necessary. The details shall be submitted along with the six monthly monitoring reports.	DPA assigned the work "Shoreline Change Study for Deendayal Port Authority (Erstwhile Deendayal Port Authority), Kandla, Kachchh District, Gujarat, to Study the Effect of Dumping, if any" vide their work order dated 12/10/2021 to NCSCM, Chennai. The work has been completed and the final report is attached herewith as **Annexure K**.

iii	Necessary arrangements for the treatment of the effluents and solid wastes must be made and it must be ensured that they conform to the standards laid down by the competent authorities including the Central or State Pollution Control Board and under the Environment (Protection) Act, 1986.	Sewage generated in the port area is treated in the STP (1.5 MLD capacity) at Kandla and the treated sewage is utilized for gardening/ plantation purposes. Further, DPA has been conducting regular Monitoring of environmental parameters including STP monitoring since the year 2016 through NABL Accredited laboratories. The latest monitoring report are attached herewith as **Annexure D**.
iv	The solid wastes shall be managed and disposed as per the norms of the Solid Waste Management Rules, 2016.	Work of Oil Jetty No. 8 - Jetty & allied facilities is in progress. DPA has included clause in the tender for the Contractor to implement procedures regarding Construction Waste Management and disposal.
v	Any wastes from construction and demolition activities related thereto shall be managed so as to strictly conform to the Construction and Demolition Waste Management Rules, 2016.	Work of Oil Jetty No. 8 - Jetty & allied facilities is in progress. DPA has included clause in the tender for the Contractor to implement procedures regarding Construction Waste Management and disposal. DPA had already issued general circular vide dated 3/9/2019 (Copy – **Annexure H**) regarding Construction and Demolition Waste Management for strict implementation in DPA.
vi	A certificate from the competent authority handling municipal solid wastes should be obtained, indicating the existing civic capacities of handling and their adequacy to cater to the M.S.W. generated from project.	Work is in progress (Oil Jetty No. 8 - Jetty & allied facilities). However, it is assured that necessary certification from the competent authority will be obtained.
vii	Used CFLs and TFLs should be properly collected and disposed off/sent for recycling as per the prevailing guidelines/ rules of the regulatory authority to avoid mercury contamination.	Point Noted for compliance.
viii	Oil spill contingency plan shall be prepared and part of DMP to tackle emergencies. The equipment and recovery of oil from a spill would be assessed. Guidelines given in MARPOL and Shipping Acts for oil spill management would be followed. Mechanism for integration of terminals oil contingency plan with the overall area contingency plan under the co-ordination of Coast should be covered.	DPA is already having Oil Spill Contingency Plan and Disaster Management Plan **(The Copies has already been submitted with the last compliance report communicated vide letter dated 30/06/2022).**
VII. Green Belt:		
i	Green belt shall be developed in area as provided in project details with a native tree species in accordance with CPCB guidelines.	Work is in progress (Oil Jetty No. 8 - Jetty & allied facilities). However, it is assured that necessary Green belt

		will be provided as per the condition stipulated. Further, it is relevant to mention that, DPA had already taken up the greenbelt Development activity through Forest Department, GoG, at the cost of 352.32 lakhs (Green Belt development in DPA area in an area of 31.942 Ha.) Further, DPA has appointed the Gujarat Institute of Desert Ecology (GUIDE) for "Green belt development in Deendayal Port Authority and its Surrounding Areas, Charcoal site' (Phase-I)" vide Work Order No.EG/WK/4757/Part [Greenbelt GUIDE, dated 31st May 2022 (**Annexure G**).
ii	Top soil shall be separately stored and used in the development of green belt.	Point noted for compliance.
VIII. Marine Ecology:		
i	The dredging schedule shall be so planned that the turbidity developed is dispersed soon enough to prevent any stress on the fish population.	It is assured that DPA will comply with the condition stipulated. No dredging activity started yet on project site.
ii	While carrying out dredging, an independent monitoring shall be carried out through a Government Agency/Institute to assess the impact and necessary measures shall be taken on priority basis if any adverse impact is observed.	Point Noted for compliance. No dredging activity started yet on project site.
iii	A detailed marine biodiversity management plan shall be prepared through the NIO or any other institute of repute on marine, brackish water and fresh water ecology and biodiversity and submitted to and implemented to the satisfaction of the State Biodiversity Board and the CRZ authority. The report shall be based on a study of the impact of the project activities on the intertidal biotopes, corals and coral communities, molluscs, sea grasses, sea weeds, sub-tidal habitats, fishes, other marine and aquatic micro, macro and mega flora and fauna including benthos, plankton, turtles, birds etc. as also the productivity. The data collection and impact assessment shall be as per standards survey methods and include underwater photography.	Further, it is once again to submit here that, DPA issued work order to M/s GUIDE vide its letter no. EG/WK/ 4751 /Part (Marine Ecology Monitoring) /12 dated 03/05/2021 for preparation of Detailed marine biodiversity plan. The copy of the second year monsoon season report for the year 2022-23 is attached herewith as **Annexure C.**
iv	Marine ecology shall be monitored regularly also in terms of sea	DPA assigned work to M/s GUIDE, Bhuj for regular monitoring of Marine Ecology since the

	weeds, sea grasses, mudflats, sand dunes, fisheries, echinoderms, shrimps, turtles, corals, coastal vegetation, mangroves and other marine biodiversity components including all micro, macro and mega floral and faunal components of marine biodiversity.	year 2017 (From 2017 – 2021) and reports of the same has been submitted to the Regional Office, MoEF&CC, GoI, Bhopal as well as to the MoEF&CC, GoI, New Delhi along with compliance reports submitted. The final report for the Holistic Marine Ecological Monitoring for the period upto May 2021 was submitted on 22.05.2021. Copy of the report was communicated vide earlier compliance report submitted vide letter **dated 29/6/2021**. Further, it is once again to submit her that, DPA issued work order to M/s GUIDE vide its letter no. EG/WK/ 4751 /Part (Marine Ecology Monitoring) /11 dated 03/05/2021 for Regular monitoring of Marine Ecology in and around Deendayal Port Authority (Erstwhile Deendayal Port Trust) and continuous Monitoring Program covering all seasons on various aspects of the Coastal Environs for the period 2021-24. The second year monsoon season report for the year 2022-23 is attached as **Annexure C.**
v	The project proponent shall ensure that water traffic does not impact the aquatic wildlife sanctuaries that fall along the stretch of the river.	Not applicable.
IX. Public hearing and human health issues:		
i	The work space shall be maintained as per international standards for occupational health and safety with provision of fresh air respirators, blowers, and fans to prevent any accumulation and inhalation of undesirable levels of pollutants including VOCs.	Work is in progress (Oil Jetty No. 8 - Jetty & allied facilities). Point Noted for compliance.
ii	Workers shall be strictly enforced to wear personal protective equipment's like dust mask, ear muffs or ear plugs, whenever and wherever necessary/ required. Special visco-elastic gloves will be used by labour exposed to hazards from vibration.	DPA has included clause in the tender for the Contractor to provide protective clothing or other appliances for security of his workers.
iii	Safety training shall be given to all workers specific to their work area and every worker and employee will be engaged in fire hazard awareness training and mock drills which will be conducted regularly, All standard safety and occupational hazard measures shall be implemented and monitored by the concerned officials to prevent the occurrence of untoward incidents/	Work of Oil Jetty No. 8 and allied facilities is in progress. Point Noted for compliance.

	accidents.	
iv	Emergency preparedness plan based on the Hazard identification and Risk Assessment (HlRA) and Disaster Management Plan shall be implemented.	It is assured that Emergency preparedness plan based on the Hazard identification and Risk Assessment (HIRA) and Disaster Management Plan will be implemented.
v	Provision shall be made for the housing of construction labour within the site with all necessary infrastructure and facilities such as fuel for cooking, mobile toilets, mobile STP, safe drinking water, medical health care, creche etc. The housing may be in the form of temporary structures to be removed after the completion of the project.	DPA has included clause in the tender for the Contractor to make provisions for the construction labour with necessary infrastructure.
vi	Occupational health surveillance of the workers shall be done on a regular basis.	Work is in progress (Oil Jetty No. 8 - Jetty & allied facilities). DPA has included clause in the tender for the Contractor to comply with the Health and Safety requirements of the workers.
X. Environment Responsibility:		
i	The company shall have a well laid down environmental policy duly approved by the Board of Directors. The environmental policy should prescribe for standard operating procedures to have proper checks and balances and to bring into focus any infringements/deviation/violation of the environmental/forest /wildlife norms/ conditions. The company shall have defined system of reporting infringements / deviation / violation of the environmental/ forest / wildlife norms / conditions and / or shareholders / stake holders. The copy of the board resolution in this regard shall be submitted to the MoEF&CC as a part of six-monthly report.	DPA is already having Environmental Policy **(Copy – Annexure L).**
ii	A separate Environmental Cell both at the project and company head quarter level, with qualified personnel shall be set up under the control of senior Executive, who will directly report to the head of the organization.	DPA is already having Environment Management cell. Further, DPA has also appointed expert agency for providing Environmental Experts from time to time. Recently, DPA appointed M/s Precitech Laboratories, Vapi for providing Environmental Experts vide work order dated 5/2/2021 **(Copy of work order & scope of work attached as Annexure M).** Further DPA has appointed Environmental Manager on contractual basis for the period of 3+2 years.A copy of office order is attached herewith as **Annexure N.**
iii	Action plan for implementing EMP and environmental conditions along	The allocation made under the "Environmental Services & Clearance of other related

	with responsibility matrix of the company shall be prepared and shall be duly approved by competent authority. The year wise funds earmarked for environmental protection measures shall be kept in separate account and not to be diverted for any other purpose. Year wise progress of implementation of action plan shall be reported to the Ministry/Regional Office along with the Six Monthly Compliance Report.	Expenditure" scheme during BE 2021- 22 is Rs. 266 Lakhs. and BE 2022-2023 is Rs. 345 Lakhs.
iv	Self-environmental audit shall be conducted annually. Every three years third party environmental audit shall be carried out.	Point Noted for compliance.
XI. **Miscellaneous:**		
i	The project proponent shall make public the environmental clearance granted for their project along with the environmental conditions and safeguards at their cost by prominently advertising it at least in two local newspapers of the District or State, of which one shall be in the vernacular language within seven days and in addition this shall also be displayed in the project proponent's website permanently.	DPA has given advertisement in two local news papers regarding Environmental Clearance granted by the MoEF&CC,GoI for the subject project as under : **1)** In English – EXIM INDIA dated 27/11/2020 **(Copy – Annexure O).** **2)** In Gujarati – AAJ KAL dated 25/11/2020 **(Copy – Annexure P).**
ii	The copies of the environmental clearance shall be submitted by the project proponents to the Heads of local bodies, Panchayats and Municipal Bodies in addition to the relevant offices of the Government who in turn has to display the same for 30 days from the date of receipt.	DPA vide letter dated 23 (26)/11/2020 has already been communicated copy of EC & CRZ Clearance accorded by the MoEF&CC, GoI dated 20/11/2020 to the Heads of Local bodies, Panchayats and Municiple Bodies etc. **(Copy – Annexure Q).**
iii	The project proponent shall upload the status of compliance of the stipulated environment clearance conditions, including results of monitored data on their website and update the same on half-yearly basis.	DPA has been regularly submitting the six-monthly compliance reports of the stipulated environment clearances including results of monitored data to MoEF&CC. The same is also uploaded on the official website of Deendayal Port Authority (www.deendayalport.gov.in).
iv	The project proponent shall submit six-monthly reports on the status of the compliance of the stipulated environmental conditions on the website of the ministry of Environment, Forest and Climate Change at environment clearance portal.	DPA has been regularly submitting the six-monthly reports on the status of the compliance of the stipulated environmental conditions to MoEF&CC, GoI.
v	The project proponent shall submit the environmental statement for each	Point noted for compliance

	financial year in Form-V to the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently and put on the website of the company.	
vi	The criteria pollutant levels namely; $PM_{2.5}$, PM_{10}, SO_2, NO_x (ambient levels) or critical sectoral parameters, indicated for the project shall be monitored and displayed at a convenient location near the main gate of the company in the public domain.	Point Noted for compliance. However, monitoring reports of entire DPA area already enclosed at **Annexure D**.
vii	The project proponent 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, commencing the land development work and start of production operation by the project.	As per the stipulated condition, DPA vide letter dated 10/2/2021 **(Copy – Annexure R)** has already informed about the work to be started for "Construction of Oil Jetty no. 8 at Kandla" and also incorporating that for balance Oil Jetties no. 9, 10 & 11 to be implemented on BOT/PPP Mode (under approval stage) and for development of Land (under approval stage), the requisite details will be communicated in due course.
viii	The project authorities must strictly adhere to the stipulations made by the State Pollution Control Board and the State Government.	Point Noted.
ix	The project proponent shall abide by all the commitments and recommendations made in the EIA/EMP report, commitment made during Public Hearing and also that during their presentation to the Expert Appraisal Committee.	Public Hearing was exempted for this project.
x	No further expansion or modifications in the port. Area shall be carried out without prior approval of the Ministry of Environment, Forests and Climate Change (MoEF&CC).	Point Noted for compliance.
xi	Concealing factual data or submission of false/fabricated data may result in revocation of this environmental clearance and attract action under the provisions of Environment (Protection) Act, 1986.	Point Noted.
xii	The Ministry may revoke or suspend the clearance, if implementation of any of the above conditions is not satisfactory.	Point Noted.
xiii	The Ministry reserves the right to stipulate additional conditions if found necessary. The Company in a time bound manner shall implement these conditions.	Point Noted.

xiv	The Regional Office of this Ministry shall monitor compliance of the stipulated conditions. The project authorities should extend full cooperation to the officer (s) of the Regional Office by furnishing the requisite data / information/monitoring reports.	It is assured that DPA will extend full cooperation to the officer (s) of the Regional Office & will also furnish all the requisite data/information/monitoring reports etc. to them as and when asked by them.
xv	The above conditions shall be enforced, inter-alia under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, the Air (Prevention & Control of Pollution) Act, 1981, the Environment (Protection) Act, 1986, Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 and the Public Liability Insurance Act, 1991 along with their amendments and Rules and any other orders passed by the Hon'ble Supreme Court of India / High Courts and any other Court of Law relating to the subject matter.	Point Noted.
xvi	Any appeal against this EC shall lie with the National Green Tribunal, if preferred, within a period of 30 days as prescribed under Section 16 of the National Green Tribunal Act,2010.	Point noted

Annexure -A

GPCB

GUJARAT POLLUTION CONTROL BOARD
PARYAVARAN BHAVAN
Sector-10-A, **Gandhinagar** 382 010
Phone : (079) 23222425
(079) 23232152
Fax : (079) 23232156
Website : www.gpcb.gov.in

By R.P.A.D

CONSENT TO ESTABLISH
CTE- 94118

No. PC/CCA-KUTCH-1524/GPCB ID 56985/ **Date:**

To,
Deendayal Port Trust Land,
Kandla Port Trust Land,
A.O Building,P.O box No. 50,
Tal.:Gandhidham,
Dist.Kutch-370201

Subject : **Consent to Establish (NOC)** under Section 25 of Water (Prevention and Control of Pollution) Act 1974 and Section 21 of Air (Prevention and Control of Pollution) Act 1981

Reference : Your CTE Application **Inward ID No 133847 dated 04/04/2018**

Sir,

Without prejudice to the powers of the Board under the Water (Prevention and Control of Pollution) Act-1974, the Air (Prevention and Control of Pollution) Act-1981 and the Environment (Protection) Act-1986 and without reducing your responsibilities under the said Acts in any way, this is to inform you that the Board grants **Consent to Establish (NOC)** of industrial activity at **Kandla Port Trust Land,A.O Building,P.O box No. 50,Tal.:Gandhidham,**For Creation of water front facilities of oil jetties of 8,9,10,&11 & development of land (1432 Areas).

1. The validity period of the order shall be up to **03/04/2023**

SUBJECT TO FOLLOWING SPECIFIC CONDITIONS:

1. Proposed jetties shall be handled of 3 5 MMTP/Annum of liquid cargo of edible oil. Fertilizer & food grains etc.
2. Unit shall strictly adhere to all condition of TOR issued by MoEF & CC, Delhi dated 04/08/2017 & shall not carry out any construction activities till obtaining EC & CRZ from competent authority
3. No ground water shall be withdrawn without prior approval from competent authority.

2. **CONDITIONS UNDER WATER ACT 1974:**

2.1 There shall be no industrial water consumption and hence there shall be no industrial waste water generation from manufacturing process and other ancillary operations.

2.2 Domestic water consumption shall not exceed 20 KL/day.

2.3 The quantity of domestic waste water (Sewage) shall not exceed 16 KL/Day.

2.4 The quality of the sewage shall conform to the following standards

PARAMETERS	GPCB NORMS
pH	6.5 to 9.0
BOD (5 days at 20^0 C)	30 mg/L
Suspended Solids	100 mg/L
Fecal Coliform	1000 MPN/ 100 ml

2.5 The domestic sewage shall be treated in Sewage Treatment Plant and treated sewage conforming to standards mentioned in 2.4 shall be reused in various activities shall not be used for gardening and plantation purpose in premises.

3. CONDITIONS UNDER AIR ACT 1981:

3.1 There shall be no use of fuel hence there shall be no flue gas emission from manufacturing process and other industrial operations.

3.2 There shall be no process gas emission from manufacturing process and other industrial operations.

3.3 The concentration of the following parameters in the ambient air within the premises of the industry shall not exceed the limits specified hereunder as per National Ambient Air Quality Standards issued by MoEF&CC dated 16th November-2009.

Sr. No.	Pollutant	Time Weighted Average	Concentration in Ambient air in $\mu g/m^3$
1	Sulphur Dioxide (SO_2)	Annual	50
		24 Hours	80
2	Nitrogen Dioxide (NO_2)	Annual	40
		24 Hours	80
3	Particulate Matter (Size less than 10 µm) OR PM_{10}	Annual	60
		24 Hours	100
4	Particulate Matter (Size less than 2.5 µm) OR $PM_{2.5}$	Annual	40
		24 Hours	60

3.4 The level of Noise in ambient air within the premises of industrial unit shall not exceed following levels:

Between 6 A.M. to 10 P.M. : 75 dB(A)
Between 10 P.M. to 6 A.M. : 70 dB(A)

4. CONDITIONS UNDER HAZARDOUS WASTE:

4.1 The applicant shall provide temporary storage facilities and maintain the record for each type of Hazardous Waste as per Hazardous Waste (Management, Handling & Transboundary Movement) Rules, 2016 as amended from time to time.

4.2 The applicant shall be obtain membership of common TSDF site for disposal Hazardous Waste as categorized in Hazardous Waste (Management, Handling & Transboundary Movement) Rules, 2016 as amended thereof.

5. GENERAL CONDITION

5.1 Any change in personnel, equipment or working conditions as mentioned in the consents form/order should immediately be intimated to this Board.

5.2 The waste generator shall be totally responsible for (i.e. Collection, storage, transportation and ultimate disposal) of the wastes generated.

5.3 Records of waste generation, its management and annual return shall be submitted to Gujarat Pollution Control Board in Form – 4 by 31st January of every year.

5.4 In case of any accident, details of the same shall be submitted in Form – 5 to Gujarat Pollution Control Board.

5.5 Applicant shall comply relevant provision of "Public Liability Insurance Act-91".

GPCB

GUJARAT POLLUTION CONTROL BOARD
PARYAVARAN BHAVAN
Sector-10-A, **Gandhinagar** 382 010
Phone : (079) 23222425
(079) 23232152
Fax : (079) 23232156
Website : www.gpcb.gov.in

5.6 Unit shall take all concrete measures to show tangible results in waste generation reduction, voidance, reuse and recycle. Action taken in this regards shall be submitted within 03 months and also along with Form 4

5.7 Industry shall have to display on-line data outside the main factory gate with regard to quantity and nature of hazardous chemicals being handled in the plant, including wastewater and air emissions and solid hazardous waste generated within the factory premises.

5.8 Adequate plantation shall be carried out all along the periphery of the industrial premises in such a way that the density of plantation is at least 1000 trees per acre of land and a green belt of 10 meters width shall be developed.

5.9 The applicant shall have to submit the returns in prescribed form regarding water consumption and shall have to make payment of water cess to the Board under the Water (Prevention and Control of Pollution) Cess Act- 1977.

For and on behalf of
Gujarat Pollution Control Board

(Sushil Vegda)
Senior Environment Engineer

Annexure -B

Annexure 1

Compliance Report (For the period up to November, 2022)

Subject: Point-wise Compliance of conditions stipulated in CRZ Recommendations for project "Creation of water front facilities (oil jetties 8,9,10 and 11) and development of land (1432 acres – revised area 554 acres) for associated facilities for storage at old Kandla, Tal: Gandhidham Dist. Kutch, Gujarat by Deendayal Port Authority (Erstwhile Deendayal Port Trust)" -reg.

Ref No: - CRZ recommendation issued by GCZMA vide Letter No- ENV-10-2018-24- T Cell dated 30.07.2020

S. No.	CRZ Conditions	Compliance Status
	SPECIFIC CONDITIONS	
1.	The DPA shall strictly adhere to the provisions of the CRZ Notification, 2011 issued by the Ministry of Environment, Forests and Climate Change, Government of India	It is assured that, the provisions of the CRZ Notification, 2011 shall be strictly adhere to by the DPA.
2.	Necessary permissions from different departments/ agencies under different laws/ acts shall be obtained before commencing any activity (including the construction)	The Consent to Establish (CTE) from the GPCB had already been obtained vide CTE No. 94118 granted by the GPCB vide letter no. PC/CCA-KUTCH 1524/GPCB ID 56985 dated 23/7/2018 (**Copy Annexure A**).
3.	The DPA shall ensure that that the all the provisions of CRZ Notification 2011 shall be complied with and storage facilities in CRZ areas shall be in compliance with Annexure-ll of the above said Notification	It is assured that all the provisions of CRZ Notification, 2011 will be complied with and only storage of permissible cargo as per CRZ Notification, 2011, Annexure II will be allowed to store in storage facilities to be developed.
4.	There shall not be any blockage of creek due to laying of pipeline. and free flow of water shall be maintained.	Work is in progress (Oil Jetty No. 8 - Jetty & allied facilities). It is hereby assured that, no creeks or rivers shall be blocked, due to any activities at the project site and free flow of water will be maintained.
5.	There shall not be any mangrove destruction/ damage due to proposed activities and adequate buffer zone of 70 metres shall be maintained from mangrove areas	It is assured that all the proposed activities shall be carried out strictly as per the EC & CRZ Clearance accorded by the MoEF&CC, GoI dated 20/11/2020.

6.	The DPA shall effectively implement the Mangrove Development, Protection & Management plan for control of indirect impact on mangrove habitat	As per the directions of the GCZMA and MoEF&CC, GoI, DPA had already undertaken Mangrove Plantation in an area of 1500 Ha. till date since the year 2005. A statement showing details of mangrove plantation at various locations with cost incurred is placed at **Annexure B**. Further, DPA is carrying out an additional mangrove plantation of 100 ha. with the consultation of the Gujarat Ecology Commission vide Work Order No. DD/WK/3050/Pt-I/GIM/PC-44 dated 02/06/2022 (**Annexure C**). It is also relevant to submit here that, as per the direction of the Gujarat Coastal Zone Management Authority, DPA had already prepared & submitted a report on mangrove conservation and management plan formulated by Gujarat Institute of Desert Ecology during the study period of Jan-April, 2015 (Report already submitted along with earlier compliance reports submitted). In addition to the above, DPA appointed M/s GUIDE, Bhuj for "Regular Monitoring of Mangrove Plantation carried out by DPA" (period 15/9/2017 to 14/9/2018 vide work order dated 1/9/2017 and 24/5/2021 to 23/5/2022 vide work order dated 3/5/2021). The final report for the year 2021 to 2022 is attached herewith as **Annexure D**.
7.	The DPA shall have to make a provision that mangrove areas get proper flushing water and free flow of water shall not be obstructed	It is assured that necessary provisions will be made so that mangrove area get proper flushing water and to maintain free flow of water.
8.	The DPA shall have to dispose of the dredged material at the designated dredged material disposal point based on scientific study and approved by the MOEF&CC, GOI	No dredging activity has been started yet. However, it is assured that dredging activity will be carried out strictly as per the requirement of the condition and the same shall be disposed at designated dumping ground (25° 51′ 00″ N & 70°10′ 00″ E).
9.	The DPA shall have to maintain the record for generation and disposal of capital dredging and maintenance dredging	No dredging activity has been started yet. However, it is assured that necessary record will be maintained as per the requirement of the condition.
10.	No dredging, reclamation or any other project related activities shall be carried out in the CRZ area categorized as CRZ I (i) (A) and it shall have to be ensured	It is assured that all the project related activities will be strictly carried out as per the EC & CRZ Clearance accorded by the MoEF&CC, GoI dated 20/11/2020.

	that the mangrove habitat and other ecologically important and significant areas, if any, in the region are not affected due to any of the project activities.	
11.	The DPA shall ensure that construction activities like dredging etc. shall be caried out in confined manner to reduce the impact on marine environment.	No dredging activities have been started yet. However, it is assured that construction activities like dredging will be carried out as per the requirement of the condition.
12.	The DPA shall ensure that the dredging shall not be carried out during the fish breeding season.	No dredging activities have been started yet. Point Noted for compliance.
13.	Construction waste including debris and dredged material shall be disposed safely in the designed areas as approved by MoEF&CC, GoI and it shall be ensured that there shall be no impact on flora and fauna	DPA had already issued general circular vide dated 3/9/2019 (**Copy – Annexure E**) regarding Construction and Demolition Waste Management for strict implementation in DPA.
14.	No effluent or sewage shall be discharged into the sea / creek or in the CRZ area and shall be treated to conform the norms prescribed by the Gujarat Pollution Control Board and would be reused / recycled as per the approval of the Board.	It is assured that No effluent or sewage will be discharged into the Sea/creek or in the CRZ area. Further, the same will be treated in STP as per the norms prescribed by the GPCB.
15.	All the recommendations and suggestions given by the Cholamandalam MS Risk Services Limited in their Environment Impact Assessment report shall be implemented strictly by DPA	The compliance of the recommendations and suggestions is given by the EIA Consultant, M/s SV Enviro, Vizag in EIA Report is attached herewith as **Annexure F.**
16.	The DPA shall exercise extra precautions to ensure the navigation safety and mitigation of the risk associated with the project activities especially due to collision, sinking or accidents of the vessels and would deploy the latest communication and navigation aids for this purpose. The proposed facilities shall also be covered under the VTMS being developed by the GMB	In this regard, it is to state that, Deendayal Port Authority had already contributed Rs. 41.25 crores for installing and operating the VTMS in the Gulf of Kachchh.
17.	The cost of the external agency that may be appointed by this department for supervision / monitoring of the project activities during construction/ operational phases shall be paid by DPA	Point Noted.
18.	The DPA shall contribute financially for any common study or project that may be proposed by this Department for environmental management / conservation / improvement for the Gulf Kutch	Point noted for compliance.

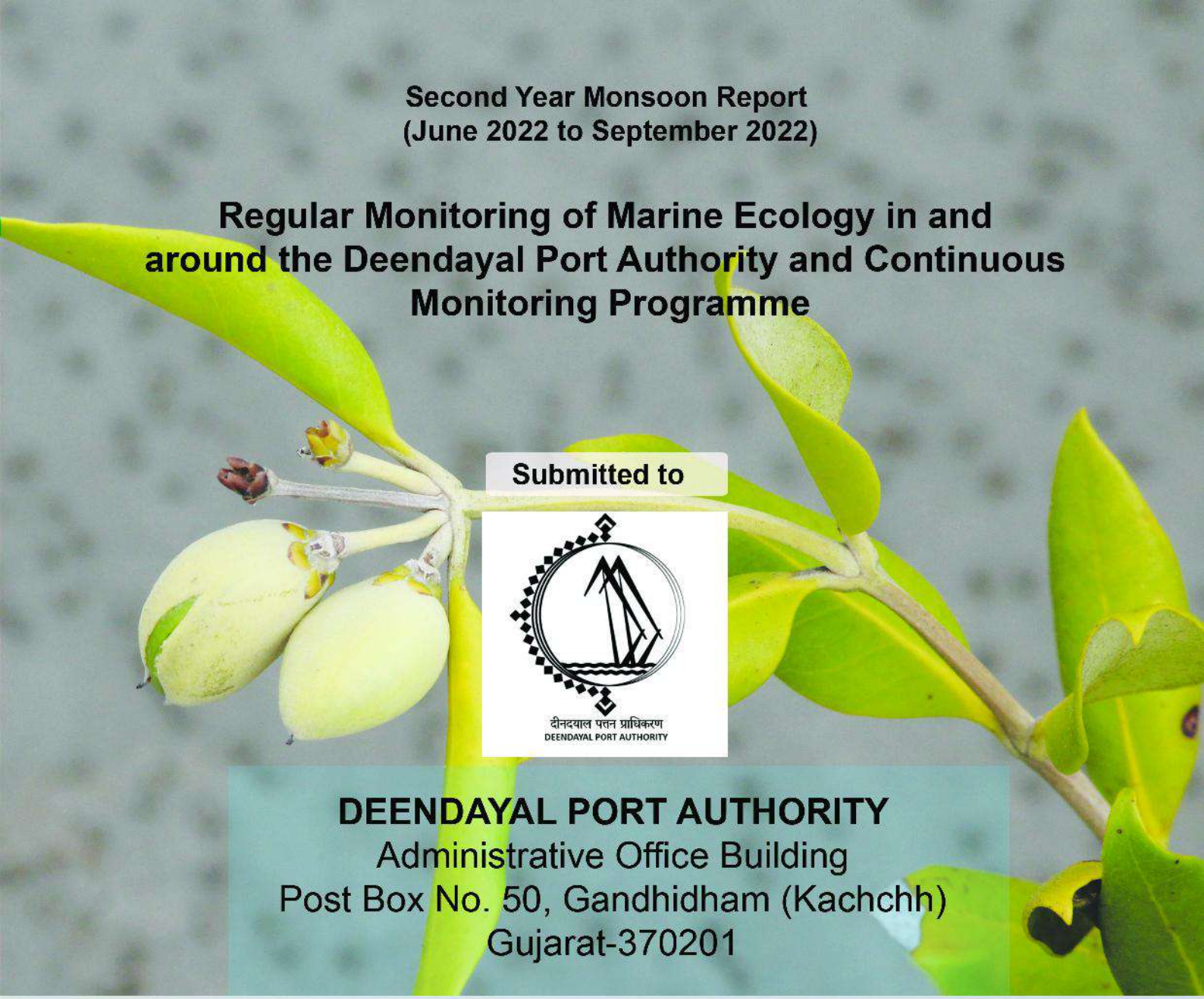
S. No.	CRZ Conditions	Compliance Status
19.	The piling activities debris and any other type of waste shall not be discharged into the sea or creek or in the CRZ areas. The debris shall be removed from the site immediately after the piling activities are over.	Work is in progress (Oil Jetty No. 8 - Jetty & allied facilities). DPA has included clause in the tender for the Contractor to undertake precautions for safeguarding the environment during the course of the construction work.
20.	The camps shall be located outside the CRZ area and the labour shall be provided with the necessary amenities, including sanitation, water supply and fuel and it shall be ensured that the environmental conditions are not deteriorated by the labours.	Point Noted for compliance.
21.	The DPA shall prepare and regularly update their Local Oil Spill Contingency and Disaster Management Plan in consonance with the National Oil Spill and Disaster Contingency Plan	Point Noted for compliance. DPA is already having Local Oil Spill contingency plan and updated DMP.
22.	The DPA shall bear the cost of the external agency that may be appointed by this Department for supervision / monitoring of proposed activities and the environmental impacts of the proposed activities	Point noted for compliance.
23.	The groundwater shall not be tapped to meet with the water requirements in any case	Water requirements will be met through procurement from GWSSB or private tankers. It is hereby assured that no groundwater shall be tapped.
24.	DPA shall take up greenbelt development activities in consultation with the Gujarat institute of Desert Ecology / Forest Department / Gujarat Ecology Commission	DPA has already developed Green belt in and around the Port area. Further, DPA assigned work for Green belt development in an area of about 32 hectares to the Forest Department, Govt. of Gujarat during August, 2019 at the cost of Rs. 352.32 lakhs. The work is completed. Further, DPA also undertook massive green belt development in and around the Port area and at Gandhidham area. Further, DPA also assigned the work of ***"Greenbelt Development in Deendayal Port Authority and its surrounding areas Charcoal Site (Phase I)"*** vide Work Order dated 31/05/2022 at the cost of Rs. 33.22 lakhs (**Annexure G**).
25.	The DPA shall have to contribute financially for taking up the socio-economic upliftment activities in this region in consultation with the Forests and Environment Department and the District Collector / District Development Officer	Point noted for compliance. Work is in progress (Oil jetty No. 8 and allied facilities) As per the CSR Guidelines issued by the Ministry of Ports, Shipping & Waterways, Government of India, from time to time, DPA had undertaken CSR activities since

		the year 2011-12. The details of CSR Activities undertaken & planned is attached herewith as **Annexure H.**
26.	A six-monthly report on compliance of the conditions mentioned in this letter shall have to be furnished by DPA on a regular basis to this Department and MoEF&CC, GoI.	DPA has been regularly submitting the six-monthly report on compliance of the conditions mentioned in the CRZ Recommendation letter dated 30/7/2020 to the CRZ Authority and to the MoEF&CC, GoI.
27.	The DPA shall ensure that the numbers of the Vessels and machinery deployed during marine construction, which are a source of low level organic and PHC pollution will be optimized to minimize risks of accidents involving these vessels.	Point Noted for compliance. Work is in progress (Oil Jetty No. 8 - Jetty & allied facilities).
28.	The noise level during transport and construction of marine facilities shall be kept minimum.	DPA has been conducting regular Monitoring of environmental parameters including STP monitoring since the year 2016 through NABL Accredited laboratories. The latest monitoring report are attached herewith as **Annexure I**.
29.	The DPA shall regularly conduct the surveys to identify changes in the channel bathymetry to minimize navigation hazards. Proper navigational aids and guidance should be provided to ships navigating the channel and there should be a properly structured vessels traffic management strategy to avoid accidents.	Point noted for compliance. Further, it is to state that, Deendayal Port Authority had already contributed Rs. 41.25 crores for installing and operating the VTMS in the Gulf of Kachchh.
30.	The DPA shall carry out separate study for further erosion and deposition pattern in the area after dredging through a reputed agency and shall follow the suggestions of the study done by reputed agency, for maintenance dredging, the recommendations/ suggestions of the reputed agency shall be follow by the DPA.	No dredging activity has been started yet. However, it is assured that necessary will be conducted as per the requirement of the condition.
31.	Any other condition that may be stipulated by this Department and MoEF&CC, GoI from time to time for environmental protection / management purpose shall also have to be complied with by DPA.	Point noted.

Annexure -C

Second Year Monsoon Report
(June 2022 to September 2022)

Regular Monitoring of Marine Ecology in and around the Deendayal Port Authority and Continuous Monitoring Programme



Submitted to

दीनदयाल पत्तन प्राधिकरण
DEENDAYAL PORT AUTHORITY

DEENDAYAL PORT AUTHORITY
Administrative Office Building
Post Box No. 50, Gandhidham (Kachchh)
Gujarat-370201

Submitted by

GUJARAT INSTITUTE OF DESERT ECOLOGY
P.B. No. 83, Mundra Road, Opp. Changleshwar Temple
Bhuj-Kachchh, Gujarat-370001

October 2022

Second Year Monsoon Report
(June 2022 to September 2022)

Regular Monitoring of Marine Ecology in and around the Deendayal Port Authority and Continuous Monitoring Programme

Submitted to

दीनदयाल पत्तन प्राधिकरण
DEENDAYAL PORT AUTHORITY

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Administrative Office Building
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Gujarat-370201

Submitted by

GUJARAT INSTITUTE OF DESERT ECOLOGY
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Bhuj-Kachchh, Gujarat-370001

October 2022

Project Team

Project Coordinator

Dr. V. Vijay Kumar, Director

Principal Investigator

Dr. Durga Prasad Behera	Project Scientist	Phytoplankton & Zooplankton, Physico-chemical parameters, Seaweed, Seagrass & Marine Fisheries

Co-Principal Investigator

Dr. R. Ravinesh	Project Scientist	Marine Biodiversity & Taxonomy

Core Team

Dr. Jaikumar, M.	Senior Scientist	Mangrove & Mudflat
Dr. L. Prabha Devi	Advisor	Management Plan
Dr. Nikunj B. Gajera,	Scientist	Avifauna
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Snapshot

Monsoon (June 2022 to September 2022)

S. No	Components of the Study	Remarks
1	MoEF & CC sanction letter and details	(i). EC & CRZ clearance granted by the MoEF &CC, GoI dated 19/12/16 Dev. Of 7 integrated facilities – specific condition no. xviii. (ii). EC & CRZ clearance granted by the MoEF &CC, GoI dated 18/2/2020 Dev. Remaining 3 integrated facilities – specific condition no. xxiii. (iii). EC & CRZ clearance granted by the MoEF &CC, GoI dated 19/2/2020 Dev. integrated facilities (Stage II-5 -specific condition no. xv. (iv). EC & CRZ clearance granted by the MoEF &CC, GoI dated 20/11/20 – Creation of waterfront facilities (OJ 8 to 11- Para VIII Marine Ecology, specific condition iv.
2	Deendayal Port letter sanctioning the project	DPA work Order: WK/4751/Part/ (Marine Ecology Monitoring)/11 date 03.05.2021
3	Duration of the project	Three years-from 24.05.2021 to 23.05.2024
4	Period of the survey carried	Second Year Monsoon season (June 2022 to September 2022)
5	Survey area within the port limit	All major and minor creek systems from Tuna to Surajbari and Vira coastal area.
6	Number of sampling locations	Fifteen sampling locations in and around the DPA port jurisdiction
7	**Components of the report**	
7a	Mangroves	The overall average density was 4602 trees/ha of *A. marina* during monsoon 2022. The highest tree density was reported at the S-12 station in the Tuna creek area (7359 plants/ha). The lowest average tree density (2935 plants/ha) was reported in Phang creek. However, the lowest density in the individual site was recorded in site S-5 at Phang creek. The highest regeneration (140,000 plants/ha) at S-9 of Navlakhi creek and recruitment (31,500 plants/ha) class density were recorded at Kharo creek (S-7).
7b	Mudflats	The highest TOC value (0.83%) was recorded at station S-4 followed by S-2 site. The lowest TOC value was reported at S-12. It is observed that TOC values varied significantly among the sampling stations, which means that organic carbon depends on the living life forms and the type of life forms in the mudflats.

7c	Zooplankton	The zooplankton identified from the 15 stations falls under 10 phyla and 41 genera which are described 16 groups. The phylum Arthropoda was the predominant represented with 25 genera, including copepods, crabs, shrimps and their larvae. The highest percentage was due to the calanoid copepods (36.9%) followed by Decapoda (13.2%) and Gastropoda (8.2%).
7d	Phytoplankton	The generic number recorded during the monsoon period ranged from 24 to 33 at the sampling stations with remarkable variations concerning the composition. The maximum number (33 genera) was observed at S-11, and the minimum from S-15 represented 24 genera. The percentage composition of the various groups varied from 5 % to 47 %, of which the centrales and pennales are the dominant, constituting 47% and 27%, respectively.
7e	Intertidal Fauna	The intertidal fauna and the species diversity of the invertebrates showed the maximum for phylum Arthropoda (8 species), followed by Mollusca (6 species). The phylum Chordata was represented by two species. The overall percentage composition of the four groups of intertidal fauna at the 15 sites revealed the Arthropoda (50%), Mollusca (37%), and Chordata (13%).
7f	Sub-tidal Macrobenthos	The DPA port environment revealed that Mollusca (14 species) and Annelida (2 species) were the major constituents, followed by Arthropoda (1 species) and Cnidaria (1 species). The phylum Mollusca constituted the maximum (78%) share of the subtidal Fauna, followed by Annelida (11%), Arthropoda (5.5%) and Cnidaria (5.5%) in the total benthic samples collected.
7g	Seaweeds	No seaweed is reported in the DPA area.
7h	Seagrass	No seagrass is reported in the DPA area.
7i	Marine reptiles	One species of reptile was recorded from the DPA area.
7j	Marine mammals	One species of marine mammal was recorded from the DPA area.
7k	Halophytes	Four halophytes were recorded along the selected Deendayal Port Authority sites during the Monsoon sampling; among the halophyte species recorded, *Salicornia brachiata* alone was found in the 3 sampling locations. The percentage of *Salicornia brachiata* was found to be the highest at stations S-8 (78%) and the lowest at S-11.
7l	Avifauna	A total of 49 species belonging to 6 orders, 25 families and 38 genera were recorded from the coastal area of Deendayal Port Authority during the Monsoon season study.

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1. Introduction

Deendayal Port is located at the inner end of Gulf of Kachchh on the Kandla creek (22°59'4.93N and longitude 70°13'22.59 E) in the Kachchh district of Gujarat state, operated by Deendayal Port Authority (DPA). Being the India's busiest major port in recent years, is gearing to add substantial cargo handling capacity with private participation. Since its formation in the 1950s, the Deendayal Port provides the maritime trade requirements of states such as Rajasthan, Madhya Pradesh, Uttar Pradesh, Haryana and Gujarat. Because of its proximity to the Gulf countries, large quantities of crude petroleum are imported through this port. About 35% of the country's total export takes place through the ports of Gujarat in which the Deendayal port has a considerable contribution. Assortments of liquid and dry cargo are being handled at DPA Port. The dry cargo includes fertilizers, iron and steel, food grains, metal products, ores, cement, coal, machinery, sugar, wooden logs, etc. The liquid cargo includes edible oil, crude oil and other petroleum products. Cargo handling has increased from 117.5 MMT to127 MMT during 2021-2022. Presently, the Port has total 1-16 dry cargo berths for handling dry cargo, 6 oil jetties, and one barge jetty at Bunder basin, dry bulk terminal at Tuna Tekra, barge jetty at Tuna and two SPMs at Vadinar for handling oil. Regular expansion or developmental activities such as the addition of jetties, allied SIPC and ship bunkering facilities are underway in order to cope with the increasing demand for cargo handling during the recent times.

A developmental initiative of this magnitude is going on since past 7 decades, which will have its own environmental repercussions. Being located at the inner end of Gulf of Kachchh, Deendayal Port Authority encompasses a number of fragile marine ecosystems that includes a vast expanse of mangroves, mudflats, creek systems and associated biota. Deendayal Port is a natural harbour located on the eastern bank of North-South trending Kandla creek at an aerial distance of 90 km from the mouth of Gulf of Kachchh. The Port's location is marked by a network of major and minor mangrove lined creek systems with a vast extent of mudflats. Coastal belt in and around the port has an irregular and dissected configuration. Due to its location at the inner end of the Gulf, the tidal amplitude is elevated, experiencing 6.66 m during mean high-water spring (MHWS) and 0.78 m during mean low water spring (MLWS) with MSL of 3.88 m. Commensurate with the increasing tidal amplitude, vast intertidal expanse is present in and around the port environment. Thus, the occurrence of mudflats on the intertidal zone enables mangrove formation to an extensive

area. Contrary to the southern coast of Gulf of Kachchh, the coral formations, seaweed and seagrass beds are absent in the northern coast due to high turbulence induced suspended sediment load in the water column, a factor again induced due to the conical Gulf geomorphology and surging tides towards its inner end.

1.1. Rationale of the present study

The ongoing developmental activities at Deendayal Port Authority has been intended for the following.

i. The development of 3 remaining integrated facilities (Stage 1) within the existing Port at Kandla which includes development of a container terminal at Tuna off Tekra on BOT base T shaped jetty, construction of port craft jetty and shifting of SNA section of Deendayal port and railway line from NH-8A to Tuna port.

ii. EC & CRZ clearance granted by the MoEF &CC, GoI dated 18/2/2020 Dev. Remaining 3 integrated facilities – specific condition no. xxiii.

iii. EC & CRZ clearance granted by the MoEF &CC, GoI dated 19/2/2020 Dev. integrated facilities (Stage II-5 -specific condition no. xv.

iv. EC & CRZ clearance granted by the MoEF &CC, GoI dated 20/11/20 – Creation of water front facilities (OJ 8 to 11- Para VIII Marine Ecology,specific condition iv).

As per the environmental clearance requirements to these developmental initiatives, by MoEF & CC, among other conditions, has specified to conduct the continuous monitoring of the coastal environment on various aspects covering the three the seasons. The regular monitoring shall include physico-chemical parameters coupled with biological indices such as mangroves, seagrasses, macrophytes and plankton on a periodic basis during the construction and operation phase of the project. Besides, the monitoring study also includes assessment of Mudflats, Fisheries, and Intertidal fauna including the macrobenthos as components of the management plan. The regular marine ecology monitoring includes Micro, Macro and Mega floral and fauna components of marine biodiversity of the major intertidal ecosystems, the water and sediment characteristics. In accord with MoEF&CC directive, DPA has consigned the project on 'Regular Monitoring of Marine Ecology in and around the Deendayal Port Authority and Continuous Monitoring Programme" to Gujarat Institute of Desert Ecology (GUIDE), Bhuj during May, 2021. Further, Deendayal Port authorities has entrusted Gujarat Institute of Desert Ecology (GUIDE) to continue the study for another three years, i.e., 2021 – 2024. The study covers all the seasons as specified

by the specific condition of the Ministry of Environment, Forest and Climate Change (MoEF&CC). The present study is designed considering the scope of the work given in the EC conditions.

1.2. Scope of work

The scope of the present investigation includes physico-chemical and marine biological components as mentioned in the specific conditions of MoEF&CC, EC & CRZ clearance dated 19.12.2016,18.2.2020,19.2.2022 and 20.11.2020 with specific conditions xviii, xxiii, xv & iv respectively. A detailed holistic approach to different components of the study such as marine physico-chemical parameters of water and sediment and marine biodiversity within the Deendayal Port area will be carried out. Based on the results obtained during the project period, a detailed management plan will be drawn at the end of the project period. The biological and physico-chemical variables will be investigated during the present study on a seasonal basis i.e., monsoon, post monsoon and pre-monsoon as follows.

- ✓ Physico-chemical characteristics of water and sediment
- ✓ Detailed assessment of mangrove vegetation structure including density,
- ✓ diversity, height, canopy, and other vegetation characteristics.
- ✓ GIS and RS studies to assess different ecological sensitive land use and land cover categories within the Port area such as the extent of dense and sparse mangroves, mudflats, creek systems, and other land cover categories within the port limits.
- ✓ Quantitative and qualitative assessment of the intertidal fauna, composition, distribution, diversity, density, and other characteristics.
- ✓ Data collection on the species composition, distribution, diversity and density of sub-tidal benthic fauna.
- ✓ Estimation of primary productivity at the selected sampling sites located in around the DPA area.
- ✓ Investigation of the species composition, distribution, density, and diversity of phytoplankton and zooplankton.
- ✓ Recording the occurrence, diversity and distribution of halophytes, seagrasses, seaweeds and other coastal flora. Investigations on the Avifaunal density, diversity, composition, habitat, threatened and endangered species and characters. Fishery

Resources – Species composition, diversity, Catch Per Unit Effort (CPUE) and other socio-economic information.

1.2.1. Study Area

The coastal belt in and around Deendayal Port Authority jurisdiction is characterized by a network of creek systems and mudflats which are covered by sparse halophytic vegetation like scrubby to dense mangroves, creeks and salt-encrusted landmass which form the major land components. The surrounding environment in 10 km radius from the port includes built-up areas, salt pans, human habitations and port related structures on the west and north creek system, mangrove formations and mudflats in the east and south. The nearest major habitation is Gandhidham town located about 12 km away on the western part with population of 2,48,705 (as per 2011 census).

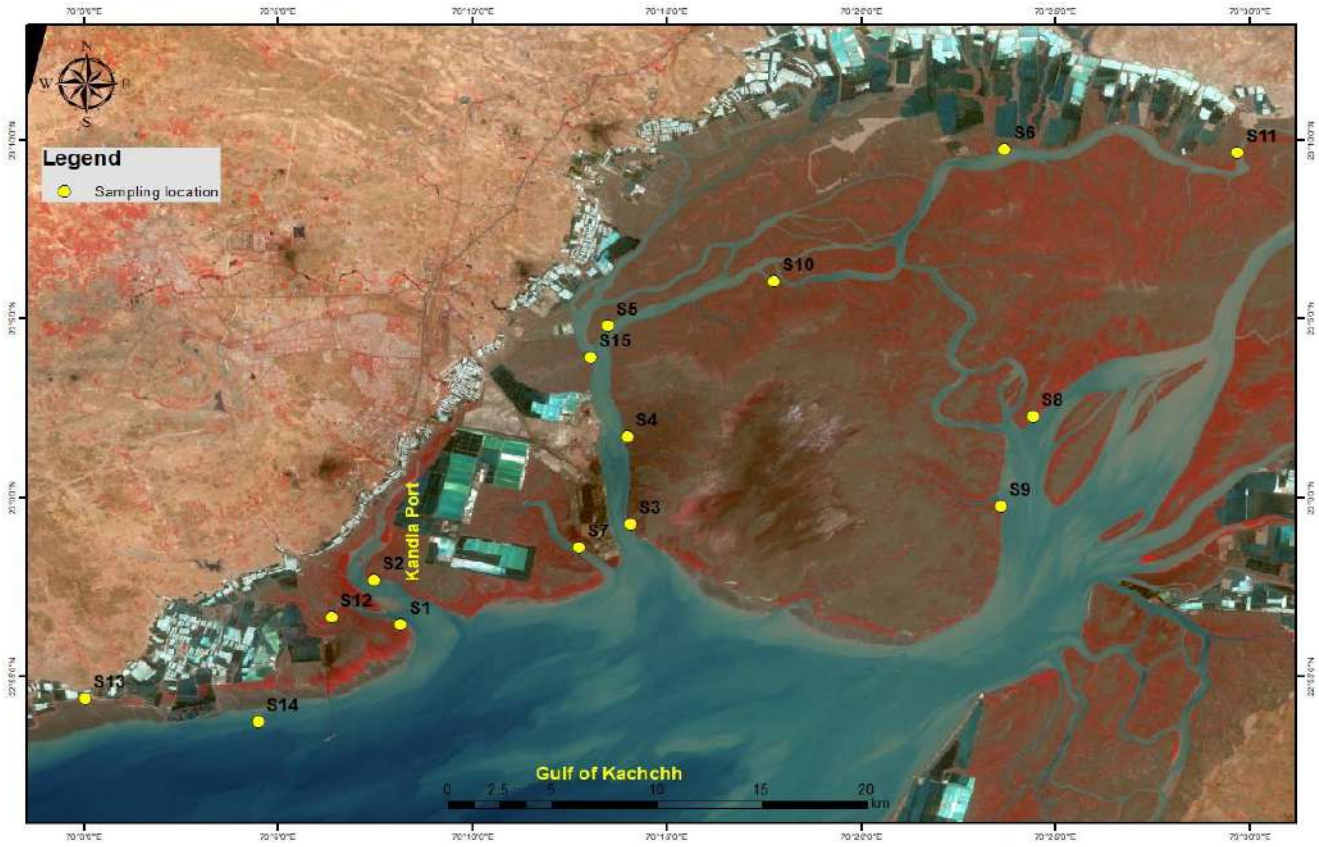

Figure 1: Map showing the sampling locations 2021-2024

2. Sampling of water and sediment samples

Sampling was carried out for the coastal water (surface) and sediment to determine physical and chemical characteristics from the prefixed sampling sites. The biological parameters (benthic and pelagic fauna, flora and productivity) were also estimated (Table.1).

Table 1: Physico-chemical and biological parameters analysed

Parameters	
Water	**Mangrove & Other Flora**
• pH	**Mangrove**
• Temperature	• Vegetation structure, density
• Salinity (ppt)	• Diversity
• Petroleum Hydrocarbons-PHC	• Height
• Dissolved oxygen	• Canopy and other vegetation characteristics
• Total Suspended Solids (TSS)	
• Total Dissolved solids (TDS)	**Halophytes:**
Nutrients	• Percentage of distribution
Nitrate (NO_3)	• Diversity
• Nitrite (NO_2)	
• Total Nitrogen	**Seagrass and Seaweed**
• **Sediment**	• Occurrence, distribution, and diversity.
• Texture	**Intertidal fauna**
• Total organic carbon (TOC)	• Composition, distribution, diversity, density and other characteristics.
• **Biological Parameters**	**Avifauna**
Phytoplankton- Genera, abundance, diversity and biomass	• Density, diversity, composition, habitat,
• Productivity-Chlorophyll a	• Threatened and endangered species and characters
• Zooplankton – Species, abundance, diversity	
• Macrobenthos - genera, abundance, diversity	
• Fishery Resources	
• Common fishes available	
• composition, diversity	
• Catch Per Unit Effort (CPUE)	

The water samples were collected from each pre-designated site in pre-cleaned polyethylene bottles. Prior to sampling, the bottles were rinsed with sample water to be collected and stored in an ice box for transportation to laboratory and refrigerated at 4°C till further analysis. The analysis of the water quality parameters was carried out by following standard methods (APHA, 2017). All extracting reagents were prepared using metal-free, AnalaR grade chemicals (Qualigens Fine Chemicals Division of Glaxo SmithKline Pharmaceuticals Limited, Mumbai) and double distilled water prepared from quartz double distillation assembly.

2.1. Methodology

Physico-chemical Parameters

pH and Temperature

A Thermo fisher pH / EC / Temperature meter was used for pH and temperature measurements. The instrument was calibrated with standard buffers just before use.

Salinity

A suitable volume of the sample was titrated against Silver nitrate (20 g/l) with Potassium chromate as an indicator. The chlorinity was estimated, and from that, salinity values were derived using a formula (Strickland and Parsons,1972).

Total Suspended Solids (TSS)

About 100 ml of the water sample was filtered through pre-weighed filter paper and placed in the Hot air oven at a specified temperature as per the protocol for 1 hour. The filter paper was allowed to cool in a desiccator to obtain a constant weight by repeating the drying and desiccation steps.

Total Dissolved Solids (TDS)

The water samples were subjected for gravimetric procedure for confirmation of the readings obtained from the hand -held meter. About 100 ml of the water sample was taken in a beaker and filtered which was then dried totally in a Hot Air Oven (105°C). The TDS values were calculated using the difference in the initial and final weight of the container.

Turbidity

The sample tube (Nephelometric cuvette) was filled with distilled water and placed in the sample holder. The lid of the sample compartment was closed. By adjusting the'SET ZERO' knob, the meter reading was adjusted to read zero. The sample tube with distilled water was removed, the 40 NTU standard solutions were filled in the tube, and the meter reading was set to read 100. Other standards were also run. The turbidity of the marine water sample was then found by filling the sample tube with the sample, and the reading was noted.

Dissolved Oxygen (DO)

DO was determined by Winkler's method (Strickland and Parsons,1972).

Phosphate

Acidified Molybdate reagent was added to the sample to yield a phosphomolybdate complex that is reduced with Ascorbic acid to a highly coloured blue compound, which is measured at the wavelength of 690 nm in a Spectrophotometer (Shimadzu UV 5040).

Total phosphorus

Phosphorus compounds in the sample were oxidized to phosphate with alkaline Potassium per sulphate at high temperature and pressure. The resulting phosphate was analyzed and described as total phosphorous.

Nitrite

Nitrite in the water sample was allowed to react with Sulphanilamide in acid solution. The resulting diazo compound was reacted with N-1-Naphthyl ethylenediamine dihydrochloride to form a highly coloured azo-dye. The light absorbance was measured at the wavelength of 543 nm in Spectrophotometer (Shimadzu UV 5040).

Nitrate

The Nitrate content was determined as nitrite (as mentioned above) after its reduction by passing the sample through a column packed with amalgamated Cadmium.

Petroleum Hydrocarbon (PHs)

The water sample (1liter) was extracted with hexane and the organic layer was separated, dried over anhydrous sulphate and reduced to 10 ml at 30°C under low pressure. Fluorescence of the extract was measured at 360 nm (excitation at 310 nm) with Saudi Arabian crude residue as a standard. The residue was obtained by evaporating lighter fractions of the crude oil at 120°C.

Sediment characteristics

Sediment samples were collected from the prefixed stations by using a Van Veen grab having a mouth area of 0.04m^2 or by a non-metallic plastic spatula. Sediment analysis was carried out using standard methodologies. In each location (grid), sediment samples were collected from three different spots and pooled together to make a composite sample, representative of a particular site. The collected samples were air dried and used for further analysis.

Sediment Texture

For texture analysis, specified unit of sediment sample was sieved through sieves of different mesh size as per Unified Soil Classification System (USCS). Cumulative weight retained in each sieve was calculated starting from the largest sieve size and adding subsequent sediment weights from the smaller size sieves (USDA,1951). The percentage of the various fractions was calculated from the weight retained and the total weight of the sample. The cumulative percentage was calculated by sequentially subtracting percent retained from the 100%.

Total Organic carbon

Percentage of organic carbon in the dry sediment was determined by oxidizing the organic matter in the sample by Chromic acid and estimating the excess Chromic acid by titrating against Ferrous ammonium sulphate with Ferroin as an indicator (Walkley and Black, 1934).

2.3. Biological Characteristics of water and Sediment

Primary productivity

Phytoplankton possess the plant pigment chlorophyll ‘a’ which is responsible for synthesizing the energy for metabolic activities of phytoplankton through the process of photosynthesis in which CO_2 is used and O_2 is released. It is an essential component to understand the consequences of pollutants on the photosynthetic efficiency of phytoplankton in the system. To estimate this, a known volume of water (500 ml) was filtered through a 0.45 µm Millipore Glass filter paper and

the pigments retained on the filter paper were extracted in 90% Acetone. For the estimation of chlorophyll 'a' and pheophytin pigments the fluorescence of the Acetone extract was measured using Fluorometer before and after treatment with dilute acid (0.1N HCL) (Strickland and Parsons,1972).

Phytoplankton

Phytoplankton samples were collected from prefixed 15 sampling sites from the coastal water in and around DPA location using standard plankton net with a mesh size of 25µm and a mouth area of 0.1256 m^2 (20 cm radius). The net fitted with a flow meter (Hydrobios) was towed from a motorized boat moving at a speed of 2 nautical miles/hr. Plankton adhering to the net was concentrated in the net bucket by splashing seawater transferred to a pre-cleaned and rinsed container and preserved with 5% neutralized formaldehyde and appropriately labelled indicating the details of the collection, and stored for further analysis. The Quantitative analysis of phytoplankton (cell count) was carried out using a Sedgewick-Rafter counting chamber. The density (No/l) was calculated using the formula: $N=n \times v/V$ (Where, N is the total No/liter, n is the average number of cells in 1 ml, v is the volume of concentrate; V is the total volume of water filtered. The identification was done by following the standard literature of Desikachary, (1987), Santhanam et.al. (2019) and Kamboj et.al. (2018).

Zooplankton

Zooplankton samples were collected using a standard zooplankton net made of bolting silk having 50µm with mouth area of 0.25 m^2 fitted with a flow meter. The net was towed from a boat for 5 minutes with a constant boat speed of 2 nautical miles/hr. The initial and final reading in the flow meter was noted down and the plankton concentrate collected in the bucket was transferred to appropriately labeled container and preserved with 5% neutralized formaldehyde. One ml of the zooplankton concentrate was added to a Sedgwick counting chamber and observed under a compound microscope and identified by following standard literature. The group/taxa were identified using standard identification keys and their number was recorded. Random cells in the counting chamber were taken for consideration and the number of zooplankton was noted down along with their binomial name. This process was repeated for five times with 1 ml sample and the average value was considered for the final calculation. For greater accuracy, the final density values were counter-checked and compared with the data collected by the settlement method.

Univariate measures such as Shannon-Wiener diversity index (H'), Margalef's species richness (d), and Pielou's evenness (J'), Simpson's dominance (D) was determined using PAST software.

Intertidal Fauna

Intertidal faunal assemblages were studied for their density, abundance and frequency of occurrence during monsoon 2022 at the pre-fixed 15 sampling locations within the DPA jurisdiction. Sample collection and assessment of intertidal communities were done in the intertidal zone during the low tide period. At each site, 1 x1 m^2 quadrates were placed randomly and all visible macrofaunal organisms encountered inside the quadrate were identified, counted and recorded. At each site, along the transects which run perpendicular to the waterfront, three to six replicate quadrate samples were assessed for the variability in macro-faunal population structure and the density was averaged for the entire intertidal belt. Organisms, which could not be identified in the field, were preserved in 5% formaldehyde, brought to the laboratory and identified using standard identification keys (Abott, 1954; Vine, 1986; Oliver, 1992; Rao, 2003; 2017; Psomadakis *et al.,* 2015; Apte, 2012; 2014; Naderloo 2017; Ravinesh *et al.* 2021; Edward *et al.,* 2022). Average data at each site were used to calculate the mean density (No/m^2).

Subtidal macro benthic Fauna

The sampling methods and procedures were designed in such a way to obtain specimens in the best possible condition as to maximize the usefulness of the data obtained. For studying the benthic organisms, triplicate samples were collected at each station using Van Veen grab, which covered an area of 0.04m^2. The wet sediment was passed through a sieve of mesh size 0.5 mm for segregating the organisms. The organisms retained in the sieve were fixed in 5-7% formalin and stained further with Rose Bengal dye for ease of spotting at the time of sorting. The number of organisms in each grab sample was expressed as No. /m^2. All the species were sorted, enumerated and identified by following the available literature. The works of Day (1967), Hartman (1968, 1969), Rouse and Pleijel (2001), Robin et al., (2003), Amr (2021), were referred for polychaetes; Crane (1975), Holthuis (1993), Naderloo (2017). Xavier et al., (2020) for crustaceans; Subba Rao (1989, 2003. 2017), Apte (2012, 2014), Ramakrishna and Dey (2007), Ravinesh *et al*. (2021) and Edward *et al*, (2022) for molluscs. Statistical analyses such as diversity indices and quadrat richness were calculated using Paleontological Statistics Software Package for Education and Data (PAST) version 3.2.1 (Hammer et al., 2001).

Plate 1: Estimation of intertidal fauna by the quadrate method

Plate 2: Collection of Plankton and macrobenthos in subtidal habitat

2.4. Mudflats

Mudflats are ecologically and socio-economically vital ecosystems that bring benefits to human populations around the globe. These soft-sediment intertidal habitats, with >10% silt and clay (Dyer 1979), sustain global fisheries through the establishment of food and habitat (including important nursery habitats), support resident and migratory populations of birds, provide coastal defenses, and have aesthetic value. Mudflats are intimately linked by physical processes and dependent on coastal habitats, and they commonly appear in the natural sequence of habitats between subtidal channels and vegetated salt marshes. In some coastal areas, which may be several kilometress wide and commonly form the largest part of the intertidal area. Mudflats are characterized by high biological productivity and abundance of organisms but low in species diversity with few rare species. The mudflat biota reflectsthe prevailing physical conditions of the region. Intertidal mudflats can be separated into three distinct zones such as the lower tidal, middle and upper mudflats. The lower mudflats lie between mean low water neap and mean low water spring tide levels, and are often subjected to strong tidal currents. The middle mudflats are located between mean low water neaps and mean high water springs. The upper mudflats lie between the mean high-water neap and mean high water springs. The upper mudflats are the least inundated part and are only submerged at high water by spring tides (Klein, 1985). Salt marsh vegetation may colonize as far seaward as mean high water neaps. Mudflats will often continue below the level of low water spring tides and form sub-tidal mudflats (McCann, 1980). The upper parts of mudflats are generally characterized by coarse clays, the middle parts by silts, and the lower region by sandy mud (Dyer *et al*., 2000). The intertidal mudflats are prominent sub-environments that occurred on the margin of the estuaries and low relief sheltered coastal environments. The fine-grained sediments of intertidal mudflats (70%-90%) are derived from terrestrial and marine regions (Lesuere *et.al*.,2003). Estuarine mudflats are potential sites for deposition of organic matter derived from terrigenous, marine, atmospheric and anthropogenic sources and are mainly associated with fine grained particles (Wang *et.al*., 2006).

Sampling locations

The Sediment samples were collected from 15 sampling locations by using sediment corer. From each site triplicate samples were collected from up to 100 cm depth with four intervals (0-25cm, 25-50cm, 50-75cm & 75-100cm) and made into composite sample for analysis. The samples were packed in zip lock bags, stored in icebox and shifted to the laboratory for subsequent analysis.

Plate 3: Sediment sample collection at mangrove and mudflat areas

Total Organic Carbon

The organic carbon content of the mudflats was estimated to assess the biological productivity of the sediment. Soil Organic Carbon (SOC) was estimated following the method of Walkley and Black (1934). In this method, organic matter (humus) in the soil gets oxidized by Chromic acid (Potassium dichromate plus concentrated H2SO4) by utilizing the heat evolved with the addition of H_2SO4. The unreacted dichromate is determined by back titration with Ferrous ammonium sulphate (redox titration). Organic carbon was determined by following the below given formula:

$$\text{Oxidizable organic carbon (\%)} = \frac{10\ (B\ -\ T)}{B} \times\ 0.003\ \times\ \frac{100}{\text{wt. of soil}}$$

Where B = volume (mL) of Ferrous ammonium sulfate required for blank titration.T = volume of Ferrous ammonium sulfate needed for soil sample. Wt. =weight of soil (g).

Estimation of Bulk Density (BD)

The soil under field condition exists as a three-phase system viz. solid (soil particles), liquid (water) and gas (mostly air). The soil organic matter contained in a unit volume of the soil sample is called its bulk density. The amount of bulk density depends on the texture, structure and organic matter status of the soil. High organic matter content lowers the bulk density, whereas compaction increases the bulk density. To determine the bulk density of the sediment samples collected during the present study, the oven-dry weight of a known sediment volume was considered, and mass per unit volume was calculated (Maiti, 2012).

2.5. Mangrove assessment

Mangroves are widely distributed on the Deendayal Port Authority jurisdiction along the Kandla coast. The 15 mangrove sites selected at the different creeks belong to Deendayal Port Authority jurisdiction and all these stations are supposed to be sufficient to represent the mangroves status in Kandla. The mangrove stations in this study were named Tuna, Jangi, Kandla, Phan and Navlakhi based on the nearest location to the respective creek system. The Point Centered Quadrate Method (PCQM) was used for the collection of data of mangrove vegetation structure. The data included measurements of density of plants, height variations, canopy and basal area of mangrove trees as per the method of Cintron and Novelli (1984). For this method, a transect of a maximum of 200 m was applied mostly perpendicular or occasionally parallel to the creek. The sampling points considered at an interval of every 10 m and the vegetation structure of the that area were recorded. As the orientation of the transect line was already fixed, it was easy for movements within the station area for data recording. The distance between trees from the center of the sampling point for nearest 4 trees of four different directions, height of trees from the ground level, canopy length and canopy width were measured to determine the canopy cover in this study. The equipments utilized in the field were handy, and easy to use such as ranging rods, pipes and for measurement of girth at root collar above the ground (GRC), a measuring tape was used. The plants with a height <50 cm was considered as regeneration class and >50 cm but <100 cm was considered as recruitment class. Along the transects, sub-plots of 1×1 m^2 for regeneration and 2×2 m^2 were laid randomly for recruitment class of the mangrove sites.

Plate 4: Assessment of mangrove density, height, canopy cover and girth

2.6. Halophytes

To quantify and document the halophytes at Deendayal Port Authority region, quadrate method was followed. At each sampling location quadrates of various sizes have been laid during every seasonal sampling. For recording the plant density at each transect, a quadrate 1 x 1m^2 has been laid within the site each tree quadrates were used randomly (Misra,1968; Bonham, 1989). Four quadrates each for shrubs and herbs were laid in side each tree quadrate to assess the halophytes and the percentage cover in the study area. To enrich the species inventory, areas falling outside the quadrates were also explored and the observed species were recorded and photographed and identified using standard keys. Specimens of the various species were collected to know more information on habitat and for the preparation of herbarium.

Plate 5: Assessment and percentage cover of halophytes

2.7. Marine Fishery

Fishery resources and the diversity were assessed from the selected sampling sites. Finfish and shellfish samples were collected using a gill net with a 10 mm mesh size. The net was operated onto the water from a canoe or by a person standing in waist deep water during the high tide using a cast net. For effective sampling, points were fixed at distances within the 15 offshore sites for deploying fishing nets to calculate the Catch per Unit effort estimated per hour. The collected specimens were segregated into groups, weighed and preserved in 10% neutralized formalin solution. Finfishes were identified following Fischer and Bianchi (1984), Masuda *et al*. (1984), de Bruin et al. (1995) and Mohsin and Ambiak (1996). Relevant secondary information pertaining to fishery resources of Deendayal Port creek systems were gathered through technical reports, the District Fisheries department, Government gazette and other research publications.

Plate 6: Collection of fisheries information from DPA environment

2.8. Avifauna

The Avifauna population was determined along DPA mangrove strands for which the area was demarcated into fifteen major stations. In each station, creeks of varying lengths from 2 to 5 km are available. These creeks were surveyed by using boat and adopting "line transect" method. A total of fifteen boat transect (one in each site) survey was conducted in the Monsoon season (June-September, 2022). Survey was done in both terrestrial habitats like Mangrove plantations adjoining the mudflats, waste land, and aquatic habitats, like creek area, rivers and wetland.

Boat Surveys

Mangrove bird diversity was calculated by using Boat Survey method. Birds were observed from an observation post on board the boat which has given the greatest angle of clear view. Birds within a 100 meter transect on one side of the boat were counted in 10-minute blocks of time (Briggs *et al.* 1985; van Franeker, 1994). Detection of birds was done with a binocular (10 x 40) and counts were made: (1) continuously of all stationary birds (swimming, sitting on mangrove, or actively feeding) within the transect limits and (2) in a snap-shot fashion for all flying birds within the transect limits. The speed of the boat determines the forward limit of the snapshot area within a range of 100 meters. Longer or shorter forward distances were avoided by adapting the frequency of the snapshot counts. Birds that following and circling the boat were omitted from both snapshot and continuous counts. If birds arrive and then follow the boat, they were included in the count only if their first sighting falls within a normal snapshot or continuous count of the transect area. For each bird observation species, number of individuals and activity at the time of sighting, were recorded. Species richness and diversity index were calculated for different mangrove patches (i.e. fifteen station) of the study station in the Deendayal port Authority.

2.9. Data analysis

Data collected in- situ and through laboratory analysis of samples were subjected to descriptive statistical analysis (PAST and Primer 7.0) for the mean, range and distribution of different variables from the selected 15 study stations.

3. Results

Water quality assessment

The data on the mean water quality parameters measured at the time of sampling of the biological components from the 15 study sites are presented in Table1.

Temperature (°C) and pH

The water temperature at the sampling sites ranged from 23°C to 31°C.The maximum temperature of seawater was reported at S-5 and the minimum at S-6 in Kandla creek. The pH of seawater ranged from 7.1 to 8.3. The highest pH was reported at sites S-15 and S-10, however, the lowest pH 7.1 was noticed at S-14 in Kandla creek. The overall observation along the port environment revealed that the temperature fluctuation might be due to high degree of warmth in summer on the land but the pH range did not show major fluctuations among the sampling locations.

Salinity (ppt)

Salinity of the water strongly influences the abundance and distribution of marine biota in coastal and marine environments. The salinity ranged from 28 ppt to 40 ppt with the average value of 37 ppt. Minimum salinity was observed S-7 and maximum at S-9, S-13 & S-15. The poor rainfall induced aridity in the Gulf of Kachchh (GoK) region renders Gulf waters hypersaline round the year. In addition, GoK is known to be a negative water body where evaporation exceeds precipitation.

Dissolved oxygen (DO)

Dissolved oxygen is the amount of oxygen dissolved in water and is a fundamental requirement of all biota and chemical processes in the aquatic environment. The concentration varies mainly due to photosynthesis and respiration by plants and animals in water. Generally, the coastal waters are having high level of dissolved oxygen due to the dissolution from the atmosphere through diffusion process on the surface layer (CCME,1999). The dissolved oxygen in the coastal waters of Deendayal port authority area ranged from 4.5 mg/L to 6.9 mg. The highest DO concentration was observed at station S-7 and lowest was observed at stati-15.

Suspended Solids (TSS)

The total suspended solids (TSS) concentration at the 15 sampling sites ranged from 127 mg/L to 403 mg/L with the average of 255 mg/L. The highest TSS values was reported at S-15 in the Phang creek followed by 354 mg/L in S-3 oil jetty. The minimum TSS value was recorded at S-7 which was 127 mg/L.

Total Dissolved solids (TDS)

The total dissolved solids (TDS) in the water consist of inorganic salts and dissolved materials which mostly comprises of anions and cations. The TDS of the samples varied from 1967 mg/L 11,288 mg/L with an average of 5,703 mg/L. The maximum value was reported at S-6.

Turbidity

The turbidity of the water samples from the study sites ranged between 44 NTU and 147 NTU with the average of 76 NTU. The lowest value was reported at S-3 and a highest value at S-6 followed by S-6 (170 NTU).

Water nutrients (Nitrate, Nitrite and Total Phosphorus)

The nutrients influence growth, metabolic activities and reproduction of biotic components in the aquatic environment. The distribution of nutrients mainly depends upon tidal conditions, season and fresh water influx from land. The nitrate concentration ranged from 0.01 mg/L to 0.02 mg/L with an average of 0.01 mg/L. The highest nitrate concentration was observed at station S-7 and the lowest at station S-11. There was no remarkable variation in concentration of nitrate among the study station. Similarly, nitrite values varied between 0.05 mg/L to 0.94 mg/L. The highest concentration was observed at station S-13 and lowest concentration was observed at station S-2.The highest concentration might be due to influx effluents from industries producing metals, dyes and celluloid in the periphery of port authority The Total phosphorus values among the study station ranged from 0.02 mg/L to 0.96 mg/L with in average of 0.47 mg/L. The highest phosphorus concentration was observed at station S-13 near veera of Kandla creek and lowest concentration was observed at station S-11 in Jhangi creek. Highest concentration might be due to leaching of phosphatic fertilizer while handling of cargo port area**.**

Petroleum Hydrocarbons (PHs)

Due to urbanization and modernization, petrochemical products are in heavy demand. Petroleum hydrocarbons (PHs) represent short-chain hydrocarbons like aromatic, paraffin, alicyclic complexes, and non-hydrocarbon mixtures such as thiol, and asphaltene, naphthenic acid, phenol, thiol, heterocyclic nitrogen, sulfuric amalgams and metalloporphyrin. Due to the hydrophobic nature of the PHs, they possess low solubility in water and a high persistence level in soil, water as well as sediments (Babu *et al.*, 2019). PHs are significant toxic compounds representing one of the major wide-scale environmental threats caused due to the coastal oil refining, production, leaks or accidental spilling, transport, shipping activities, offshore oil production and other anthropogenic activities. The release of such compounds into the environment irrespective of it being accidental or due to any anthropogenic activities leads to soil as well as water pollution. This in turn poses catastrophic health effects either directly or indirectly on all the forms of life thereby deteriorating the overall ecosystem. In the current study, the presence of PHs in water samples collected along all the 15 sampling sites were detected and estimated. The PHs ranged from 2.2 µg/L to 9.9 µg/L. The PHs detected from the individual sites have been represented in (Fig 2). The highest concentration of the PHs was detected at S-1 site (Tuna creek) while the lowest was noted for S-13 (Veera). A high level of the PHs content was noted down at site S-1 too followed by the rest of the sites.

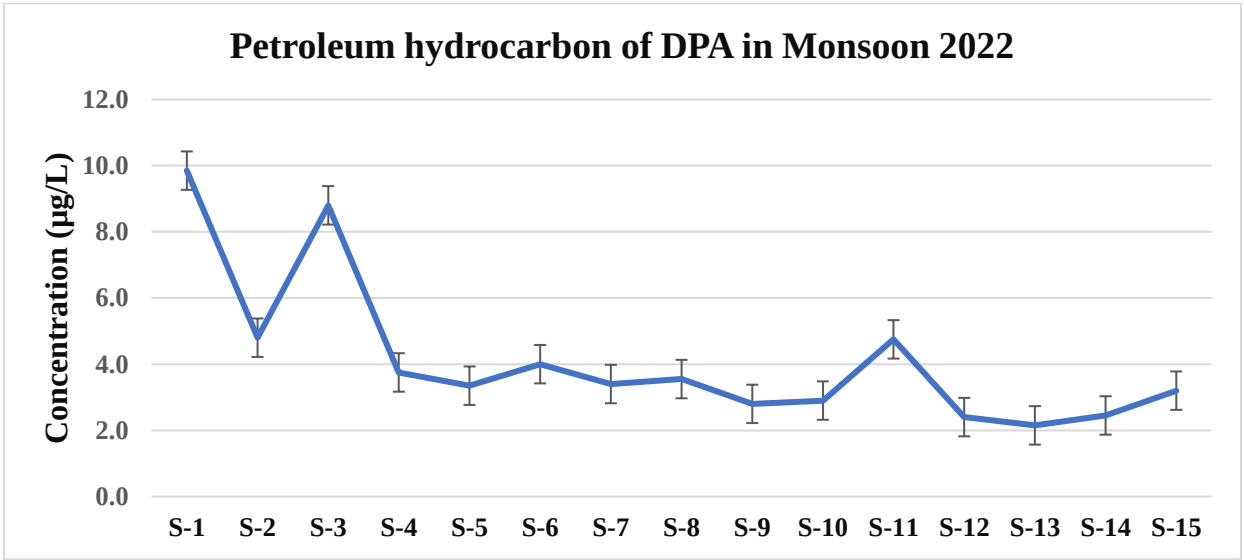

Figure 2: Petroleum hydrocarbons in water (µg/L) during Monsoon 2022

Table 2: Physico-chemical characteristics of coastal waters during Monsoon 2022

Parameters	**S-1**	**S-2**	**S-3**	**S-4**	**S-5**	**S-6**	**S-7**	**S-8**	**S-9**	**S-10**	**S-11**	**S-12**	**S-13**	**S-14**	**S-15**
Temp (°C) (Air)	27	28	31	33	36	26	31	29	30	32	26	34	29	29	34
Temp (°C) (Water)	25	25	29	30	31	23	29	26	27	30	23	30	27	26	29
pH	8	8.09	7.9	7.5	7.8	7.8	7.7	7.6	8.2	7.9	7.9	8.06	8.2	7.1	8.3
Salinity (ppt)	34.7	36.7	39.2	38.7	36.5	36.2	28.3	35.8	39.9	38.8	36.4	39	40.2	38.2	40.1
Dissolved oxygen (mg/L)	4.86	4.66	6.69	5.27	5.87	4.66	6.89	6.28	5.06	5.87	4.66	6.48	5.27	5.47	4.45
Total Suspended Solids (TSS) (mg/L)	200	236	354	132	347	234	127	172	342	232	334	190	272	252	403
Total Dissolved solids (TDS) (mg/L)	3970	4676	2985	3851	7885	1967	5988	4320	7549	11288	8983	3886	5676	4792	7733
Turbidity (NTU)	48	58	147	95	93	44	45	93	119	108	57	58	58	52	63
Nitrate (NO_3) (mg/L)	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.02	0.01	0.01	0.01	0.07	0.02	0.01
Nitrite (NO_2) (mg/L)	0.39	0.05	0.36	0.39	0.41	0.74	0.38	0.53	0.58	0.27	0.73	0.39	0.94	0.63	0.55
Total Phosphorus (mg/L)	0.35	0.64	0.46	0.41	0.39	0.90	0.76	0.30	0.04	0.06	0.02	0.35	0.96	0.85	0.63
PHs (µg/L)	9.85	4.8	8.8	3.75	3.35	4	3.4	3.55	2.8	2.9	4.75	2.4	2.15	2.45	3.2
Chlorophyll a (mg/L)	0.19	0.20	0.21	0.18	0.13	0.15	0.19	0.15	0.16	0.14	0.19	0.21	0.15	0.16	0.22

3.2. Sediment

Sediment texture

The percentage composition of the soil particles in the sediment analyzed from the 15 sampling sites are presented in Fig.3.There were noticeable variations in the soil fractions, sand, silt and clay, among the stations. In the present study the highest percentage of clay was reported at S-7 followed by S-9. The highest percentage of sand was observed at S-1 followed by S-14 station. As per the observations, the percentage of silt content was less compared to clay and sand in many sampling sites except S-1 and S-14. The nature of soil texture was characterized by the proportion of clay, sand and silt fractions. The Soil texture revealed the dominance of silty-clay type in all the stations with less variations among them. This consistently high clay-loam value may be attributed to the winnowing activity of sediment transport system. The absence of perennial flow of freshwater into the coast along with lack of wave induced sand transport from open sea are the possible reasons for this uniform pattern of soil texture.

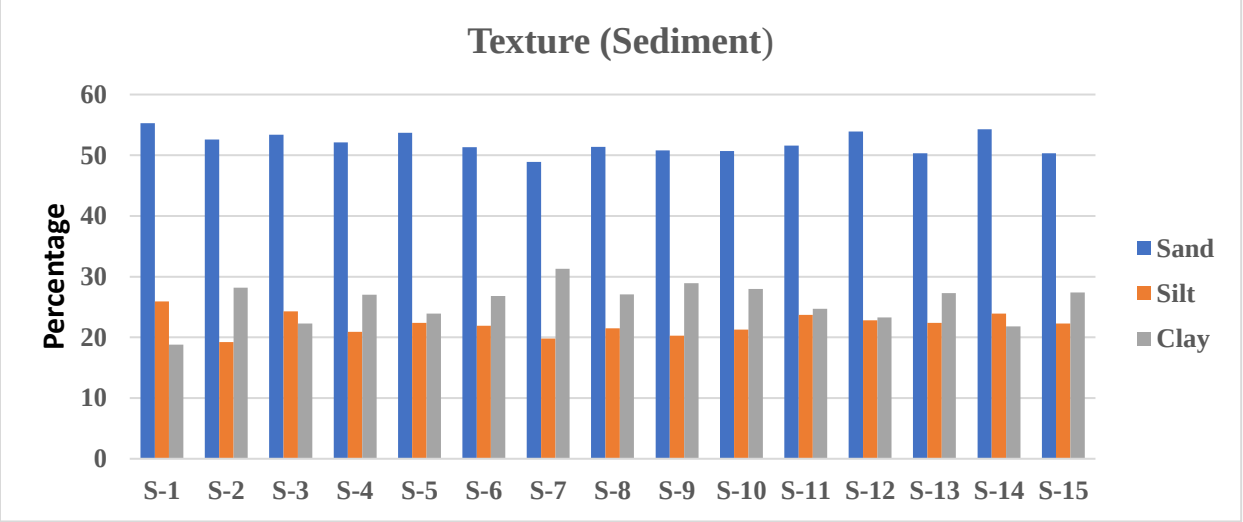

Figure 3: Characteristics of sediment at the study stations in Monsoon 2022

Total Organic Carbon (TOC)

In the present study, the total organic carbon content varied from 0.63% to 0.84% (Fig.4). The highest values of TOC were reported at S-11 followed by S-15. The lowest TOC value was recorded at the S-7. The distribution of total organic carbon closely followed the distribution of sediment type i.e., sediment low in clay content contained relatively low organic carbon.

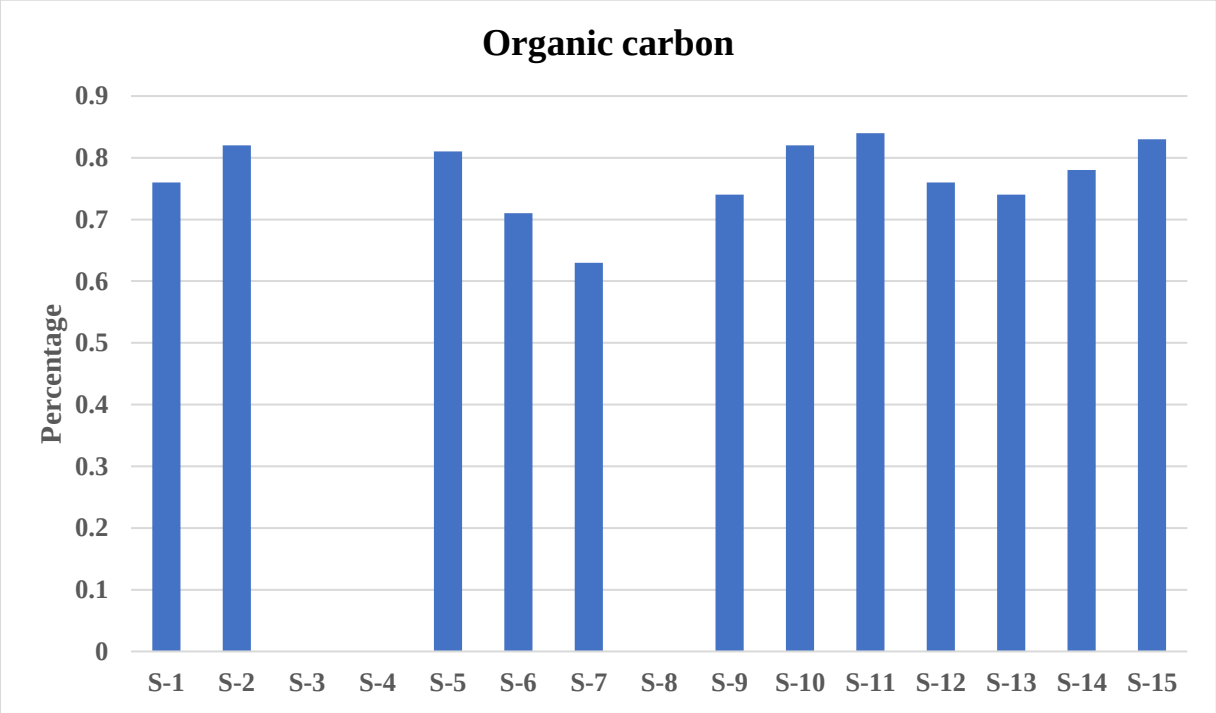

Figure 4: Total Organic Carbon content (%) in the sediment during Monsoon 2022

3.3. Biological characteristics of water and sediment

Primary productivity

Chlorophyll 'a' the photosynthetic pigment which can be used as a proxy for phytoplankton productivity and thus is an essential water quality parameter. Generally, the primary production of the water column is assessed from Chlorophyll 'a' concentration. It is well known that half of the global primary production being mediated by the activity of microscopic phytoplankton.

In the present study, Chlorophyll 'a' concentration ranged from 0.13 mg/L to 0.22 mg/L. The highest concentration 0.22 mg/L was reported at S-15 (Fig.5) followed by S-12 (0.21) and S 3 (0.20mg/L). The photosynthetic pigment chlorophyll a which is a measure of the population density of phytoplankton during the monsoon period showed narrow range of variations among the sites. The Chlorophyll 'a' content was very low at S-5.

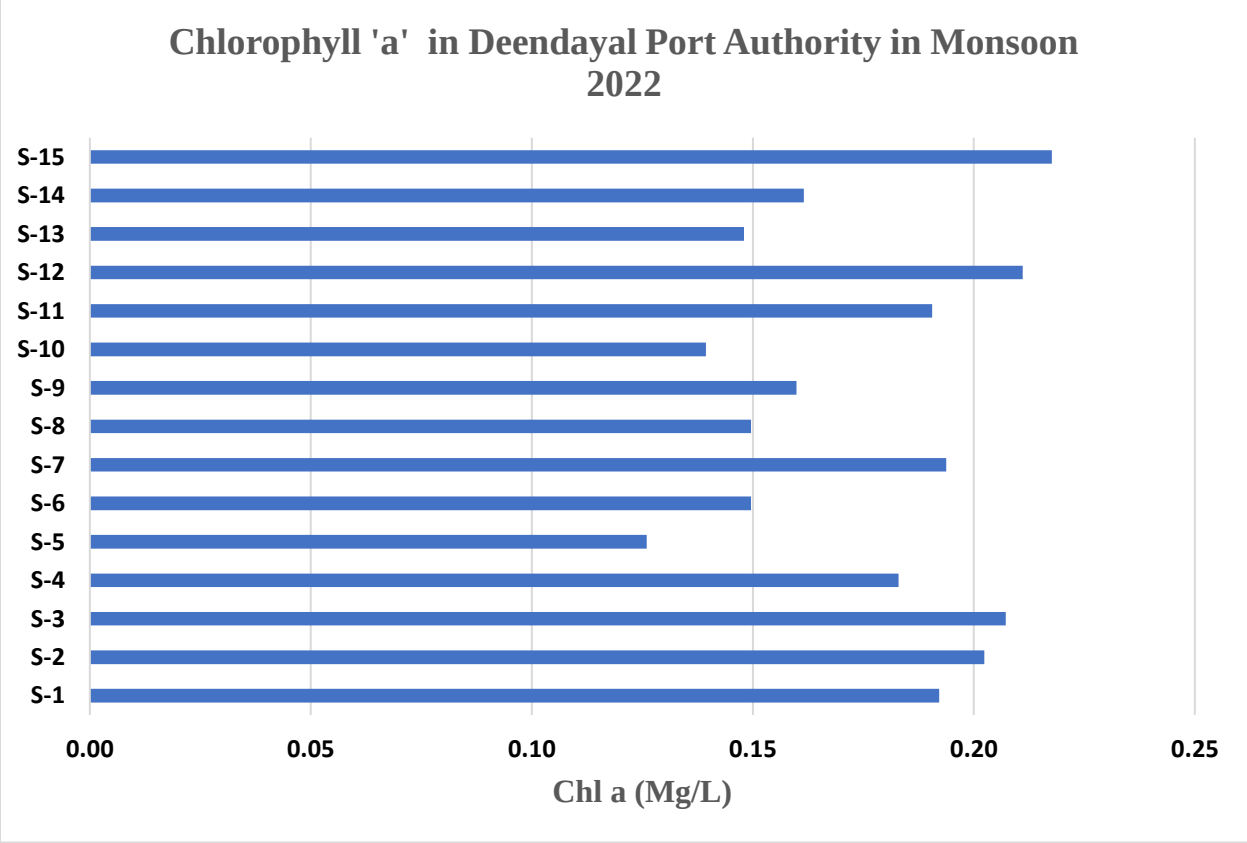

Figure 5: Chlorophyll 'a' concentration at the study stations in Monsoon 2022

3.4. Phytoplankton

Phytoplankton are free-floating, photosynthetic, aquatic microorganisms, which are distributed either actively by their locomotory organs (flagella) or passively by water currents. Most of the phytoplankton survive on the open surface waters of lakes, rivers and oceans. The phytoplankton community is mainly represented by algal representatives including both prokaryotes and eukaryotic genera. Plankton populations are mostly represented by members of Cyanobacteria, Chlorophyta, Dinophyta, Euglenophyta, Haptophyta, Chrysophyta, Cryptophyta, and Bacillariophyta. Planktonic representative taxa are absent in other algal divisions like Phaeophyta and Rhodophyta.

Generic Status

There were four groups of phytoplankton occurred during monsoon along the DPA, Kandla coast and its peripheral creek system which include Diatom (Pennales, Centrales), Dinophyceae and Cyanophyceae. The number of genera recorded during the monsoon period was 24 to 33 at the sampling stations with remarkable variations with respect to the composition. The maximum number (33) genera were observed at S-11 and the minimum from S-15 representing 24 genera. As far as generic status is concerned the centrales diatom contributed a greater number of genera (16) followed by Pennales (10) (Fig.6 & Table 3). Among the 4 groups of phytoplankton, the genera *Pseudonitzschia, Rhizosolenia, Coscinodiscus, Eucampia, Melosira* and *Planktoniella* occurred at all the sites.

Percentage composition of phytoplankton

The cumulative percentage composition of the five groups of phytoplankton from all the study sites is presented in Fig.7. The percentage composition varied from 5 % to 47 % of which the centrales and pennales are the dominant constituting 47% and 27% respectively. The diatoms pennales and centrales together formed 74% of the phytoplankton population by number of genera as well as number of individuals while the rest is constituted by Dinophyceae (10%) and Cyanophyceae (12%) and Chlorophyceae (4%) during the monsoon 2022.

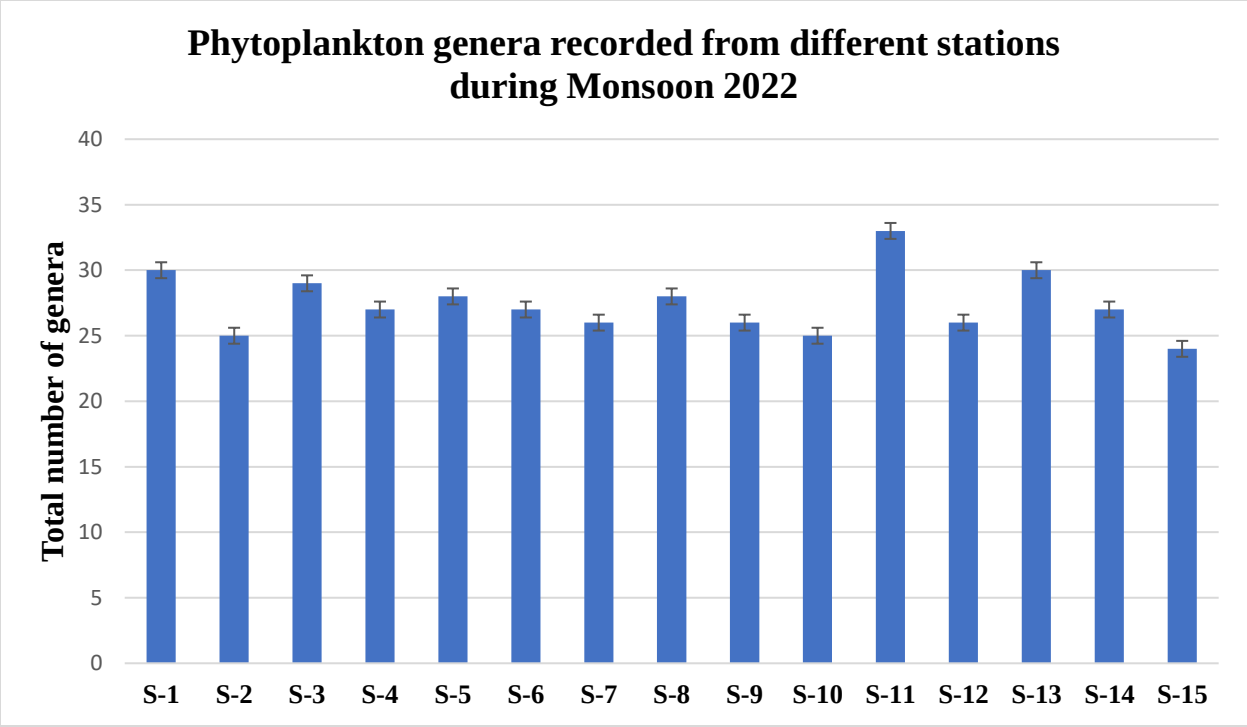

Figure 6: Number of Phytoplankton genera in Monsoon 2022

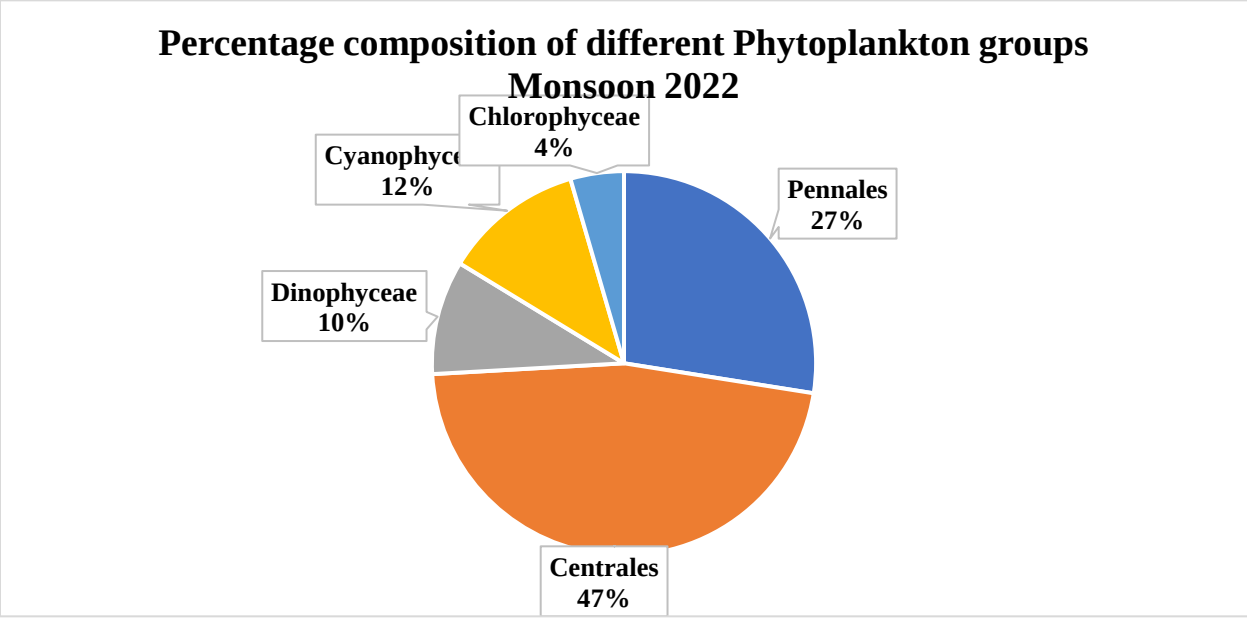

Figure 7: Percentage composition of phytoplankton groups in Monsoon 2022

Percentage of occurrence

The percentage occurrence denotes the number of representations by a genus among the sites sampled. The percentage occurrence of different phytoplankton genera varied from 27% to 100% with an average of 78%. Seven phytoplankton genera have the highest percentage of occurrence (100%) (fig 8) followed by *Pleurosigma*, *Gyrosigma*, *Thalassionema* and *Aphanizomenon* (93%) occurrence during the monsoon season

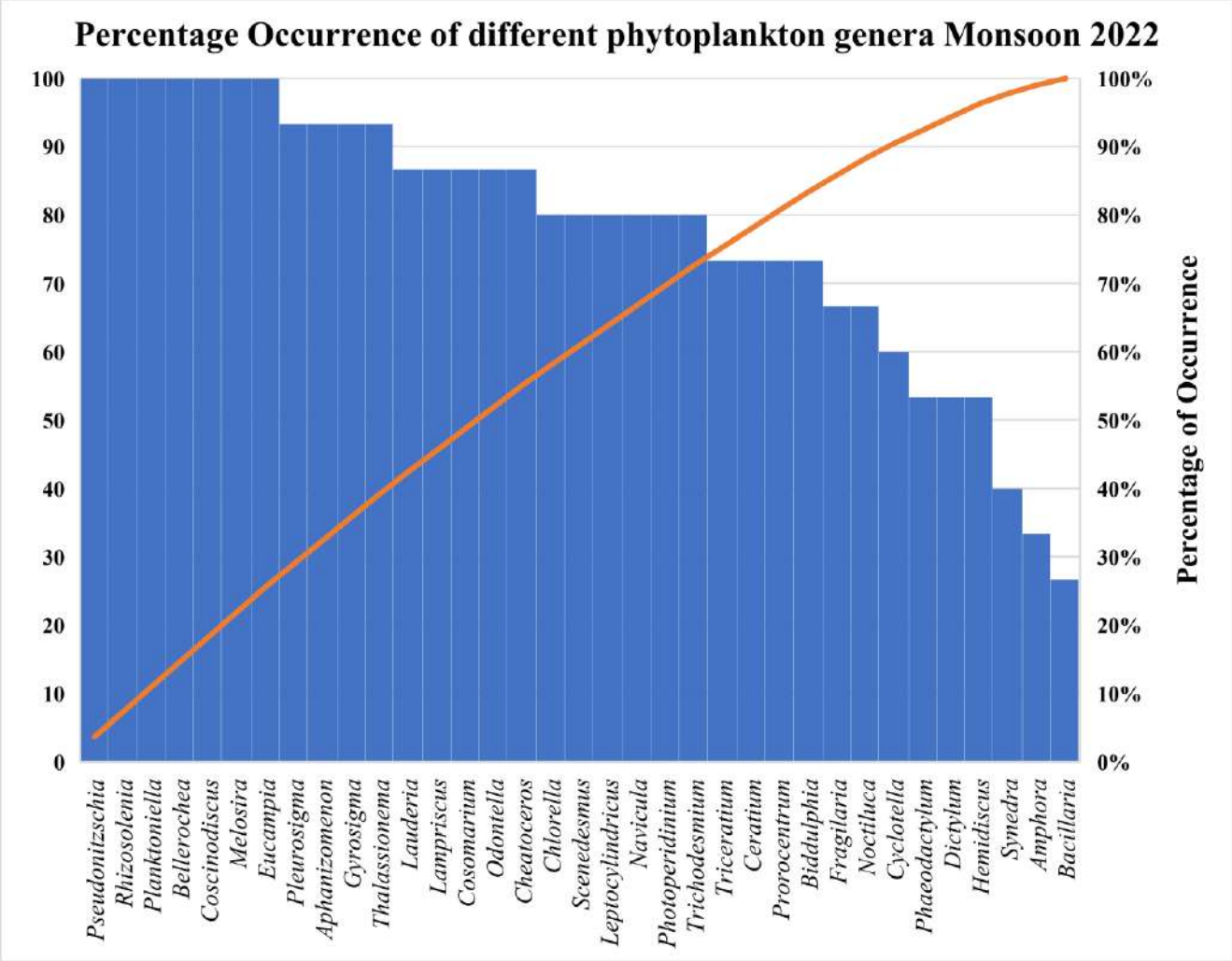

Figure 8: Percentage occurrence of phytoplankton genera in Monsoon 2022

Phytoplankton density and diversity

The density signifies the abundance of plankton which is measured as cell/ individual/L. The phytoplankton density varied from 1,760 No/L to 16,960 No/L with the average 13,483 No/L. The highest phytoplankton density was observed at station S-4 (16,960 No/L) followed by S-12 (16,480 No/L), whereas the lowest 1,760 No/L at S-1(fig.9). Diversity indices have become part of standard methodology in the ecological studies particularly, impact analysis and biodiversity monitoring of the environments (PEET,1974). Biodiversity indices reflects the biological variability which can be used for comparison with space and time. Various species diversity indices respond differently to different environmental and behavioral factors of biotic communities. Among the different stations, the phytoplankton taxa varied from 24 to 33 (Table-4). During monsoon the Margalef and Menhinik richness indices were maximum at stations S-11 (4.28& 0.79). The Shannon diversity index was maximum 3.31 (S-11) and minimum 2.93 at S-15. The Simpson index clearly reflexes the species dominance (genera) at S-11 (0.96) and the low value (0.94) was noticed at S-12.

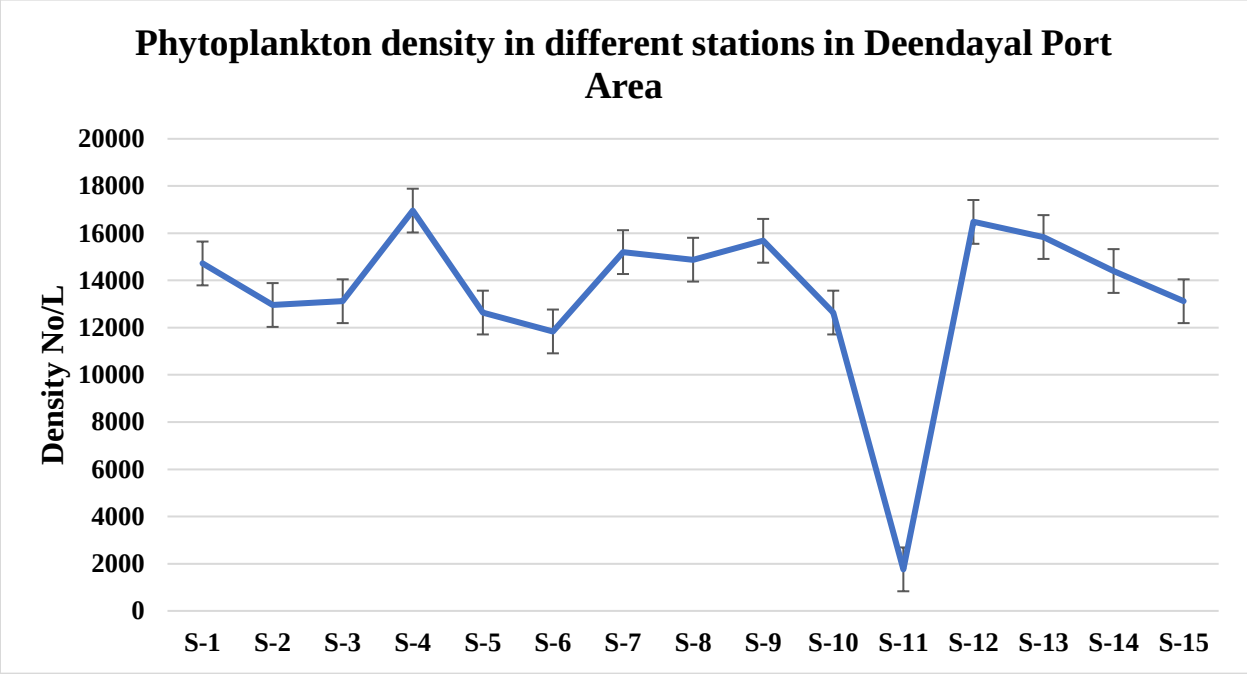

Figure 9: Phytoplankton density in Monsoon 2022

As per Shannon Wiener's rules for the aquatic environment i.e., both soil and water are classified as very good when H' value is greater than four (>4), whereas the good quality represents the H' value with a range of 4-3, similarly moderate-quality (H' value 3-2), poor quality (H' value 2-1) and very poor-quality H' value significantly less than one (<1). Presently Deendayal Port Authority and its periphery environment has been influenced by contaminants deposited from industries and the cargo movements. Accordingly, species diversity decreases at sites with poor water quality. As deduced from the Shannon diversity index values between 2.93 to 3.31 representing the moderate quality of environmental status dominated by the few genera such as *Pleurosigma, Gyrosigma, Thalassionema* and *Aphanizomenon*. A community dominated by relatively few species indicates environmental stress (Plafkin *et al.*, 1989). According to Staub *et. al* (1970) species diversity index value between 3.0 to 4.5 represents slightly polluted and the lightly polluted environment, the index value characterizes 2.0-3.0, similarly, moderately polluted environment shows index value of 1.0-2.0 and finally, the heavily polluted environment index value is 0.0-1.0. While considering the overall index values it is inferred that the study sites can be included under the category of lightly polluted.

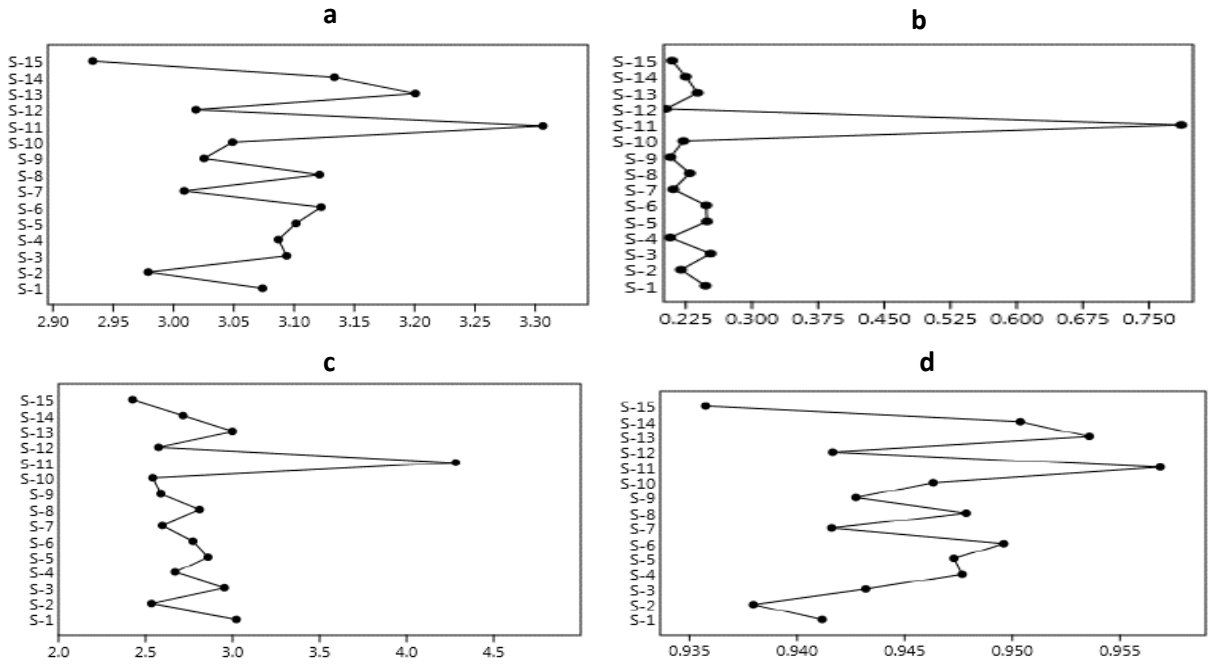

Figure 10: Different diversity indices a. Shannon Index b. Menhinick Index c. Margalef Index d. Simpson Index

Table 3: Phytoplankton density, percentage composition and occurrence during Monsoon 2022

Group	Genera	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10	S-11	S-12	S-13	S-14	S-15	PO	PC
Pennales	*Amphora*	0	0	0	0	160	0	160	0	0	0	20	0	160	0	160	33	0.3
	Bacillaria	0	0	160	0	160	0	0	0	0	0	20	0	160	0	0	27	0.2
	Dtylum	160	0	0	960	480	0	0	640	0	320	100	640	480	0	0	53	1.9
	Pseudonitzschia	1760	320	480	640	960	640	1280	800	320	480	100	1600	960	640	1280	100	6.1
	Pleurosigma	160	320	640	1120	320	960	640	320	0	320	20	480	320	960	640	93	3.6
	Rhizosolenia	160	160	320	480	160	800	960	320	1120	160	40	640	160	800	960	100	3.6
	Synedra	320	0	320	160	0	0	0	160	0	0	20	320	0	0	0	40	0.6
	Fragilaria	480	320	480	0	0	160	0	1600	800	320	80	160	0	160	0	67	2.3
	Gyrosigma	160	320	160	640	800	320	480	1120	320	0	20	480	800	320	480	93	3.2
	Thalassionema	320	480	960	1600	1280	1120	800	480	800	640	60	0	1280	1120	800	93	5.8
Centrales	*Bellerochea*	800	480	1120	960	800	640	1760	960	1280	640	40	160	800	640	1760	100	6.3
	Biddulphia	160	0	320	160	160	480	0	160	0	640	40	320	160	480	0	73	1.5
	Cheatoceros	160	0	0	160	160	320	160	480	320	640	40	160	160	320	160	87	1.6
	Coscinodiscus	1440	640	320	480	640	800	160	320	1120	960	60	640	640	800	160	100	4.5
	Cyclotella	320	160	160	0	160	0	640	0	320	0	60	0	160	0	640	60	1.3
	Eucampia	800	960	320	1120	160	320	640	640	160	160	40	480	160	320	640	100	3.4
	Hemidiscus	0	0	160	0	0	160	320	0	320	0	40	160	0	160	320	53	0.8
	Lauderia	160	0	1600	800	320	640	160	320	480	320	60	0	320	640	160	87	3.0
	Leptocylindricus	320	480	1120	320	0	160	480	0	160	320	20	640	0	160	480	80	2.3
	Lampriscus	1120	800	480	800	640	480	0	160	320	480	120	1600	640	480	0	87	4.0
	Melosira	640	1760	960	1280	640	320	160	480	800	480	140	960	640	320	160	100	4.8
	Navicula	480	0	160	0	640	320	320	320	160	0	40	160	640	320	320	80	1.9
	Odontella	320	160	480	320	640	320	160	320	160	0	0	160	640	320	160	87	2.1
	Planktoniella	800	160	320	1120	960	480	640	800	1440	640	40	480	960	480	640	100	4.9
	Phaeodactylum	0	640	0	320	0	480	0	160	320	160	20	0	0	480	0	53	1.3
	Triceratium	160	160	160	1120	480	0	0	160	800	960	40	1120	480	0	0	73	2.8

Dinophyceae	*Ceratium*	160	0	160	160	160	160	1120	480	0	0	20	800	960	320	1120	73	2.8
	Prorocentrum	160	800	480	160	480	480	480	0	0	160	40	0	320	0	320	73	1.9
	Photoperidinium	640	1280	0	640	0	0	960	320	480	160	100	960	320	1120	160	80	3.5
	Noctiluca	160	800	160	480	160	160	160	320	160	0	0	0	160	0	0	67	1.3
Cyanophyceae	*Aphanizomenon*	160	160	160	160	160	160	320	160	640	800	40	480	1120	320	0	93	2.4
	Cosomarium	0	640	640	480	640	640	0	960	1600	1280	140	800	480	800	640	87	4.8
	Trichodesmium	160	160	0	320	0	0	1120	1120	960	800	80	1760	960	1280	640	80	4.6
Chlorophyceae	*Chlorella*	800	320	160	0	160	160	960	0	0	160	40	320	640	160	320	80	2.1
	Scenedesmus	1280	480	160	0	160	160	160	800	320	640	20	0	160	480	0	80	2.4
Total genera		**30**	**25**	**29**	**27**	**28**	**27**	**26**	**28**	**26**	**25**	**33**	**26**	**30**	**27**	**24**		
Density No/L		**14720**	**12960**	**13120**	**16960**	**12640**	**11840**	**15200**	**14880**	**15680**	**12640**	**1760**	**16480**	**15840**	**14400**	**13120**		

Table 4: Diversity indices of Phytoplankton during Monsoon 2022

Diversity Indices	**S-1**	**S-2**	**S-3**	**S-4**	**S-5**	**S-6**	**S-7**	**S-8**	**S-9**	**S-10**	**S-11**	**S-12**	**S-13**	**S-14**	**S-15**
Shannon_H	3.07	2.98	3.09	3.09	3.10	3.12	3.01	3.12	3.03	3.05	3.31	3.02	3.20	3.13	2.93
Simpson_1-D	0.94	0.94	0.94	0.95	0.95	0.95	0.94	0.95	0.94	0.95	0.96	0.94	0.95	0.95	0.94
Margalef	3.02	2.53	2.95	2.67	2.86	2.77	2.60	2.81	2.59	2.54	4.28	2.58	3.00	2.72	2.43
Menhinick	0.25	0.22	0.25	0.21	0.25	0.25	0.21	0.23	0.21	0.22	0.79	0.20	0.24	0.23	0.21
Dominance_D	0.06	0.06	0.06	0.05	0.05	0.05	0.06	0.05	0.06	0.05	0.04	0.06	0.05	0.05	0.06

3.5. Zooplankton

Zooplankton are highly sensitive to changes caused by physical and chemical factors in aquatic ecosystems and their distribution deliver information regarding the productivity and pollution of the particular area (Gajbhiye and Desai, 1981). Zooplankton are distributed in a wide range of habitats extending from the neuston to benthos and play vital roles influencing fisheries, oceanography and climate (Terdalkar and Pai, 2001). It has various significant roles in the estuarine ecosystem and connecting link between nutrient cycling and phytoplankton, primary production and many commercial fisheries in estuaries and coastal waters and form a chief food for a variety of pelagic consumers including coelenterates, ctenophores, fish larva forage fish and some benthic organisms such as sponges and molluscs (Day *et al*., 1989).

Phylum, group and generic status

The zooplankton identified from the 15 stations falls under 10 phyla and 41 genera belonging to the 16 groups (Table 5). The phylum Arthropoda was the predominant, represented with 25 genera including copepods, crabs, shrimps and their larva. The phylum Arthropoda dominated in the samples with major groups Calanoida, Harpacticoida, Cyclopoida, (Copepoda) Decapoda, and the larval forms of crustaceans. There were 14 genera of copepods in the samples. Among copepods, the Calanoida ranked first in terms of generic representation particularly *Acartia* sp, *Acrocalanus* sp, *Aetideus* sp. and *Calanus* sp. (figure-11).

Percentage composition

The overall percentage of the various groups of zooplankton varied from 0.3% to 36.9%. The highest percentage was due to the calanoid copepods (36.9%) followed by Decapoda (13.2%) and Gastropoda (8.2%). The group which contributed the least was *Chaetognatha* (0.3%) followed by Nematoda (0.4%) (Fig.12). Among the zooplankton groups calanoid group wase observed predominantly at all sites.

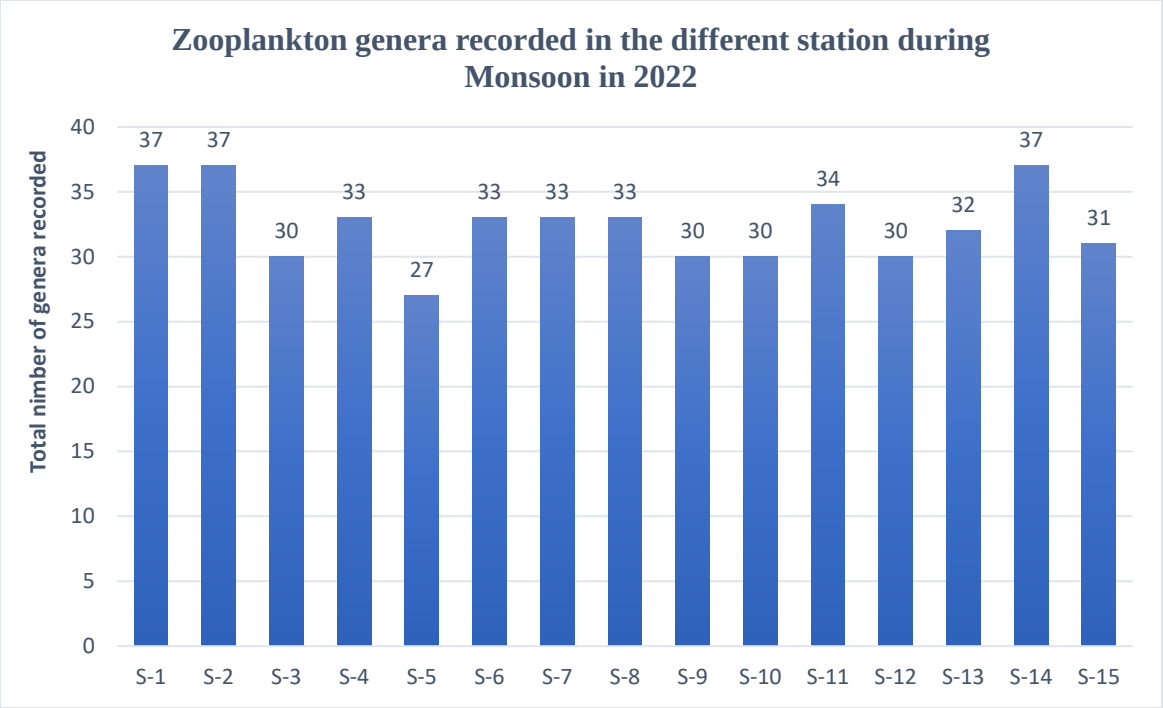

Figure 11: Phylum and generic status of zooplankton during Monsoon 2022

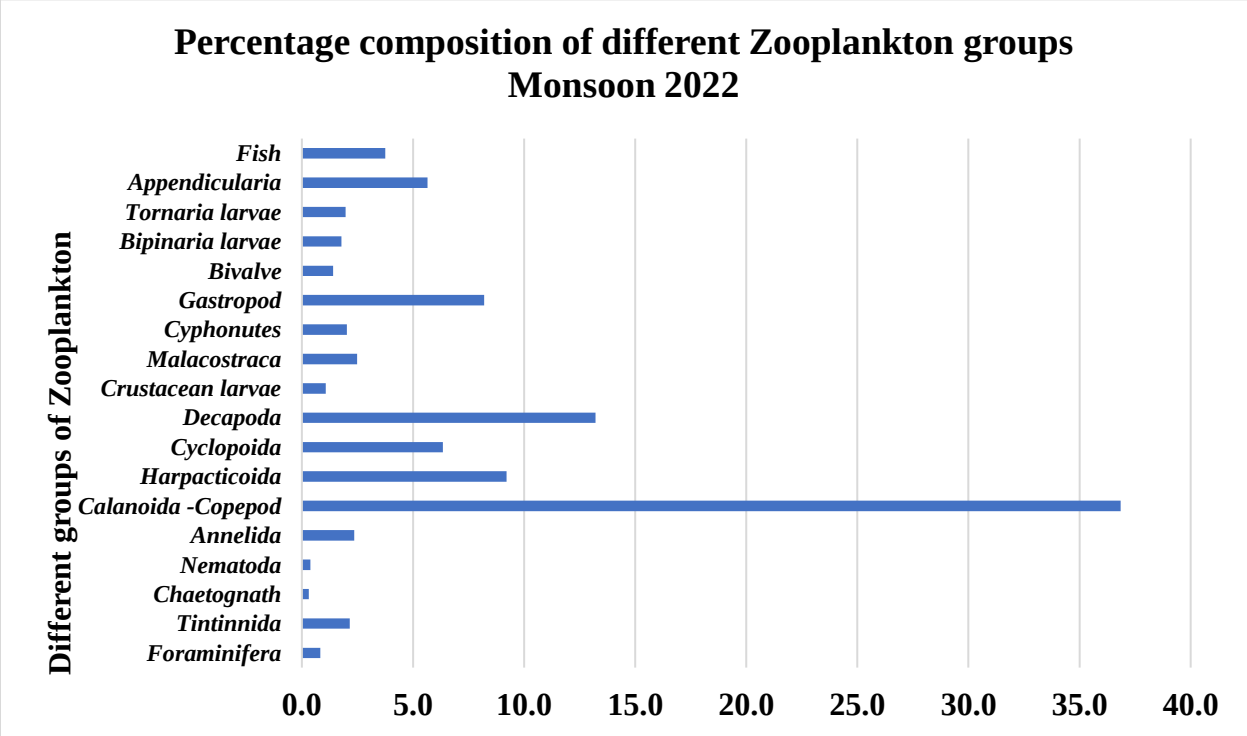

Figure 12: Percentage composition of zooplankton groups during Monsoon 2022

Percentage occurrence of zooplankton

The percentage occurrence of zooplankton communities varied from 33% to 100 %. There were 9 zooplankton genera that exhibited 100% of occurrence (Fig.12) followed by the copepods *Microsetella, Aerocalanus,Copelata, Eucalanus* and the Cyphonautes larva (93%) from the study sites (Table5).

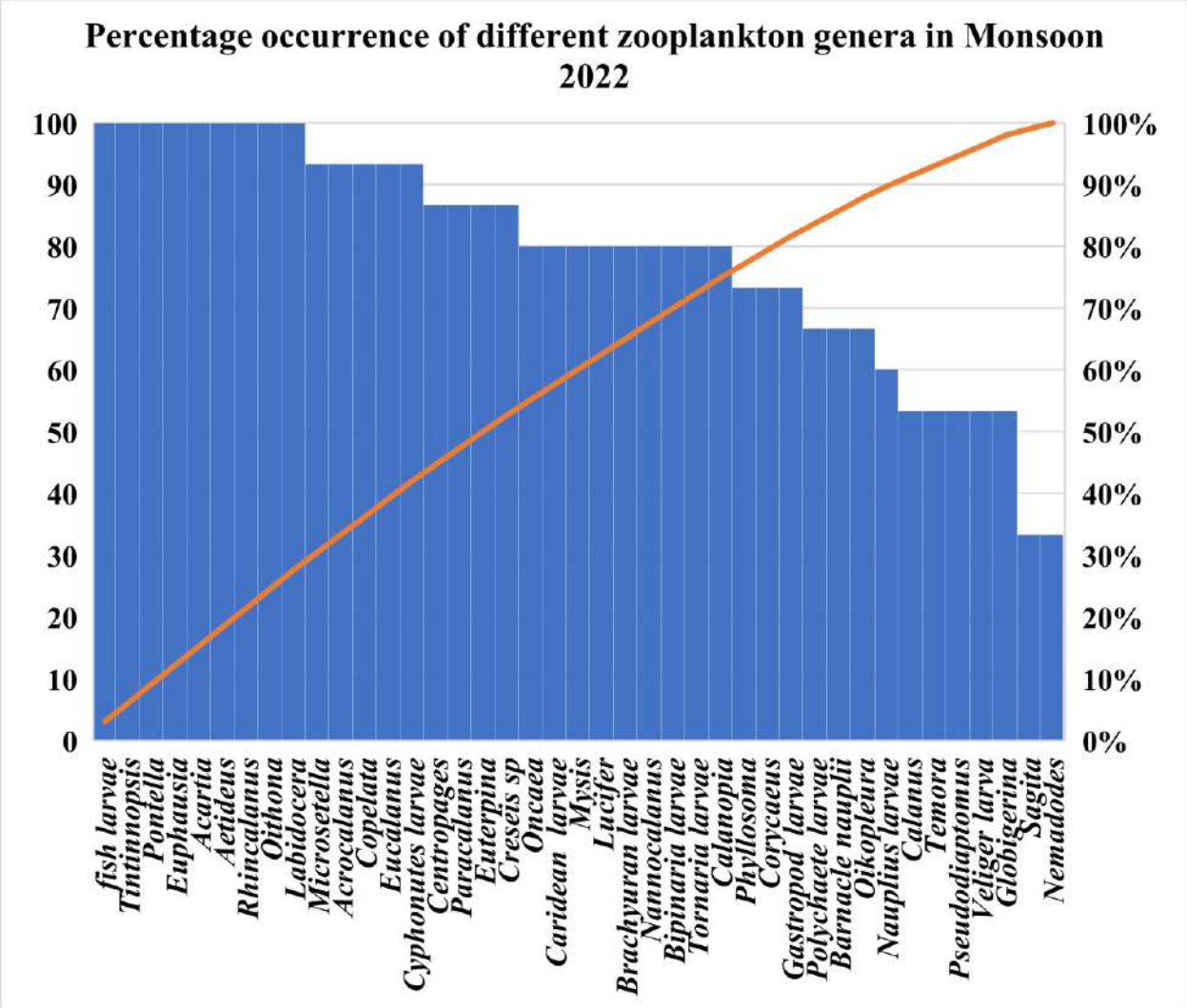

Figure 13: Percentage occurrence of Zooplankton groups during Monsoon 2022

Density of zooplankton

Zooplankton population density values during the Monsoon 2022 at the 15 sampling sites ranged from 12,640 No/L to21,120 No/L with an overall average of 16,789 No/ L (Table 5). Station-wise, the highest density of 21,120 No/ L was recorded in S-7 followed by S-2 (18,880 No/ L) and lowest density was reported at S-5 (12,640 No/ L) (Figure 14).

Diversity Index

The Shannon diversity index of the zooplankton ranged between 3.05 to 3.41. Similarly, Margalef and Menhinick species richness index also varied from 2.75 to 3.70, and 0.22 to 0.29 respectively representing the moderate quality of the environment. (Table 6).

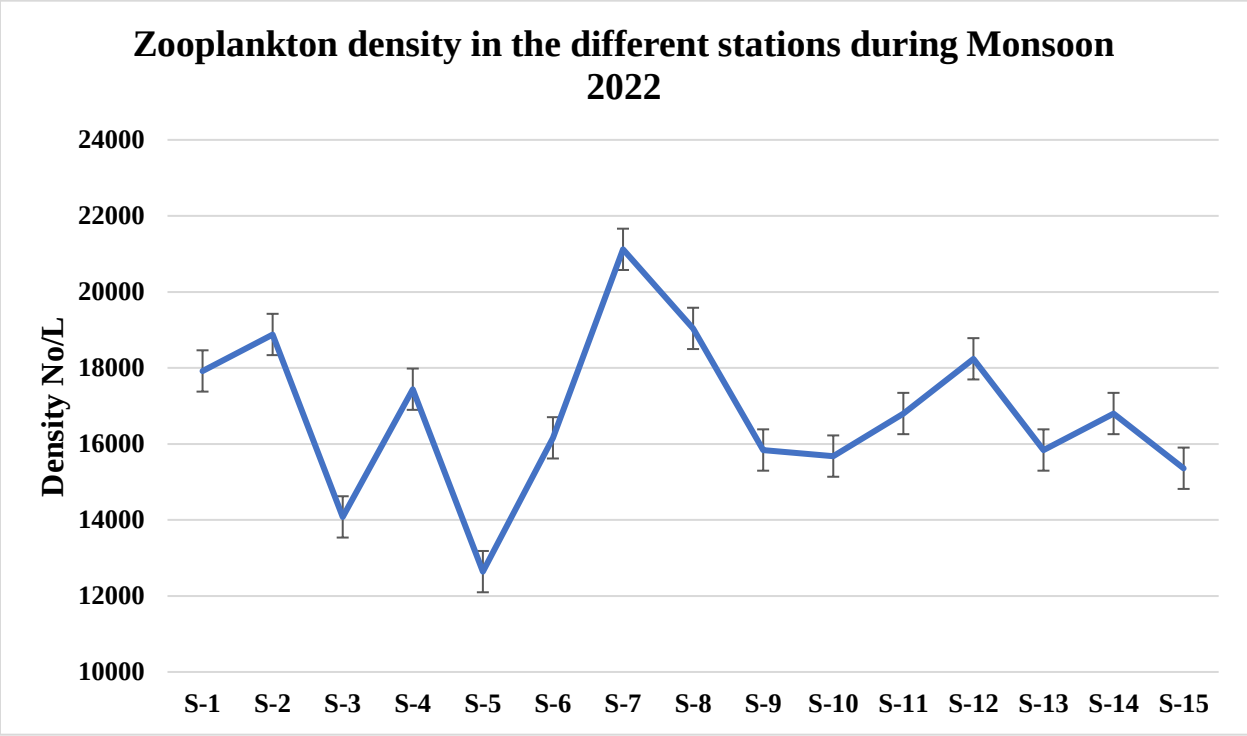

Figure 14: Zooplankton Density in the different stations during Monsoon 2022

Table 5: Zooplankton generic status during Monsoon 2022 in Deeendayal Port Authority area

Phylum	Group	Genera	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10	S-11	S-12	S-13	S-14	S-15	PO	PC
Protozoa	Foraminifera	*Globigerina*	160	160	0	0	0	160	320	0	0	0	320	160	0	480	320	53	0.8
Ciliophora	Tintinnida	*Tintinnopsis*	480	320	320	160	480	160	320	640	320	480	640	320	160	320	320	100	2.2
Chaetognath		*Sagitta*	160	160	0	0	0	0	0	160	0	160	0	0	0	160	0	33	0.3
Nematoda		*Nemadodes*	320	160	0	0	0	160	0	160	0	0	0	0	0	160	0	33	0.4
Annelida		*Polychaete larva*	1120	480	320	160	0	0	960	480	0	0	640	0	320	800	640	67	2.4
Arthropoda	Calanoida	*Acartia*	480	1280	800	1760	320	480	640	960	640	1280	800	320	480	800	1600	100	5.0
		Acrocalanus	640	320	480	160	320	640	1120	320	960	640	320	0	320	160	480	93	2.7
		Aetideus	320	800	640	160	160	320	480	160	800	960	320	1120	160	320	640	100	2.9
		Calanus	480	320	0	320	0	320	160	0	0	0	160	0	0	160	320	53	0.9
		Calanopia	1120	800	320	480	320	480	0	0	160	0	1600	800	320	640	160	80	2.9
		Centropages	320	480	0	160	320	160	640	800	320	480	1120	320	0	160	480	87	2.3
		Eucalanus	640	480	160	320	480	960	1600	1280	1120	800	480	800	640	480	0	93	4.1
		Labidocera	320	160	480	800	480	1120	960	800	640	1760	960	1280	640	320	160	100	4.3
		Nannocalanus	160	320	320	160	0	320	160	160	480	0	160	0	640	320	320	80	1.4
		Paracalanus	320	160	320	160	0	0	160	160	320	160	480	320	640	320	160	87	1.5
		Pontella	1760	480	800	1440	640	320	480	640	800	160	320	1120	960	480	640	100	4.4
		Pseudodiaptomus	0	0	160	320	160	160	0	160	0	640	0	320	0	480	0	53	1.0
		Rhincalanus	320	480	160	800	960	320	1120	160	320	640	640	160	160	320	480	100	2.8
		Temora	320	160	0	0	0	160	0	0	160	320	0	320	0	320	160	53	0.8
	Harpacticoida	*Corycaeus*	480	0	0	160	0	1600	800	320	640	160	320	480	320	480	0	73	2.3
		Euterpina	160	640	800	320	480	1120	320	0	160	480	0	160	320	160	640	87	2.3

		Microsetella	960	1600	1280	1120	800	480	800	640	480	0	160	320	480	960	1600	93	4.6
	Cyclopoida	*Oithona*	1120	960	800	640	1760	960	1280	640	320	160	480	800	480	1120	960	100	5.0
		Oncaea	320	160	160	480	0	160	0	640	320	320	320	160	0	320	160	80	1.4
	Decapoda	*Caridean larva*	0	160	160	320	160	480	320	640	320	160	320	160	0	0	160	80	1.3
		Euphausia	320	480	640	800	160	320	1120	960	480	640	800	1440	640	320	480	100	3.8
		Nauplius larva	160	0	160	0	640	0	320	0	480	0	160	320	160	160	0	60	1.0
		Mysis	160	0	160	160	160	160	1120	480	0	0	160	800	960	320	1120	80	2.3
		Phyllosoma	160	800	480	160	480	480	480	0	0	160	320	0	320	0	320	73	1.7
		Lucifer	640	1280	0	640	0	0	960	320	480	160	800	960	320	1120	160	80	3.1
	Crustacean larva	*Barnacle nauplius*	160	800	160	480	160	160	160	320	160	0	0	0	160	0	0	67	1.1
	Malacostraca	*Brachyuran larva*	320	160	320	960	320	320	480	480	0	0	160	0	1600	800	320	80	2.5
Bryozoan		*Cyphonautes larva*	160	160	160	160	160	160	320	160	640	800	320	480	1120	320	0	93	2.0
Mollusca	**Gastropod**	*Creseis sp*	0	640	640	480	640	640	0	960	1600	1280	1120	800	480	800	640	87	4.3
		Gastropod larva	160	160	0	320	0	0	1120	1120	960	800	640	1760	960	1280	640	73	3.9
	Bivalve	*Veliger larva*	0	320	0	0	0	0	480	1120	160	320	640	0	160	320	0	53	1.4
Echinodermata		*Bipinnaria larva*	800	320	160	0	160	160	960	0	0	160	320	320	640	160	320	80	1.8
Hemichordata		*Tornaria larva*	1280	480	160	0	160	160	160	800	320	640	160	0	160	480	0	80	2.0
Chordata	**Appendicularia**	*Oikopleura*	800	160	0	800	0	0	480	320	0	160	480	640	480	0	160	67	1.8
		Copelata	160	960	1600	1280	1120	800	320	800	640	480	0	640	320	160	480	93	3.9
	Fish	*Fish larva*	160	1120	960	800	640	1760	0	1280	640	320	160	640	320	320	320	100	3.7
		Total genera	**37**	**37**	**30**	**33**	**27**	**33**	**33**	**33**	**30**	**30**	**34**	**30**	**32**	**37**	**31**		
		Density No/L	**17920**	**18880**	**14080**	**17440**	**12640**	**16160**	**21120**	**19040**	**15840**	**15680**	**16800**	**18240**	**15840**	**16800**	**15360**		

Table 6. Diversity indices of Zooplankton along Deendayal Port Authority area during Monsoon 2022

	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10	S-11	S-12	S-13	S-14	S-15
Taxa_S	37	37	30	33	27	33	33	33	30	30	34	30	32	37	31
Shannon_H	3.34	3.36	3.14	3.22	3.05	3.20	3.31	3.31	3.23	3.15	3.32	3.19	3.27	3.41	3.20
Simpson_1-D	0.96	0.96	0.95	0.95	0.94	0.95	0.96	0.96	0.95	0.95	0.96	0.95	0.96	0.96	0.95
Margalef	3.68	3.66	3.04	3.28	2.75	3.30	3.21	3.25	3.00	3.00	3.39	2.96	3.21	3.70	3.11
Menhinick	0.28	0.27	0.25	0.25	0.24	0.26	0.23	0.24	0.24	0.24	0.26	0.22	0.25	0.29	0.25

3.6. Intertidal Fauna

The intertidal zone is the area above the water level at low tide and submerged at high tide. Intertidal habitats are found along the margins of the sea and include rocky shores, mudflats, salt marshes, and estuaries. The intertidal diversity was documented during monsoon at the prefixed 15 sampling locations within the DPA jurisdiction. All the macroinvertebrates and vertebrate samples were collected from the sampling stations during the low tide. At each site, 1x 1 m^2 quadrate was placed randomly, and all visible macro-faunal organisms encountered inside the quadrate were identified, counted and recorded. At each site along the transects that run perpendicular to the waterfront, three to six replicate quadrate samples were assessed for the variability in macro-faunal population structure (Davidson *et al*., 2004; Ravinesh and Biju Kumar, 2013). The density of the different faunal groups was averaged for the entire intertidal belt. Organisms, which could not be identified in the field, were preserved in 5% formaldehyde, brought to the laboratory and identified using standard identification keys (Abott, 1954; Vine, 1986; Oliver, 1992; Rao, 2003; 2017; Psomadakis *et al*., 2015; Apte, 2012; 2014; Naderloo 2017; Ravinesh *et al*., 2021; Edward *et al.,* 2022). The invertebrates' taxonomic composition, relative abundance, species richness and diversity were determined (Zar, 1984) to describe the mangrove environment's overall biodiversity at DPA premises. Statistical analyses such as diversity indices and richness were calculated using Paleontological Statistics Software Package for Education and Data (PAST) version 3.2.1 (Hammer *et al*., 2001).

Faunal composition of intertidal macrobenthos

The intertidal ecological survey has been conducted at the prefixed 15 locations within the vicinity of the Deendayal port Authority. The species diversity of the invertebrate phyla showed the maximum for phylum Arthropoda (8 species), which is followed by Mollusca (6 species). The phylum Chordata was represented by two species (Table 7 & Fig.15).

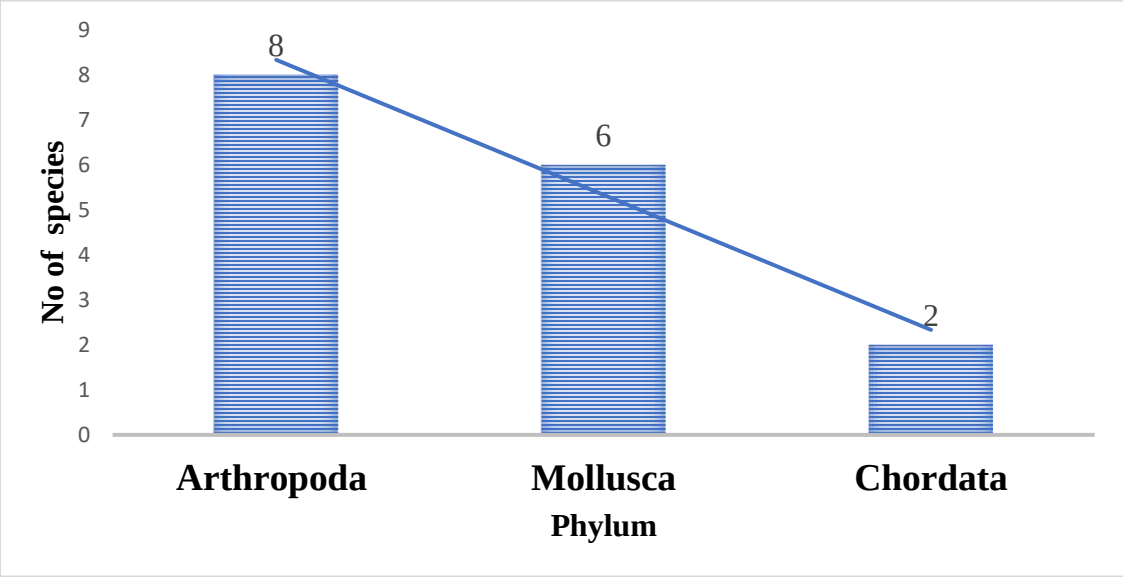

Figure 15: Number of genera of intertidal fauna (Phylum) during in Monsoon 2022

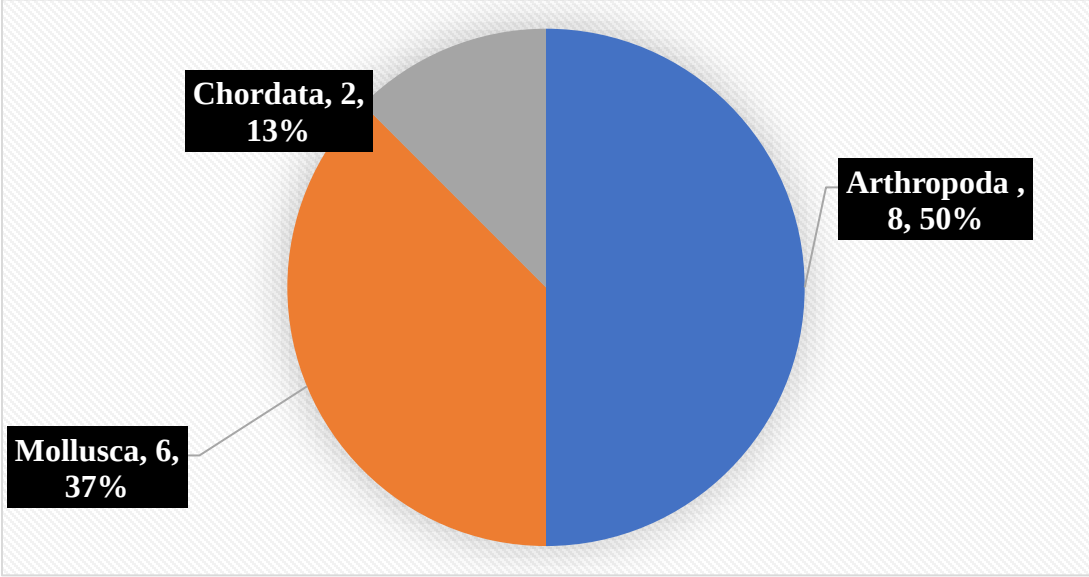

Figure 16: Percentage composition of intertidal fauna during Monsoon 2022

Cumulative percentage composition of Fauna

The overall percentage composition of the three groups of intertidal fauna at the 15 sites was followed, ie Arthropoda (50%), Mollusca (37%), and Chordata (13%), as shown in figure 16.

Intertidal Fauna density (No/m^2) variation between the stations

The number of individuals of the Fauna collected from the intertidal zone of the mangroves are presented in Fig 17. It was observed that the faunal density was the highest in stations S- 3 and S-4 while the least from S-10.

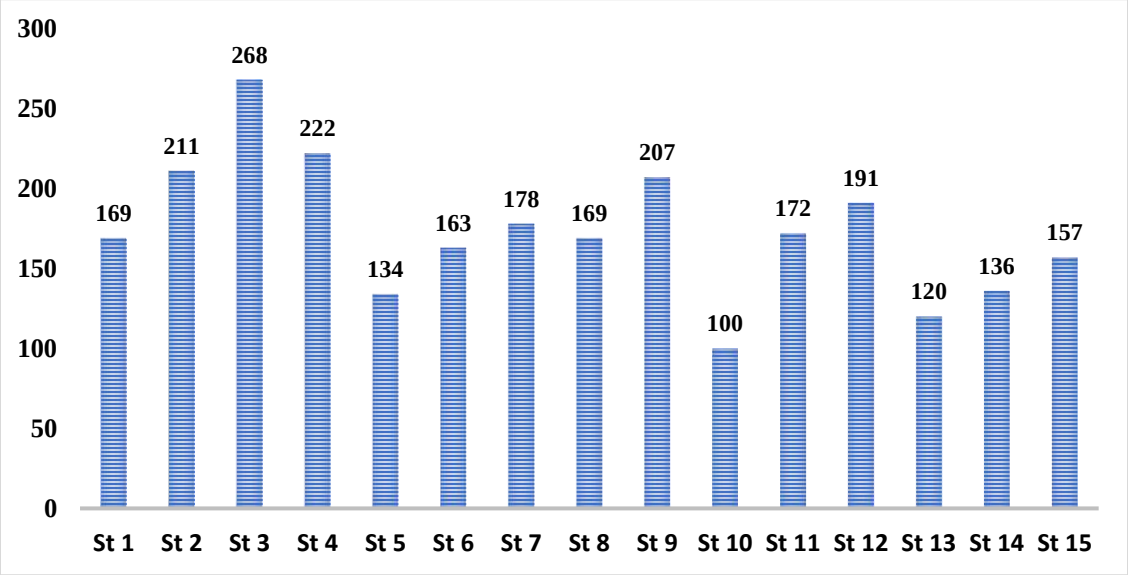

Figure 17: Density of intertidal fauna during Monsoon 2022

The Intertidal faunal diversity documented during the monsoon period of 2022 has shown that the highest number of animals were collected from S-3, and the lowest was from S-10. The most common species were the crustaceans such as *Parasesarma plicatum* and *Austruca iranica*. The lowest density noticed was that of *Littoraria pallescens* (Table.7)

Diversity indices

Table.8 presents the various diversity indices calculated for the different fauna recorded from the 15 sites adjoining the DPA port area, Kandla. Diversity indices were calculated for the subtidal fauna in which the Dominance diversity (D) values varied from 0.12 (S-5, S-15) to 0.27 (S -3). Shannon diversity (H') values varied from 1.50 (S-10) to 2.31 (S-5). The Simpson_1-D varied from 0.73 (S -3) to 0.88 (S-5, S-15). The Evenness values varied from 0.42 to 0.83, with the maximum in S-3 and the minimum at S-12. The Margalef index ranged from 1.04 to 2.15, the maximum at S-13 and the minimum at S-3.

Table 7: Intertidal faunal distribution along Deendayal Port Authority area during Monsoon 2022

Intertidal Fauna	**S-1**	**S-2**	**S-3**	**S-4**	**S-5**	**S-6**	**S-7**	**S-8**	**S-9**	**S-10**	**S-11**	**S-12**	**S-13**	**S-14**	**S-15**
Arthropoda															
Scylla serrata	0	3	0	0	5	0	6	0	0	0	5	0	0	3	4
Austruca sindensis	0	17	6	8	11	0	18	23	12	15	19	17	0	4	9
Austruca iranica	12	19	16	31	21	24	28	26	31	39	41	52	11	26	19
Parasesarma plicatum	56	72	32	52	23	42	26	53	85	19	36	42	38	52	28
Dotilla blanfordi	0	1	2	0	2	0	1	0	0	0	0	0	0	2	3
Eurycarcinus orientalis	2	0	0	1	2	5	1	0	0	0	0	0	0	0	2
Amphibalanus amphitrite	0	23	0	56	11	0	0	38	0	0	0	21	0	0	14
Tubuca dussumieri	3	2	1	6	9	1	2	1	8	2	1	6	0	0	5
Mollusca															
Pirenella cingulata	2	8	123	19	0	11	35	0	12	0	8	0	31	6	0
Telescopium telescopium	0	0	2	3	0	0	6	0	2	0	5	0	2	0	1
Bakawan rotundata	8	0	5	0	2	0	15	0	0	0	12	0	0	2	8
Littoraria pallescens	0	1	2	0	2	0	0	0	0	0	0	0	0	0	0
Platevindex martensi	0	0	1	0	2	0	0	0	0	0	5	0	0	2	1
Optediceros breviculum	35	42	52	12	7	42	0	0	34	0	15	25	0	0	19
Chordata															
Periophthalmus waltoni	25	11	15	21	12	7	8	9	11	4	2	9	11	8	26
Scartelaos histophorus	26	12	11	13	25	31	32	19	12	21	23	19	27	31	18
Total	169	211	268	222	134	163	178	169	207	100	172	191	120	136	157

Table 8: Diversity indices of Intertidal Fauna during Monsoon 2022

Indices	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10	S-11	S-12	S-13	S-14	S-15
Dominance_D	0.21	0.19	0.27	0.16	0.12	0.20	0.14	0.21	0.23	0.26	0.15	0.17	0.23	0.24	0.12
Shannon_H	1.77	1.95	1.70	2.02	2.31	1.75	2.12	1.69	1.77	1.50	2.11	1.89	1.56	1.70	2.30
Simpson_1-D	0.79	0.81	0.73	0.84	0.88	0.80	0.86	0.79	0.77	0.74	0.85	0.83	0.77	0.76	0.88
Evenness_e^H/S	0.65	0.58	0.42	0.69	0.72	0.72	0.69	0.77	0.65	0.75	0.69	0.83	0.79	0.55	0.71
Margalef	1.56	2.06	2.15	1.85	2.65	1.37	2.12	1.17	1.50	1.09	2.14	1.33	1.04	1.83	2.57

3.7. Subtidal Fauna (Macrobenthos)

Subtidal ecosystems are permanently submerged due to tidal influence, whereas intertidal ecosystems are found between the high tide and low tide, experiencing fluctuating influences of land and sea. Macrobenthos are an important component of estuarine and marine ecosystems. At large scales, food may be the prime limiting factor for benthic biomass. Depending on the system's characteristics, grazing by benthic suspension feeders may be the most important factor determining system dynamics. The sampling methods and procedures were designed in such a way as to obtain specimens in the best possible condition to maximize the usefulness of the data obtained. For studying the benthic organisms, triplicate samples were collected at each station using Van Veen grab, which covered an area of $0.04m^2$. The wet sediment was passed through a sieve of mesh size 0.5 mm for segregating the organisms. The organisms retained in the sieve were fixed in 5-7% formalin and stained further with Rose Bengal dye for the ease of spotting at the time of sorting (Ravinesh and Biju Kumar, 2022). The number of organisms in each grab sample was expressed as No $/m^2$. All the species were sorted, enumerated and identified by following available literature. The works of Day (1967), Hartman (1968, 1969), Rouse and Pleijel (2001), Robin et al., (2003), Amr (2021), were referred for polychaetes; Crane (1975), Holthuis (1993), Naderloo (2017). Xavier *et a*l., (2020) for crustaceans; Subba Rao (1989, 2003. 2017), Apte (2012,2014), Ramakrishna and Dey (2007), Ravinesh *et al.* (2021) and Edward *et al*., (2022). for molluscs. Statistical analyses such as diversity indices and quadrat richness were calculated using Paleontological Statistics Software Package for Education and Data (PAST) version 3.2.1 (Hammer *et al*., 2001).

Faunal composition of subtidal macrobenthos

The number of macrobenthic species of the various groups recorded (Fig.18) from the DPA port environment revealed that Mollusca (14 species) and Annelida (2 species) were the major constituents, while the Arthropoda (1 species) and Cnidaria (1 species) were comparatively low in the species composition.

The percentage composition of the four phyla that occurred during the monsoon is shown in (Fig 19) The phylum Mollusca is represented by maximum (78%) share of the subtidal Fauna, followed by Annelida (11%), Arthropoda (5.5%) and Cnidaria (5.5%) in the total benthic samples collected.

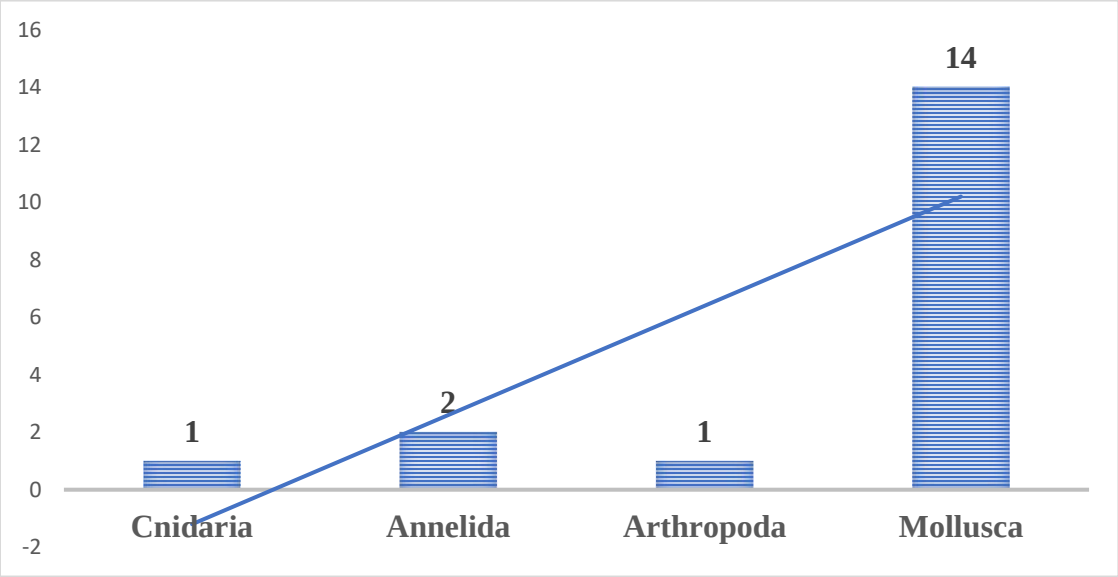

Figure 18. Number of genera of macrobenthos during Monsoon 2022

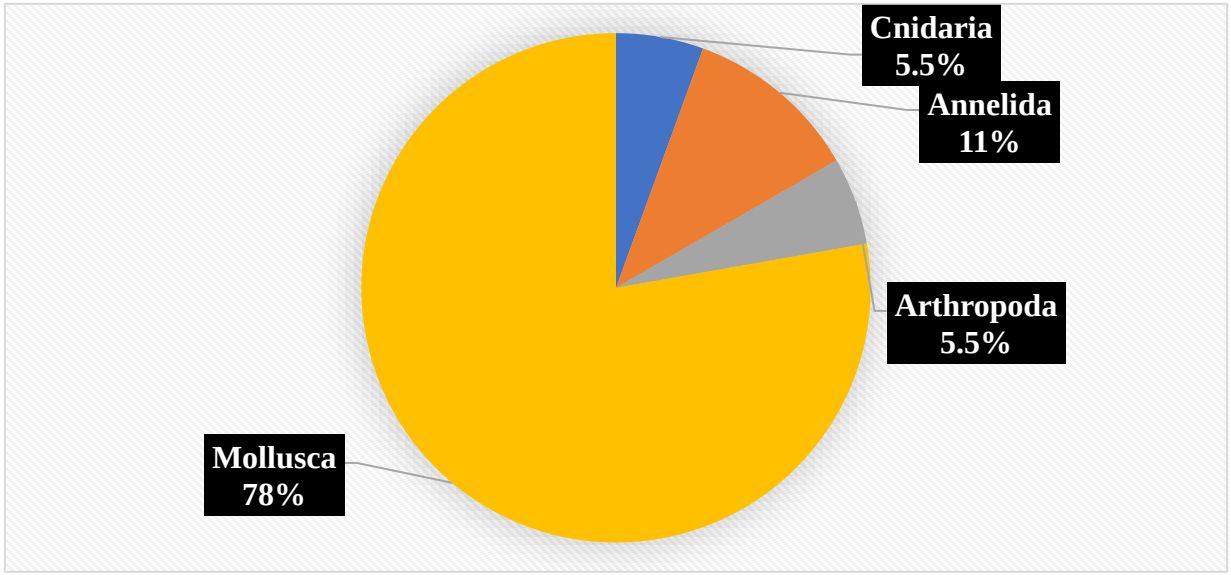

Figure 19: Percentage composition of macrobenthos during Monsoon 2022

Subtidal Faunal density (No/m^2) variation between the stations

The number of individuals of the animals collected from the different sites are shown in Fig 20. The density of the Fauna was high at S-7 (24No/m^2), and the lowest number (6/m^2) was noticed at S-13 during the monsoon season 2022.

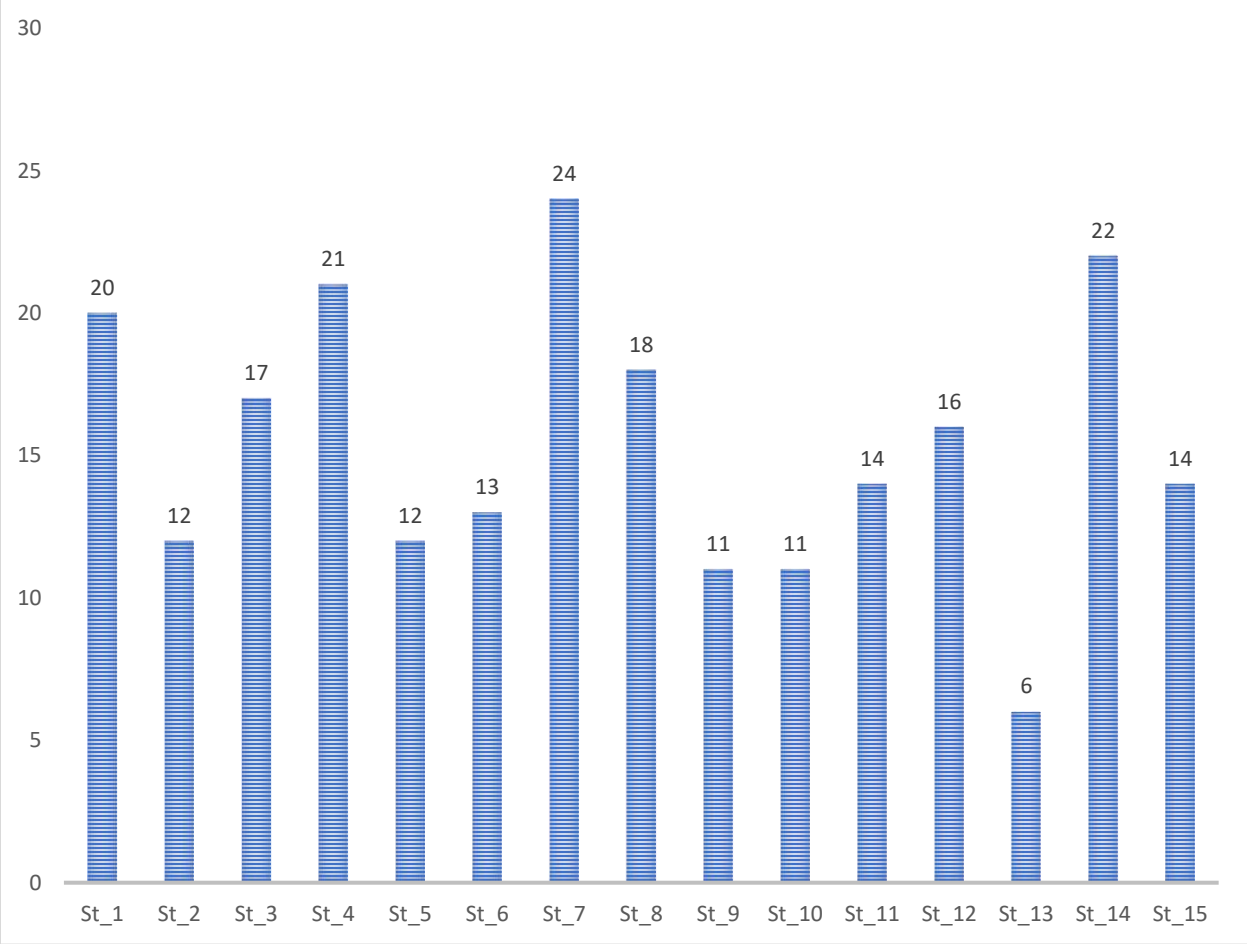

Figure 20: Subtidal fauna density during Monsoon 2022

Subtidal fauna distribution at the selected sites in the Deendayal Port area during monsoon

The table.9 depicts the subtidal microbenthic faunal diversity documented in the monsoon 2022. The highest diversity was documented from stations S-7, S-14, S-4 and S-1 and the lowest from stations S-9,10 and S- 6. The most common species are *Optediceros breviculum, Glauconome angulata and Pirenella cingulata.* The least diversity was documented for *Turritella* sp, *Stephensonactis* sp and *Natica* sp were found significantly less diversity. The Table.10 presents the various diversity indices calculated for the different Fauna recorded from the 15 sites adjoining

the DPA port area, Kandla. Diversity indices were calculated for the subtidal fauna in which the Dominance diversity (D) values varied from 0.12 (S- 4) to 0.24 (S -9). Shannon diversity (H') values varied from 1.52 (S-9) to 2.27 (S-4). The Simpson_1-D varied from 0.76 (S -9) 0.87 (S-3, S-15). The Evenness values varied from 0.72 to 0.96, with the maximum in S-3 and the minimum at S-14. The Margalef index ranged from 1.67 to 3.03, the maximum at S-3 and the minimum at S-15.

Table 9: Macro-benthic faunal distribution during Monsoon 2022 in Deendayal Port Area

	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10	S-11	S-12	S-13	S-14	S-15	% of Occurrence
Cnidaria																
Stephensonactis sp.	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0.9
Annelida																
Lumbrineries sp.	0	2	0	0	0	2	0	0	2	0	0	0	0	0	0	2.6
Nereis sp.	0	0	3	0	0	0	0	0	0	1	0	0	1	0	1	2.6
Arthropoda																
Ampithoe sp.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1.3
Mollusca																
Umbonium vestiarium	0	0	0	3	0	1	2	1	0	0	0	0	0	1	0	3.5
Mitrella blanda	0	0	0	2	0	1	0	2	2	0	3	0	0	5	0	6.5
Clypeomorus bifasciata	1	0	2	0	1	0	0	1	0	0	0	3	0	0	2	4.3
Natica sp	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0.9
Optediceros breviculum	5	1	2	1	2	2	4	5	4	1	1	3	1	2	1	15.2
Pirenella cingulata	5	2	3	1	2	1	1	2	2	1	1	2	1	1	2	11.7
Turritella sp	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0.4
Mactra sp.	0	1	0	3	0	0	2	1	0	0	0	2	0	2	3	6.1
Glauconome angulata	4	1	2	1	2	3	5	0	0	2	3	2	0	1	0	11.3
Pelecyora sp	0	0	1	2	0	1	3	0	0	2	1	1	0	0	1	5.2
Gafrarium divaricatum	2	0	0	2	1	0	0	0	0	0	0	2	1	1	0	3.9
Meretrix sp.	0	2	0	4	3	0	1	2	0	3	0	0	0	0	1	6.9
Solen sp.	1	0	2	0	0	0	4	0	1	0	2	0	0	7	1	7.8
Protapes cor	1	3	2	1	1	2	1	2	0	1	3	1	2	1	0	9.1
Total	20	12	17	21	12	13	24	18	11	11	14	16	6	22	14	100
Total No/m^2	500	300	425	525	300	325	350	450	275	275	350	400	150	550	350	

Table10: Diversity indices of the benthic fauna during Monsoon 2022

Indices	St_1	St_2	St_3	St_4	St_5	St_6	St_7	St_8	St_9	St_10	St_11	St_12	St_13	St_14	St_15
Dominance_D	0.19	0.17	0.13	0.12	0.17	0.15	0.14	0.15	0.24	0.17	0.17	0.14	0.22	0.18	0.13
Shannon_H	1.84	1.86	2.04	2.27	1.86	1.99	2.13	2.06	1.52	1.85	1.83	2.01	1.56	1.98	2.11
Simpson_1-D	0.82	0.83	0.87	0.88	0.83	0.85	0.86	0.85	0.76	0.83	0.83	0.86	0.78	0.82	0.87
Evenness_e^H/S	0.79	0.92	0.96	0.88	0.92	0.92	0.84	0.87	0.91	0.91	0.89	0.94	0.95	0.72	0.91
Margalef	2.34	2.42	2.47	3.29	2.42	2.73	2.83	2.77	1.67	2.50	2.27	2.53	2.23	2.91	3.03

3.8. Seaweeds

Along the Gujarat coast which is represented by 1600 km coastline, harbors 198 species of which 109 species from 62 genera belonging to Rhodophyta, 54 species of 23 genera to Chlorophyta, and 35 species from 16 genera to Ochrophyta (Jha *et.al*.,2009). According to Mantri *et.al*. (2020) there are 13 potential sites for the occurrence of seaweed density and diversity. The survey conducted by CSIR-CSMCRI (Jha *et.al*., 2009) confirmed the presence of industrially important taxa, namely, *Gelidiella acerosa, Gelidium micropterum, G. pusillum, Ahnfeltia plicata, Gracilaria dura, G. debilis, Gracilariopsis longissima* (formerly *G. verrucosa*), *Hypnea musciformis, Meristotheca papulosa, Porphyra sp, Asparagopsis taxiformis* (Rhodophyta), *Sargassum tenerrimum, S. plagiophyllum, S. swartzii, Turbinaria ornata* (Ochrophyta), *Ulva prolifera* (formerly *Enteromorpha prolifera*), *Ulva compressa* (formerly *Enteromorpha compressa*), and *Ulva flexuosa* (formerly *Enteromorpha tubulosa*) (Chlorophyta) from the coastal waters of Gujarat. In the present study, an attempt was made to describe the occurrence, diversity and other ecological features of seaweeds within Deendayal Port jurisdiction. It was found that except for some drifted species *Enteromorpha and Chaetomprpha* at S-13 and S-14 of Vira coast (Plate-6) no natural seaweed beds are seen in the different locations within DPA environment.

Seaweeds grow in the rocky intertidal and sub tidal habitats that offer a hard substratum for attachment. Low turbidity level in the water column with high nutrient content is a major habitat requirement that enables photosynthesis. Total dissolved solids (TDS) load in the Deendayal Port area creek waters ranged from 32088 to 42086 mg/L and suspended solids value between 88-223 mg/L restricts the photosynthetic activity of seaweeds which are highly sensitive to light. Hence, seaweed formations are absent in the creek systems of the Deendayal Port coastal environment.

3.9. Seagrass

Similar to seaweeds, sea grasses were also absent in the creek systems of Deendayal Port area and in the adjacent coastal stretches of Kachchh due to inherent habitat conditions. Sea grasses generally thrive in shallow coastal waters and are adapted to live in submerged conditions from mid intertidal to depth as much as 50 m when light penetration is sufficient; conditions contrary to the one prevailing in Deendayal Port and the nearby creek systems explain the total absence of sea grasses.

3.10. Halophytes

The holophytes are the plants that are adopted in coastal estuaries and salt marshes. It is common in arid and desert milieu which often have substantial salt accumulation. Technically it is the plant which has tolerance to moderate to high salt concentration in its growth substrate. Halophytes, that survive to reproduce in environments where the salt concentrations around 200 mM NaCl or more, constitute about 1% of the world's flora. (Timothy *et al*., 2008). Halophytes are classified based on their growth conditions as obligate halophytes, facultative halophytes, and habitat-indifferent halophytes. In the present study, four major halophytes recorded along the selected Deendayal Port Authority sites during the Monsoon sampling, were *Salicornia brachiata*, *Aeluropus lagopoides*, *Salvadora persica* and *Sesuvium portulacastrum*. Among the halophyte species recorded, *Salicornia brachiata* alone was found in the 3 sampling locations. (Table-11 and Plate-12). The percentage of *Salicornia brachiata* was found to be the highest at station S-8 (78%) and the lowest in S-11.

Table 11: Percentage of Halophytes cover in the DPA during Monsoon 2022

	S-1	**S-2**	**S-3**	**S-4**	**S-5**	**S-6**	**S-7**	**S-8**	**S-9**	**S-10**	**S-11**	**S-12**	**S-13**	**S-14**	**S-15**
Aeluropus lagopoides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Salicornia brachiata	0	0	0	0	0	0	0	78%	63%	0	57%	0	0	0	0
Salvadora persica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sesuvium portulacastrum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

a. ***Salicornia brachiata*** **b.** ***Aeluropus lagopoides*** **c.** ***Salvadora persica*** **d.** ***Sesuvium portulacastrum***

Plate 7: Halophyte species on the intertidal zone of Deendayal Port Authority area

3.11. Mangroves

In India, the second largest mangrove cover is located in the Gujarat state which accounts for 1175 km^2 (23.66%) cover of mangroves. However, it is also the fact that, this mangrove cover is predominance of *Avicennia marina*. In Gujarat, the Gulf of Kachchh shows major part of mangrove abundance, particularly of *A. marina*. The arid and hot environment of this area make it mono-species formation of *A. marina* within DPA area of Kandla.

Tree Density

In this study, totally 13 sites were surveyed for recoding the mangrove growth parameters and the density of plants. The overall average density of mangrove was 4602 plants per hector. Among all sampling stations, the mean plant density was maximum at Tuna creek (6199/ha), followed by Kandla creek (5205/ha). Considering the sampling sites individually the highest tree density was reported at S-12 station in the Tuna creek area (7359/ha). The lowest average tree density (2935 trees/ha) was reported in Phang creek, however, the lowest density (individual site) was recorded in the site S-5 at Phang creek. Form this study, it is clear that geomorphology and environmental characteristics of the Kandla coastal regions play an important role in the formation of variability in mangrove (Fig.21 & Table 12).

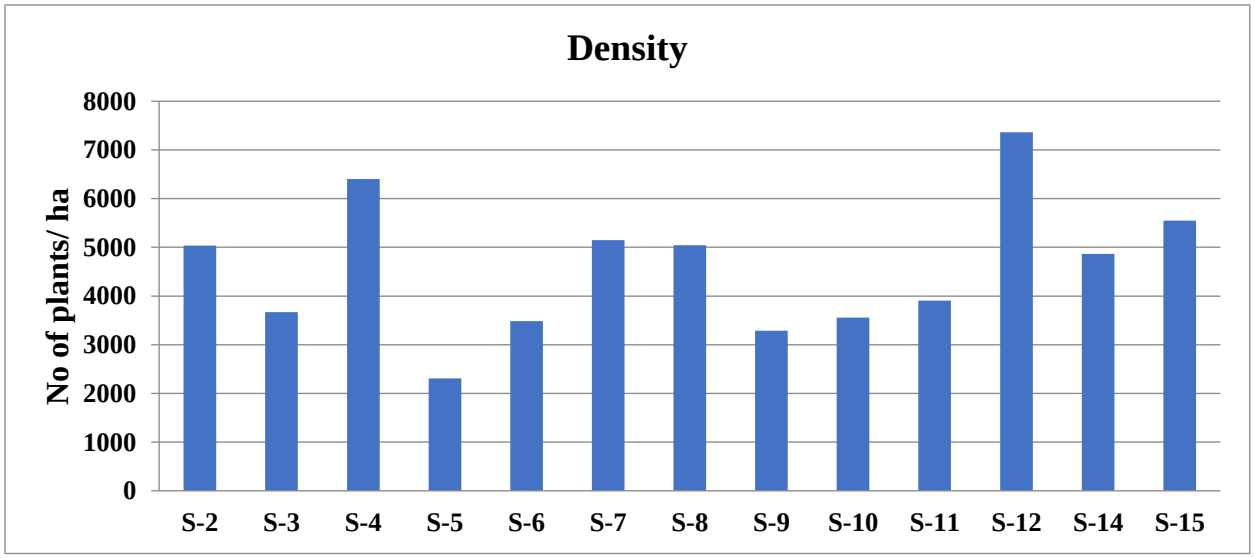

Figure 21. Mangrove Plant density during Monsoon 2022

Height

The overall mean height of the mangroves from the study sites along the DPA port environment was 105 cm. The highest average tree height was found at Phang creek area (167 cm) followed by Navlakhi creek (160 cm). The highest tree height was recorded in station S-9 of Navlakhi creek, followed by S-4 of Kandla creek (Fig. 22).

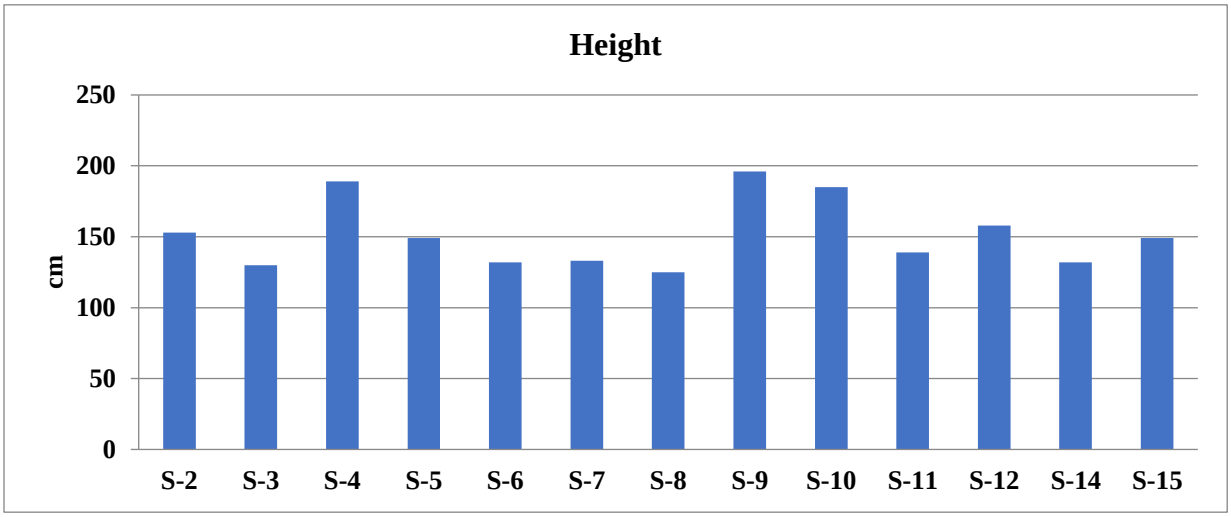

Figure 22. Plant height during Monsoon 2022

Canopy Crown Cover

The canopy cover of sampling stations exhibited wide variation and the average was 2.54 m^2. The sites S-5, S-9 and S-10 showed relatively large canopy cover. However, the lowest canopy cover was reported at S-2 and S-7 stations located at Tuna creek and Kharo creek respectively (Fig.23).

Basal area

The overall average basal area (GBH) of the mangroves of the DPA environment was 14.64 cm. Station wise the maximum mean basal area (21 cm) was at S-4 located in the Kandla creek followed by S-5 and S-11 in Phang creek and Jangi creek respectively. The minimum basal area reported to all sites was 7 cm (Fig.24). The highest value of DBH indicates the mangrove plants have multiple stems or main branches arising close to the ground from a single buttress or base. This type of growth pattern is characteristics of mangroves particularly *Avicennia marina* and *Aegiceros corniculatum*

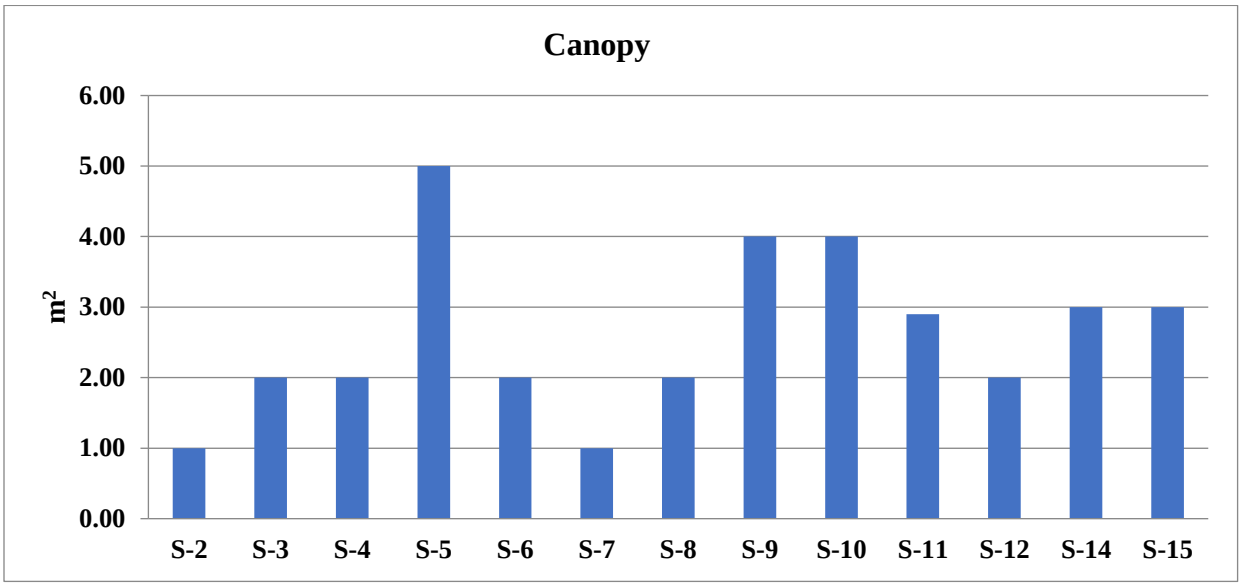

Figure 23. Mangrove canopy cover during Monsoon 2022

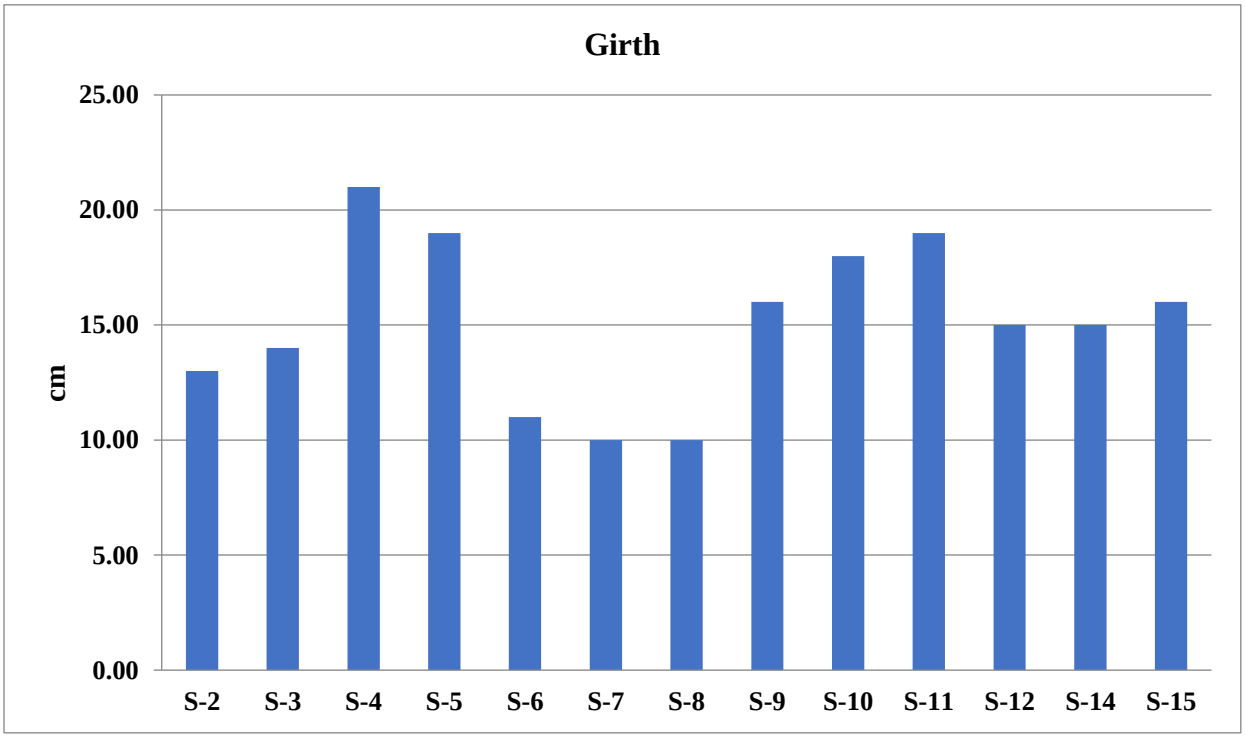

Figure 24. Mangrove basal area during Monsoon 2022

Regeneration and Recruitment class

During the monsoon, generally higher values of regeneration class of mangroves is expected, but the average density was 60167 plants/ha and that of recruitment class 15434 plants/ha. The highest regeneration (140000 plants/ha) at S-9 of Navlakhi creek and recruitment (31500 plants/ha) class density were recorded at Kharo creek (S-7). The lowest regeneration class and recruitment plant density were found at S-14 station of Vira coast site. The highest density of recruitment class after the S-7 site was observed at S-8 and S-9 sites of Navlakhi creek.

Plate 8: Mangrove species recorded along the Deendayal Port area

a. ***Avicenna marina*** **b.** ***Aegiceras corniculatum*** **c.** ***Ceriops tagal*** **d.** ***Rhizophora mucronata***

Table 12: Density of mangroves in the DPA vicinity during monsoon 2022

Sampling stations	Density (Tree/Ha)	Tree height (m)			Canopy cover (m)			Basal Area (cm)		
		Min	Max	Avg.	Min	Max	Avg.	Min	Max	Avg.
Tuna creek										
S-2	5038	110.00	230.00	153.00	0.24	6.48	1.00	7.00	36.00	13.00
S-12	7359	100.00	300.00	158.00	0.42	11.55	2.00	7.00	43.00	15.00
Mean	6198.64	105.00	265.00	155.50	0.33	9.02	1.50	7.00	39.50	14.00
Phang creek										
S-5	2311	110.00	220.00	149.00	0.88	11.20	5.00	7.00	50.00	19.00
S-10	3558	100.00	310.00	185.00	0.63	10.50	4.00	9.00	43.00	18.00
Mean	2934.70	105.00	265.00	167.00	0.76	10.85	4.50	8.00	46.50	18.50
Kandla creek										
S-3	3669	100.00	160.00	130.00	0.05	5.04	2.00	7.00	32.00	14.00
S-4	6400	110.00	310.00	189.00	0.16	6.48	2.00	8.00	50.00	21.00
S-15	5545	110.00	220.00	149.00	0.77	7.20	3.00	7.00	30.00	16.00
Mean	5204.96	106.67	230.00	156.00	0.33	6.24	2.33	7.33	37.33	17.00
Kharo creek										
S-7	5144	100.00	300.00	133.00	0.30	6.25	1.00	7.00	43.00	10.00
Jangi creek										
S-6	3483	100.00	190.00	132.00	0.17	3.99	2.00	8.00	14.00	11.00
S-11	3906	110.00	185.00	139.00	2.24	3.42	2.90	9.00	30.00	19.00
Mean	3694.59	105.00	187.50	135.50	1.21	3.71	2.45	8.50	22.00	15.00
Navlakhi creek										
S-8	5045	100.00	210.00	125.00	0.35	8.00	2.00	7.00	25.00	10.00
S-9	3290	110.00	420.00	196.00	0.30	42.25	4.00	7.00	85.00	16.00
Mean	4167.65	105.00	315.00	160.50	0.33	25.13	3.00	7.00	55.00	13.00
Vira coast										
S-14	4867.50	110.00	210.00	132.00	0.48	8.00	3.00	7.00	35.00	15.00
Overall average	4601.71	105.24	253.21	148.50	0.53	9.88	2.54	7.40	39.76	14.64

Table 13: Regeneration and Recruitment class plants during Monsoon 2022

Station	Tree density- No/ha (1)	Regeneration density- No/ha (2)	Recruitment density- No/ha (3)	Ratio of 1:3	Ratio of 2:3
Tuna creek				1 to	to 1
S-2	5038	68000	13250	2.63	5.13
S-12	7359	70000	16500	2.24	4.24
Mean	6198.64	69000	14875	2.40	4.64
Phang creek					
S-5	2311	24000	3750	1.62	6.40
S-10	3558	75000	17500	4.92	4.29
Mean	2934.70	49500	10625	3.62	4.66
Kandla creek					
S-3	3669	79000	17000	4.63	4.65
S-4	6400	56000	8250	1.29	6.79
S-15	5545	23000	3750	0.68	6.13
Mean	5204.96	52667	9667	1.86	5.45
Kharo creek					
S-7	5144	77000	31500	6.12	2.44
Jangi creek					
S-6	3483	49000	13250	3.80	3.70
S-11	3906	79000	18000	4.61	4.39
Mean	3694.59	64000	15625	4.23	4.10
Navlakhi creek					
S-8	5045	52000	26500	5.25	1.96
S-9	3290	140000	19500	5.93	7.18
Mean	4167.65	96000	23000	5.52	4.17
Vira coast					
S-14	4867.50	13000	2750	0.56	4.73
Overall average	4601.71	60166.67	15434.52	3.35	3.90

3.12. Marine Reptiles

During the field surveys, one reptilian species, the saw-scaled *viper Echis carinatus sochureki* was recorded at site S-3 located in the northern part of Sat Saida bet opposite to oil jetty during monsoon season. This species was spotted on the ground among the mangrove trees. The literature describes the species as aggressive and strikes at a lightning speed, the observed specimen was active. In monsoon, the maximum number of this snake was recorded in S-10 located on the northern part of Sat Saida bet.

Plate 9: Marine reptiles recorded along the Deendayal Port Authority area

3.13. Marine Fishery

Marine fish production of India during the financial year 2019-2020 was 37.27 lakhs tons (Fisheries statistics 2021). The production varied from 0.2 to 7.01 lakh tons and Gujarat state contributed the highest production (Fisheries statistics 2021). The Ichthyofauna diversity of the Gulf of Kachchh includes a total of 20 orders, 47 families and 96 species (Katira & Kardani 2017). Along the Sikka coast of Jamnagar where 112 ichthyofauna species belonging to 50 families, 12 orders, and 84 genera has been reported. Similarly, the locality of Jamnagar Marine National Park, Gulf of Kachchh reported 109 ichthyofauna species belonging to 58 families, 19 orders, and 93 genera (Brahmane et al. 2014). Apart from this, a recent study conducted by Sidat *et al.*, (2021) reported 96 species which include 20 order and 47 families. During the field observation, in the gill net catches *Mugil cephalus*, *Planiliza klunzinger*i, *Planiliza planiceps*, *Planiliza macrolepis* (Plate 9) were observed of which *Mugil cephalus* catch was the maximum during monsoon season of (20 kg) followed by mud crab (30 kg).

Plate 10: Fish and Crab catch along the Deendayal Port Authority in monsoon 2022

3.14. Marine Mammals

Sousa plumbea (Cuvier, 1829) is commonly referred to as the Indian Ocean humpback dolphin. During the field surveys, the Indian Ocean humpback dolphin (*Sousa plumbea*) was recorded at the site between the S-3 and S-4 opposite the oil jetty during monsoon season. The length of the humpback dolphin is approximately 1.7 to 2m. Humpback dolphins feed mostly on small fishes, sometimes shrimps; occur mostly in small groups (mostly 12 or less); have limited nearshore movements and in most parts of their range, exhibit a fission/fusion type of social organization. The evaluation of the conservation status of a species and its subsequent listing as a Threatened species is a function of its risk of extinction, which is influenced primarily by population dynamics (population size and trends, population structure) and the key biological and environmental factors influencing those dynamics (distribution, behaviour, life history, habitat use and the effects of human activities).

Plate 11. Indian Ocean humpback dolphin *Sousa plumbea*

4. Mud flat

Mudflats and mangroves establish a major ecosystem of the DPA coastal region and the significance of ecosystem services rendered by mudflat is endorsed in Coastal Regulation Zone (CRZ, 2011) as it accords special status to highly productive zone. Mudflat has an assemblage of plant-animal-geomorphological entities. DPA has been surrounded by two major ecosystems such as mangroves and mudflats which support a number of ecosystem services like nursery grounds for fish and shellfishes and breeding/feeding grounds for the birds (Spencer and Harvey, 2012). The TOC concentration is direct indicator of mudflat productivity and blue carbon sequestration.

Bulk density of the sediment samples

The data on the bulk density of the sediment samples are presented in (Fig.25). The bulk density of mangrove soil at Deendayal Port Authority coastal region ranged from 1.26 g/cm^3 to 1.34 g/cm^3. The highest bulk density was recorded at S-4 and S-12 sites followed by S-15. The lowest bulk density was recorded at site S-8 located at Tuna creek and S-1.

Total Organic Carbon (TOC)

The highest TOC value (0.83%) was recorded at station S-4 followed by S-2 site. Lowest TOC value was reported at site S-12 (Fig.26). It is observed that TOC values varied significantly among the sampling stations which means that organic carbon is dependent on the living life forms and variations in the life forms in the mudflats. The TOC concentration is a direct indicator of mudflat productivity and blue carbon sequestration. The data on monsoon samplings revealed that the different sampling sites of Deendayal Port Authority jurisdiction have considerable variations with respect to organic carbon.

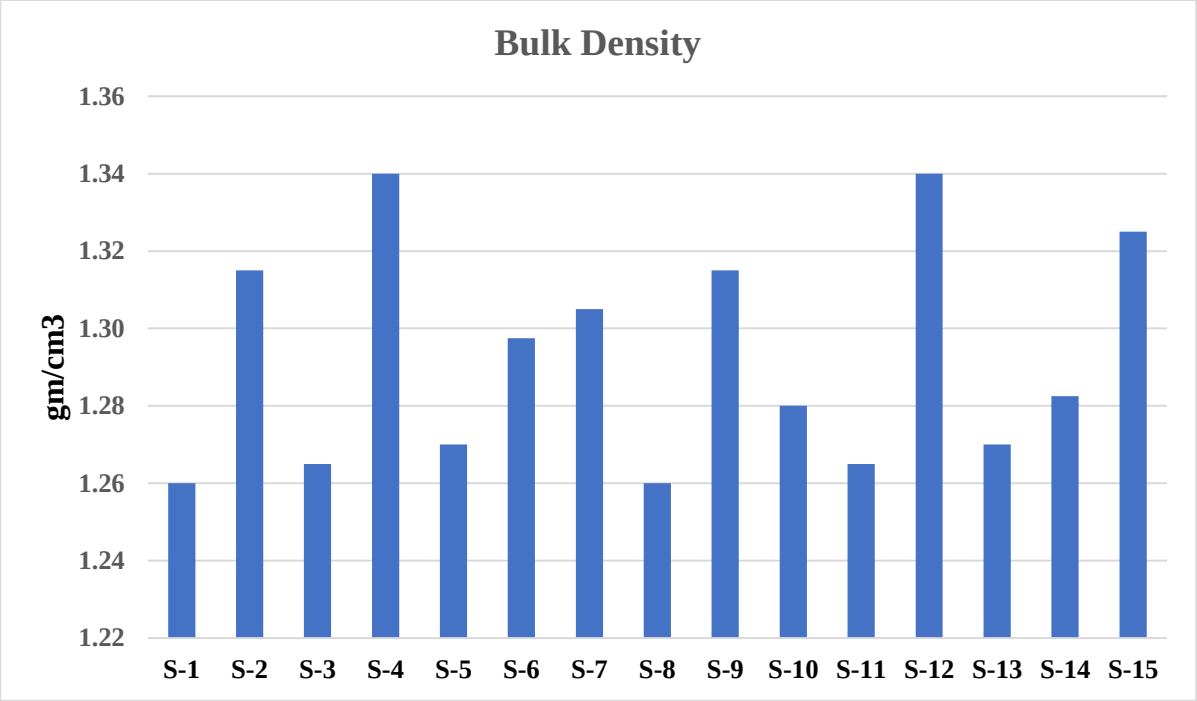

Figure 25: Bulk density of mudflat sediment during Monsoon 2022

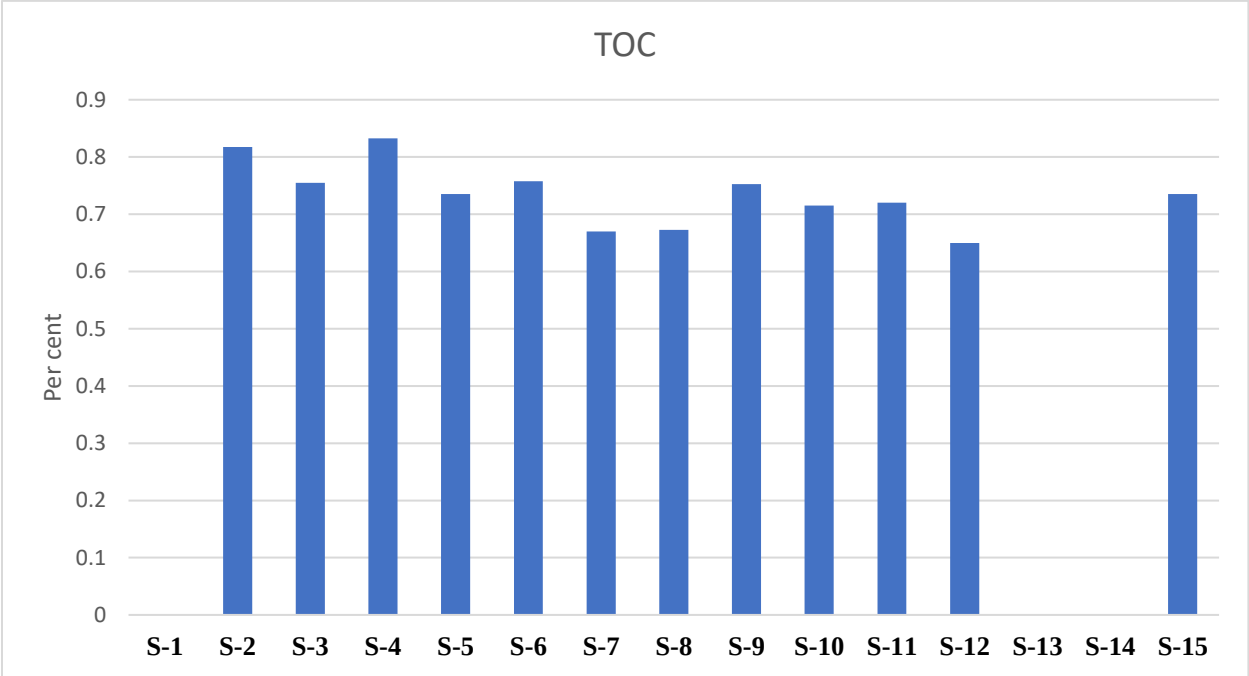

Figure 26: Percentage of Total Organic Carbon in the mudflat in Monsoon 2022

5. Avifauna

A large amount of research on bird diversity emphasizes the general negative effects of land conversion to human dominated habitats (Brooks *et al*. 1997; Castelletta *et al*. 2000). But human dominated and coastal habitats vary a lot and therefore the effect on birds can be very different. Birds depend on the habitats where they occurred, so the response of the species in particular habitat may always differ according to the habitat changes (Tworek, 2002, Winter & Faaborg, 1999; Cornelius *et al*. 2000; Zanette 2000; Zanette *et al*. 2000; Johnson & Igl, 2001; Beier *et al*. 2002; Herkert *et al*. 2003; Kurosawa & Askins, 2003). A total of 49 species belonging to six orders, 25 families and 38 genera were recorded from the coastal area of Deendayal Port during this study (Annexure 1). Among these, 26 species were aquatic and 23 species were terrestrial, which included three species listed as Near Threatened in the IUCN (2022), Red List.

Order Charadriiformes i.e. aquatic birds (including raptors and most water birds) constituted the predominant groups representing 58% of all species recorded from the study area followed by order Passeriformes (31%), i.e., perching birds (including babblers, drongos, mynas, sunbirds, doves, warblers, larks, chats, wagtails, robins). The families with a greater number of species were Ardeidae (eight spp.), Scolopacidae (seven spp.), Charadriidae (three spp.), Columbidae (three spp.), Laridae (two spp.), and Passeridae (one spp.). Among the recorded species, four were migrants, 10 were local migrants or resident migrants, 35 were breeding resident. During the present investigation, birds with diverse food habits viz., Aquatic (20 spp.), Insectivores (12 spp.), Granivores (eight spp.), Piscivores (six spp.), Omnivores (one spp.) Frugivores (one spp.), and Nectarivores (one spp.) were observed. The overall Shannon diversity (H')was 3.6 with species richness index for study area 1.2. The overall species evenness index value for study area was 0.77 and Equitability 0.93 (Table 13).

Status, distribution and diversity of avifauna in different stations:

A Total of fifteen sites were surveyed, of which the maximum number of species was found in Site 1 & 2 (33 spp.) followed by Site 9 (27 spp.) and Site 10 & 15 (26 spp.). Site 5 recorded the least richness (16 spp.) (Fig. 27).

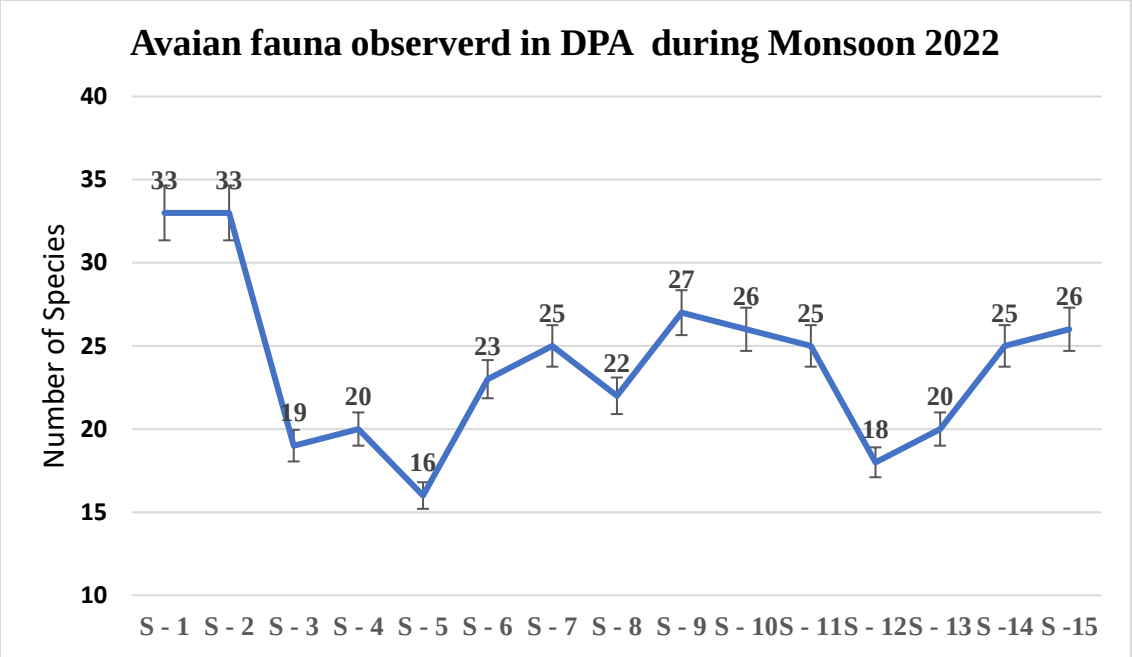

Figure 27. Number of Avian species recorded from the Deendayal Port Area

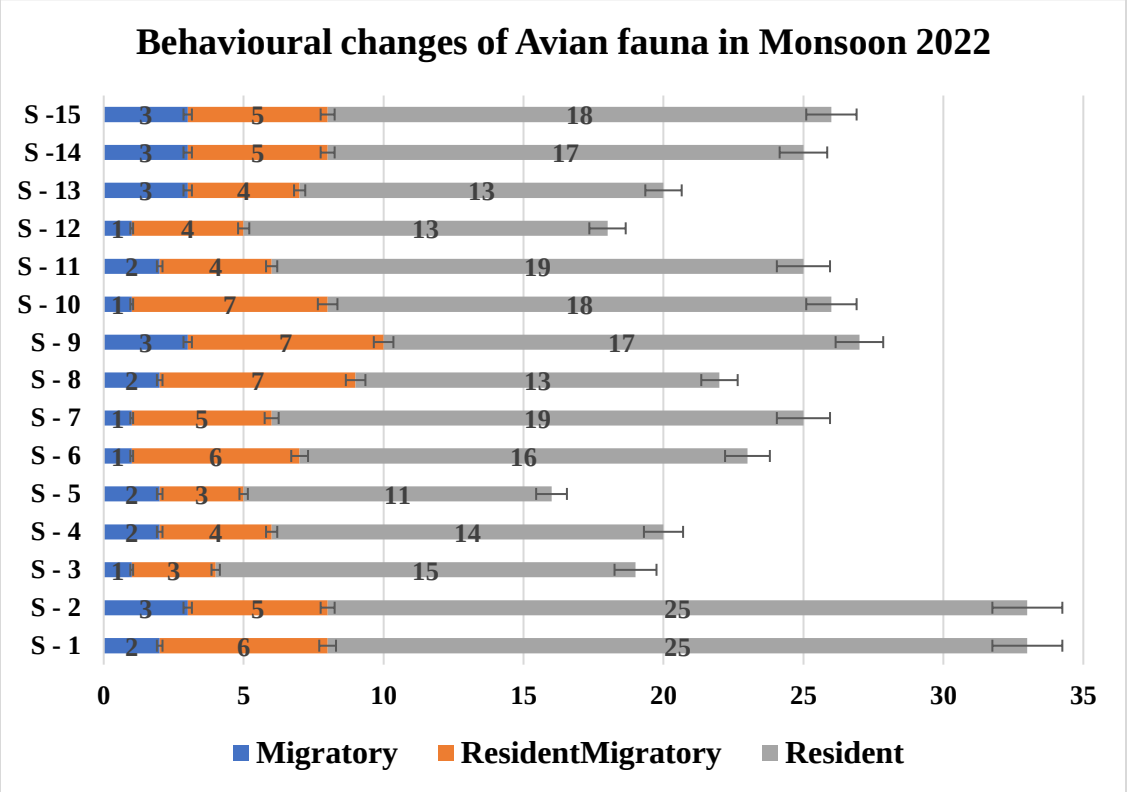

Figure 28. Behavioral status of Avian species from the DPA in Monsoon 2022

Site wise migratory status showed that maximum migratory species were found in S- 2, S-9,S-13,S-14 & S-15 (three spp.) followed by S- 1,S-4,S-5,S-8 & S-11 (two spp.) (Fig. 28). From the study area all the species were categorized into two habitats i.e. terrestrial and aquatic. Survey for terrestrial and aquatic avifauna showed that maximum terrestrial avifaunal richness was recorded from S-2 (17 spp.) followed by site S-1 (15 spp.), S-11 (13 spp.) and site S-9 (12 spp.); while aquatic avifaunal species richness was more in site S-1 (18 spp.) followed by S- 15 (17 spp.), S-2 (16 spp.) and S- 8 (15 spp.) (Fig. 29).

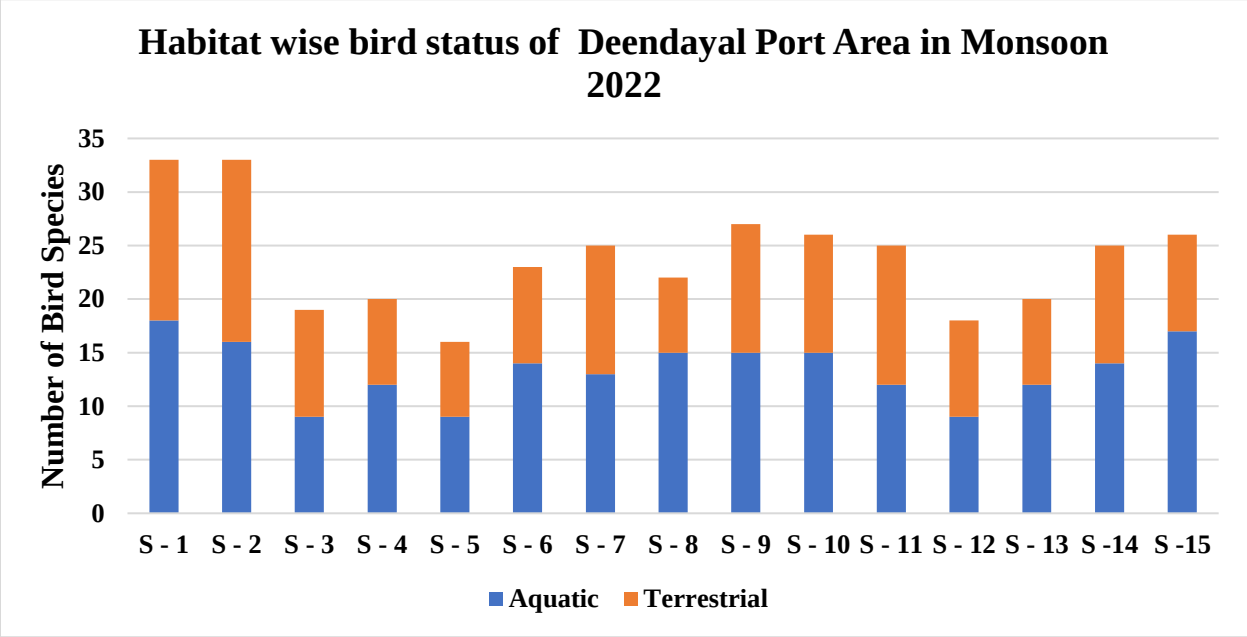

Figure 29. Habitat wise distribution of Bird species from the DPA in Monsoon 2022

During the present investigation birds with diverse food habits were observed, viz., Aquatic, Insectivores, Granivores, Piscivores, Frugivores, Omnivores and Nectarivores. All the sites have found more number of aquatic birds species (maximum 16 species recorded from S- 15) followed by Insectivores (Maximum 8 species recorded from Site 1&2), granivore (maximum 8 species recorded from S-2) and piscivores (maximum 4 species recoded from S-3,S-6,S-8&S-11) and least species found of frugivores, omnivores and nectorivores (Fig.30)

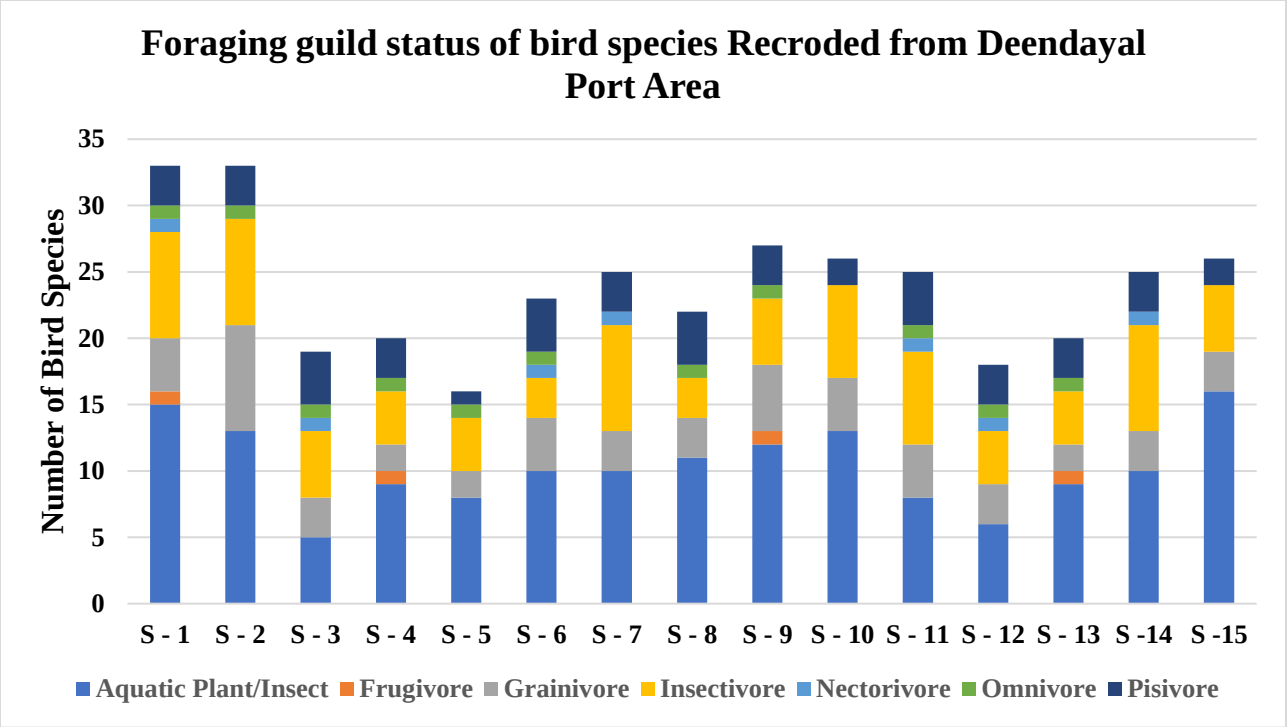

Figure 30. Station wise Foraging Guild status of species recorded during Monsoon 2022

Data collected from point counts allows us to calculate species diversity, richness and species composition. The results showed that the maximum diversity was found from the S-1 (H' 3.3) followed by S-2 (H' 3.2) and the minimum diversity recorded from site 12 (H' 2.6) and S- 5 (H' 2.5). The maximum species richness was recorded from Site 1 (2.9 spp.) and the minimum from Site 12 (2.1 spp.). These changes in individual species abundance, whether they occur independently of one another (Wiens, 1989) or are influenced by interactions with other bird species are governed by the degree of anthropogenic pressure including disturbance to habitat of species (Block & Brennan, 1993). The distribution and abundance of many bird species are mainly determined by the configuration and composition of the vegetation that comprises a major element of their habitat (Cody, 1985; Block & Brennan, 1993). As vegetation changes along complex geographical and environmental gradients, particular bird species may appear, increase in abundance, decrease, and disappear, when habitat becomes more or less suitable for its persistence. Totally 16% species were found rarely distributed in the study area while 36% species were very common. Aquatic and Insectivores species form the major groups while each of the frugivores, omnivores and nectarivores constitute about 2% of all species. Although more than 67% of the birds in the study area were Aquatic and insectivores, food competition was reduced by the

utilization of different habitat types and distinct feeding behaviour. Largely insectivorous birds like babblers (Sylviidae) and drongos (Corvidae) feed on fruits and seeds of plants particularly during winter season due to the shortage of insect food. Wetland birds were dominated largely by the aquatics followed by insectivore and grainivore species (Annexure 1). The present season study shows 49 different types of birds belonging to six orders and 25 families from the coastal area of Deendayal Port. The richness of avifauna is little low, indicator of ecological health of the coastal area of Deendayal Port. Proper and in-depth study, awareness, regarding the importance of birds and their role in ecosystem, to the local peoples through different massive programs will ultimately help the protection of birds of this region

Great Egret *Ardea alba*

Grey Heron *Ardea cinerea*

Great Cormorant *Phalacrocorax carbo*

Western Reef Egret *Egretta gularis*

Plate 12: Some common Birds from the Deendayal Port Authority

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Annexure -D

ENVIRONMENTAL MONITORING REPORT
FOR DEENDAYAL PORT AUTHORITY

REPORT	:	DCPL/DPA/21-22/31
Mont	:	November 01
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Prepare	:	DETOX CORPORATION PVT. LTD.,

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EXECUTIVE SUMMARY

ENVIRONMENTAL MONITORING PLAN FOR DEENDAYAL PORT ENVIRONMENTALMONITORING REPORT- NOVEMBER, 2022

1. EXECUTIVE SUMMARY

Monitoring of various environmental aspects of the Deendayal port by M/s Detox Corporation Pvt. Ltd. has been carried out through collection of samples, analysis of the same, comparing results with respect to the national standards and any other relevant standards by GBCB/CPCB/MoEF & CC to understand status of various parameters in the Environment of the Deendayal Port. The results shall address the identified impacts and suggest measures to minimize the environmental impact due to various operations at Deendayal Port.

A) Ambient Air

The monitoring of Ambient Air quality at 6-locations at Deendayal Port Authority Kandla and 2- location at Vadinar Port on 24 hourly basis for TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_2, NH_3, CO_2, CO, C_6H_6 and NMHC in twice a week 24 hourly at uniform intervals (as per NAAQS) at Gopalpuri, Tuna Port, Marine Bhavan Building, Coal storage area, Estate building, Oil jetty and at Vadinar port, Vadinar Jetty and Vadinar colony area using respirable dust sampler, Fine particulate sampler and gaseous sampler.

The Maximum TSPM values in month of November 2022 were found 846 µg/m^3 at Coal Storage area on 25.11.2022 and minimum 107 µg/m^3 at Gopalpuri Hospital on 01.11.2022. The Maximum PM_{10} values were 654 µg/m^3 at Coal Storage area on 25.11.2022 and minimum was 67 µg/m^3 at Gopalpuri Hospital 01.11.2022. Maximum $PM_{2.5}$ values were 187 µg/m^3 at Coal Storage area on 25.11.2022 and minimum was 34 µg/m^3 at Gopalpuri on 01.11. 2022. The PM_{10} and $PM_{2.5}$ values were found for all monitoring locations (Marine Bhavan Building, Oil Jetty, Estate Office, Gopalpuri, Coal Storage Area and Tuna Port) to exceed the Standard limit (NAAQS).

At Gopalpuri location the mean concentration of PM_{10} was 127 µg/m^3 & $PM_{2.5}$ was 66 µg/m^3 which are slightly exceed the Standard limit (NAAQS).

The AAQ monitoring for Vadinar at Admin building the mean TSPM, PM_{10} and $PM_{2.5}$ were 237µg/m^3, 138 µg/m^3 and 97 µg/m^3 respectively which was exceed the Standard limit (NAAQS) the while at Signal Building the mean TSPM, PM_{10} and $PM_{2.5}$ were 113 µg/m^3 , 74 µg/m^3 and 38 µg/m^3 respectively slightly exceed the Standard limit (NAAQS).

The overall values of November for Gaseous SO_2, NO_2, NH_3, CO_2, CO, C_6H_6 concentration were within the permissible limit at all location and NMHC were found BQL (Below Quantification Limit).

B) Weather

The mean day time temperature at Deendayal Port was 27.92 °C. The day-time maximum temperature was 32.9°C and minimum was 21.1 °C. The mean night time temperature recorded was 25.47 °C. The night-time maximum temperature was 29.7°C and minimum was 20.0 °C. The mean Solar Radiation in November month was 167.27 w/m^2. The maximum solar radiation was recorded 759 w/m^2 in 4th November, 2022 and the minimum solar radiation was recorded 1.80 w/m^2 in 30th November, 2022. The mean Relative humidity was 69.00 % for the month of November. Maximum Relative humidity was recorded 99.0 % and minimum Relative humidity was recorded 34.0 %. The average wind velocity for the entire month of November was 1.21 m/s. Maximum wind velocity was recorded 10.19 m/s. The wind direction was mostly West-South.

C) Marine Ecology (Flora and Fauna) / Marine Water / Sediments:

The results obtained from the study for the month of November 2022 for biological and ecological parameters in marine water for Arabian Sea at surrounding area of Deendayal Port Authority (DPA) Kandla and Vadinar were not affected by Port activities.

D) Drinking Water Quality

The drinking water being supplied to Deendayal Port Authority was safe for drinking purpose. At all drinking water monitoring stations around port area were in line with the standard limit as per the drinking water specifications given in IS 10500:2012 as per tested parameters only.

The average results for 20 locations were as: pH were found Min 7.24 and maximum 7.52, TDS were found min 300.0 mg/l and Max found 1060.0 mg/l, Chloride were found Min 140.31 mg/l and Max 576.28 mg/l, Total Hardness were found Min 270.0 mg/l and Max 380.0 mg/l and Calcium were found Min 34.47 mg/l and Max 43.29 mg/l, color were colorless and odor were odorless. In all water samples BOD, Heavy metal like manganese, Hexavalent chromium, Copper, Cadmium, Arsenic, Mercury, Lead, zinc all are found BQL (Below Quantification Limit). The bacterial count (E-coli & Coliform) is absent in all drinking water samples.

E) Monitoring Performance of Sewage Treatment Plant

It was seen that the performance of STP at Deendayal Township Gopalpuri, DPA STP Plant Kandla and Vadinar STP plant was satisfactory by overall. The treatment plant was well maintained during [November 2022] with considerable removal efficiency achieving the standards prescribed for final disposal. At Gopalpuri STP, the pollutant removal efficiency for TSS, BOD and COD was ranged from 49.66-81.04%, 58.97-68.42% and 45.45-73.33% respectively. At Kandla STP, removal efficiency for TSS, BOD and COD was ranged from 53.47-73.49%, 46.15-76.74% and 50.00-82.35% respectively & at Vadinar STP removal efficiency for TSS, BOD and COD was ranged from 42.09-56.69%, 50.00-78.12% and 60.00-84.61% respectively. At all STP location treated waste water the pH were ranged from 7.21-7.42,Total Suspended Solids were found 16.9-67.9 mg/l , Residual Chlorine were below Detection Limit (< 0.5) , COD were found 20-60 mg/l and 3day BOD @ 27 °C were found 7.0-16.0 mg/l.

F) Noise

Noise sources in port operations include cargo handling, vehicular traffic, and loading / unloading containers and ships. The Day Time Noise Level (SPL) in all 10 locations at Deendayal Port Authority ranged from 53.2 dB(A) to 70.4 dB(A) while at Vadinar port 3 location ranged from 52.5 dB(A) to 60.6 dB(A) which was within the permissible limits of 75 dB(A) for the industrial area for the daytime. The Night Time Average Noise Level (SPL) in all locations of Deendayal Port Authority ranged from 45.4 dB to 61.7 dB(A) while at Vadinar port ranged from 52.5 dB (A) to 60.6 dB(A) which was within the permissible limits of 70 dB(A) for the industrial area for the night time.

CHAPTER-1

INTRODUCTION

DEENDAYAL PORT AUTHORITY

1.0 Introduction

About Deendayal Port

The Deendayal Port is situated in the Kandla Creek and is 90 Kms. From the mouth of Gulf of Kachchh. Latitude: 23° 01" N Longitude: 70° 13"E. Deendayal Port's journey began in 1931 with construction of RCC Jetty by Maharao Khengarji. After partition, Deendayal Port's success story has continued and it rise to the No. 1 Port in India in the year 2007-08 and since then retained the position for the 15 consecutive year. On 31.03.2016, Deendayal Port created history by handling 100 MMT cargoes in a year, the first Major Port to achieve the milestone. Kandla, also known as the Deendayal Port Authority is a seaport in Kutch District of Gujarat state in western India, near the city of Gandhidham. Located on the Gulf of Kutch, it is one of major ports on west coast. Kandla was constructed in the 1950s as the chief seaport serving western India, after the partition of India from Pakistan left the port of Karachi in Pakistan. The Port of Deendayal is located on the Gulf of Kutch on the northwestern coast of India some 256 nautical miles North West of the Port of Karachi in Pakistan and over 430 nautical miles north-northwest of the Port of Mumbai (Bombay). It is the largest port of India by volume of cargo handled. Kandla history Deendayal Port Authority, India's busiest major port in recent years, is gearing to add substantial cargo handling capacity with private sector participation. Deendayal port Authority creates a new record by handling 127.10 million metric tons of cargo during the FY 2021-22, as against 117.566 million metric tons in FY 2020-21. Showing a growth of 8.11 %. Incidentally, DPA is the only major Indian port of handle more than 127 MMT cargo throughout and it has also registered the highest cargo throughput in its history. While the port has flagged off several projects related to infrastructure creation, DPA has successfully awarded the work of augmentation of liquid cargo handling capacity by revamping the existing pipeline network at the oil jetty area in Sept. 2021. Even as much of this growth has come from handling of crude oil imports, mainly for Essar Oil's Vadinar refinery in Gujarat, the port is also taking measures to boost non-POL cargo. Last fiscal, POL traffic accounted for 63 per cent of the total cargo handled at Deendayal Port, as against 59% in 2007-08. The Deendayal Port Authority had commissioned the Off-shore Oil Terminal facilities at Vadinar in the year 1978, for which M/s. Indian Oil Corporation Limited (IOCL) provided Single Bouy Mooring (SBM) system, having a capacity of 54 MMTPA, which was first of its kind in India. Further, significant. Quantum of infrastructural up-gradation has been affected & excellent maritime infrastructure been created at Vadinar for the 32 MMTPA Essar Oil Refinery in Jamnagar District. Monitoring of various environmental aspects of the Deendayal port by M/s Detox Corporation Pvt. Ltd. has been carried out through collection of samples, analysis of the same, comparing results with respect to the prescribed standards by GPCB/CPCB/MoEF& CC. The results shall address the identified impacts and suggest measures to minimize the environmental impact due to various operations at Deendayal Port. The environmental monitoring is carried out as per the Environment Management and Monitoring Plan submitted by Detox Corporation Pvt. Ltd.

CHAPTER-2

AMBIENT AIR QUALITY MONITORING

2. Introduction

Air pollutants are added in the atmosphere from variety of sources that change the composition of atmosphere and affect the biotic environment. The concentration of air pollutants depend not only on the quantities that are emitted from air pollution sources but also on the ability of the atmosphere to either absorb or disperse these emissions. The air pollution concentration vary spatially and temporarily causing the air pollution pattern to change with different locations and time due to changes in meteorological and topographical condition. Air pollution occurs when harmful substances including particulates and biological molecules are introduced into earth's atmosphere. It may cause diseases, allergies or death of humans; it may also cause harm to other living organisms such as animals and food crops, and may damage the natural or built environment. Human activity and natural processes can both generate air pollution. A physical, biological or chemical alteration to the air in the atmosphere can be termed as pollution. It occurs when any harmful gases, dust, smoke enters into the atmosphere and makes it difficult for plants, animals and humans to survive as the air becomes dirty. The consequences of industrialization and the demand for improved quality of life has been increased exposure to air pollution (Vallero, 2014). An air pollutant is a substance in the air that can have adverse effects on humans and the ecosystem. The substance can be solid particles, liquid droplets, or gases. A pollutant can be of natural origin or man-made. Pollutants are classified as primary or secondary. Any gas could qualify as pollution if it reached a high enough concentration to do harm. Theoretically, that means there are dozens of different pollution gases. In practice, about ten different substances cause most concern. Heavy metals represent a class of omnipresent pollutants, with toxic potential, in some cases even at low exposure levels. They concentrate in each tropic level because of their weak mobility, so the concentration in plants is higher than in soil, in herbivore animals higher than in plants, in carnivores' tissues higher than in herbivore, the highest concentration being reached at the end of the tropic chain, at big predacious and human bodies.

Globally, one of the main contributors to emissions of atmospheric pollutants and a significant user of energy is the industrial sector (Conti et al. 2015).

The concentration of air pollutants depends not only on the quantities that are emitted from the polluting sources, but also on the ability of the atmosphere to either absorb or disperse such emissions (USEPA, 2008).

Nowadays, the shipping sector provides low-cost and reliable delivery services in the economic field (Arunachalam et al. 2015). Nevertheless, shipping-related activities have a considerable impact on air pollution, especially in coastal areas but also globally (Buccolieri et al. 2016). The primary air pollutants are PM, VOCs, NOx, O_3, SO_2, and CO (Bailey and Solomon 2004). As a consequence, a wide range of options toward "greener" seaports is needed (Bailey and Solomon 2004). Some of these measures are easy to adopt such as the regulation of fuel quality (by using low-sulfur alternative fuels), the speed reduction (Lack et al. 2011), and the use of alternative transportation equipment (Lai et al. 2011).

Clean air is the basic requirement of all living organisms. In recent times, due to population growth, urban sprawl, industrial development, and vehicular boom, the quality of air is deteriorating and being polluted. Pollutants of major public health concerns include particulate matter, carbon monoxide, ozone, nitrogen dioxide, and sulfur dioxide, which pose serious threats to human health and hygiene. In the present study, prime particulate pollutants (PM_{10}, $PM_{2.5}$), and gaseous pollutants (SO_2, and NO_2) were estimated at seven stations in and around Dahej Port, Gujarat, India (Soni and Jagruti Patel, 2017).

Among particulate pollutants, particulate matter (PM) is a ubiquitous entity, and is especially a grave problem due to its higher suspension rate into the atmosphere, and adverse health effects on plants, animals, humans, and materials in the form of visibility reduction, soiling of buildings, etc. (Horaginamani and Ravichandran, 2010; Chaurasia *et al*., 2013).

The sources of air pollutants include vehicles, industries, domestic sources and natural sources. Because of the presence of high amount of air pollutants in the ambient air, the health of the population and property is getting adversely affected. In order to arrest the deterioration in air quality, Govt. of India has enacted Air (Prevention and Control of Pollution) Act in 1981. The responsibility has been further emphasized under Environment (Protection) Act, 1986. It is necessary to assess the present and anticipated air pollution through continuous air quality survey/monitoring programs. Therefore, Central Pollution Control Board had started National Ambient Air Quality Monitoring (NAAQM) Network during 1984 - 85 at national level. The programme was later renamed as National Air Quality Monitoring Programme (NAMP).

2.1 Ambient Air Quality Monitoring

As per the Environmental Monitoring Plan of Deendayal Port Authority, Air monitoring was carried out at six identified locations at Deendayal Port and two locations at Vadinar Port.

Table: 1. Ambient Air Sampling Location

Sr. No.	Name of Location	Location Code	Latitude	Longitude	Remarks
1.	Marine Bhavan	AL-1	23° 0' 26.524"N	70° 13' 22.414"E	**DPA-Kandla**
2.	Oil Jetty	AL-2	23° 1' 45.613"N	70° 13' 11.052"E	
3.	Estate Office	AL-3	23° 1' 11.273"N	70° 12' 48.657"E	
4.	Gopalpuri Hospital	AL-4	23° 4' 53.551"N	70° 8' 7.047"E	
5.	Coal Storage Area	AL-5	22° 59' 31.812"N	70° 13' 9.979"E	
6.	Tuna Port	AL-6	22° 59' 15.291"N	70° 58' 57.018"E	
7.	Signal Building	AL-7	22° 26' 26.750"N	69° 40' 22.127"E	**DPA-Vadinar**
8.	Admin Building	AL-8	22° 26' 25.223"N	69° 40' 19.358"E	

- **Air Quality Monitoring Methodology**

  Air quality is measured in all the stations, for 24 hour for Total Suspended Particulate Matter (TSPM), PM_{10}, $PM_{2.5}$, SO_2, NO_2, NH_3 & Benzene and Grab-sampling for CO & CO_2 measurements. The Air samplers are operated for a period of 24 hours and after a continuous operation of 8 hours for gaseous parameters. The absorbing reagents for SO_2:- Absorbing Reagent TCM (Potassium Tetrachloromercurate 0.04M): Mercuric Chloride, Potassium Chloride and EDTA used. For NO_2:- Absorbing Reagent Sodium Hydroxide (NAOH): Sodium Hydroxide and Sodium Arsenite used. For NH_3 need Conc. Sulphuric Acid and Distilled water was used. By replacing 3 times the reagents per day for each parameter namely, SO_2, NO_2, NH_3. The GFA filter paper and PTFE Membrane bound filter paper are used for a period of 24 hours to obtain one sample each of TSPM, PM_{10} & $PM_{2.5}$. The AAQ samples are collected two consecutive days a week as per CPCB guidelines, from all the eight locations as mentioned in the EMP.

2.2 Results

The ambient air quality monitoring data for six stations, viz. Marine Bhavan, Oil Jetty, Port Colony, Gopalpuri Hospital, Tuna Port and Nr. Coal Storage Area for the month of November 2022 are given in Tables 2 to 7. The ambient air quality monitoring data for two stations at Vadinar (Nr. Admin Building & Nr. Signal Building) are given in Tables 8 to 9.

The Movement of heavy transport with uncovered coal transportation, raw road around ambient location may be causes fugitive dust emission from dry conditions. Particulate Matter then enters the atmosphere through the action of wind, vehicular movement, or other activities. The dust produces tends to float in air and spread all around the vicinity. Direction and speed of wind affect the dispersion of the dust particulate matter. Humidity of air also has strong effect on the spreading of particulate matter. With increasing humidity, moisture particles eventually grow in size to a point where 'dry deposition' occurs, reducing PM_{10} concentrations in the atmosphere.

Location 1: Marine Bhavan (AL1)

Table 2 : Results of Air Pollutant Concentration at Marine Bhavan										
	Date	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period		**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS Limit			**100 µg/m3**	**60 µg/m3**		**80 µg/m3**		**80 µg/m3**		**400 µg/m3**
AL1 – 1	01.11.2022	435	302	121	3.93 6.04 1.81	3.93	5.19 23.66 14.43	14.43	2.07 6.33 3.91	4.11
AL1 – 2	04.11.2022	344	228	106	3.32 2.72 1.51	2.52	17.31 8.66 12.12	12.70	2.42 5.18 3.57	3.72
AL1 – 3	08.11.2022	398	281	116	2.31 6.34 2.88	3.84	25.39 17.89 8.66	17.31	4.72 2.42 3.57	3.57
AL1 – 4	11.11.2022	445	315	124	3.63 9.07 6.35	6.35	17.89 12.70 8.66	13.08	4.03 4.72 2.07	3.61
AL1 – 5	15.11.2022	364	253	110	4.53 6.35 2.72	4.53	11.54 19.62 10.39	13.85	4.60 2.88 1.73	3.07
AL1 - 6	18.11.2022	442	315	121	8.46 3.32 2.72	4.84	23.08 8.66 17.89	16.54	3.22 5.87 4.03	4.37
AL1 - 7	22.11.2022	375	266	106	3.32 7.55 2.42	4.43	17.89 25.97 11.54	18.47	4.83 5.87 2.65	4.45
AL1 – 8	25.11.2022	483	350	129	4.53 6.95 2.42	4.63	23.66 28.86 12.12	21.55	3.22 5.29 2.53	3.68
AL1 – 9	29.11.2022	534	383	142	6.35 8.46 2.72	5.84	17.89 25.97 13.27	19.04	3.57 4.95 2.19	3.57
Monthly Average		424	299	119		4.55		16.33		3.79
Standard Deviation		61	48	12		1.12		3.03		0.44

Table 2 : Results of Air Pollutant Concentration at Marine Bhavan					
	Date	**C6H6 [µg/m3]**	**HC**	**CO [mg/m3]**	**CO2 [ppm]**
Sampling Period		**8 hr**		**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m3**	**ppm**	**4.0 mg/m3**	**-**
AL1 – 1	01.11.2022	1.09	BQL	1.44	444
AL1 – 2	04.11.2022	1.2	BQL	1.54	374
AL1 – 3	08.11.2022	1.17	BQL	1.08	538
AL1 – 4	11.11.2022	1.1	BQL	1.14	470
AL1 – 5	15.11.2022	1.11	BQL	1.26	481
AL1 - 6	18.11.2022	1.1	BQL	1.64	500
AL1 - 7	22.11.2022	1.12	BQL	1.35	620
AL1 - 8	25.11.2022	1.16	BQL	1.69	511
AL1 - 9	29.11.2022	1.21	BQL	1.16	522
Monthly Average		**1.14**	**-**	**1.37**	**495.56**
Standard Deviation		**0.05**	**-**	**0.22**	**67.59**

* NMHC- Non- Methane Hydrocarbons

BQL- Below Quantification Limit (Quantification Limit – NMHC: 0.5 ppm)

At Marine Bhavan, the overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_2 and NH_3 is attributed mainly by motor vehicle emission produced from various types of automobiles (both diesel and petrol driven). Moreover, the loading and unloading of Food Grains and Timber at Jetty no. 1 and 2 also contributes to the high levels of TSPM and PM_{10}. The mean TSPM value at Marine Bhavan was 424 µg/m^3, the mean PM_{10} value was 299 µg/m^3, and $PM_{2.5}$ value was 119 µg/m^3 which is above the permissible limit prescribed by NAAQS. The average values of SO_2, NO_2 and NH_3 were 4.55 µg/m^3, 16.33 µg/m^3 & 3.79 µg/m^3 respectively; these values were within the standard limit prescribed by NAAQS.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Marine Bhavan. The mean Benzene concentration was 1.14 µg/m^3, well below the permissible limit of 5.0 µg/m^3. NMHC's were below the detectable limit and Carbon Monoxide concentration was 1.37 mg/m^3, well below the permissible limit of 4.0 mg/m^3 prescribed by NAAQS.

Location 3: Oil Jetty (AL2)

Table 2 : Results of Air Pollutant Concentration at Oil Jetty										
	Date	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period		**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS Limit			**100 µg/m3**	**60 µg/m3**		**80 µg/m3**		**80 µg/m3**		**400 µg/m3**
AL2 -1	01.11.2022	150	99	50	2.42 4.53 2.72	3.22	6.35 13.27 21.35	13.66	2.88 6.79 3.91	4.53
AL2 -2	04.11.2022	253	180	70	2.72 3.32 4.53	3.53	5.77 17.89 11.54	11.73	0.81 4.03 4.72	3.18
AL2 -3	08.11.2022	235	166	67	2.59 3.46 1.44	2.50	5.19 13.27 23.66	14.04	2.19 2.65 3.57	2.80
AL2 -4	11.11.2022	275	194	76	6.35 4.53 2.72	4.53	10.39 20.20 12.12	14.24	2.42 3.80 1.04	2.42
AL2 – 5	15.11.2022	245	169	71	3.02 6.65 3.93	4.53	8.66 16.16 17.31	14.04	3.57 2.30 1.27	2.38
AL2 – 6	18.11.2022	185	119	53	5.74 2.72 6.35	4.94	14.43 17.31 8.66	13.47	4.95 3.57 2.99	3.84
AL2 – 7	22.11.2022	373	252	109	3.02 6.35 2.72	4.03	20.20 12.12 10.39	14.24	3.80 5.53 2.07	3.80
AL2 -8	25.11.2022	292	199	86	1.81 6.35 3.32	3.83	14.43 19.62 9.23	14.43	3.57 4.72 5.99	4.76
AL1 – 9	29.11.2022	299	194	97	3.63 7.55 2.72	4.63	5.19 23.66 11.54	13.47	2.88 4.95 2.65	3.49
Monthly Average		256	175	75		3.97		13.70		3.47
Standard Deviation		65	45	19		0.79		0.81		0.85

Table 3 : Results of Air Pollutant Concentration at Oil Jetty					
	Date	**C_6H_6 [µg/m^3]**	***NMHC**	**CO [mg/m^3]**	**CO2 [ppm]**
Sampling Period		**8 hr**		**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m3**		**4.0 mg/m3**	**-**
AL2-1	01.11.2022	1.17	BQL	1.22	467
AL2-2	04.11.2022	1.01	BQL	1.53	451
AL2-3	08.11.2022	1.1	BQL	1.65	502
AL2-4	11.11.2022	1.19	BQL	1.04	447
AL2 –5	15.11.2022	1.24	BQL	1.27	634
AL2 –6	18.11.2022	1.16	BQL	1.22	531
AL2-7	22.11.2022	1.2	BQL	1.28	800
AL2-8	25.11.2022	1.06	BQL	1.89	1023
AL2-9	29.11.2022	1.22	BQL	1.46	576
Monthly Average		**1.15**	**-**	**1.40**	**603.44**
Standard Deviation		**0.08**	**-**	**0.26**	**193.07**

* NMHC- Non- Methane Hydrocarbons
BQL- Below Quantification Limit (Quantification Limit – NMHC: 0.5 ppm)

Oil Jetty Area, the overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_2 and NH_3 was mainly by motor vehicle emission produced from various types of vehicles at Oil Jetty Area. The mean TSPM value at Oil Jetty was 256 µg/m^3. The mean PM_{10} value was 175 µg/m^3 and mean $PM_{2.5}$ value was 75 µg/m^3 which was above the permissible limit. The average values of SO_2, NO_2 and NH_3 were within the permissible limit prescribed by NAAQS. The mean concentration of SO_2, NO_2 and NH_3 were 3.97 µg/m^3, 13.70 µg/m^3 and 3.47 µg/m^3 respectively.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Oil Jetty. The mean Benzene concentration was 1.15 µg/m^3 which was well below the permissible limit of 5.0 µg/m^3. NMHC's were below the detectable limit and Carbon Monoxide concentration was 1.40 mg/m^3, well below the permissible limit of 4.0 mg/m^3.

Location 3: Kandla Colony – Estate Office (AL-3)

Table 4 : Results of Air Pollutant Concentration at Estate Office										
	Date	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period		**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS Limit			**100 µg/m3**	**60 µg/m3**		**80 µg/m3**		**80 µg/m3**		**400 µg/m3**
AL3 – 1	01.11.2022	245	172	69	1.51	2.32	10.39	9.62	3.68	5.10
					3.32		13.27		7.02	
					2.12		5.19		4.60	
AL3 – 2	04.11.2022	577	445	130	4.53	2.32	5.19	10.39	3.57	2.49
					1.51		17.31		2.88	
					0.91		8.66		1.04	
AL3 – 3	08.11.2022	440	321	109	6.05	3.94	19.04	12.31	4.72	3.64
					2.59		12.12		2.42	
					3.17		5.77		3.80	
AL3 – 4	11.11.2022	518	403	111	3.32	4.23	18.47	10.58	1.38	2.42
					2.72		8.66		3.57	
					6.65		4.62		2.30	
AL3 – 5	15.11.2022	451	340	107	1.81	3.73	23.08	15.97	3.22	2.42
					6.04		14.43		2.30	
					3.32		10.39		1.73	
AL3 – 6	18.11.2022	459	346	112	4.53	4.43	16.16	15.97	5.76	4.14
					2.72		8.66		4.72	
					6.04		23.08		1.96	
AL3 – 7	22.11.2022	453	325	116	2.42	4.33	19.62	17.31	3.91	3.84
					4.23		23.66		5.18	
					6.35		8.66		2.42	
AL3 – 8	25.11.2022	337	252	83	6.04	3.93	15.00	15.58	3.80	3.91
					3.32		23.08		5.76	
					2.42		8.66		2.19	
AL1 – 9	29.11.2022	491	359	129	4.84	4.63	17.89	16.16	3.57	3.57
					6.95		24.24		5.18	
					2.12		6.35		1.96	
Monthly Average		441	329	107		3.76		13.77		3.50
Standard Deviation		98	80	20		0.87		3.00		0.91

Table 4 : Results of Air Pollutant Concentration at Estate Office					
Sampling Period	**Date**	**C_6H_6 [µg/m³]**	***NMHC**	**CO [mg/m³]**	**CO_2 [ppm]**
		8 hr		**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m3**		**4.0 mg/m3**	**-**
AL3 -1	01.11.2022	1.06	BQL	1.27	508
AL3 -2	04.11.2022	1.1	BQL	1.19	508
AL3 -3	08.11.2022	1.1	BQL	1.65	502
AL3 -4	11.11.2022	1.09	BQL	1.83	429
AL3 – 5	15.11.2022	1.09	BQL	1.76	813
AL3 – 6	18.11.2022	1.2	BQL	1.14	559
AL3 – 7	22.11.2022	1.19	BQL	2.18	1022
AL3 – 8	25.11.2022	1.11	BQL	2	1026
	29.11.2022	1.06	BQL	1.22	537
Monthly Average		**1.11**	**-**	**1.58**	**656.00**
Standard Deviation		**0.05**	**-**	**0.39**	**234.02**

* NMHC- Non- Methane Hydrocarbons
BQL- Below Quantification Limit (Quantification Limit – NMHC: 0.5 ppm)

The overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_2 and NH_3 at Kandla Port Colony (Estate Office) was attributed by vehicle emission produced from trucks and heavy duty vehicles that pass through the road outside Kandla Port Colony. The mean TSPM values at Estate Office were 441 µg/m³, the mean PM_{10} value was 329 µg/m³, and $PM_{2.5}$ value was 107 µg/m³ which was above the permissible limit prescribed by NAAQS. The average values of SO_2, NO_2 and NH_3 were 3.76 µg/m³, 13.77 µg/m³ and 3.50 µg/m³ respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Kandla Port Colony. The mean Benzene concentration was 1.11 µg/m³, well below the permissible limit of 5.0 µg/m³. NMHC's were below the detectable limit and Carbon Monoxide was 1.58 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 4: Gopalpuri Hospital (AL-4)

Table 5 : Results of Air Pollutant Concentration at Gopalpuri Hospital										
	Date	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period		**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS Limit			**100 µg/m3**	**60 µg/m3**		**80 µg/m3**		**80 µg/m3**		**400 µg/m3**
AL4 -1	01.11.2022	107	67	34	1.21	2.22	5.77	6.93	2.42	2.53
					3.02		10.39		4.14	
					2.42		4.62		1.04	
AL4 -2	04.11.2022	177	117	54	0.91	2.22	5.19	10.00	1.61	2.49
					4.53		8.66		2.42	
					1.21		16.16		3.45	
AL4 -3	08.11.2022	148	101	44	1.15	2.21	6.93	9.81	1.73	1.69
					2.88		17.31		2.42	
					2.59		5.19		0.92	
AL4 -4	11.11.2022	184	111	68	1.51	2.62	6.93	12.89	1.04	2.30
					3.63		14.43		2.42	
					2.72		17.31		3.45	
AL4 – 5	15.11.2022	202	125	72	2.12	2.42	12.12	12.70	2.42	2.49
					3.63		8.66		3.45	
					1.51		17.31		1.61	
AL4 – 6	18.11.2022	233	153	78	1.21	2.92	8.66	12.89	2.42	2.49
					4.84		17.89		1.61	
					2.72		12.12		3.45	
AL4 – 7	22.11.2022	268	168	94	0.60	2.22	5.77	12.70	1.73	2.88
					3.32		14.43		3.68	
					2.72		17.89		3.22	
AL4 – 8	25.11.2022	202	142	56	2.12	3.42	14.43	12.50	2.07	2.99
					5.14		17.89		4.03	
					3.02		5.19		2.88	
AL1 – 9	29.11.2022	249	157	91	3.02	4.03	8.66	11.54	1.38	2.49
					6.35		20.20		3.80	
					2.72		5.77		2.30	
Monthly Average		197	127	66		2.70		11.33		2.49
Standard Deviation		50	32	20		0.65		2.05		0.37

Table 5 : Results of Air Pollutant Concentration at Gopalpuri Hospital					
Sampling Period	**Date**	**C_6H_6 [µg/m³]**	***NMHC**	**CO [mg/m³]**	**CO_2 [ppm]**
		8 hr		**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m3**		**4.0 mg/m3**	**-**
AL4 -1	01.11.2022	1.14	BQL	1.26	503
AL4 -2	04.11.2022	1.15	BQL	1.26	450
AL4 -3	08.11.2022	1.03	BQL	1.73	506
AL4 -4	11.11.2022	1.02	BQL	1.82	462
AL4 – 5	15.11.2022	1.09	BQL	1.04	1048
AL4 – 6	18.11.2022	1.14	BQL	1.32	543
AL4 – 7	22.11.2022	1.16	BQL	1.83	758
AL4 – 8	25.11.2022	1.22	BQL	1.8	816
AL4 – 9	29.11.2022	1.16	BQL	1.36	665
Monthly Average		**1.12**	**-**	**1.49**	**639.00**
Standard Deviation		**0.07**	**-**	**0.30**	**201.83**

* NMHC- Non- Methane Hydrocarbons
BQL- Below Quantification Limit (Quantification Limit – NMHC: 0.5 ppm)

The overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_2 and NH_3 at Gopalpuri Hospital was attributed by vehicle emission produced from light motor vehicles of the colony residents. The mean TSPM values at Gopalpuri Hospital were 197 µg/m³, the mean PM_{10} value was 127 µg/m³ and $PM_{2.5}$ was 66 µg/m³ which was exceed the standard limit. The average values of SO_2, NO_2 and NH_3 were 2.70 µg/m³, 11.33 µg/m³ and 2.49 µg/m³ respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Gopalpuri Hospital. The mean Benzene concentration was 1.12 µg/m³, well below the permissible limit of 5.0 µg/m³. NMHC's were below the detectable limit and Carbon monoxide concentration was 1.49 mg/m³ which is well below the permissible limit of 4.0 mg/m³.

Location 5: Coal Storage Area (AL-5)

Table 6 : Results of Air Pollutant Concentration at Coal Storage Area										
	Date	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period		**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS Limit			**100 µg/m3**	**60 µg/m3**		**80 µg/m3**		**80 µg/m3**		**400 µg/m3**
AL6 – 1	01.11.2022	779	598	175	2.72 6.65 3.63	4.33	6.35 25.97 17.31	16.54	3.68 8.17 3.34	5.06
AL6 – 2	04.11.2022	635	492	137	2.12 5.44 3.02	3.53	23.08 12.12 17.89	17.70	6.79 8.17 4.83	6.60
AL6 – 3	08.11.2022	538	412	125	8.94 3.46 2.59	5.00	23.66 12.12 29.43	21.74	2.53 2.07 7.02	3.88
AL6 – 4	11.11.2022	815	635	178	4.53 2.72 6.95	4.73	18.47 8.66 25.97	17.70	5.87 2.65 4.72	4.41
AL6 – 5	15.11.2022	792	614	176	6.35 9.07 4.53	6.65	18.47 10.39 12.12	13.66	4.72 3.68 3.22	3.88
AL6 – 6	18.11.2022	771	595	171	9.37 5.74 6.35	7.15	20.20 8.08 23.08	17.12	4.83 2.53 5.76	4.37
AL6 – 7	22.11.2022	706	543	156	4.84 6.04 2.72	4.53	10.39 23.66 21.35	18.47	4.83 5.99 4.26	5.03
AL6 – 8	25.11.2022	846	654	187	3.32 7.86 4.53	5.24	17.31 25.97 16.16	19.81	3.91 6.91 4.03	4.95
AL1 – 9	29.11.2022	801	621	172	5.14 9.07 2.72	5.64	16.16 28.86 9.81	18.28	3.57 6.22 3.11	4.30
Monthly Average		743	574	164		5.20		17.89		4.72
Standard Deviation		99	78	21		1.14		2.22		0.84

Table 6 : Results of Air Pollutant Concentration at Coal Storage Area					
Sampling Period	**Date**	**C_6H_6 [µg/m^3]**	***NMHC**	**CO [mg/m^3]**	**CO_2 [ppm]**
		8 hr		**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m3**		**4.0 mg/m3**	**-**
AL5 – 1	01.11.2022	1.1	BQL	1.12	483
AL5 – 2	04.11.2022	1.06	BQL	1.48	475
AL5 – 3	08.11.2022	1.08	BQL	1.66	421
AL5 – 4	11.11.2022	1.06	BQL	1.69	492
AL5 – 5	15.11.2022	1.06	BQL	1.06	702
AL5 – 6	18.11.2022	1.22	BQL	1.18	483
AL5 – 7	22.11.2022	1.11	BQL	1.86	564
AL5 – 8	25.11.2022	1.2	BQL	1.54	777
AL5 – 9	29.11.2022	1.22	BQL	1.89	895
Monthly Average		**1.12**	**-**	**1.50**	**588.00**
Standard Deviation		**0.07**	**-**	**0.31**	**164.11**

* NMHC- Non- Methane Hydrocarbons
BQL- Below Quantification Limit (Quantification Limit – NMHC: 0.5 ppm)

The overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_2 and NH_3 at Coal Storage Area was comparatively highest among all the locations of Air Quality monitoring in Kandla Port. High values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_2 at this location was due to lifting of coal with grab and other coal handling processes near Berth no. 6 & 7. Moreover, the traffic was also heavy around this place for transport of coal thus emissions produced from heavy vehicles. The mean TSPM values at Coal storage were 743 µg/m^3, the mean PM_{10} value was 574 µg/m^3, and the $PM_{2.5}$ value was164 µg/m^3 which was above the permissible limit prescribed by NAAQS. The average values of SO_2, NO_2 and NH_3 were 5.20 µg/m^3, 17.89 µg/m^3 and 4.72 µg/m^3 respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Coal Storage Area. The mean Benzene concentration was1.12 µg/m^3, well below the permissible limit of 5.0 µg/m^3. NMHC's were below the detectable limit and Carbon Monoxide concentration was 1.50 mg/m^3, well below the permissible limit of 4.0 mg/m^3.

Location 6: Tuna Port (AL-6)

Table 7 : Results of Air Pollutant Concentration at Tuna Port										
	Date	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period		**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS Limit			**100 µg/m3**	**60 µg/m3**		**80 µg/m3**		**80 µg/m3**		**400 µg/m3**
AL5 -1	01.11.2022	141	88	47	0.91	1.61	2.89	6.16	2.07	2.84
					2.72		12.12		4.03	
					1.21		3.46		2.42	
AL5 – 2	04.11.2022	232	166	64	1.51	2.22	6.35	7.89	1.38	2.76
					3.02		5.19		4.49	
					2.12		12.12		2.42	
AL5 – 3	08.11.2022	184	120	55	1.44	2.40	10.39	13.08	1.73	2.61
					3.46		11.54		2.65	
					2.31		17.31		3.45	
AL5 – 4	11.11.2022	233	153	78	2.12	2.32	11.54	11.54	1.27	1.57
					3.93		17.89		1.04	
					0.91		5.19		2.42	
AL5 – 5	15.11.2022	221	145	74	1.21	2.32	6.35	12.12	3.57	2.49
					3.32		12.12		2.30	
					2.42		17.89		1.61	
AL5 – 6	18.11.2022	248	162	83	1.81	2.01	17.31	17.12	2.30	10.21
					1.21		23.66		15.57	
					3.02		10.39		12.76	
AL5 – 7	22.11.2022	214	139	74	1.51	2.52	8.66	8.46	3.57	2.84
					2.72		12.70		2.88	
					3.32		4.04		2.07	
AL5 – 8	25.11.2022	255	175	77	2.72	3.02	8.66	8.08	3.45	3.30
					4.84		11.54		4.72	
					1.51		4.04		1.73	
AL1 – 9	29.11.2022	245	155	87	1.51	3.63	12.70	11.73	1.04	2.88
					6.04		17.31		5.18	
					3.32		5.19		2.42	
Monthly Average		219	145	71		2.45		10.69		3.50
Standard Deviation		36	27	13		0.58		3.37		2.56

Table 7 : Results of Air Pollutant Concentration at Tuna Port					
	Date	C_6H_6 [µg/m^3]	*NMHC	CO [mg/m^3]	CO_2 [ppm]
Sampling Period		8 hr		Grab Sampling	Grab Sampling
NAAQMS limit		5.0 µg/m3		4.0 mg/m3	-
AL6 -1	01.11.2022	1.12	BQL	1.43	543
AL6 – 2	04.11.2022	1.17	BQL	1.41	463
AL6 – 3	08.11.2022	1.13	BQL	1.39	410
AL6 – 4	11.11.2022	1.13	BQL	1.74	509
AL6 – 5	15.11.2022	1.17	BQL	1.08	911
AL6 – 6	18.11.2022	1.17	BQL	1.1	528
AL6 – 7	22.11.2022	1.06	BQL	1.88	565
AL6 – 8	25.11.2022	1.1	BQL	1.89	999
	29.11.2022	1.22	BQL	1.89	895
Monthly Average		1.14	-	1.53	647.00
Standard Deviation		0.05	-	0.33	222.45

* NMHC- Non- Methane Hydrocarbons
BQL- Below Quantification Limit (Quantification Limit – NMHC: 0.5 ppm)

The mean TSPM values at Tuna Port was 219 µg/m^3, the mean PM_{10} value was 145 µg/m^3 and the mean $PM_{2.5}$ value was 71 µg/m^3 which was exceed the standard limit prescribed by NAAQS. The average values of SO_2, NO_2 and NH_3 were 2.45 µg/m^3, 10.69 µg/m^3 and 3.50 µg/m^3 respectively and were all within the standard limit prescribed by NAAQS.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Tuna Port. The mean Benzene concentration was 1.14 µg/m3, well below the permissible limit of 5.0 µg/m^3. NMHC's were below the detectable limit and Carbon Monoxide concentration was 1.53 mg/m^3, well below the permissible limit of 4.0 mg/m^3.

Location 7: Admin Building (Vadinar) (AL-7)

Table 8 : Results of Air Pollutant Concentration at Admin Building										
	Date	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period		**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS Limit			**100 µg/m3**	**60 µg/m3**		**80 µg/m3**		**80 µg/m3**		**400 µg/m3**
AL7 -1	01.11.2022	150	98	51	2.20 4.84 3.52	3.52	9.53 16.51 5.72	10.59	5.36 2.81 7.66	5.28
AL7 -2	04.11.2022	177	115	61	3.08 7.03 3.96	4.69	17.78 21.60 26.04	21.81	2.81 8.93 6.64	6.13
AL7 -3	08.11.2022	193	113	73	6.15 8.79 3.96	6.30	6.99 20.96 6.35	11.43	3.83 10.47 8.17	7.49
AL7 -4	11.11.2022	200	121	78	3.96 5.28 8.79	6.01	17.78 22.23 5.72	15.24	10.47 5.87 4.08	6.81
AL7 -5	15.11.2022	179	108	69	1.76 5.71 8.35	5.28	7.62 26.04 20.33	18.00	3.06 5.87 7.91	5.62
AL7 -6	18.11.2022	223	121	96	2.64 4.40 6.59	4.54	8.89 16.51 19.69	15.03	5.62 8.17 3.32	5.70
AL1 -7	22.11.2022	162	104	57	4.84 7.03 3.96	5.28	14.61 5.72 23.50	14.61	13.02 8.68 5.62	9.10
AL1-8	25.11.2022	237	138	97	6.59 3.96 2.64	4.40	9.53 14.61 21.60	15.24	7.91 5.62 10.47	8.00
AL1-9	28.11.2022	203	112	87	3.96 2.20 4.84	3.66	6.99 14.61 19.69	13.76	5.62 7.91 4.60	6.04
Monthly Average		191	114	74		4.85		15.08		6.68
Standard Deviation		28	12	17		0.96		3.34		1.28

Table 8 : Results of Air Pollutant Concentration at Admin Building Vadinar					
Sampling Period	**Date**	**C_6H_6 [µg/m^3]**	***NMHC**	**CO [mg/m^3]**	**CO_2 [ppm]**
		8 hr		**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m3**		**4.0 mg/m3**	**-**
AL7 -1	01.11.2022	1.08	BQL	1.43	225
AL7 -2	04.11.2022	1.13	BQL	1.54	236
AL7 -3	08.11.2022	1.17	1.81	1.53	455
AL7 -4	11.10.2022	1.14	BQL	1.61	443
AL7 -5	15.10.2022	1.03	BQL	1.1	347
AL7 -6	18.10.2022	1.06	BQL	1.57	416
AL7 -7	22.10.2022	1.10	BQL	1.05	372
AL7 -8	25.10.2022	1.20	BQL	1.79	464
AL7 -9	28.10.2022	1.13	BQL	1.42	487
Monthly Average		**1.12**	**-**	**1.46**	**388**
Standard Deviation		**0.06**	**-**	**0.25**	**75**

*NMHC- Non- Methane Hydrocarbons
BQL- Below Quantification Limit (Quantification Limit – NMHC: 0.5 ppm)

At Admin Building, Vadinar the mean TSPM value was 191 µg/m^3, the mean PM_{10} value was 114 µg/m^{3}and the mean $PM_{2.5}$ value was 74 µg/m^3 which was slightly exceed the standard limit. The average values of SO_2, NO_2 and NH_3 concentrations were 4.85 µg/m^3, 15.08 µg/m^3 and 6.68 µg/m^3 respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Vadinar Port. The mean Benzene concentration was 1.12 µg/m^3, well below the permissible limit of 5.0 µg/m^3. NMHC's were below the detectable limit and Carbon Monoxide concentration was 1.46 mg/m^3, well below the permissible limit of 4.0 mg/m^3.

Location 8: Signal Building (Vadinar) (AL-8)

Table 9 : Results of Air Pollutant Concentration at Signal Building, Vadinar										
	Date	TSPM [µg/m3]	PM10 [µg/m3]	PM2.5 [µg/m3]	SO2 [µg/m3]		NOx [µg/m3]		NH3 [µg/m3]	
Sampling Period		24hr	24hr	24hr	8 hr	24hr (Avg.)	8 hr	24hr (Avg.)	8 hr	24hr (Avg.)
NAAQMS Limit			100 µg/m3	60 µg/m3		80 µg/m3		80 µg/m3		400 µg/m3
AL8 -1	01.11.2022	113	74	38	3.96	4.40	6.99	13.34	2.30	7.15
					6.59		19.05		8.68	
					2.64		13.97		10.47	
AL8 -2	04.11.2022	146	93	49	2.64	4.40	14.61	15.88	5.36	6.13
					4.84		22.23		8.42	
					5.71		10.80		4.60	
AL8 -3	08.11.2022	124	82	42	3.08	3.52	14.61	16.73	5.62	5.62
					5.28		26.04		7.91	
					2.20		9.53		3.32	
AL8 -4	11.11.2022	175	105	67	2.20	4.40	8.26	13.76	8.93	9.02
					7.03		19.05		12.76	
					3.96		13.97		5.36	
AL8 -5	15.11.2022	152	97	52	3.52	4.98	5.72	13.13	6.89	7.57
					4.84		13.34		10.98	
					6.59		20.33		4.85	
AL8 -6	18.11.2022	176	111	61	3.08	3.81	15.24	17.57	7.15	8.42
					3.96		26.04		7.91	
					4.40		11.43		10.21	
AL8 -7	22.11.2022	214	118	93	3.52	5.71	5.72	12.91	7.91	8.25
					5.28		13.34		6.38	
					8.35		19.69		10.47	
AL8-8	25.11.2022	219	125	92	3.08	4.54	9.53	11.01	5.36	6.04
					4.84		17.78		8.17	
					5.71		5.72		4.60	
AL8-9	28.11.2022	154	97	57	5.71	3.81	10.80	16.94	7.15	8.76
					3.96		22.23		8.93	
					1.76		17.78		10.21	
Monthly Average		164	100	61		4.40		14.59		7.44
Standard Deviation		36	16	20		0.67		2.25		1.27

Table 9 : Results of Air Pollutant Concentration at Signal Building Vadinar					
	Date	C_6H_6 [µg/m^3]	*NMHC	CO [mg/m^3]	CO_2 [ppm]
Sampling Period		**8 hr**		**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m3**		**4.0 mg/m3**	**-**
AL8 -1	01.11.2022	1.06	BQL	1.5	467
AL8 -2	04.11.2022	1.05	BQL	1.46	501
AL8 -3	08.11.2022	1.14	1.81	1.31	489
AL8 -4	11.11.2022	1.16	BQL	1.38	439
AL8 -5	15.11.2022	1.17	BQL	1.29	231
AL8 -6	18.11.2022	1.10	BQL	1.31	244
AL8 -7	22.11.2022	1.00	BQL	1.34	227
AL8 -8	25.11.2022	1.05	BQL	1.37	261
AL8 -9	28.11.2022	1.02	BQL	1.29	234
Monthly Average		**1.16**	**-**	**1.46**	**442**
Standard Deviation		**0.05**	**-**	**0.27**	**63**

* NMHC- Non- Methane Hydrocarbon
BQL- Below Quantification Limit (Quantification Limit – NMHC: 0.5 ppm)

At Signal Building, Vadinar the mean TSPM value was 164 µg/m^3, the mean PM_{10} value was 100 µg/m^3 which was boundary line of the permissible limit, the mean $PM_{2.5}$ value was 61 µg/m^3 which was within the permissible limit. The average values of SO_2, NO_2 and NH_3 concentrations were 4.40 µg/m^3, 14.59 µg/m^3 and 7.44 µg/m^3 respectively and were all within the standard limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Vadinar Port. The mean Benzene concentration was 1.16 µg/m^3, well below the standard limit of 5.0 µg/m^3. NMHC's were below the detectable limit and Carbon Monoxide concentration was 1.46 mg/m^3, well below the standard limit of 4.0 mg/m^3.

Fig. No:-1 Average ambient air qulaity (PM) month of November-2022 at DPA and Vadinar Sampling Station

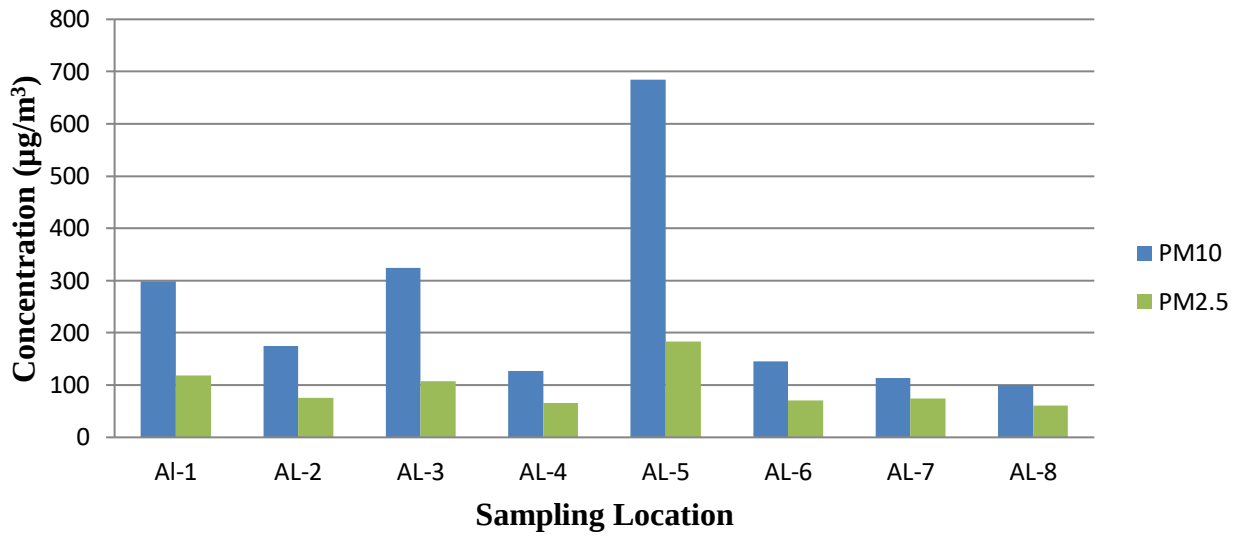


Fig. No:-2. Average ambient air qulaity (Gaseous) month of November-2022 at DPA and Vadinar sampling location

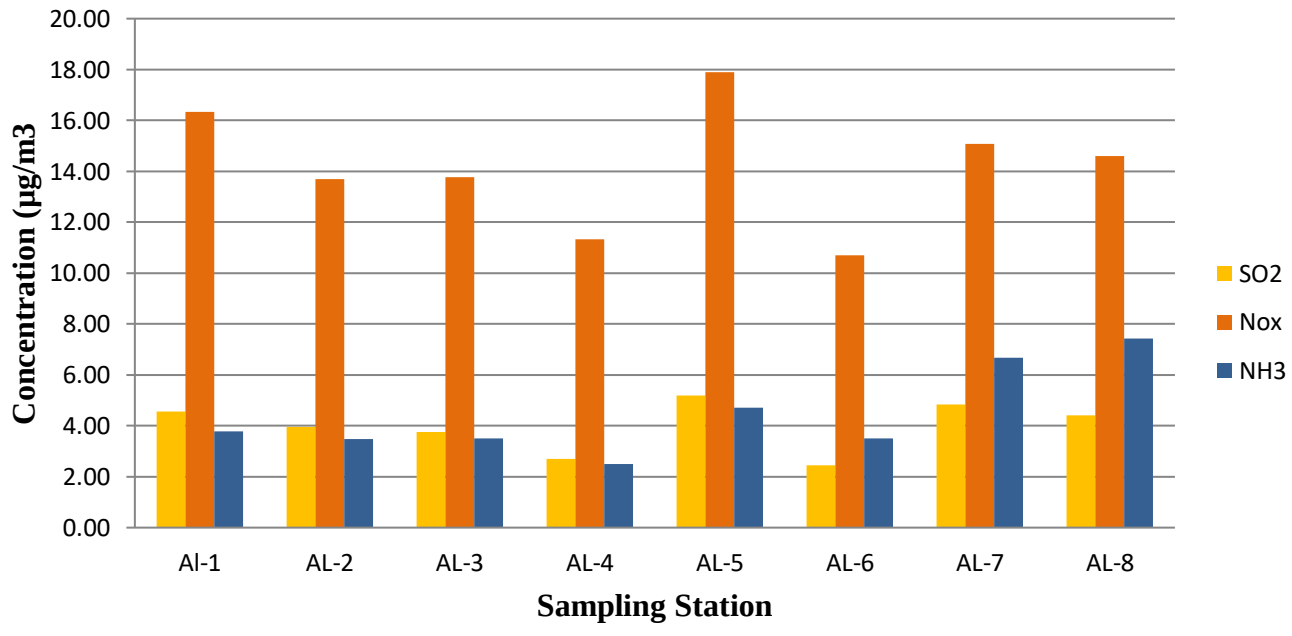


Fig. No:-3. Average ambient air qulaity (Gaseous) month of November-2022 at DPA and Vadinar sampling location

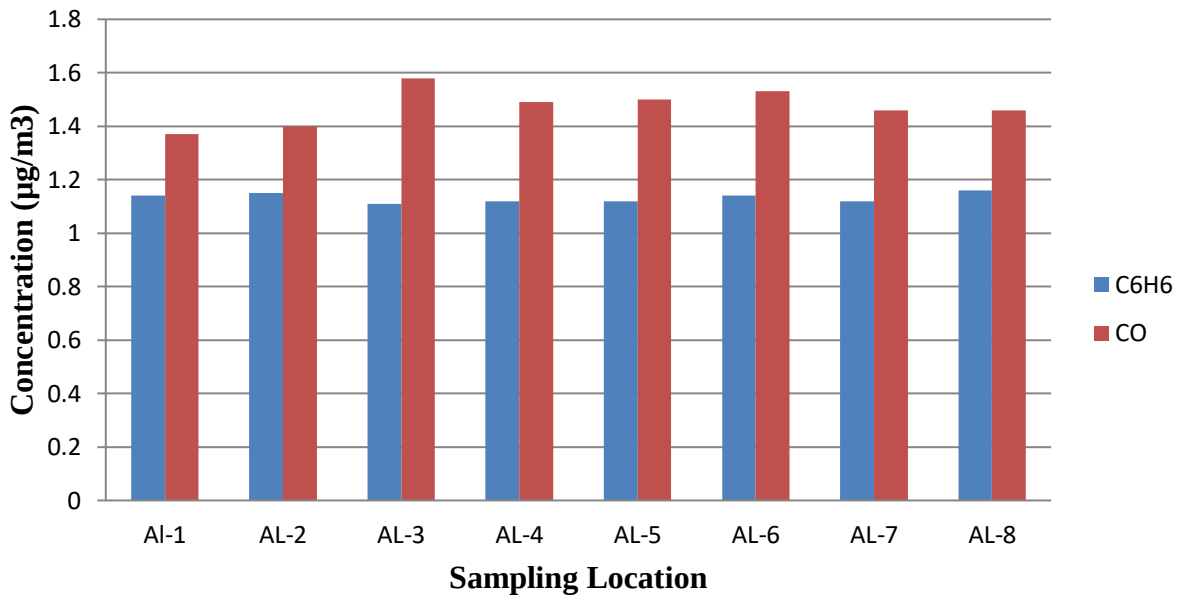
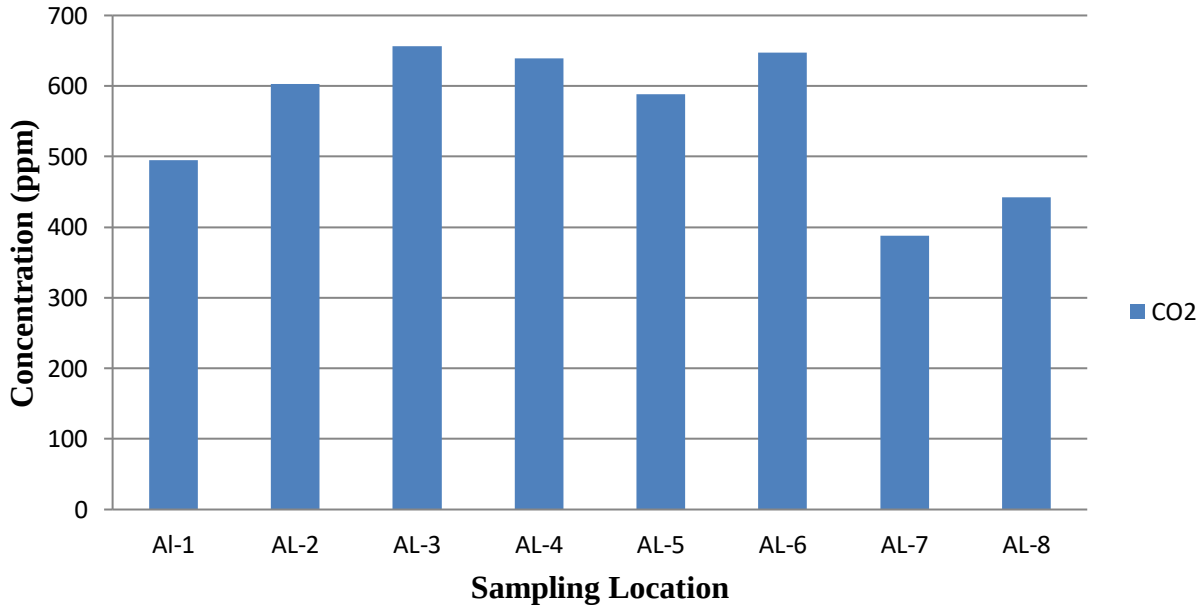


Fig. No:-4. Average ambient air qulaity (Gaseous) month of November-2022 at DPA and Vadinar sampling location



2.3 Observations and Conclusion

During the monitoring period, the overall Ambient Air Quality of the port area was found within permissible levels for various gaseous pollutants. However, Total Suspended Particulate matter as TSPM, Particulate matter as PM_{10} and $PM_{2.5}$ was found to exceed the limits at locations at all ambient air sampling location.

The concentration of PM_{10} and $PM_{2.5}$ were slightly exceeded at Gopalpuri and Tuna Port.

The mean concentration of PM_{10} and $PM_{2.5}$ were slightly exceeded at Admin building Vadinar & at Signal building Vadinar was very close to the standard limit.

CHAPTER-3

METEOROLOGICAL OBSERVATIONS

4.1 Meteorological Data

Automatic Weather station (ID KAZPHOEN424) have been installed in Seva Sadan-3 at the Deendayal Port which records the data on Temperature (°C), Relative Humidity (%),Wind speed (m/s),Wind Direction (°), Solar radiation (w/m^2) and Rainfall mm.

Meteorological factors play an important role in environmental pollution studies particularly in pollutant transport irrespective of their entry into the environment. The wind speed and direction play a major role in dispersion of environment pollutants. Effects of pollution on receptors animate and inanimate depends on atmospheric condition.

Temperature

At Deendayal Port, the day time temperature was found range 21.1-32.9^{0}C. The average day time temperature was 27.92°C. The night time temperature was range from 20.0-29.7^{0}C. The mean night time temperature recorded was 25.47 °C.

Solar Radiation

The mean Solar Radiation in November month was 167.27 w/m^2. The maximum solar radiation was recorded 759.0 w/m^2 in 4th November, 2022 and the minimum solar radiation was recorded 1.80 w/m^2 in 30th November, 2022.

Rainfall

Rain fall of November month was recorded 0.00 mm.

Relative Humidity

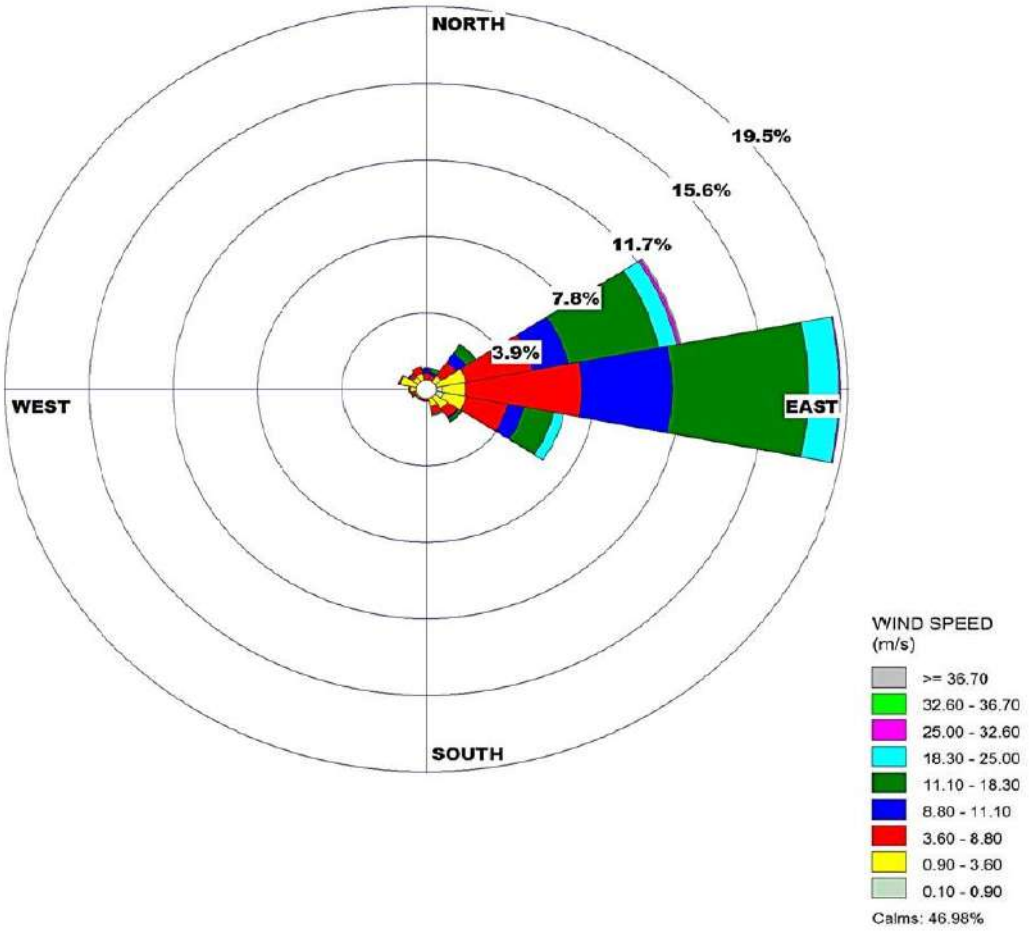
The mean Relative humidity was 69.00 % for the month of November. Maximum Relative humidity was recorded 99.0 % and minimum Relative humidity was recorded 34.0 %.

Wind Velocity and Wind Direction

Velocity and direction of wind have a significant role in the dispersion of air borne materials and therefore determines the air quality of the area. The average wind velocity for the entire month of November was 1.21 m/s. Maximum wind velocity was recorded 10.19 m/s. The wind direction was mostly North-East.

WIND ROSE PLOT:
M/s. Deendayal Port Authority (DPA)
Project Site, Sevasadan-3, Kandla Port.

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:	**DATA PERIOD:** Start Date: 01-11-2022 - 00:00 End Date: 30-11-2022 - 23:00	**COMPANY NAME:** M/s. Deendayal Port Authority (DPA)	
		MODELER: M/s. Eco Chem Sales & Services	
	CALM WINDS: 46.98%	**TOTAL COUNT:** 1438 hrs.	
	AVG. WIND SPEED: 4.33 m/s	**DATE:** 09-12-2022	**PROJECT NO.:**

WRPLOT View - Lakes Environmental Software

CHAPTER-4

DRINKING WATER QUALITY MONITORING

4.0 Drinking Water Quality Monitoring

Drinking Water Quality Monitoring was carried out at twenty stations at Kandla, Vadinar & Township Area of Deendayal Port.

Table No:-10. Drinking Water Sampling Location

Sr. No.	Name of Location	Location Code	Latitude	Longitude
1.	Nirman Building	DL-1	23° 0' 27"N	70° 13' 21"E
2.	P & C Building	DL-2	23° 0' 33"N	70° 13' 20"E
3.	North Gate	DL-3	23° 0' 26.97"N	70° 13' 21.87"E
4.	KPT-Canteen	DL-4	23° 2' 17.2674"N	70° 13'18.2814"E
5.	West Gate	DL-5	23° 59' 40.48"N	70° 12' 50.96"E
6.	Wharf Area	DL-6	22° 59' 52.2"N	70° 13' 22.95"E
7.	Sevasadan-3	DL-7	23° 0' 22.55"N	70° 13' 15.34"E
8.	Workshop	DL-8	23° 0' 33.74"N	70° 13' 20.05"E
9.	Custom Building	DL-9	23° 1' 8.70"N	70° 12' 52.0"E
10.	Kandla Colony	DL-10	23° 11' 14.9"N	70° 12' 48.4"E
11.	KPT Hospital	DL-11	23° 1' 5.02"N	70° 12' 44.38"E
12.	A.O. Building	DL-12	23° 3' 42.89"N	70° 8' 41.5"E
13.	Gopalpuri School	DL-13	23° 5' 1.03"N	70° 7' 55.42"E
14	Gopalpuri Guest House	DL-14	23° 4' 43.14"N	70° 7' 51.92"E
15.	E-Type Quarters	DL-15	23° 4' 59.90"N	70° 7' 56.72"E
16.	F-Type Quarters	DL-16	23° 4' 38.45"N	70° 8' 8.63"E
17.	Gopalpuri Hospital	DL-17	23° 4' 54.09"N	70° 8' 7.5"E
18.	Tuna Port	DL-18	23° 58' 23.06"N	70° 5' 35.6"E
19.	Vadinar Jetty	DL-19	22° 25' 51.73"N	69° 41' 36.62"E
20.	Vadinar Colony	DL-20	22° 30' 26.25"N	69° 39' 45.03"E

4.1 Drinking Water Monitoring Methodology

Samples for physico-chemical analysis were collected in 2 Carboys and samples for microbiological parameters were collected in sterilized bottles. These samples were then analyzed in laboratory for various drinking water parameters at Kandla Lab/Surat.

The Sampling was done as per IS: 3025 Part-1, analysis was done as per IS: 3025/APHA standard methods and, the analysis results compare with IS 10500:2012. The water samples were analyzed for various parameters, viz. Color , Odor, Turbidity , Conductivity , pH , Chlorides , TDS, Total Hardness, Iron , Sulphate, Salinity , DO, BOD, Na, K, Ca, Mg, F, NO_3, NO_2, Mn, Cr-6, Cu, Cd, As, Hg, Pb, Zn, Bacterial Count (CFU) .

4.2 Results

The Drinking Water Quality monitoring data for 20 stations are given in below from table No. 11 to Table No. 17

Table 11: Drinking Water Quality Monitoring Parameters for Nirman Building, P & C Building and Main Gate (North) at Kandla.

Sr. No.	Parameter	Unit	Nirman Building 1	P & C Building	Main Gate North	Acceptable Limits as per IS 10500 :2012 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	-	7.35	7.33	7.41	7.35	6.5 to 8.5
2	Total Dissolved Solids	mg/l	690	670	670	690	2000
3	Turbidity	NTU	0	1	1	0	5
4	Odor	-	Odorless	Odorless	Odorless	Agreeable	Agreeable
5	Color	-	Colorless	Colorless	Colorless	5	15
6	Conductivity	µs/cm	1229	1194	1211	NS*	NS*
7	Biochemical Oxygen	mg/l	BQL	BQL	BQL	NS*	NS*
8	Chloride as Cl	mg/l	576.28	355.79	340.76	250	1000
9	Ca as Ca	mg/l	43.29	41.68	39.28	75	200
10	Mg as Mg	mg/l	58.8060	57.3480	56.3760	30	100
11	Total Hardness	mg/l	350	340	330	200	600
12	Iron as Fe	mg/l	BQL	BQL	BQL	0.3	No Relaxation
13	Fluorides as F	mg/l	0.35	0.37	0.31	1	1.5
14	Sulphate as SO_4	mg/l	35.80	30.20	28.30	200	400
15	Nitrite as NO_2	mg/l	BQL	BQL	BQL	NS*	NS*
16	Nitrate as NO_3	mg/l	12.70	16.70	15.50	45	No Relaxation
17	Salinity	‰	1.04	0.64	0.62	NS*	NS*
18	Sodium as Na	mg/l	204.00	180.00	192.00	NS*	NS*
19	Potassium as K	mg/l	3.22	3.15	3.18	NS*	NS*
20	Manganese	mg/l	BQL	BQL	BQL	0.1	0.3
21	Hexavalent Chromium	mg/l	BQL	BQL	BQL	NS*	NS*
22	Copper	mg/l	BQL	BQL	BQL	0.05	1.5
23	Cadmium	mg/l	BQL	BQL	BQL	0.003	NS*
24	Arsenic	mg/l	BQL	BQL	BQL	0.01	0.05
25	Mercury	mg/l	BQL	BQL	BQL	0.001	NS*
26	Lead	mg/l	BQL	BQL	BQL	0.01	NS*
27	Zinc	mg/l	BQL	BQL	BQL	5	15
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

BQL- Below Quantification Limit, (BOD-2.0 mg/l, Fe- 0.009 mg/l, Mn- 0.01 mg/l, Cr^{+6}- 0.03 mg/l, Cu- 0.004 mg/l, Cd- 0.003 mg/l, As- 0.003mg/l, Hg- 0.001 mg/l, Pb- 0.006mg/l, Zinc- 0.021 mg/l).

Table 12: Drinking Water Quality Monitoring Parameters for Canteen, West Gate – I & Wharf Area at Kandla

Sr. No.	Parameter	Unit	Canteen	West Gate – I	Wharf Area	Acceptable Limits as per IS 10500 :	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	-	7.48	7.52	7.36	7.48	6.5 to 8.5
2	Total Dissolved Solids	mg/l	640	650	680	640	2000
3	Turbidity	NTU	0	1	0	0	5
4	Odor	-	Odorless	Odorless	Odorless	Agreeable	Agreeable
5	Color	-	Colorless	Colorless	Colorless	5	15
6	Conductivity	µs/cm	1166	1152	1196	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	BQL	BQL	BQL	NS*	NS*
8	Chloride as Cl	mg/l	335.75	360.80	350.78	250	1000
9	Ca as Ca	mg/l	40.88	38.48	40.08	75	200
10	Mg as Mg	mg/l	62.6940	66.5820	53.4600	30	100
11	Total Hardness	mg/l	360	370	320	200	600
12	Iron as Fe	mg/l	BQL	BQL	BQL	0.3	No Relaxation
13	Fluorides as F	mg/l	0.32	0.30	0.35	1	1.5
14	Sulphate as SO4	mg/l	31.20	28.30	26.00	200	400
15	Nitrite as NO_2	mg/l	BQL	BQL	BQL	NS*	NS*
16	Nitrate as NO_3	mg/l	6.60	11.40	5.80	45	No Relaxation
17	Salinity	‰	0.61	0.65	0.63	NS*	NS*
18	Sodium as Na	mg/l	202.00	200.00	-	NS*	NS*
19	Potassium as K	mg/l	3.38	3.48	3.16	NS*	NS*
20	Manganese	mg/l	BQL	BQL	BQL	0.1	0.3
21	Hexavalent Chromium	mg/l	BQL	BQL	BQL	NS*	NS*
22	Copper	mg/l	BQL	BQL	BQL	0.05	1.5
23	Cadmium	mg/l	BQL	BQL	BQL	0.003	NS*
24	Arsenic	mg/l	BQL	BQL	BQL	0.01	0.05
25	Mercury	mg/l	BQL	BQL	BQL	0.001	NS*
26	Lead	mg/l	BQL	BQL	BQL	0.01	NS*
27	Zinc	mg/l	BQL	BQL	BQL	5	15
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified,
BQL- Below Quantification Limit, (Nitrite - 0.05 mg/l,BOD-2.0 mg/l, Fe-0.009 mg/l,Mn- 0.01 mg/l, Cr+6- 0.03 mg/l, Cu-0.004 mg/l, Cd-0.003 mg/l, As-0.003mg/l, Hg-0.001 mg/l, Pb-0.006mg/l, Zinc-0.021 mg/l).

Table 13: Drinking Water Quality Monitoring Parameters for Sewa sadan–3, Workshop I and Custom Building at Kandla

Sr. No.	Parameter	Unit	Sewa Sadan – 3	Workshop	Custom Building	Acceptable Limits as per IS 10500 : 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	-	7.45	7.38	7.29	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	700	670	910	500	2000
3	Turbidity	NTU	0	1	1	1	5
4	Odor	-	Odorless	Odorless	Odorless	Agreeable	Agreeable
5	Color	-	Colorless	Colorless	Colorless	5	15
6	Conductivity	µs/cm	1213	1164	1564	NS*	NS*
7	Biochemical	mg/l	BQL	BQL	BQL	NS*	NS*
8	Chloride as Cl	mg/l	365.81	370.82	340.76	250	1000
9	Ca as Ca	mg/l	42.48	37.68	39.28	75	200
10	Mg as Mg	mg/l	59.2920	59.7780	53.9460	30	100
11	Total Hardness	mg/l	350	340	320	200	600
12	Iron as Fe	mg/l	BQL	BQL	BQL	0.3	No Relaxation
13	Fluorides as F	mg/l	0.41	0.30	0.35	1	1.5
14	Sulphate as SO_4	mg/l	24.90	34.20	27.2	200	400
15	Nitrite as NO_2	mg/l	BQL	BQL	BQL	NS*	NS*
16	Nitrate as NO_3	mg/l	6.90	3.90	11.00	45	No Relaxation
17	Salinity	‰	0.66	0.67	0.62	NS*	NS*
18	Sodium as Na	mg/l	-	-	-	NS*	NS*
19	Potassium as K	mg/l	3.26	4.03	3.29	NS*	NS*
20	Manganese	mg/l	BQL	BQL	BQL	0.1	0.3
21	Hexavalent Chromium	mg/l	BQL	BQL	BQL	NS*	NS*
22	Copper	mg/l	BQL	BQL	BQL	0.05	1.5
23	Cadmium	mg/l	BQL	BQL	BQL	0.003	NS*
24	Arsenic	mg/l	BQL	BQL	BQL	0.01	0.05
25	Mercury	mg/l	BQL	BQL	BQL	0.001	NS*
26	Lead	mg/l	BQL	BQL	BQL	0.01	NS*
27	Zinc	mg/l	BQL	BQL	BQL	5	15
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified,
BQL- Below Quantification Limit, (Nitrite - 0.05 mg/l,BOD-2.0 mg/l, Fe-0.009 mg/l, Mn- 0.01 mg/l, Cr+6- 0.03 mg/l, Cu-0.004 mg/l, Cd-0.003 mg/l, As-0.003mg/l, Hg-0.001 mg/l, Pb-0.006mg/l, Zinc-0.021 mg/l).

Table 14: Drinking Water Quality Monitoring Parameters for Port Colony Kandla, Hospital Kandla and A.O. Building at Gandhidham.

Sr. No.	Parameter	Unit	Port Colony Kandla	Hospital Kandla	A.O. Building	Acceptable Limits as per IS 10500 : 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 :
1	pH	-	7.39	7.31	7.24	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	760	710	1060	500	2000
3	Turbidity	NTU	1	0	0	1	5
4	Odor	-	Odorless	Odorless	Odorless	Agreeable	Agreeable
5	Color	-	Colorless	Colorless	Colorless	5	15
6	Conductivity	µs/cm	1328	1251	1821	NS*	NS*
7	Biochemical	mg/l	BQL	BQL	BQL	NS*	NS*
8	Chloride as Cl	mg/l	335.75	345.77	365.81	250	1000
9	Ca as Ca	mg/l	41.68	42.48	40.88	75	200
10	Mg as Mg	mg/l	50.0580	54.4320	62.6940	30	100
11	Total Hardness	mg/l	310	330	360	200	600
12	Iron as Fe	mg/l	BQL	BQL	BQL	0.3	No Relaxation
13	Fluorides as F	mg/l	0.35	0.32	0.46	1	1.5
14	Sulphate as SO_4	mg/l	28.10	24.50	24.50	200	400
15	Nitrite as NO_2	mg/l	BQL	BQL	BQL	NS*	NS*
16	Nitrate as NO_3	mg/l	20.20	7.40	15.60	45	No Relaxation
17	Salinity	‰	0.61	0.62	0.66	NS*	NS*
18	Sodium as Na	mg/l	192.80	193.60	194.50	NS*	NS*
19	Potassium as K	mg/l	4.13	4.18	3.26	NS*	NS*
20	Manganese	mg/l	BQL	BQL	BQL	0.1	0.3
21	Hexavalent Chromium	mg/l	BQL	BQL	BQL	NS*	NS*
22	Copper	mg/l	BQL	BQL	BQL	0.05	1.5
23	Cadmium	mg/l	BQL	BQL	BQL	0.003	NS*
24	Arsenic	mg/l	BQL	BQL	BQL	0.01	0.05
25	Mercury	mg/l	BQL	BQL	BQL	0.001	NS*
26	Lead	mg/l	BQL	BQL	BQL	0.01	NS*
27	Zinc	mg/l	BQL	BQL	BQL	5	15
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified,

BQL- Below Quantification Limit, (Nitrite - 0.05 mg/l,BOD-2.0 mg/l, Fe-0.009 mg/l,Mn- 0.01 mg/l, Cr+6- 0.03 mg/l, Cu-0.004 mg/l, Cd-0.003 mg/l, As-0.003mg/l, Hg-0.001 mg/l, Pb-0.006mg/l, Zinc-0.021 mg/l).

Table 15: Drinking Water Quality Monitoring Parameters for School Gopalpuri, Guest House) and E - Type Quarter at Gopalpuri, Gandhidham

Sr. No.	Parameter	Unit	Gopalpuri School	Guest House	E - Type Quarter	Acceptable Limits as per IS 10500 : 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	-	7.3	7.24	7.26	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	830	950	1030	500	2000
3	Turbidity	NTU	1	1	0	1	5
4	Odor	-	Odorless	Odorless	Odorless	Agreeable	Agreeable
5	Color	-	Colorless	Colorless	Colorless	5	15
6	Conductivity	µs/cm	1435	1638	1769	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	BQL	BQL	BQL	NS*	NS*
8	Chloride as Cl	mg/l	355.79	350.78	340.76	250	1000
9	Ca as Ca	mg/l	39.28	43.29	39.28	75	200
10	Mg as Mg	mg/l	61.2360	61.2360	51.5160	30	100
11	Total Hardness	mg/l	350	360	310	200	600
12	Iron as Fe	mg/l	BQL	BQL	BQL	0.3	No Relaxation
13	Fluorides as F	mg/l	0.45	0.42	0.47	1	1.5
14	Sulphate as SO_4	mg/l	24.90	26.00	30.20	200	400
15	Nitrite as NO_2	mg/l	BQL	BQL	BQL	NS*	NS*
16	Nitrate as NO_3	mg/l	7.10	8.30	12.60	45	No Relaxation
17	Salinity	‰	0.64	0.63	0.62	NS*	NS*
18	Sodium as Na	mg/l	199.00	193.80	193.00	NS*	NS*
19	Potassium as K	mg/l	3.90	3.26	3.18	NS*	NS*
20	Manganese	mg/l	BQL	BQL	BQL	0.1	0.3
21	Hexavalent Chromium	mg/l	BQL	BQL	BQL	NS*	NS*
22	Copper	mg/l	BQL	BQL	BQL	0.05	1.5
23	Cadmium	mg/l	BQL	BQL	BQL	0.003	NS*
24	Arsenic	mg/l	BQL	BQL	BQL	0.01	0.05
25	Mercury	mg/l	BQL	BQL	BQL	0.001	NS*
26	Lead	mg/l	BQL	BQL	BQL	0.01	NS*
27	Zinc	mg/l	BQL	BQL	BQL	5	15
28	Bacterial Count	CFU/100 ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified,

BQL- Below Quantification Limit, (Nitrite - 0.05 mg/l,BOD-2.0 mg/l, Fe-0.009 mg/l,Mn- 0.01 mg/l, Cr+6- 0.03 mg/l, Cu-0.004 mg/l, Cd-0.003 mg/l, As-0.003mg/l, Hg-0.001 mg/l, Pb-0.006mg/l, Zinc-0.021 mg/l).

Table 16: Drinking Water Quality Monitoring Parameters for F-Type Quarter, Hospital Gopalpuri and Tuna Port.

Sr. No.	Parameter	Unit	F - Type Quarter	Hospital Gopalpuri	Tuna Port	Acceptable Limits as per IS 10500 : 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	-	7.28	7.42	7.51	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	1050	990	600	500	2000
3	Turbidity	NTU	1	1	-	1	5
4	Odor	-	Odorless	Odorless	Odorless	Agreeable	Agreeable
5	Color	-	Colorless	Colorless	Colorless	5	15
6	Conductivity	µs/cm	1796	1700	1044	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	BQL	BQL	BQL	NS*	NS*
8	Chloride as Cl	mg/l	345.77	360.80	380.85	250	1000
9	Ca as Ca	mg/l	38.48	40.88	32.87	75	200
10	Mg as Mg	mg/l	61.7220	62.6940	72.41	30	100
11	Total Hardness	mg/l	350	360	380	200	600
12	Iron as Fe	mg/l	BQL	BQL	BQL	0.3	No Relaxation
13	Fluorides as F	mg/l	0.42	0.45	0.43	1	1.5
14	Sulphate as SO_4	mg/l	26.00	26.10	24.50	200	400
15	Nitrite as NO_2	mg/l	BQL	BQL	BQL	NS*	NS*
16	Nitrate as NO_3	mg/l	10.30	6.80	3.00	45	No Relaxation
17	Salinity	‰	0.62	0.65	0.69	NS*	NS*
18	Sodium as Na	mg/l	201.00	201.00	193.60	NS*	NS*
19	Potassium as K	mg/l	3.15	3.16	3.21	NS*	NS*
20	Manganese	mg/l	BQL	BQL	BQL	0.1	0.3
21	Hexavalent Chromium	mg/l	BQL	BQL	BQL	NS*	NS*
22	Copper	mg/l	BQL	BQL	BQL	0.05	1.5
23	Cadmium	mg/l	BQL	BQL	BQL	0.003	NS*
24	Arsenic	mg/l	BQL	BQL	BQL	0.01	0.05
25	Mercury	mg/l	BQL	BQL	BQL	0.001	NS*
26	Lead	mg/l	BQL	BQL	BQL	0.01	NS*
27	Zinc	mg/l	BQL	BQL	BQL	5	15
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified, BQL- Below Quantification Limit, (Nitrite - 0.05 mg/l,BOD-2.0 mg/l, Fe-0.009 mg/l,Mn- 0.01 mg/l, Cr+6-0.03 mg/l, Cu-0.004 mg/l, Cd-0.003 mg/l, As-0.003mg/l, Hg-0.001 mg/l, Pb-0.006mg/l, Zinc-0.021 mg/l).

Table 17: Drinking Water Quality Monitoring Parameters for Vadinar Jetty and Port Colony at Vadinar.

Sr. No.	Parameter	Unit	Vadinar Jetty	Port Colony Vadinar	Acceptable Limits as per IS 10500 : 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	-	7.4	7.43	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	320	300	500	2000
3	Turbidity	NTU	0.00	1.00	1	5
4	Odor	-	Odorless	Odorless	Agreeable	Agreeable
5	Color	-	Colorless	Colorless	5	15
6	Conductivity	µs/cm	570	300	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	BQL	BQL	NS*	NS*
8	Chloride as Cl	mg/l	160.36	140.31	250	1000
9	Ca as Ca	mg/l	36.87	34.47	75	200
10	Mg as Mg	mg/l	43.25	52.00	30	100
11	Total Hardness	mg/l	270	300	200	600
12	Iron as Fe	mg/l	BQL	BQL	0.3	No Relaxation
13	Fluorides as F	mg/l	0.25	0.22	1	1.5
14	Sulphate as SO_4	mg/l	0.75	0.24	200	400
15	Nitrite as NO_2	mg/l	BQL	BQL	NS*	NS*
16	Nitrate as NO_3	mg/l	15.60	12.70	45	No Relaxation
17	Salinity	‰	0.29	0.25	NS*	NS*
18	Sodium as Na	mg/l	191.6	192.0	NS*	NS*
19	Potassium as K	mg/l	BQL	BQL	NS*	NS*
20	Manganese	mg/l	BQL	BQL	0.1	0.3
21	Hexavalent Chromium	mg/l	BQL	BQL	NS*	NS*
22	Copper	mg/l	BQL	BQL	0.05	1.5
23	Cadmium	mg/l	BQL	BQL	0.003	NS*
24	Arsenic	mg/l	BQL	BQL	0.01	0.05
25	Mercury	mg/l	BQL	BQL	0.001	NS*
26	Lead	mg/l	BQL	BQL	0.01	NS*
27	Zinc	mg/l	BQL	BQL	5	15
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent

*NS: Not Specified,
BQL- Below Quantification Limit, (Nitrite - 0.05 mg/l,BOD-2.0 mg/l, Fe-0.009 mg/l,Mn- 0.01 mg/l, Cr+6- 0.03 mg/l, Cu-0.004 mg/l, Cd-0.003 mg/l, As-0.003mg/l, Hg-0.001 mg/l, Pb-0.006mg/l, Zinc-0.021 mg/l).

4.3 Results & Discussion

The colour of all drinking water samples was found Colourless and odour of the samples also agreeable. All parameters were found within the specified limit as per the Drinking water Standard.

pH

The pH is measure of the intensity of acidity or alkalinity and the concentration of hydrogen ion in water. At DPA Site the pH values for drinking water samples ranged from 7.24-7.52 and mean value was 7.36 while at Vadinar pH ranged from 7.40-7.43 and mean value was 7.42. All the sampling points showed pH values within the prescribed limit by Indian Standards.

Turbidity

The selected drinking water sample location turbidity range from 0-1NTU at all location of DPA and Vadinar in month of November. The Turbidity values were within the permissible limit at all sampling location prescribed limit by Indian standards.

Total Dissolved Solids (TDS)

Water has the ability to dissolve a wide range of inorganic and some organic minerals or salts such as potassium, calcium, sodium, bicarbonates, chlorides, magnesium, sulfates etc.

TDS values at DPA varied between 600-1060 mg/l. The average TDS value was found 792 mg/l. The minimum value for TDS was 600 mg/l at Hospital Gopalpuri and maximum was 980 mg/l at Tuna Port while at Vadinar TDS ranged from 280-300 mg/l and mean was 290.0 mg/l. The TDS values were within the permissible limit at all sampling location prescribed limit by Indian standards.

Conductivity

Electrical Conductivity is the ability of a solution to transfer (conduct) electric current. Conductivity is used to measure the concentration of dissolved solids which have been ionized in a polar solution such as water. The conductivity in the samples collected during the month of November DPA ranged from 1044.0 µs/cm at Tuna Port to1821.0 µs/cm at A.O. Building and mean value was 1381.72 µs/cm while at Vadinar ranged from 300-570 µs/cm and mean was 435 µs/cm.

BOD

BOD value in the studied area of DPA and Vadinar was found Below Quantification Limit (<2.0 mg/l). IS 10500:2012 does not show any standard values for BOD in drinking water.

Chlorides

Excessive chloride concentration increase rates of corrosion of metals in the distribution system. This can lead to increased concentration of metals in the supply. The Chloride value in the studied area of DPA ranged from 335.75-576.28 mg/l. The mean value was 365.53 mg/l. The minimum chloride was 335.75 mg/l at Port colony and maximum was 576.28 mg/l at Nirmal Building while at Vadinar location chloride ranged from 140.31-160.36 mg/l and mean was 150.33 mg/l. The Chloride was found within the Permissible limit of the Drinking Water Standard.

Calcium

Calcium is most abundant element on the earth crust and is very important for human cell physiology and bones. About 95% calcium in human body stored in bones and teeth. The high deficiency of calcium in humans may caused rickets, poor blood clotting, bones fracture etc. and the exceeding limit of calcium produced cardiovascular diseases.

The Calcium value in the studied area of DPA ranged from 32.87-43.29 mg/l. The mean value was 40.12 mg/l. The minimum calcium was 32.87 mg/l at Tuna Port and maximum was 43.29 mg/l at Gopalpuri Hospital while at Vadinar location Calcium ranged from 34.47-36.87 and mean was 35.67 mg/l. All the locations had calcium within the prescribed limits of 75-200 mg/L.

Magnesium

The magnesium value in the studied area of DPA ranged from 50.06-72.41 mg/l. The mean value was 59.24 mg/l. The minimum magnesium was 50.06 mg/l at Port Colony and maximum was 74.41 mg/l at Tuna Port while at Vadinar location magnesium ranged from 43.25-52.00 and mean was 47.61 mg/l. All the locations had magnesium within the prescribed limits of 30-100 mg/L.

Total Hardness

Total Hardness value in the studied area of DPA ranged from 310.0 mg/l at Port Colony to 380.0 mg/l at Tuna Port and mean value was 343.89 mg/l while at Vadinar location total hardness ranged from 270.0-300.00 mg/l and mean was 285.0 mg/l. The values of total

hardness were found within the Permissible limit of the Drinking Water Standard (200-600 mg/L). These results clear, that hardness of water is according to the IS standards and it is not harmful for local inhabitants.

Iron

Iron values in the studied area of DPA & Vadinar were Below Quantification Limit (0.009 mg/l) and hence well below the permissible limit as per Indian Standards are 0.3 mg/L.

Fluoride

Fluoride value in the studied area of DPA varied between 0.3-0.47 mg/l and mean was 0.38 mg/l. The minimum value was 0.3 mg/ at West gate workshop and maximum was 0.47 mg/l at E-Type and mean was 0.38 mg/l while at Vadinar location fluoride ranged from 0.22-0.25 mg/l and mean was 0.24 mg/l. The Fluoride values were well below the permissible limit as per Indian Standards is 1.0-1.5 mg/L. Moderate amounts lead to dental effects, but long-term ingestion of large amounts can lead to potentially severe skeletal problems.

Sulphate

Sulphate value in the studied area of DPA varied between 24.5–35.8 mg/l and mean was 27.83 mg/l. The minimum value was 24.5 mg/ at A.O. Building, Hospital Kandla and Tuna Port and maximum was 35.8 mg/l at Nirmal Building while at Vadinar location Sulphate ranged from 0.24-0.75 mg/l and mean was 0.50 mg/l. All the sampling points showed Sulphate values within the prescribed limits by Indian Standards (200-400 mg/L). Sulphate content in drinking water exceeding the 400 mg/L imparts bitter taste.

Nitrites (NO_2) and Nitrates (NO_3)

The all values of Nitrite were found BQL (<0.05 mg/l) and Nitrate were well within the permissible limit of the Drinking water Standard.

Salinity

Salinity in drinking water in the present samples collected at DPA ranged from 0.61 ‰ at Canteen to 1.04 ‰ at Nirmal Building and average salinity was 0.66 ‰ while at Vadinar sampling location salinity ranged from 0.25-0.29 ‰. There are no prescribed Indian standards for salinity in Drinking water**.**

Sodium and Potassium Salts

Sodium values in the samples collected at DPA ranged from 180 - 204 mg/l and average was 195.74 mg/l while at Vadinar sodium ranged from 191.6- 192.0 mg/l and average was191.8 mg/l . Potassium salts ranged at DPA ranged from 3.15 to 4.18 mg/l while average was 3.42 mg/l while at Vadinar sampling locations potassium were BQL (<2.0 mg/l). There are no prescribed limits of Sodium and Potassium in Indian standards for Drinking water**.**

Heavy Metals in Drinking Water

In the present study period drinking water samples were analyzed for Mn, Cr, Cu, Cd, As, Hg, Pb and Zn. All these heavy metals were well Below the Quantification limits prescribed by the Indian Standards.

Bacteriological Study

Analysis of the bacteriological parameter (E-coli and total coliform) at all location shows that Bacteria were not detectable. This shows that drinking water samples were safe for human consumption as per tested parameters.

4.4 Conclusions

These results were compared with permissible limits as prescribed in IS 10500:2012 – Drinking Water Specification. It was seen from the analysis data that during the study period at selected sampling location the water was safe for human consumption as per analyzed parameters at all drinking water monitoring stations.

CHAPTER-5

NOISE MONITORING

5.0 Noise Level Monitoring

Noise sources in port operations include cargo handling, vehicular traffic, and loading / unloading containers and ships. Noise Monitoring was done at 13 stations at Kandla, Vadinar and Township area.

5.1 Method of Monitoring

Sampling was done at all stations for 24 hour period. Data was recorded using automated sound level meter. The intensity of sound was measured in sound pressure level (SPL) and common unit of measurement is decibel (dB).

5.2 Results

Table 18: Noise Monitoring data for ten locations of Deendayal Port and three locations of Vadinar Port

Sr. No.	Location	Day Time Average Noise Level (SPL) in dB(A)	Night Time Average Noise Level (SPL) in dB(A)
	Sampling Time	**6:00 am to 10:00 PM**	**10:00PM to 6:00 AM**
1	Marine Bhavan	60.8	51.9
2	Nirman Building 1	69.9	52.0
3	Tuna Port	53.2	45.4
4	Main Gate North	63.3	51.9
5	West Gate I	67.7	58.1
6	Canteen Area	68.2	51.2
7	Main Road	66.3	52.2
8	ATM Building	69.1	51.1
9	Wharf Area /Jetty Area	70.4	61.7
10	Port & Custom Office	54.7	50.2
Vadinar Port			
11	Entrance Gate of Vadinar Port	55.0	53.5
12	Nr. Port Colony, Vadinar	60.6	57.6
13	Nr. Vadinar Jetty	52.5	51.0

5.3 Conclusions

Transportation systems are the main source of noise pollution in urban areas. Construction of buildings, highways, and roads cause a lot of noise, due to the usage of air compressors, bulldozers, loaders, dump trucks, and pavement breakers. Noise sources in port operations include cargo handling, vehicular traffic, and loading / unloading containers and ships.

Noise sources in port operations include cargo handling, vehicular traffic, and loading / unloading containers and ships. The Day Time Noise Level (SPL) in all 10 locations at Deendayal Port Authority ranged from 53.2 dB(A) to 70.4 dB(A) while at Vadinar port 3 location ranged from 52.5 dB(A) to 60.6 dB(A) which was within the permissible limits of 75 dB(A) for the industrial area for the daytime. The Night Time Average Noise Level (SPL) in all locations of Deendayal Port Authority ranged from 45.4 dB to 61.7 dB(A) while at Vadinar port ranged from 52.5 dB (A) to 60.6 dB(A) which was within the permissible limits of 70 dB(A) for the industrial area for the night time.

CHAPTER-6

SOIL MONITORING

6.0 Soil Monitoring

Sampling and analysis of soil samples were undertaken at six locations within the study area (Deendayal Port and Vadinar Port) as a part of EMP. The soil sampling locations are initially decided based on the locations as provided in the tender document of the Deendayal Port.

Table No.:-19. Soil Sampling Location

Sr. No.	Name of Location	Location Code	Latitude	Longitude	Remarks
1.	Tuna Port	SL-1	22° 58' 10.18"N	70° 6' 3.7"E	Near main gate of Port
2.	IFFCO Plant	SL-2	23° 26' 8.37"N	70° 13' 4.4"E	10 m away from main gate
3.	Khori creek	SL-3	22° 58' 10.18"N	70° 6' 3.7"E	Sand from creek after tide
4.	Nakti Creek	SL-4	23° 2' 1.10"N	70° 9' 33.6"E	
5.	DPA admin site	SL-5	22° 26' 30.9"N	69° 40' 37.03"E	Vadinar
6.	DPA colony	SL-6	22° 23' 57.09"N	69° 42' 49.42"E	

6.1 Methodology

The soil samples were collected in the month of November 2022. The samples collected from the all locations are homogeneous representative of each location. At random locations were identified at each location and soil was dug from 30 cm below the surface. It was uniformly mixed before homogenizing the soil samples. The samples were filled in polythene bags, labeled in the field with number and site name and sent to laboratory for analysis.

6.2 Results

Table-20: Chemical Characteristics of Soil in the Study Area for Tuna port, IFFCO, Khori Creek, Nakti Creek, DPA admin site, DPA colony.

Sr. No.	Parameter	Unit	Station Name					
			SL1	SL2	SL3	SL4	SL5	SL6
			Tuna Port	IFFCO Plant	Khori Creek	Nakti Creek	DPA Admin Site	DPA Colony
			Near main gate of Port	10 m away from main	Sand from creek after tide		Vadinar	
1	Texture		Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam
2	pH	-	7.79	7.80	7.54	7.58	8.14	7.54
3	Electrical Conductivity	µs/cm	35000.0	36100.0	26,820.00	12,700.0	155.0	594.0
4	Phosphorus	mg/kg	10.3	10.5	9.19	8.49	6.00	4.80
5	Moisture	%	15.9	20.3	20.90	3.50	7.20	10.10
6	Total Organic	%	4.04	1.7	3.64	7.80	2.30	2.00
7	Alkalinity	mg/kg	900.0	1000.0	800.0	500.0	800.0	600.0
8	Total Nitrogen	%	BQL	BQL	BQL	BQL	BQL	BQL
9	Sulphate	mg/kg	820.00	982.00	1,080.00	810.00	30.0	70.0
10	Chloride	mg/kg	15598.0	14275.0	12,600.00	2,950.00	140.00	525.00
11	Calcium	mg/kg	2,605.00	2,505.00	31,600.00	3,086.00	1,729.00	1,849.00
12	Sodium	mg/kg	5657	7136.0	7,649.00	4,675.00	33.02	116.90
13	Potassium	mg/kg	552	694	708.00	437.00	44.60	44.52
14	Copper as Cu	mg/kg	27.4	15.5	30.50	14.50	54.10	31.60
15	Lead as Pb	mg/kg	7.4	7.4	9.50	6.30	74.10	75.30
16	Nickel as Ni	mg/kg	39.40	32.70	44.40	27.20	30.30	32.00
17	Zinc as Zn	mg/kg	62.4	77.40	79.20	56.50	50.60	86.00
18	Cadmium as Cd	mg/kg	BQL	BQL	BQL	BQL	BQL	BQL

BQL- Below Quantification Limit, (TN: 0.001%, Cd: 1.0mg/kg)

6.3 Discussion

- DPA Kandla soil sampling data shows that value of pH ranges from 7.54 at Khori Creek to 7.80 at IFFCO Plant while the average value was 7.68. At Vadinar sampling location pH were 7.54 at DPA colony and 8.14 at DPA Admin Site.
- The Electrical Conductivity of DPA Kandla soil sample ranged from 12700.0 µs/cm at Nakti Creek (Sand from creek after tide) to 36100 µs/cm at IIFCO Plant and mean was 27655 µs/cm while Vadinar soil sampling location conductivity were 155 µs/cm at DPA Admin Site and 594 µs/cm at DPA Colony site.
- Total organic Carbon of DPA Kandla soil sample ranged from 1.7 % at IFFCO Plant to 7.80 % at Nakti Creek (Sand from creek after tide) and mean was 4.30 % while Vadinar soil sample were 2.0 % at DPA Colony and 2.30 % at DPA admin Site.
- The concentration of Phosphorus in the soil samples of DPA Kandla varies from 8.49 mg/kg at Nakti Creek (Sand from creek after tide) and 10.5 mg/kg at IIFCO Plant and mean was 9.62 mg/kg while the Vadinar soil sample for Phosphorus were 4.80 mg/kg at DPA Colony and 6.00 mg/kg at DPA Admin Site.
- Chloride in soil sample of DPA ranged from 2950.00 mg/kg at Nakti Creek (Sand from creek after tide) to 15598 mg/kg at Tuna Port and mean was11356 mg/kg while Vadinar soil sample were 140 mg/kg at DPA admin and 525 mg/kg at DPA Colony.
- The Concentration of Potassium in the soil samples of DPA Kandla ranged from 437 mg/kg at Nakti creek and 708 mg/kg at Khori Creek and mean was 597.75 mg/kg while the Vadinar soil sample for Potassium were 44.52 mg/kg at DPA Colony Site and 44.60 mg/kg at DPA Admin Site.
- The concentration of Sodium in the soil samples of DPA Kandla ranged from 4675.0 mg/kg at Nakti creek and 7649.0 mg/kg at Khori Creek and mean was 6279 mg/kg while the Vadinar soil sample for Sodium were 33.00 mg/kg at DPA Admin Site and 117 mg/kg at DPA Colony.

These differences in NPK in soil at different locations are due to the dissimilar nature of soil at each of the locations. Samples SL3 & SL4 (Khori Creek & Nakti Creek) were coastal soil; where as other locations are inland locations and have different chemical properties.

Heavy Metals in the Soil

Traces of Copper, Lead, Nickel and Zinc were observed in the soil samples collected from all the four locations of Deendayal Port Authority Kandla and two locations of Vadinar Port. Cadmium metal was below detection limit in the Soil.

6.4 Conclusion

The soils of Deendayal Port Authority Kandla and Vadinar Port appears to be neutral to basic with varying levels of Chloride, Sulphate, NPK and Calcium. As the nature of soil at different locations are different with respect to its proximity to the sea, the samples showed high degree of variations in their chemical properties.

CHAPTER-7

SEWAGE TREATMENT PLANT MONITORING

7.0 Sewage Treatment Plant Monitoring

This involves safe collection of waste water (spent/used water) from wash areas, bathroom, industrial units, etc., waste from toilets of various buildings and its conveyance to the treatment plant and final disposal in conformity with the requirement and guidelines of State Pollution Control Board and other statutory bodies.

7.1 Methodology for STP Monitoring

To monitor the working efficiency of Sewage Treatment Plant (STP), STP Inlet and Outlet Samples were collected once a week. Locations selected are namely Gopalpuri Township, Deendayal Port and Vadinar. Samples were collected in 1 lit. Carboys and were analyzed in laboratory for various parameters.

A new STP with an improved capacity of 1 MLD is being constructed at Gopalpuri Colony.

Table No. 21. Sewage Treatment Plant

Sr. No.	Location of STP	Types of Treatment	STP Capacity	Treated water Utilization
1.	Gopalpuri Township	MBBR	450 KLD	Plantation and Gardening
2.	Deendayal Port, Kandla	MBBR	600 KLD	Discharge to marine through pipeline, Plantation, Gardening
3.	Vadinar Port Colony	MBBR	1.5 MLD	Plantation and Gardening

7.2 Results

Table 22: Sewage Water Monitoring at Kandla STP (1st Week)

Date of Sampling	03.11.2022

Sr. No.	**Parameters**	**Unit**	**Results**		**GPCB Prescribed Limit**
			DPA STP I/L	**DPA STP O/L**	
1	pH	-	7.55	7.42	6.5 - 8.5
2	Total Suspended Solids	mg/l	100.6	46.8	100
3	Residual Chlorine	mg/l	-	<0.5	-
4	COD	mg/l	80.8	30.3	100
5	BOD @ 27 °C	mg/l	22	11	30
Aeration Tank					
6	MLSS	mg/l	14.0		
7	MLVSS	%	99.73		

Table 23: Sewage Water Monitoring at Kandla STP (2nd Week)

Date of Sampling	10.11.2022

Sr. No.	**Parameters**	**Unit**	**Results**		**GPCB Prescribed Limit**
			DPA STP I/L	**DPA STP O/L**	
1	pH	-	7.41	7.36	6.5 - 8.5
2	Total Suspended Solids	mg/l	127	52.6	100
3	Residual Chlorine	mg/l	-	<0.5	-
4	COD	mg/l	90.9	40.4	100
5	BOD @ 27 °C	mg/l	23	11	30
Aeration Tank					
6	MLSS	mg/l	18.0		
7	MLVSS	%	85.00		

Table 24: Sewage Water Monitoring at Kandla STP (3rd Week)

Date of Sampling	17.11.2022

Sr. No.	**Parameters**	**Unit**	**Results**		**CPCB Prescribed Limit**
			DPA STP I/L	**DPA STP O/L**	
1	pH	-	7.48	7.29	6.5 - 8.5
2	Total Suspended Solids	mg/l	86.4	22.9	100
3	Residual Chlorine	mg/l	-	<0.5	-
4	COD	mg/l	101	50.5	100
5	BOD @ 27 °C	mg/l	26	14	30
Aeration Tank					
6	MLSS	mg/l	20.0		
7	MLVSS	%	98.0		

Table 25: Sewage Water Monitoring at Kandla STP (4th Week)

Date of Sampling	24.10.2022

Sr. No.	**Parameters**	**Unit**	**Results**		**GPCB Prescribed Limit**
			DPA STP I/L	**DPA STP O/L**	
1	pH	-	7.41	7.29	6.5 - 8.5
2	Total Suspended Solids	mg/l	164.2	58.7	100
3	Residual Chlorine	mg/l	-	<0.5	-
4	COD	mg/l	171.7	30.3	100
5	BOD @ 27 °C	mg/l	43	10	30
Aeration Tank					
6	MLSS	mg/l	20.0		
7	MLVSS	%	89.0		

Table 26: Sewage Water Monitoring at Gopalpuri STP (1st Week)

Date of Sampling	03.11.2022

Sr. No.	**Parameters**	**Unit**	**Results**		**GPCB Prescribed Limit**
			DPA STP I/L	**DPA STP O/L**	
1	pH	-	7.47	7.31	6.5 - 8.5
2	Total Suspended Solids	mg/l	121.2	61	100
3	Residual Chlorine	mg/l	-	<0.5	-
4	COD	mg/l	111.1	60.6	100
5	BOD @ 27 °C	mg/l	32	13	30
Aeration Tank					
6	MLSS	mg/l	22.0		
7	MLVSS	%	97.16		

Table 27: Sewage Water Monitoring at Gopalpuri STP (2nd Week)

Date of Sampling	10.11.2022

Sr. No.	**Parameters**	**Unit**	**Results**		**GPCB Prescribed Limit**
			DPA STP I/L	**DPA STP O/L**	
1	pH	-	7.35	7.27	6.5 - 8.5
2	Total Suspended Solids	mg/l	189	67.9	100
3	Residual Chlorine	mg/l			-
4	COD	mg/l	141.4	60.6	100
5	BOD @ 27 °C	mg/l	37	15	30
Aeration Tank					
6	MLSS	mg/l	16.0		
7	MLVSS	%	89.6		

Table 28: Sewage Water Monitoring at Gopalpuri STP (3rd Week)

Date of Sampling	17.11.2022

Sr. No.	**Parameters**	**Unit**	**Results**		**GPCB Prescribed Limit**
			Gopalpuri STP I/L	**Gopalpuri STP O/L**	
1	pH	-	7.41	7.36	6.5 - 8.5
2	Total Suspended Solids	mg/l	127	52.6	100
3	Residual Chlorine	mg/l			-
4	COD	mg/l	90.9	40.4	100
5	BOD @ 27 °C	mg/l	23	11	30
Aeration Tank					
6	MLSS	mg/l	08.0		
7	MLVSS	%	98.0		

Table 29: Sewage Water Monitoring at Gopalpuri STP (4th Week)

Date of Sampling	24.11.2022

Sr. No.	**Parameters**	**Unit**	**Results**		**GPCB Prescribed Limit**
			Gopalpuri STP I/L	**Gopalpuri STP O/L**	
1	pH	-	7.48	7.28	6.5 - 8.5
2	Total Suspended Solids	mg/l	110.2	42.1	100
3	Residual Chlorine	mg/l	-	<0.5	-
4	COD	mg/l	78	40	100
5	BOD @ 27 °C	mg/l	24.0	12.0	30
Aeration Tank					
6	MLSS	mg/l	18.0		
7	MLVSS	%	90.0		

Table 30: Sewage Water Monitoring at Vadinar STP (1st Week)

Date of Sampling	03.11.2022

Sr. No.	**Parameters**	**Unit**	**Results**		**GPCB Prescribed Limit**
			Vadinar STP I/L	**Vadinar STP O/L**	
1	pH	-	7.35	7.25	6.5 - 8.5
2	Total Suspended Solids	mg/l	74.9	39.5	100
3	Residual Chlorine	mg/	-	<0.5	-
4	COD	mg/l	101	40.4	100
5	BOD @ 27 °C	mg/l	26.0	10.0	30

Table 31: Sewage Water Monitoring at Vadinar STP (2nd Week)

Date of Sampling	10.11.2022

Sr. No.	**Parameters**	**Unit**	**Results**		**GPCB Prescribed Limit**
			Vadinar STP I/L	**Vadinar STP O/L**	
1	pH	-	7.38	7.21	6.5 - 8.5
2	Total Suspended Solids	mg/l	69.6	40.3	100
3	Residual Chlorine	mg/l	-	<0.5	-
4	COD	mg/l	131.3	50.5	100
5	BOD @ 27 °C	mg/l	32.0	7.0	30

Table 32: Sewage Water Monitoring at Vadinar STP (3rd Week)

Date of Sampling	17.11.2022

Sr. No.	**Parameters**	**Unit**	**Results**		**GPCB Prescribed Limit**
			Vadinar STP I/L	**Vadinar O/L**	
1	pH	-	7.51	7.42	6.5 - 8.5
2	Total Suspended Solids	mg/l	38.6	16.9	100
3	Residual Chlorine	mg/l	-	<0.5	-
4	COD	mg/l	80.8	20.2	100
5	BOD @ 27 °C	mg/l	24.0	12.0	30

Table 33: Sewage Water Monitoring at Vadinar STP (4th Week)

Date of Sampling	24.11.2022

Sr. No.	**Parameters**	**Unit**	**Results**		**GPCB Prescribed Limit**
			Vadinar STP I/L	**Vadinar STP O/L**	
1	pH	-	7.61	7.42	6.5 - 8.5
2	Total Suspended Solids	mg/l	76.9	33.3	100
3	Residual Chlorine	mg/l	-	<0.5	-
4	COD	mg/l	131.3	20.2	100
5	BOD @ 27 °C	mg/l	20.0	8.0	30

Table No. 34. General Standards for discharge of Environmental Pollutant Part-A

Sr. No.	Parameter	Inland Surface Water	Land Irrigation	Marine Coastal Areas
1.	pH	5.5-9.0	5.5-9.0	5.5-9.0
2.	Total Suspended Solids (mg/l)	100	200	100
3.	Residual Chlorine (mg/l)	1.0	-	1.0
4.	BOD (mg/l)	30	100	100
5.	COD (mg/l)	250	-	250

Sources:-CPCB

7.3 Results & Discussion

The STP Sample carried out to evaluate the efficiency and performance of the wastewater treatment plant at Gopalpuri, Kandla and Vadinar STP. The performance of these plants is an essential parameter to monitor because the treated sewage water is discharged for irrigation purposes and discharge into marine. Wastewater samples were collected from different unit operations of the plant i.e, the inlet, aeration tank and the final treated outlet. These samples were analyzed for various physico-chemical characteristics such as pH, TSS, Residual Chlorine, COD, BOD, MLSS and MLVS.

The final treated outlet observed pH values were within the allowed range at STP Gopalpuri, STP Kandla & STP Vadinar ranged from 7.22 -7.35, 7.29-7.42 & 7.21-7.42 respectively. The wastewater treatment makes it suitable for irrigation. These values are below the allowed limit of the GPCB.

- The final treated outlet observed Total suspended solid values at Gopalpuri, DPA Kandla & Vadinar ranged from 27.10-67.90 mg/l, 22.90-58.70 mg/l & 16.60-40.30 mg/l respectively. These values are below the allowed limit of the GPCB.
- The final treated outlet observed Residual Chlorine values were <0.5 at Gopalpuri, DPA Kandla & Vadinar. These values are below the allowed limit of the CPCB.
- The final treated outlet observed COD values were at Gopalpuri, DPA Kandla & Vadinar ranged from 40.40-60.60 mg/l, 30.30-50.50 mg/l & 20.20-50.50 mg/l respectively. These values are below the allowed limit of the CPCB.

- The main focus of wastewater treatment plants is supposed to reduce the BOD in the effluent discharged to natural waters. Wastewater treatment plants are designed to function as bacteria farms, where bacteria are fed oxygen and organic waste. The final treated outlet observed BOD values were at Gopalpuri, DPA Kandla & Vadinar ranged from 12.0-16.0 mg/l, 10.0-14.0 mg/l & 7.0-12.0 mg/l respectively. These values are below the allowed limit of the GPCB.

7.4 Conclusions:

All parameters for STP outlet are within limit prescribed by CPCB. After the final treatment, it is found that the treated water is satisfactory.

CHAPTER-8

MARINE WATER MONITORING

8.0 Marine Water Monitoring

Marine Water Quality

The Forty Second Amendment to the Constitution in 1976 underscored the importance of 'green thinking'. Article 48A enjoins the state to protect and improve the environment and safeguard the forests and wildlife in the country. Further, Article 51A (g) states that the "fundamental duty of every citizen is to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures".

Policy Statement for Abatement of Pollution (1992) has suggested developing relevant legislation and regulation, fiscal incentives, voluntary agreements and educational programs and information campaigns. It emphasizes the need for integration by incorporating environmental considerations into decision making at all levels by adopting frameworks namely, pollution prevention at source, application of best practicable solution, ensure polluter pays for control of pollution, focus on heavily polluted areas and river stretches and involve public in decision-making. The National Conservation Strategy and Policy Statement on Environment and Development, (1992) aimed at "integrating environmental concerns with developmental imperatives to meet the challenges by redirecting the thrust of our developmental process so that the basic needs of our people could be fulfilled by making judicious and sustainable use of natural resources." The priorities mentioned in this policy document include the sustainable use of land and water resources, prevention and control of pollution and preservation of biodiversity.

The National Water Policy, (2002) contains provisions for developing, conserving, sustainable utilizing and managing this important water resources and need to be governed by national perspectives.

Sampling Stations

The monitoring of marine environment for the study of biological and ecological parameters was carried out on 01st & 02nd November-2022 in harbor regions of DPA & Vadinar during Neap tide period of New moon phase of Lunar Cycle. The monitoring of marine environment for the study of biological and ecological parameters was repeated again on 8th & 9th November-2022 in harbor regions of DPA & Vadinar during Spring tide period first quarter of Lunar Cycle.

Plankton samples from sub surface layer was collected both during high tide period and low tide period from 3 water quality monitoring stations of DPA harbor area and two stations in Nakti creek and one station in Khori creek. The same sampling schedule was repeated during consecutive spring tide and neap tide in same month. Plankton samples from sub surface layer was collected both during high tide period and low tide period from 1 water quality monitoring stations near Vadinar jetty area during spring tide and neap tide in this month. Collected water samples were processed for estimation

of Chlorophyll- a, Pheophytin- a, qualitative & quantitative evaluation of phytoplankton, qualitative & quantitative evaluation zooplanktons (density and their population).

Sampling Locations

Offshore monitoring requirement	Number of locations
Offshore Installations	3 in Kandla creek 2 in Nakti creek 1 in Khori creek 1 near Vadinar Jetty 1 near 1st SBM
Total Number of locations	**8**

8.1 Marine Water Quality and Results

Marine water quality of marine waters of Deendayal Port Harbor waters, Khori & Nakti Creeks and two locations of Vadinar are monitored for various physico-chemical parameters during spring and neap tide of each month. The results of marine water quality from table no 35 to 42. *During low tide DPA-6 Nakti-II location monitoring was not possible due to non-availability of marine water.*

Table 35: Marine Water Quality Monitoring Parameters for Location Near DPA Colony

Sr. No.	Parameters	Unit	Kandla Creek Near DPA Colony (1)			
			23°0'58"N 70°13'22."E			
			Spring Tide		Neap Tide	
	Tide		High Tide	Low Tide	High Tide	Low Tide
1	pH	-	7.61	7.58	7.55	7.46
2	Color	-	Agreeable	Agreeable	Agreeable	Agreeable
3	Odor	-	Agreeable	Agreeable	Agreeable	Agreeable
4	Salinity	‰	19.0	19.9	20.4	19.0
5	Turbidity	NTU	38	35	42	35
6	Total Dissolved Solids	mg/l	34152.0	30868.0	30941.0	31974.0
7	Total Suspended Solids	mg/l	639.6	600.6	646.4	595.6
8	Total Solids	mg/l	34791.6	31468.6	31587.4	32569.6
9	DO	mg/l	5.8	5.6	5.7	5.5
10	COD	mg/l	88.0	79.0	82.0	86.0
11	BOD	mg/l	BQL	BQL	BQL	BQL
12	Silica	mg/l	1.06	0.82	0.99	0.91
13	Phosphate	mg/l	0.48	0.31	0.09	0.04
14	Sulphate	mg/l	3580	3407	3708.0	3658
15	Nitrate	mg/l	4.70	0.50	0.75	0.42
16	Nitrite	mg/l	<0.05	<0.05	BQL	BQL
17	Calcium	mg/l	521.04	440.88	561.12	480.96
18	Magnesium	mg/l	1773.9	1749.6	1701	1773.9
19	Sodium	mg/l	8011.0	8399.0	8396.0	8699.0
20	Potassium	mg/l	299.0	385.0	391.0	395.0
21	Iron	mg/l	BQL	BQL	0.88	0.57
22	Chromium	mg/l	BQL	BQL	BQL	BQL
23	Copper	mg/l	BQL	BQL	BQL	BQL
24	Arsenic	mg/l	BQL	BQL	BQL	BQL
25	Cadmium	mg/l	BQL	BQL	BQL	BQL
26	Mercury	mg/l	BQL	BQL	BQL	BQL
27	Lead	mg/l	BQL	BQL	BQL	BQL
28	Zinc	mg/l	BQL	BQL	BQL	BQL

BQL- Below Quantification Limit, (Nitrite - 0.05 mg/l,BOD-2.0 mg/l,Cu-0.1 mg/l, As-0.1mg/l, Hg-0.01 mg/l, Zinc-0.1 mg/l).

Table 36: Marine Water Quality Monitoring Parameters for Location Near Passenger Jetty One at Kandla

Sr. No.	Parameters	Unit	Near passenger Jetty One (2)			
			23° 0'18 "N 70°13'31"E			
			Spring Tide		Neap Tide	
	Tide		High Tide	Low Tide	High Tide	Low Tide
1	pH	-	7.43	7.28	7.33	7.41
2	Color	-	Agreeable	Agreeable	Agreeable	Agreeable
3	Odor	-	Agreeable	Agreeable	Agreeable	Agreeable
4	Salinity	‰	20.8	20.4	19.9	18.6
5	Turbidity	NTU	43	48	36	41
6	Total Dissolved Solids	mg/l	35468.0	37102.0	34662.0	33398.0
7	Total Suspended Solids	mg/l	679.7	665.5	703.7	663.8
8	Total Solids	mg/l	36147.7	37767.5	35365.7	34061.8
9	DO	mg/l	5.9	6.2	5.6	5.2
10	COD	mg/l	86.0	94.0	90.0	92.0
11	BOD	mg/l	BQL	BQL	BQL	BQL
12	Silica	mg/l	1.26	0.86	1.33	0.85
13	Phosphate	mg/l	0.29	0.13	0.33	0.19
14	Sulphate	mg/l	3571	3470	4072	3407
15	Nitrate	mg/l	3.40	2.70	1.17	4.36
16	Nitrite	mg/l	<0.05	<0.05	BQL	BQL
17	Calcium	mg/l	561.12	601.20	601.2	521.04
18	Magnesium	mg/l	1701	1603.8	1749.6	1701
19	Sodium	mg/l	9142.0	9345.0	9247.0	9219.0
20	Potassium	mg/l	370.0	385.0	370.0	380.0
21	Iron	mg/l	0.47	BQL	1.76	0.30
22	Chromium	mg/l	BQL	BQL	BQL	BQL
23	Copper	mg/l	BQL	BQL	BQL	BQL
24	Arsenic	mg/l	BQL	BQL	BQL	BQL
25	Cadmium	mg/l	BQL	BQL	BQL	BQL
26	Mercury	mg/l	BQL	BQL	BQL	BQL
27	Lead	mg/l	BQL	BQL	BQL	BQL
28	Zinc	mg/l	BQL	BQL	BQL	BQL

BQL- Below Quantification Limit, (Nitrite - 0.05 mg/l,BOD-2.0 mg/l,Nitrite: 0.05mg/lCu-0.1 mg/l, As-0.1mg/l, Hg-0.01 mg/l, Zinc-0.1 mg/l).

Table 37: Marine Water Quality Monitoring Parameters for location Near Coal Berth

Sr. No.	Parameters	Unit	Near Coal Berth			
			22°59'12"N 70°13'40"E			
			Spring Tide		Neap Tide	
	Tide		High Tide	Low Tide	High Tide	Low Tide
1	pH	-	7.37	7.51	7.53	7.25
2	Color	-	Agreeable	Agreeable	Agreeable	Agreeable
3	Odor	-	Agreeable	Agreeable	Agreeable	Agreeable
4	Salinity	‰	18.6	18.1	19.5	20.8
5	Turbidity	NTU	33	42	38	45
6	Total Dissolved Solids	mg/l	39222.0	37586.0	37123.0	36668.0
7	Total Suspended Solids	mg/l	540.2	638.4	620.6	580.2
8	Total Solids	mg/l	39762.2	38224.4	37743.6	37248.2
9	DO	mg/l	7.3	6.4	7.1	6.5
10	COD	mg/l	81.0	874.0	88.0	84.0
11	BOD	mg/l	BQL	BQL	BQL	BQL
12	Silica	mg/l	0.56	0.98	0.69	1.76
13	Phosphate	mg/l	0.06	0.56	0.12	0.61
14	Sulphate	mg/l	4222	3458	2981	3758
15	Nitrate	mg/l	2.20	4.60	2.68	4.70
16	Nitrite	mg/l	<0.05	<0.05	BQL	BQL
17	Calcium	mg/l	480.96	641.28	641.28	721.44
18	Magnesium	mg/l	1628.1	1628.1	1676.7	1603.8
19	Sodium	mg/l	8346.0	9380.0	9245.0	9814.0
20	Potassium	mg/l	391.0	300.0	392.0	384.0
21	Iron	mg/l	BQL	BQL	BQL	1.34
22	Chromium	mg/l	BQL	BQL	BQL	BQL
23	Copper	mg/l	BQL	BQL	BQL	BQL
24	Arsenic	mg/l	BQL	BQL	BQL	BQL
25	Cadmium	mg/l	BQL	BQL	BQL	BQL
26	Mercury	mg/l	BQL	BQL	BQL	BQL
27	Lead	mg/l	BQL	BQL	BQL	BQL
28	Zinc	mg/l	BQL	BQL	BQL	BQL

BQL- Below Quantification Limit, (Nitrite - 0.05 mg/l,BOD-2.0 mg/l,Cu-0.1 mg/l, As-0.1mg/l, Hg-0.01 mg/l,Zinc-0.1 mg/l).

Table 38: Marine Water Quality Monitoring Parameters for location Khori creek at Kandla

Sr. No.	Parameters	Unit	Khori creek			
			Near 15/16 Berth			
			Spring Tide		Neap Tide	
	Tide		High Tide	Low Tide	High Tide	Low Tide
1	pH	-	7.48	7.27	7.34	7.21
2	Color	-	Agreeable	Agreeable	Agreeable	Agreeable
3	Odor	-	Agreeable	Agreeable	Agreeable	Agreeable
4	Salinity	‰	20.4	19.5	18.6	17.7
5	Turbidity	NTU	35	31	43	39
6	Total Dissolved Solids	mg/l	32557.0	34294.0	30473.0	33329.0
7	Total Suspended Solids	mg/l	641.2	616.3	594.7	731.2
8	Total Solids	mg/l	33198.2	34910.3	31067.7	34060.2
9	DO	mg/l	7.6	6.3	7.3	6.8
10	COD	mg/l	85.0	96.0	92.0	96.0
11	BOD	mg/l	BQL	BQL	BQL	BQL
12	Silica	mg/l	0.78	1.04	1.39	1.18
13	Phosphate	mg/l	0.44	0.67	0.35	0.42
14	Sulphate	mg/l	4047	3646	3157	3170
15	Nitrate	mg/l	3.70	1.10	1.34	5.20
16	Nitrite	mg/l	<0.05	<0.05	BQL	BQL
17	Calcium	mg/l	561.12	480.96	480.96	561.12
18	Magnesium	mg/l	1725.3	1676.7	1701	1628.1
19	Sodium	mg/l	9112.0	8436.0	7966.0	8696.0
20	Potassium	mg/l	299.0	385.0	382.0	377.0
21	Iron	mg/l	0.44	BQL	0.17	0.31
22	Chromium	mg/l	BQL	BQL	BQL	BQL
23	Copper	mg/l	BQL	BQL	BQL	0.02
24	Arsenic	mg/l	BQL	BQL	BQL	BQL
25	Cadmium	mg/l	BQL	BQL	BQL	BQL
26	Mercury	mg/l	BQL	BQL	BQL	BQL
27	Lead	mg/l	BQL	BQL	BQL	BQL
28	Zinc	mg/l	BQL	BQL	BQL	BQL

BQL- Below Quantification Limit, (Nitrite - 0.05 mg/l,BOD-2.0 mg/l,Cu-0.1 mg/l, As-0.1mg/l, Hg-0.01 mg/l, Zinc-0.1 mg/l).

Table 39: Marine Water Quality Monitoring Parameters for location Nakti Creek near Tuna Port

Sr. No.	Parameters	Unit	Nakti Creek Near Tuna Port			
			22°57'49."N 70° 7'0.67"E			
			Spring Tide		Neap Tide	
	Tide		High Tide	Low Tide	High Tide	Low Tide
1	pH	-	7.41	7.36	7.48	7.23
2	Color	-	Agreeable	Agreeable	Agreeable	Agreeable
3	Odor	-	Agreeable	Agreeable	Agreeable	Agreeable
4	Salinity	‰	19.0	18.6	19.0	19.5
5	Turbidity	NTU	45	36	40	42
6	Total Dissolved Solids	mg/l	30214.0	28996.0	31047.0	31957.0
7	Total Suspended Solids	mg/l	642.7	526.2	682.5	606.8
8	Total Solids	mg/l	30856.7	29522.2	31729.5	32563.8
9	DO	mg/l	8.1	7.5	6.4	7.2
10	COD	mg/l	94.0	112.0	98.0	100.0
11	BOD	mg/l	BQL	BQL	BQL	BQL
12	Silica	mg/l	1.12	1.20	1.42	1.22
13	Phosphate	mg/l	0.71	0.37	0.46	0.12
14	Sulphate	mg/l	4172	3846	3445	3433
15	Nitrate	mg/l	1.50	1.70	5.12	1.69
16	Nitrite	mg/l	<0.05	<0.05	BQL	BQL
17	Calcium	mg/l	440.88	641.28	601.2	521.04
18	Magnesium	mg/l	1725.3	1555.2	1701	1773.9
19	Sodium	mg/l	8639.0	9143.0	8655.0	7939.0
20	Potassium	mg/l	395.0	386.0	384.0	386.0
21	Iron	mg/l	BQL	0.33	0.34	0.18
22	Chromium	mg/l	BQL	BQL	BQL	BQL
23	Copper	mg/l	BQL	BQL	BQL	BQL
24	Arsenic	mg/l	BQL	BQL	BQL	BQL
25	Cadmium	mg/l	BQL	BQL	BQL	BQL
26	Mercury	mg/l	BQL	BQL	BQL	BQL
27	Lead	mg/l	BQL	BQL	BQL	BQL
28	Zinc	mg/l	BQL	BQL	BQL	BQL

BQL- Below Quantification Limit, (Nitrite - 0.05 mg/l,BOD-2.0 mg/l,Cu-0.1 mg/l, As-0.1mg/l, Hg-0.01 mg/l,Zinc-0.1 mg/l).

Table 40: Marine Water Quality Monitoring Parameters for location Nakti Creek Near NH-8A at Kandla

Sr. No.	Parameters	Unit	Nakti Creek Near NH-8A			
			23° 02'01"N 70° 09'31"E			
			Spring Tide		Neap Tide	
	Tide		High Tide	Low Tide	High Tide	Low Tide
1	pH	-	7.45	Sampling not possible during Low Tide	7.45	Sampling not possible during Low Tide
2	Color	-	Agreeable		Agreeable	
3	Odor	-	Agreeable		Agreeable	
4	Salinity	‰	19.9		20.8	
5	Turbidity	NTU	45		44	
6	Total Dissolved Solids	mg/l	30288.0		32796.0	
7	Total Suspended Solids	mg/l	529.6		595.7	
8	Total Solids	mg/l	30817.6		33391.7	
9	DO	mg/l	7.4		6.9	
10	COD	mg/l	118.0		110.0	
11	BOD	mg/l	BQL		BQL	
12	Silica	mg/l	1.02		0.16	
13	Phosphate	mg/l	0.75		0.46	
14	Sulphate	mg/l	4109		4961	
15	Nitrate	mg/l	2.70		3.52	
16	Nitrite	mg/l	<0.05		BQL	
17	Calcium	mg/l	681.36		641.28	
18	Magnesium	mg/l	1506.6		1628.1	
19	Sodium	mg/l	9280.0		8528.0	
20	Potassium	mg/l	427.0		427.0	
21	Iron	mg/l	BQL		0.54	
22	Chromium	mg/l	BQL		BQL	
23	Copper	mg/l	BQL		BQL	
24	Arsenic	mg/l	BQL		BQL	
25	Cadmium	mg/l	BQL		0.01	
26	Mercury	mg/l	BQL		BQL	
27	Lead	mg/l	BQL		BQL	
28	Zinc	mg/l	BQL		BQL	

BQL- Below Quantification Limit, (Nitrite - 0.05 mg/l,BOD-2.0 mg/l,Cu-0.1 mg/l, As-0.1mg/l, Hg-0.01 mg/l,Zinc-0.1 mg/l).

Table 41: Marine Water Quality Monitoring Parameters for locations Nr. Vadinar Jetty

Sr. No.	Parameters	Unit	Nr.Vadinar Jetty			
			22°26'25.26"N 69°40'20.41"E			
			Spring Tide		Neap Tide	
	Tide		High Tide	Low Tide	High Tide	Low Tide
1	pH	-	7.43	7.26	7.36	7.29
2	Color	-	Agreeable	Agreeable	Agreeable	Agreeable
3	Odor	-	Agreeable	Agreeable	Agreeable	Agreeable
4	Salinity	‰	20.4	20.8	19.0	19.9
5	Turbidity	NTU	39	42	38	42
6	Total Dissolved Solids	mg/l	35265.0	37685.0	36325.0	36681.0
7	Total Suspended Solids	mg/l	585.3	590.8	681.4	657.6
8	Total Solids	mg/l	35850.3	38275.8	37006.4	37338.6
9	DO	mg/l	5.7	5.4	6.3	5.8
10	COD	mg/l	87.0	89.0	96.0	92.0
11	BOD	mg/l	BQL	BQL	BQL	BQL
12	Silica	mg/l	0.55	0.45	0.36	0.28
13	Phosphate	mg/l	0.18	0.42	0.33	0.19
14	Sulphate	mg/l	3608	3558	3683	3645
15	Nitrate	mg/l	2.35	1.09	1.00	2.43
16	Nitrite	mg/l	<0.05	<0.05	BQL	BQL
17	Calcium	mg/l	480.96	601.20	521.04	480.96
18	Magnesium	mg/l	1603.8	1652.4	1676.7	1749.6
19	Sodium	mg/l	9448.0	7368.0	7810.0	8912.0
20	Potassium	mg/l	371.0	354.0	452.0	456.0
21	Iron	mg/l	BQL	BQL	0.31	BQL
22	Chromium	mg/l	BQL	BQL	BQL	BQL
23	Copper	mg/l	BQL	BQL	BQL	BQL
24	Arsenic	mg/l	BQL	BQL	BQL	BQL
25	Cadmium	mg/l	BQL	BQL	BQL	BQL
26	Mercury	mg/l	BQL	BQL	BQL	BQL
27	Lead	mg/l	BQL	BQL	BQL	BQL
28	Zinc	mg/l	0.29	BQL	0.77	0.35

BQL- Below Quantification Limit, (Nitrite - 0.05 mg/l,BOD-2.0 mg/l,Cu-0.1 mg/l, As-0.1mg/l, Hg-0.01 mg/l, Zinc-0.1 mg/l).

Table 42: Marine Water Quality Monitoring Parameters for locations Nr. Vadinar SPM

Sr. No.	Parameters	Unit	Nr. Vadinar SPM			
			22°30'56.15"N 69°42'12.07"E			
			Spring Tide		Neap Tide	
	Tide		High Tide	Low Tide	High Tide	Low Tide
1	pH	-	7.37	7.22	7.41	7.35
2	Color	-	Agreeable	Agreeable	Agreeable	Agreeable
3	Odor	-	Agreeable	Agreeable	Agreeable	Agreeable
4	Salinity	‰	19.0	17.7	19.5	18.6
5	Turbidity	NTU	37	40	37	39
6	Total Dissolved Solids	mg/l	39961.0	39198.0	42642.0	40730.0
7	Total Suspended Solids	mg/l	545.5	493.6	714.3	657.9
8	Total Solids	mg/l	40506.5	39691.6	43356.3	41387.9
9	DO	mg/l	6.1	5.5	5.6	6.1
10	COD	mg/l	95.0	98.0	96.0	94.0
11	BOD	mg/l	BQL	BQL	BQL	BQL
12	Silica	mg/l	0.47	0.37	0.34	0.30
13	Phosphate	mg/l	1.08	0.19	0.46	0.28
14	Sulphate	mg/l	3495	3796	3745	4008
15	Nitrate	mg/l	3.86	2.18	4.95	2.10
16	Nitrite	mg/l	<0.05	<0.05	BQL	BQL
17	Calcium	mg/l	561.12	400.80	681.36	641.28
18	Magnesium	mg/l	1628.1	1676.7	1555.2	1628.1
19	Sodium	mg/l	8473.0	10386.0	9131.0	8526.0
20	Potassium	mg/l	452.0	406.0	413.0	441.0
21	Iron	mg/l	BQL	BQL	0.24	BQL
22	Chromium	mg/l	BQL	BQL	BQL	BQL
23	Copper	mg/l	BQL	BQL	BQL	BQL
24	Arsenic	mg/l	BQL	BQL	BQL	BQL
25	Cadmium	mg/l	BQL	BQL	BQL	BQL
26	Mercury	mg/l	BQL	BQL	BQL	BQL
27	Lead	mg/l	BQL	BQL	BQL	BQL
28	Zinc	mg/l	0.28	BQL	0.40	BQL

BQL- Below Quantification Limit, (Nitrite - 0.05 mg/l,BOD-2.0 mg/l,Cu-0.1 mg/l, As-0.1mg/l, Hg-0.01 mg/l,Zinc-0.1 mg/l)

8.2 Results & Discussion for Marine water samples

Marine water quality of Deendayal Port Harbor waters, Khori and Nakti Creeks and two locations of Vadinar are monitored for various physico-chemical parameters during spring and neap tide of each month. The Heavy metal analyzed and mostly found below quantification limit.

pH

During spring tide the pH values was ranged from 7.27-7.61 at DPA Kandla and 7.22-7.43 at Vadinar while during Neap Tide pH values was ranged from 7.21-7.55 at DPA Kandla and 7.29-7.41 at Vadinar.

Color and Odor

All marine samples for Odor and Color were found agreeable at all sampling locations.

Turbidity

During spring tide the Turbidity values was ranged from 31-48 NTU at DPA Kandla and 37-42 NTU at Vadinar while during Neap Tide Turbidity values was ranged from 35-45 NTU at DPA Kandla and 37-42 NTU at Vadinar. Turbidity is the amount of particulate matter that is suspended in water. Turbidity measures the scattering effect that suspended solids have on light: the higher the intensity of scattered light, the higher the turbidity (Yap et al, 2011). Materials that cause water to be turbid include clay, silt, finely divided organic and inorganic matter, soluble colored organic compounds, plankton and microscopic organisms (Lawler, 2004). The turbidity affects the amount of light penetrating to the plants for photosynthesis.

Total Dissolved Solids (TDS)

TDS values in the studied area during Spring Tide varied between 28966- 39222 mg/l at DPA Kandla and 35265-39961 mg/l at Vadinar while during Neap Tide TDS values was varied 30473-37123 mg/l at DPA Kandla and 36325-42642 mg/l at Near Vadinar.

Calcium

Calcium value in the studied area during Spring Tide varied between 440.9-681.4 mg/l at DPA Kandla and 400.8-601.2 mg/l at Vadinar while during Neap Tide calcium values between 481.0-721.4 mg/l at DPA Kandla and 481.0-681.4 mg/l at Vadinar.

Magnesium

Magnesium value in the studied area during Spring Tide varied between 1506.6-1773.9 mg/l at DPA Kandla and 1603.8-1676.7 mg/l at Vadinar while during Neap Tide magnesium values between 1603.80-173.9 mg/l at DPA Kandla and 1555.2 -1749.60 at Vadinar. Calcium and magnesium both play an important role in antagonizing the toxic effects of various ions and neutralizing the excess acid produced (Narayan R. et. al., 2007)

Nitrate

Nitrate value in the studied area during Spring Tide varied between 0.5-4.7 mg/l at DPA Kandla and 1.09-3.86 mg/l at Vadinar while during Neap Tide Nitrate values between 0.42-5.2 mg/l at DPA Kandla and 1.0-4.95 at Vadinar.

The variations were observed due to variation in phytoplankton excretion, oxidation of ammonia, reduction of nitrate and by recycling of nitrogen and bacterial decomposition of planktonic detritus (Asha and Diwakar, 2007).

Iron

Iron values in the studied area during Spring Tide ranged from 0.33-0.47 mg/l at DPA Kandla and at Vadinar were BQL (<0.10) while during Neap Tide Iron values ranged from 0.17-1.76 mg/l at DPA Kandla and 0.24-0.31 mg/l at Vadinar.

Sulphates

Sulphate values in the studied area during Spring Tide ranged from 3407-4222 mg/l at DPA Kandla and 3495-3796 mg/l at Vadinar while during Neap Tide the Sulphate values was varied 2981-4961 mg/l at DPA Kandla and 3645-4008mg/l at Vadinar.

Salinity

Salinity values in the studied area during Spring Tide varied ranged 18.11 to 20.82 ‰ at DPA Kandla and 17.65 to 20.82 ‰ at Vadinar while during Neap Tide the Salinity values was varied 17.65 to 20.82 ‰ at DPA Kandla and 18.55 to 19.92 ‰ at Vadinar.

Sodium and Potassium Salts

During Spring Tide the Sodium values ranged from 8011-9380 mg/l at DPA Kandla & 7368-10386 mg/l at Vadinar and Potassium salts ranged from 299-427 mg/l at DPA Kandla & 354-452 mg/l at Vadinar while during Neap Tide the Sodium values was ranges from 7939-

9814 mg/l at DPA Kandla & 7810-9131 mg/l at Vadinar and Potassium salts ranged from 370-427 mg/l at DPA Kandla & 413-456 mg/l at Vadinar.

DO

The DO refers to the amount of oxygen dissolved in the water and it is particularly important in limnology {(aquatic ecology) (Weiss 1970)}. The fate and behavior of DO is of critical importance to marine organisms in determining the severity of adverse impacts (Best et al. 2007). The major factor controlling dissolved oxygen concentration is biological activity: photosynthesis producing oxygen while respiration and nitrification consume oxygen (Best et al. 2007). From the studied samples, DO in marine water during Spring Tide was found in ranges from 5.6-8.1 mg/l at DPA Kandla and 5.4-6.1 mg/l at Vadinar while during Neap Tide 5.2-7.3 mg/l at DPA Kandla and 5.6-6.3 mg/l at Vadinar.

BOD

BOD in marine water at all sampling location in the studied samples were found BQL (<2.0 mg/l).

Heavy Metals in Marine Water

In the present study period marine water samples were analyzed for Cr, Cu, Cd, As, Hg, Pb and Zn. Maximum heavy metals parameters were well Below the Quantification limits.

9.3 Conclusion

In the present study period marine water samples were analyzed and found inline as per Primary Water Quality criteria for class-IV WATERS (For Harbour Waters).

CHAPTER-9

MARINE SEDIMENT MONITORING

9.0 Marine Sediments

The deep-sea ocean floor is made up of sediment. This sediment is composed of tiny particles such as fine sand, silt, clay, or animal skeletons that have settled on the ocean bottom. Over long periods of time, some of these particles become compressed and form stratified layers. Scientists that study these layers look at particle size, particle composition, and origin to help them create historical records of the deep ocean floor. This process is called weathering. Weathering can be either mechanical or chemical. Mechanical weathering can occur as ice, wind, or water wears away the rock's surface. Chemical weathering can occur as rocks are dissolved by a chemical such as acid rain. The particles created as a result of weathering are called terrigenous sediments. These particles are transported to the ocean by wind and by rivers and streams. Once the particles enter the ocean, they are dispersed by waves, currents, and tides. The heaviest and largest particles that reach the oceans, such as sand, settle very quickly to the bottom as a result of gravity. Sand is deposited near the coast whereas the smaller silt and clay particles are transported farther distances offshore before they settle to the bottom. Sediments are an important component of aquatic ecosystems because they provide nutrients and habitat for aquatic organisms (Benhamed et al. 2016). However, human activities result in accumulation of toxic substances such as heavy metals in marine sediments. Heavy metals are well-known environmental pollutants due to their toxicity, persistence in the environment, and bioaccumulation. Metals affect the ecosystem because they are not removed from water by self-purification, but accumulate in sediments and enter the food chain (Astakhov et al. 2015).

Sediment samples were collected with Van Veen Grab from the six locations in Kandla Port Waters and two locations in Vadinar Port. Benthic surface grab samplers look like giant metal jaws. They dig into the bottom and take a bite of the sediment. These samplers are good for collecting softer, sandy or silty sediments that do not contain rocks. A box corer is a cross between a surface sampler and a sediment corer. It is a special device that is used to collect an undisturbed sample of the very top surface layers and the sediment underneath. Samples were collected and preserved in silver foil in ice box to prevent the contamination/decaying of the samples.

10.1 Results

The Sediment Quality results are given in below from table no. 43 & 44.

Table 43: Results of Analysis of Sediment of Kandla & Vadinar Port (Neap Tide)

Sr. No.	Parameters	Unit	DPA – 1	DPA - 2	DPA - 3	DPA - 4	DPA - 5	Jetty	SPM
1	Texture	-	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam
2	Organic Matter	mg/kg	1.32	0.6	0.1	0.1	0.16	1.14	1.59
3	Organic Carbon	mg/kg	0.76	0.35	0.07	0.06	0.09	0.66	0.91
4	Inorganic Phosphate	mg/kg	89.00	90.00	101.00	92.00	100.00	90.00	100.00
5	Moisture	%	3.90	2.37	4.12	3.00	4.10	3.40	4.00
6	Aluminum	mg/kg	ND	ND	ND	ND	ND	ND	ND
7	Silica	mg/kg	7.30	7.68	8.90	9.30	9.10	8.90	9.60
8	Phosphate	mg/kg	5.20	4.99	4.09	5.25	9.00	3.28	10.40
9	Sulphate	mg/kg	759.00	849.00	555.00	496.00	768.00	732.00	496.00
10	Nitrite	mg/kg	0.11	0.11	0.10	0.10	0.12	0.10	0.11
11	Nitrate	mg/kg	BQL	BQL	BQL	BQL	BQL	BQL	BQL
12	Calcium	mg/kg	2765.00	1523.00	861.00	961.00	981.00	1162.00	2485.00
13	Magnesium	mg/kg	1372.00	1300.00	1020.00	1263.00	1032.00	1089.00	2065.00
14	Sodium	mg/kg	2410.0	2760.0	2644.0	2940.0	2722.0	1394.00	1082.00
15	Potassium	mg/kg	404.00	459.00	390.00	510.00	447.00	811.0	560.0
16	Chromium	mg/kg	61.30	71.90	66.00	53.30	56.40	42.80	49.70
17	Nickel	mg/kg	26.80	31.70	29.00	23.00	24.10	13.80	29.20
18	Copper	mg/kg	17.40	19.40	17.80	15.50	15.80	13.80	47.10
19	Zinc	mg/kg	43.40	55.80	49.80	41.80	46.00	32.00	64.30
20	Cadmium	mg/kg	BQL	BQL	BQL	BQL	BQL	BQL	BQL
21	Lead	mg/kg	5.20	6.20	5.70	9.80	8.40	12.00	BQL
22	Mercury	mg/kg	BQL	BQL	BQL	BQL	BQL	BQL	BQL
23	Arsenic	mg/kg	BQL	BQL	BQL	BQL	BQL	BQL	BQL

*ND - Not Detected, BQL: Below Quantification Limit (NO3:10.0mg/kg, Cd: 1.0mg/kg, Hg: 1.0mg/kg, As: 1.0mg/kg).

Table 44 : Results of Analysis of Sediment of Kandla & Vadinar Port (Spring Tide)

Sr. No.	Parameters	Unit	DPA – 1	DPA - 2	DPA - 3	DPA - 4	DPA - 5	Jetty	SPM
1	Texture	-	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam
2	Organic Matter	mg/kg	0.91	0.50	1.52	0.37	0.27	1.45	1.68
3	Organic Carbon	mg/kg	0.52	0.29	0.87	0.21	0.15	0.83	0.97
4	Inorganic Phosphate	mg/kg	98.00	90.00	80.00	78.00	100.00	88.00	90.00
5	Moisture	%	17.00	8.70	15.00	6.60	4.80	14.24	13.14
6	Aluminum	mg/kg	ND	ND	ND	ND	ND	ND	ND
7	Silica	mg/kg	7.20	8.26	9.02	5.50	7.80	9.20	10.02
8	Phosphate	mg/kg	7.87	9.29	6.16	5.75	9.49	11.61	10.80
9	Sulphate	mg/kg	745.00	862.00	585.00	490.00	510.00	590.00	396.00
10	Nitrite	mg/kg	0.11	0.12	0.12	0.11	0.10	0.10	0.11
11	Nitrate	mg/kg	BQL	BQL	12.00	16.6	26.2	BQL	BQL
12	Calcium	mg/kg	1723.00	1057.00	1320.00	1220.00	1390.00	1907.00	1643.00
13	Magnesium	mg/kg	1044.00	716.00	1090.00	690.00	896.00	1563.00	2320.00
14	Sodium	mg/kg	2733.00	2720.00	2578.00	2107.00	1558.00	1042.00	952.00
15	Potassium	mg/kg	302.00	332.00	378.0	357.0	87.8	384.00	325.00
16	Chromium	mg/kg	38.00	24.40	51.70	16.10	60.00	48.90	69.20
17	Nickel	mg/kg	15.60	9.50	21.70	6.00	24.70	19.70	28.30
18	Copper	mg/kg	7.80	BQL	11.30	31.40	16.40	12.10	19.90
19	Zinc	mg/kg	30.10	21.90	35.70	13.70	44.90	31.50	51.90
20	Cadmium	mg/kg	BQL	BQL	BQL	BQL	BQL	BQL	BQL
21	Lead	mg/kg	BQL	BQL	BQL	BQL	BQL	BQL	BQL
22	Mercury	mg/kg	BQL	BQL	BQL	BQL	BQL	BQL	BQL
23	Arsenic	mg/kg	BQL	BQL	BQL	BQL	BQL	BQL	BQL

*ND - Not Detected, BQL: Below Quantification Limit (NO3:10.0 mg/kg,Cd: 1.0 mg/kg, Hg: 1.0mg/kg, As: 1.0mg/kg)

9.2 Discussion of Marine Sediment samples

Marine Sediments of Deendayal Port Harbor waters, Khori and Nakti Creeks and two locations of Vadinar are monitored for various physico-chemical parameters during spring and neap tide of each month. The Heavy metal analyzed and found below quantification limit.

9.3 Conclusion

The sediment types are majority Sandy loamy. Also maximum heavy metals parameters found below Quantification limit wise, Pb, Cd, Hg , As, Al was not Detected and Nitrate for some locations.

CHAPTER-11

MARINE ECOLOGICAL MONITORING

10.0 INTRODUCTION:

10.1 Sampling Stations:

The monitoring of marine environment for the study of biological and ecological Parameters was carried out on 01st November 2022 in harbour region of DPA at Kandla Creek, and on 02nd November 2022 in creeks near by the port during Neap tide. The monitoring of marine environment for the study of biological and ecological parameters was repeated again on 08th November, 2022 in harbour region of DPA at Kandla Creek and on 09th November, 2022 in creeks near by the port during spring tidal condition.

Plankton samples from sub surface layer was collected both during high tide period and low tide period from 3 water quality monitoring stations of DPA harbour area and two stations in Nakti creek and one station in Khori creek. Sampling at second sampling station of Nakti creek was possible only during high tide period.

Plankton samples from sub surface layer were collected during high tide period and low tide period from monitoring station near Vadinar Jetty at Path Finder Creek during Neap tide on 01/11/2022 and Spring tide period on 08/11/2022.Collected water samples were processed for estimation of Chlorophyll- a, Pheophytin- a, qualitative and quantitative evaluation of phytoplankton, qualitative and quantitative evaluation of zoo plankton density and their population.

TABLE 43. SAMPLING LOCATIONS

monitoring requirement	**Number of locations**
Kandla creek	3 in Kandla creek
Nakti creek	2 in Nakti creek
Khori Creek	1 in Khori creek
Vadinar jetty	1 near Vadinar Jetty
SPM	1 near I stSPM
Total Number of locations	**8**

Sampling methodology adopted:

A marine sampling is an estimation of the body of information in the population. The theory of the sampling design is depending upon the underlying frequency distribution of the population of interest. The requirement for useful water sampling is to collect a representative sample of suitable volume from the specified depth and retain it free from contamination during retrieval.

50 litres of the water sample were collected from Sub surface by using bucket. From the collected water sample 1 litres of water sample was taken in an opaque plastic bottle for chlorophyll estimation, thereafter plankton samples were collected by using filtration assembly with Nylobolt cloth of 20µm mesh size. . During low tide DPA-6 Nakti-II location monitoring was not possible due to non-availability of marine water.

Samples Processing for chlorophyll estimation:

Samples for chlorophyll estimation were preserved in ice box on board in darkness to avoid degradation in opaque container covered with aluminium foil. Immediately after reaching the shore after sampling, 1 litre of collected water sample was filtered through GF/F filters (pore size 0.45 µm) by using vacuum filtration assembly. After vacuum filtration the glass micro fiber filter paper was grunted in tissue grinder, macerating of glass fiber filter paper along with the filtrate was done in 90% aqueous Acetone in the glass tissue grinder with glass grinding tube. Glass fiber filter paper will assist breaking the cell during grinding and chlorophyll content was extracted with 10 ml of 90% Acetone, under cold dark conditions along with saturated magnesium carbonate solution in glass screw cap tubes. After an extraction period of 24 hours, the samples were transferred to calibrated centrifuge tubes and adjusted the volume to original volume with 90% aqueous acetone solution to make up the evaporation loss. The extract was clarified by using centrifuge in closed tubes. The clarified extracts were then decanted in clean cuvette and optical density was observed at wavelength 664, 665 nm. By using corrected optical density, Chlorophyll-a value was calculated as given in (APHA, 2017).

PLANKTON:

The entire area open water in the sea is the pelagic realm. Pelagic organisms live in the open sea. In contrast to the pelagic realm, the benthic realm comprises organisms and zone of the bottom of the sea. Vertically the pelagic realm can be dividing into two zones based on light penetration; upper photic or euphotic zone and lower dark water mass, aphotic zone below the photic zone.

The term plankton is a general term for organisms which have such limited powers of locomotion that they are at the mercy of the prevailing water movement. Plankton is subdivided to phytoplankton and zooplankton. Phytoplanktons are free floating organisms that are capable of photosynthesis and zooplankton is the various free-floating animals.

Pelagic zone, represents the entire ocean water column from the surface to the deepest depths, is home to a diverse community of organisms. Differences in their locomotive ability categorize the organisms in the pelagic realm into two, ***plankton*** and ***nekton*** (Lalli and Parsons, 1997). ***Plankton*** consists of all organisms drifting in the water and is unable to swim against water currents, whereas ***Nekton*** includes organisms having strong locomotive power. Ecological studies on the plankton community, which form the base of the aquatic food chain, help in the better understanding of the dynamics and

functioning of the marine ecosystem. The term 'Plankton' first coined by Victor Hensen (1887), Plankton, (Greek word: *planktos*meaning "passively drifting or wandering") is defined as drifting or free-floating organisms that inhabit the pelagic zone of water. Based on their mode of nutrition planktonic organisms are categorised into phytoplankton (organisms having an autotrophic mode of nutrition) and zooplankton (organisms having a heterotrophic mode of nutrition).

Phytoplankton in the marine environment:

Phytoplanktons are free floating unicellular, filamentous and colonial eutrophic organisms that grow in aquatic environments whose movement is more or less dependent upon water currents. These micro flora acts as primary producers as well as the basis of food chain, source of protein, bio-purifier and bio-indicators of the aquatic ecosystems of which diverse array of the life depends .They are considered as an important component of aquatic flora, play a key role in maintaining equilibrium between abiotic and biotic components of aquatic ecosystem.

The phytoplankton includes a wide range of photosynthetic and phototrophic organisms. Marine phytoplankton is mostly microscopic and unicellular floating flora, which are the primary producers that support the pelagic food-chain. The two most prominent groups of phytoplankton are Diatoms (Bacillariophyceae) and Dinoflagellates (Dinophyceae).The phytoplankton those normally captured in the net from the Gulf of Kutch is normally dominated by these two major groups; Diatoms and Dinoflagellates. Phytoplankton also include numerous and diverse collection of extremely small, motile algae which are termed micro flagellates (naked flagellates) as well as and Cyanophytes (Blue-green algae).

Algae are an ecologically important group in most aquatic ecosystems and have been an important component of biological monitoring programs. Algae are ideally suited for water quality assessment because they have rapid reproduction rates and very short life cycles, making them valuable indicators of short-term impacts.

Aquatic populations are impacted by anthropogenic stress, resulting in a variety of alterations in the biological integrity of aquatic systems. Algae can serve as an indicator of the degree of deterioration of water quality, and many algal indicators have been used to assess environmental status.

Zooplankton in the marine environment:

Zooplankton includes a taxonomically and morphologically diverse community of heterotrophic organisms that drift in the waters of the world's oceans. Qualitative and quantitative studies on zooplankton community are a prerequisite to delineate the ecological processes active in the marine ecosystem. Zooplankton community plays a pivotal role in the pelagic food web as the primary consumers of phytoplankton and act as the food source for organisms in the higher trophic levels, particularly the economically essential groups such as fish larvae and fishes. They also function in the cycling of elements in the marine ecosystem. The dynamics of the zooplankton community, their reproduction, and growth and survival rate are all significant factors determining the recruitment and

abundance of fish stocks as they form an essential food for larval, juvenile and adult fishes (Beaugrand et al., 2004). Zooplankton grazing in the marine environment controls the primary Production and helps in determining the pelagic ecosystem (Banse, 1995). Through grazing in surface waters and following the production of sinking faecal matters and also by the active transportation of dissolved and particulate matter to deeper waters via vertical migration, they help in the transport of organic carbon to deep ocean layers and thus act as key drivers of 'biological pump' in the marine ecosystem. Zooplankton grazing and metabolism also, transform particulate organic matter into dissolved forms, promoting primary producer community, microbial demineralization, and particle export to the ocean's interior.

The categorisation of zooplankton into various ecological groups is based on several factors such as duration of planktonic life, size, food preferences and habitat. As they vary significantly in size from microscopic to metazoic forms, the classification of zooplankton based on size has paramount importance in the field of quantitative plankton research.

Based on the duration of planktonic life, zooplankton are categorised into Holoplankton (organisms which complete their entire lifecycle as plankton) and Meroplankton (organisms which are planktonic during the early part of their lives such as the larval stages of benthic and nektonic organisms). Tychoplankton are organisms which live a brief planktonic life, such as the benthic crustaceans (Cumaceans, mysids, isopods) which ascend to the water column at night for feeding and certain ectoparasitic copepods, they leave the host and spend their life as plankton during their breeding cycle.

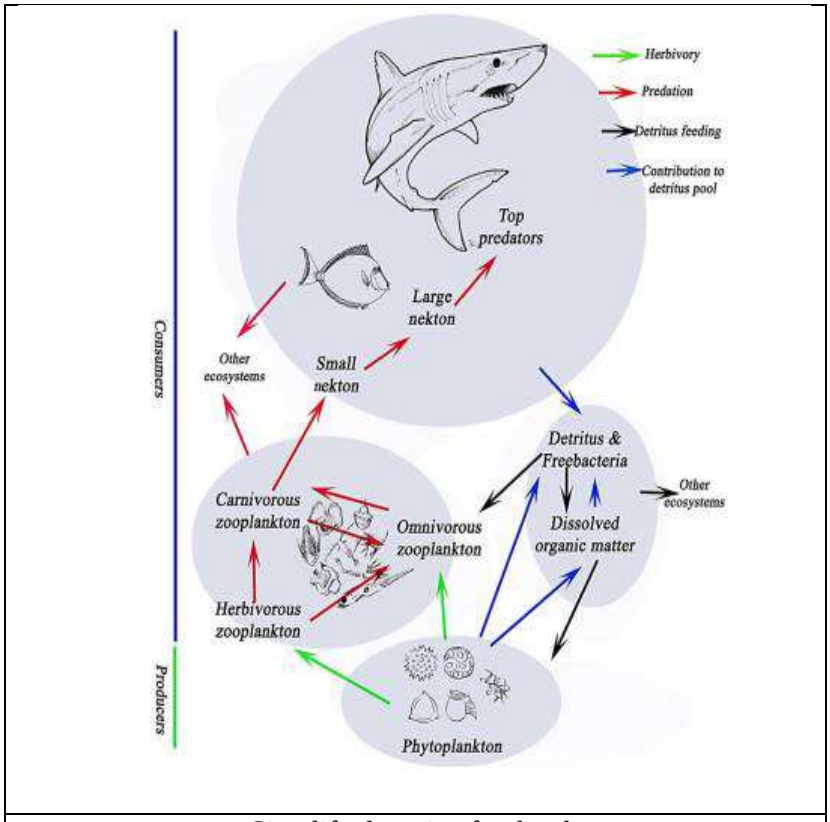
Zooplankton can be subdivided into holoplankton, i.e., permanent members of the plankton (e.g., Calanoid copepods), and meroplankton, i.e., temporary members in the plankton e.g., larvae of fish, shrimp, and crab). The meroplankton group consists of larval and young stages of animals that will adopt a different lifestyle once they mature. In contrast to phytoplankton which consist of a relatively smaller variety of organisms, Zooplankton are extremely divers, consist of a host of larval and adult forms representing many animal phylum.

Among the zooplankton one group always dominate than others; members of sub class copepods (Phylum Athropoda) and Tintinids (Phylum Protozoa) among the net planktons. These small animals are of vital importance in marine ecosystem as one of the primary herbivores animals in the sea, and it is they provide vital link between primary producer (autotrophs) and numerous small and large marine consumers.

As their community structure and function are highly susceptible to changes in the environmental conditions regular monitoring of their distribution as well as their interactions with various physicochemical parameters is inevitable for the sustainable management of the ecosystem (Kusum et al., 2014). Of all the marine zooplankton groups, copepods mainly Calanoid copepods are the

dominant groups in marine subtropical and tropical waters and exhibit considerable diversity in morphology and habitats they occupy (Madhupratap, 1991 ;)

It has been well established that potential of pelagic fishes viz. finfishes, crustaceans, molluscs and marine mammals either directly or indirectly depend on zooplankton. The herbivorous zooplanktons are efficient grazers of the phytoplankton and are referred to as living machines transforming plant material into animal tissue. Hence they play an essential role as the intermediaries for nutrients/energy transfer between primary and tertiary trophic levels. Due to their large density, shorter lifespan, drifting nature, high group/species diversity and different tolerance to the stress, they used as the indicator organisms for the physical, chemical and biological processes in the aquatic ecosystem (Ghajbhiye, 2002).



Simplified marine food web

Spatial distribution of Plankton:

A characteristic of plankton population is that they tend to occur in patches, which are varying spatially on a scale of few meters to far as few kilo metres in distance. They also vary in time scale, season as well as vertically in the water column. It is this patchiness and its constant changes in time and spot, that has made it so difficult for plankton biologist to learn about the ecology of plankton. The biological factors that causes this patchiness is due to the ability of zooplankton to migrate vertically and graze out the phytoplankton at a rapid rate that can create patchiness. Similarly the active swimming ability by certain zooplankton organisms can cause to aggregate in dense group.

At its most extreme, because the water in which plankton is suspended is constantly moving, each sample taken by the plankton biologists remain a different volume of water, so each sample is unique and replicate does not exist.

Plankton in the month of Novemberalso exhibit vertical patchiness. Physical factors contribute to this type of patchiness include light intensity, nutrients and density gradients in the water column.

Phytoplankton in particular tends to be unequally distributed vertically, which leads to the existence of different concentration of a chlorophyll value between photic zone and below the photic zone.

Methodology adopted for Plankton sampling:

Preservation and storage:

Both filtered plankton and those collected from the plankton net were preserved with 5% buffered formalin and stored in 1L plastic container for further processing in the laboratory.

Sample concentration:

The collected plankton samples were concentrated by using centrifuge and made up to 50 ml with 5% formalin -Glycerine mixture.

Taxonomic evaluation:

Before processing, the sample was mixed carefully and a subsample was taken with a calibrated Stempel-pipette. 1 ml of the concentrated plankton samples were transferred on a glass slide with automatic pipette. The plankton sample on the glass slides were stained by using Lugol's iodine and added glycerin to avoid drying while observation. The plankton samples were identified by using Labex triangular Research microscope with photographic attachment. Microphotographs of the plankton samples were taken for record as well as for confirming the identification. The bigger sized zooplankton was observed through dissecting stereomicroscope with magnification of 20-30 x. Plankton organisms in the whole slide were identified to the lowest taxon possible. A thorough literature search was conducted for the identification of the different groups of phytoplankton and zooplankton that were encountered

Cell counts by drop count method:

The common glass slide mounted with a 1ml of concentrated phytoplankton/zooplankton sample in glycerol and covered with cover slip 22 mm x 60 mm was placed under the compound microscope provided with a mechanical stage. The plankton was then counted from the microscopic field of the left top corner of the slide. Then slide is moved horizontally along the right side and plankton in each microscopic field was thus counted. When first microscopic field row was finished the next consecutive row was adjusted using the mechanical device of the stage. In this way all the plankton present in entire microscopic field are counted. From this total number in 1ml of the concentrated plankton, total amount of phytoplankton in the original volume of sample filtered was calculated as units/L and Zooplankton as N/m^3.

BENTHIC ORGANISMS:

Benthos is those organisms that are associated with the sea bed or benthic habitats. Epi- benthic organisms live attached to a hard substratum or rooted to a shallow depth below the surface. In fauna organisms live below the sediment–water interface. Interstitial organisms live and move in pore water among sedimentary grains.

Because the benthic organisms are often collected and separated on sieves, a classification based on the overall size is used. Macro benthos include organisms whose shortest dimension is greater than or equal to 0.5 mm. Meio benthos are smaller than 0.5mm but larger than 42µ in size.

The terms such as macro fauna and Meio fauna generally have little relevance with taxonomic classification. The terms Meio fauna and macro fauna depend on the size. Meio fauna were considered as good bioassay of community health and rather sensitive indicators of environmental changes

SAMPLING METHODOLOGY ADOPTED FOR SUB TIDAL REGION:

Van veen sampler ($0.09m^2$) was used for sampling bottom sediments. Two sets of sediments were sampled from each location, one for macro fauna and other for Meio fauna. The macro fauna in the sediments were sieved on board to separate out the organisms. The fixation of Meio fauna is normally done by bulk fixation of the sediment sample. The bulk fixation is done by using 10% formalin (Buffered with borate). The organisms were preserved with seawater as diluting agent.

Sample sieving:

Sediments samples were sieved to extract the organisms. Sieving was performed carefully as possible to avoid any damage to the animals. The large portion of the sediment was split in to smaller portions and mixed with sea water in a bucket. The cohesive lumps were broken down by continuous stirring. The disaggregated sediments were then passed through the sieves.

Sample staining:

Sorting of the Meio fauna from the sieve is difficult task especially in the preserved material, because organisms are not easily detectable. To facilitate the animal detection the entire sample retained on the sieve after sieving operation were stained by immersing the sieve in a flat bottom tub with 1% Rose Bengal stain; a protein stain. A staining period of 10-30 minutes is sufficient for sample detection.

DIVERSITY INDICES:

On the whole, diversity indices provide more information about community composition than simply species richness (number of species present); they also, take the relative abundances of different species into account. Based on this fact, diversity indices therefore depend not only on species richness but on the evenness, or equitability, with which individuals are distributed among the different species (Magurram, A. E. (1988)

A diversity index is a measure of species diversity within a community that consists of co-occurring populations of several (two or more) different species. It includes two components: richness and evenness. Richness is the measure of the number of different species within a sample showing that more the types of species in a community, the higher is the diversity or greater is the richness. Evenness is the measure of relative abundance of the different species with in a community.

The basic idea of diversity index is to obtain a quantitative estimate of biological variability that can be used to compare biological entities composed of discrete components in space and time (Carol H. R. *etal*. 1998). Biodiversity is commonly expressed through indices based on species richness and species abundances (Whittaker 1972, Lande 1996, Purvis and Hector 2000). Biodiversity indices are a non-parametric tool used to describe the relationship between species number and abundance. The most widely used bio diversity indices are Shannon Weiner index and Simpson's index.

A diversity Index is a single statistic that incorporates information on richness and evenness. Any study intended to interpret causes and effect of adverse impact on Biodiversity of communities require suitable measures to evaluate specie richness and Diversity. The former is number of species in community, while latter is a function of relative frequency of different species. Species richness is the iconic measure of biological diversity (Magurran, 2004). Several indices have been created to measure the diversity of species; however, the most widely used in the last decades are the Shannon (1948) and Simpson (1949) (Buzas and Hayek 1996; Gorelick 2006), with the components of diversity: richness (*S)* and evenness (*J)*

Simpson's diversity index

Simpson's index (**D**) is a measure of diversity, which takes into account both species richness, and evenness of abundance among the species present. The Simpson index is one of the meaningful and robust biodiversity measures available. (Magurran , 2004).

The formula for calculating D is presented as:

$$D = \frac{\sum n_i(n_i - 1)}{N(N-1)}$$

Where n_i = the total number of organisms of each individual species

N = the total number of organisms of all species

The value of D ranges from 0 to 1. With this index, 0 represents infinite diversity and, 1, no diversity. When D increases diversity decreases. Simpson's index is therefore usually expressed as 1-D or 1/D. (Magurran, 2004)

Low species diversity suggests:

- relatively few successful species in the habitat
- the environment is quite stressful with relatively few ecological niches and only a few organisms are really well adapted to that environment

- food webs which are relatively simple
- change in the environment would probably have quite serious effects

High species diversity suggests:

- a greater number of successful species and a more stable ecosystem
- more ecological niches are available and the environment is less likely to be hostile complex food webs
- environmental change is less likely to be damaging to the ecosystem as a whole

Species richness indices

The species richness***(S)*** is simply the number of species present in an ecosystem. Species richness Indices of species richness are widely used to quantify or monitor the effects of anthropogenic disturbance. A decline in species richness in may be concomitant with severe or chronic human-induced perturbation (Fair Fair weather 1990) Species richness measures have traditionally been the mainstay in assessing the effects of environmental degradation on the biodiversity of natural assemblages of organisms (Clarke &Warwick, 2001)

Species richness is the iconic measure of biological diversity (Magurran, 2004). The species richness***(S)*** is simply the number of species present in an ecosystem. This index makes no use of relative abundances. The term species richness was coined by Mc Intosh (1967) and oldest and most intuitive measure of biological diversity (Magurran, 2004).

Margalef's diversity index is a species richness index. Margalef's Species richness index (d), or indices that describe the evenness of the distribution of the numbers of individuals among species, were derived.

The value of a diversity index increases both when the number of types increases and when evenness increases. For a given number of types, the value of diversity index is maximised when all types are equally abundant [Rosenzweig, M. L. (1995)]

Shannon-Wiener's index:

An index of diversity commonly used in plankton community analyses is the Shannon-Wiener's index **(H),** which emphasizes not only the number of species (richness or variety), but also the apportionment of the numbers of individuals among the species (Odum 1971 and Reish 1984). Shannon-Wiener's index **(H)** reproduces community parameters to a single numberby using an equation.

Shannon and Weiner index represents entropy. It is a diversity index taking into account the number of individuals as well as the number of taxan. It varies from 0 for communities with only single taxa to high values for community with many taxan each with few individuals. This index can also determine the pollution status of a water body. Normal values range from 0 to 4. This index is a combination of species present and the evenness of the species. Examining the diversity in the range

of polluted and unpolluted ecosystems, Wilham and Dorris (1968) concluded that the values of the index greater than

3 indicate clean water, values in the range of 1 to 3 are characterized by moderate pollution and values less than 1 are characterized as heavily polluted

10.2:- RESULTS:

CHLOROPHYLL-a:

$$H' = -\sum_{j=1}^{s} \frac{n_j}{N} \ln\left(\frac{n_j}{N}\right)$$

In the sub surface water chlorophyll-a was varying from 0.472-0.969 mg/m^3 with an average value 0.645 mg/m^3 in harbour region of DPA in Kandla Creek during sampling done in spring tide period of November 2022. In the nearby creeks chlorophyll-a was varying from 0.359-0.717 mg/m^3 with an average value 0.552 mg/m^3 Pheophytin –a level was below detectable limit- the all the sampling stations during springtide. Even though the plankton diversity and abundance were more during the spring tide sampling,the chlorophyll-content was detected lesser than expected because, the phytoplankton communities were mainly represented by diatoms *Skeletonema* sp. *Coscinodiscus sp.* and *Chaetoceros* sp.

In the sub surface water chlorophyll-a was varying from 0.338-0.547 mg/m^3 with an average value 0.437 mg/m^3 in harbour region of DPA in Kandla Creek during sampling done in Neap tide period of November2022. In the nearby creeks chlorophyll-a was varying from 0.205- 0.440mg/m^3 with an average value 0.370 mg/m^3. Pheophytin–a level was below detectable limit- the all the sampling stations. During neap tide sampling phytoplankton communities were mainly represented by *Coscinodiscus sp. and Ditylum sp.*

In the sub surface water chlorophyll-a was varying from 0.598-0.968 mg/m^3 in harbour region of DPA OOT in path finder Creek during sampling done in spring tide period of November 2022. In the sub surface water chlorophyll-a was varying from 0.709 - 0.987mg/m^3 in harbour region of DPA OOT in path finder Creek during sampling done in Neap Tide period of November 2022

TABLE:-45 VARIATIONS IN CHLOROPHYLL–a PHEOPHYTIN-a AND ALGAL BIOMASS FROM SAMPLING STATIONS IN DPA HARBOUR AREA IN KANDLA CREEK ,NEAR BY CREEKS AND DPA OOT JETTY IN PATH FINDER CREEK AND SPM NEAR VADINARDURING SPRING TIDE IN NOVEMBER 2022

Sr. No.	Station	Tide	Chlorophyll-a (mg/m^3)	Pheophytin- a (mg/m^3)	Algal Biomass (Chlorophyll method) mg/m^3
DPA HARBOUR AREA KANDLA CREEK					
1	KPT1	High tide	0.969	BDL	64.92
		Low tide	0.647	BDL	43.35
2	KPT 2	High tide	0.511	BDL	34.24
		Low tide	0.521	BDL	34.91
3	KPT 3	High tide	0.749	BDL	50.18
		Low tide	0.472	BDL	31.62
CREEKS					
4	KPT-4 Khori-I	High tide	0.638	BDL	42.75
		Low tide	0.359	BDL	24.05
5	KPT-5 Nakti-I	High tide	0.717	BDL	48.04
		Low tide	0.493	BDL	33.03
6	KPT-6 Nakti-II	High tide	ND	ND	ND
PATHFINDER CREEK VADINAR					
7	VADINAR-I jetty	High tide	0.968	BDL	64.86
8		Low tide	0.732	BDL	49.04
9	SPM	High tide	0.953	BDL	63.85
10		Low tide	0.598	BDL	

BDL: Below Detectable Limit., ND: Not detected

TABLE:-46. VARIATIONS IN CHLOROPHYLL–a PHEOPHYTIN-a AND ALGAL BIOMASS FROM SAMPLING STATIONS IN DPA HARBOUR AREA, NEAR BY CREEKS AND DPA OOT JETTY IN PATH FINDER CREEK AND SPM NEAR VADINARDURING NEAP TIDE IN NOVEMBER 2022

Sr.No.	Station	Tide	Chlorophyll-a (mg/m^3)	Pheophytin- a (mg/m^3)	Algal Biomass (Chlorophyll method) mg/m^3
DPA HARBOUR AREA KANDLA CREEK					
1	KPT1	High tide	0.547	BDL	
		Low tide	0.450	BDL	
2	KPT 2	High tide	0.338	BDL	
		Low tide	0.409	BDL	
3	KPT 3	High tide	0.354	BDL	
		Low tide	0.523	BDL	
CREEKS					
4	KPT-4 Khori-I	High tide	0.440	BDL	
		Low tide	0.408	BDL	
5	KPT-5 Nakti-I	High tide	0.205	BDL	
		Low tide	0.426	BDL	
6	KPT-6 Nakti-II	High tide	ND	ND	ND
PATHFINDER CREEK VADINAR					
7	VADINAR-I jetty	High tide	0.799	BDL	
8		Low tide	0.709	BDL	
9	SPM	High tide	0.857	BDL	
10		Low tide	0.987	BDL	

BDL: Below Detectable Limit.ND: Not detected

PHYTOPLANKTON POPULATION:

For the evaluation of the Phytoplankton population in DPA harbour area and within the immediate surroundings of the port, sampling was conducted from 5 sampling locations (3 in harbour area and two in Nakti creek) during high tide period and low tide period of spring tide and neap tide.

The phytoplankton community of the sub surface water in the harbour and nearby creeks was represented by, Diatoms, blue green algae and Dinoflagellates during spring tide period. Diatoms were represented by 26 genera, Blue green algae were represented by 2 genera and Dinoflagellates were represented by 6 genera during the sampling conducted in spring tide in November, 2022. Phytoplankton of the sampling stations at sub surface layer in the harbour area and nearby creeks was varying from 39-243units/ L during high tide period and115-199 units/L during low tide of Spring Tide. During spring tide sampling phytoplankton communities were dominated by *Skeletonema* sp almost forming a bloom in the Kandla creek and other nearby creek area and abundant population of *Coscinodiscus sp.* and *Chaetoceros* sp.

The phytoplankton community of the sub surface water in the harbour and nearby creeks was represented by Diatoms, Blue green algae and DinoflagellatesduringNeap tide period. Diatoms were represented by 24 genera, Blue green algae were represented 2 genera and Dinoflagellates with 5 genera during the sampling conducted in Neap tide in November, 2022. Phytoplankton of the sampling stations at sub surface layer in the harbour area and nearby creeks was varying from 43-299 units/ L during high tide period and 143-193 units/L during low tide of Neap Tide. During Neap tide sampling phytoplankton communities were dominated by, *Ditylum sp and Coscinodiscus sp.*

For the evaluation of the Phytoplankton population in DPA OOT jetty area in Path Finder creek sampling was conducted from two sampling locations; Jetty area and SPM area during high tide period and low tide of spring tide and Neap tide period.

The phytoplankton community of the sub surface water in the path finder creeks was represented by Diatoms, Blue green algae and Dinoflagellates during spring tide period. Diatoms were represented by 25 genera, Blue Green algae by 5 genera and Dinoflagellates by 6 genera during the sampling conducted in spring tide in November, 2022. Phytoplankton of the sampling stations at sub surface path finder creek near OOT Jetty area was 209 units/L during high tide period and 177 units/L during low tide of Spring Tide. Phytoplankton of the sampling stations at sub surface layer in the SPM area was varying from 206 units/ L during high tide period and 131 units/ L during low tide of Spring Tide.

The phytoplankton community of the sub surface water in the path finder creeks was represented by Diatoms, Blue green and Dinoflagellates during Neap tide period. Diatoms were represented by 32 genera and Blue green algae by 4 genera and Dinoflagellates by 6 genera during the sampling conducted in Neap tide in November, 2022. Phytoplankton of the sampling stations at sub surface path finder creek near OOT Jetty was varying from 244units/ L during high tide period and 200

units/L during low tide of Neap Tide. Phytoplankton of the sampling stations at sub surface path finder creek near SPM area was varying from 259 units/L during high tide period and 294 units/L during low tide of Neap Tide.

Species Richness Indices and Diversity Indices:

Margalef's diversity index (Species Richness)

Margalef's diversity index (Species Richness) of phytoplankton communities in the Kandla creek and nearby creeks sampling stations was varying from 2.184- 4.688 with an average of 3.346 during the sampling conducted in High tide period of spring tide. While Margalef's diversity index (Species Richness) S of phytoplankton communities in the Kandla creek region and nearby creeks was varying from1.963- 3.589 with an average of 2.835during the consecutive low tide period.

Margalef's diversity index (Species Richness) of phytoplankton communities in the stations in Kandla creek and nearby creeks was varying from 2.393-4.279 with an average of 3.586during the sampling conducted in High tide period of Neap tide. While Margalef's diversity index (Species Richness) of phytoplankton communities in the Kandla creek region and nearby creeks was varying from 2.821-3.86 with an average of 3.357during consecutive low tide.

Margalef's diversity index (Species Richness) S of phytoplankton communities in the stations was 4.867 at OOT jetty area and 4.129 at SPM area during the sampling conducted in High tide period of spring tide. While Margalef's diversity index (Species Richness) S of phytoplankton communities in the path finder creek near OOT jetty was 4.443 and 3.692 at SPM during the consecutive low tide period.

Margalef's diversity index (Species Richness) of phytoplankton communities in the stations was 4.73 at OOT jetty area and 4.139 at SPM area during the sampling conducted in High tide period of Neap tide. While Margalef's diversity index (Species Richness) of phytoplankton communities in the path finder creek near OOT jetty was 4.152 and SPM area was 5.454 during the consecutive low tide period.

Shannon-Wiener's index:

Shannon-Wiener's Index (H) of phytoplankton communities in the sampling stations was in the range of 0.786- 1.034 between selected sampling stations with an average value of 0.925 during high tide period of spring tideat Kandla creek and nearby creeks. Shannon-Wiener's Index (H) of phytoplankton communities in the sampling stations was in the range of 0.790-0.915 between selected sampling stations with an average value of 0.855 during consecutive low tide at Kandla creek and nearby creeks.

Shannon-Wiener's Index (H) of phytoplankton communities in the sampling stations was in the range of 0.867–1.022 between selected sampling stations with an average value of 0.932 during high tide period of neap tide at Kandla creek and nearby creeks. Shannon-Wiener's Index (H) of phytoplankton

communities in the sampling stations was in the range of 0.926- 1.001 between selected sampling stations with an average value of 0.951during consecutive low tide at Kandla creek and nearby creeks.

Shannon-Wiener's Index (H) of phytoplankton communities in the stations was1.037 at OOT jetty area and 0.946 at SPM area during the sampling conducted in High tide period of spring tide. While Shannon-Wiener's Index (H) of phytoplankton communities in the path finder creek near OOT jetty was 1.043 and 0.982 at SPM during the consecutive low tide period of spring tide.

Shannon-Wiener's Index (H) of phytoplankton communities in the stations was 0.998 at OOT jetty area and1.035 at SPM area during the sampling conducted in High tide period of Neap tide. While Shannon-Wiener's Index (H) of phytoplankton communities in the path finder creek near OOT jetty was 0.942 and at SPM area was1.036 during the consecutive low tide period.

Typical values are generally between 1.5 and 3.5 in most ecological studies, and the index is rarely greater than 4. The Shannon-Wiener's index increases as both the richness and the evenness of the community increase. This result indicates that diversity of phytoplankton of Kandla Harbour region and nearby creeks is less but with abundant population of few, with relatively few ecological niches and only very few opportunist organisms are really well adapted to this environment and thrive better than other species.

Simpson's diversity index:

Simpson diversity index (1-D) of phytoplankton communities was below 0.9 at all sampling stations in the Kandla Harbour region and nearby creeks, which was varying from 0.778-0.851 between selected sampling stations with an average of 0.823 during high tide period of spring tide. Simpson diversity index (1-D) of phytoplankton communities was below 0.9 at all sampling stations in the Kandla Harbour region and nearby creeks except few, which was varying from 0.787-0.842 between selected sampling stations with an average of 0.814 during consecutive low tide.

Simpson diversity index (1-D) of phytoplankton communities was below 0.9 at all sampling stations except few in Kandla Harbour region and nearby creeks, during high tide period and low tide period during Neap tide also, which was varying from 0.813-0.874 with an average value of 0.847 between selected sampling stations during high tide period and 0.840-0.871 varying from with an average value of 0.858 between selected sampling stations during consecutive low tide period Low species diversity suggests a relatively few successful species in this habitat.

Simpson diversity index (1-D) of phytoplankton communities in the stations was0.863 at OOT jetty area and 0.820 at SPM area during the sampling conducted in High tide period of spring tide at Path finder creek. While Simpson diversity index (1-D) of phytoplankton communities in the path finder creek near OOT jetty was 0.876 and 0.867 at SPM during the consecutive low tide period in the path finder creek.

Simpson diversity index (1-D) of phytoplankton communities in the stations was 0.838 at OOT jetty area and 0.881 at SPM area during the sampling conducted in High tide period of Neap tide at Path

finder Creek. While Simpson diversity index (1-D) of phytoplankton communities in the path finder creek near OOT jetty was 0.832 and at SPM area was 0.867 during the consecutive low tide period.

Table:-47 4PHYTOPLANKTON VARIATIONS IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPA HARBOUR AREA AT KANDLA CREEK AND , NEAR BY CREEKS DURING SPRING TIDE IN NOVEMBER 2022

Tide	Sampling Station	Abundance In units/L	No of Species observed /total species	% Of diversity	Margalef's diversity index (Species Richness)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	1	207	26/34	76.47	4.688	1.034	0.8511
	2	183	22/34	64.71	4.031	1.005	0.8437
	3	193	13/34	38.24	2.28	0.811	0.7778
	4	243	18/34	52.94	3.095	0.9391	0.8192
	5	193	21/34	61.76	3.8	0.9777	0.8281
	6	39	9/34	26.47	2.184	0.786	0.8178
LOW TIDE	1	178	14/34	41.18	2.509	0.8042	0.787
	2	199	20/34	58.82	3.589	0.8982	0.8075
	3	115	14/34	41.18	2.74	0.8696	0.8365
	4	154	18/34	52.94	3.375	0.915	0.8416
	5	163	11/34	32.35	1.963	0.7895	0.7957

Table:-48 PHYTOPLANKTON VARIATIONS IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPA HARBOUR AREA AT KANDLA CREEK AND NEAR BY CREEKS DURING NEAP TIDE IN NOVEMBER 2022

Tide	Sampling Station	Abundance In units/L	No of Species observed /total species	% of diversity	Margalef's diversity index (Species Richness)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	1	216	24/31	77.42	4.279	0.98	0.8568
	2	229	22/31	70.97	3.865	0.958	0.853
	3	228	22/31	70.97	3.868	1.022	0.8743
	4	299	23/31	74.19	3.859	0.8667	0.8127
	5	254	19/31	61.29	3.251	0.8929	0.8307
	6	43	10/31	32.26	2.393	0.8712	0.8571
LOW TIDE	1	183	18/31	58.06	3.263	0.9504	0.8636
	2	143	15/31	48.39	2.821	0.946	0.8666
	3	178	21/31	67.74	3.86	1.001	0.8708
	4	193	19/31	61.29	3.42	0.931	0.84
	5	193	19/31	61.29	3.42	0.9259	0.8469

Table:-49 ABUNDANCE OF PHYTOPLANKTON SUBSURFACE SAMPLING STATIONS IN DPA HARBOUR AREA AT KANDLA CREEK AND, NEAR BY CREEKS DURING SPRING TIDE IN NOVEMBER2022

Tide	Surface	No of Sampling location	Group of phytoplankton	Phytoplankton Group range Units/L	Genera or species /total Phyto plankton	Species Composition % (Group level)
HIGH TIDE	Sub surface	6	BLUE GREEN ALGAE	0-8	2/34	5.88
			DIATOMS	38-238	26/34	76.47
			DINOFLAGELLATES	0-11	6/34	17.65
			TOTAL PHYTO PLANKTON	**39-243**	**34**	
LOW TIDE	Sub surface	5	BLUE GREEN ALGAE	1-6	2/34	5.88
			DIATOMS	110-190	26/34	76.47
			DINOFLAGELLATES	1-7	6/34	17.65
			TOTAL PHYTO PLANKTON	**115-199**	**34**	

TABLE:-50 ABUNDANCE OF PHYTOPLANKTON SUBSURFACE SAMPLING STATIONS IN DPA HARBOUR AREA AT KANDLA CREEK AND, NEAR BY CREEKS DURING NEAP TIDE IN NOVEMBER 2022

Tide	Surface	No of Sampling location	Group of phytoplankton	Phytoplankton Group range Units/L	Genera or species /total Phyto plankton	Species Composition % (Group level)
HIGH TIDE	Sub surface	6	BLUE GREEN ALGAE	0-6	2/31	6.45
			DIATOMS	43-293	24/31	77.42
			DINOFLAGELLATES	0-9	5/31	16.13
			TOTAL PHYTO PLANKTON	**43-299**	**31**	
LOW TIDE	Sub surface	5	BLUE GREEN ALGAE	2-6	2/31	6.45
			DIATOMS	133-186	24/31	77.42
			DINOFLAGELLATES	3-8	5/31	16.13
			TOTAL PHYTO PLANKTON	**143-193**	**31**	

TABLE:-51 PHYTOPLANKTON VARIATIONS IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPA OOT AT PATH FINDER CREEK , VADINAR &NEAR BY SPM, DURING SPRING TIDE IN NOVEMBER 2022

Tide	Sampling Station	Abundance In units/L	No of Species observed /total species	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	Jetty	209	27/36	75.00	4.867	1.037	0.863
	SPM	206	23/36	63.89	4.129	0.946	0.820
LOW TIDE	Jetty	177	24/36	66.67	4.443	1.043	0.876
	SPM	131	19/36	52.78	3.692	0.982	0.867

TABLE:-52 PHYTOPLANKTON VARIATIONS IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPA OOT AT PATH FINDER CREEK , VADINAR & NEAR BY SPM, DURING NEAP TIDE IN NOVEMBER 2022

Tide	Sampling Station	Abundance In units/L	No of Species observed /total species	% of diversity	Margalef's diversity index (Species Richness)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	Jetty	244	27/42	64.29	4.73	0.998	0.838
	SPM	259	24/42	57.14	4.139	1.035	0.881
LOW TIDE	Jetty	200	23/42	54.76	4.152	0.942	0.832
	SPM	294	32/42	76.19	5.454	1.036	0.867

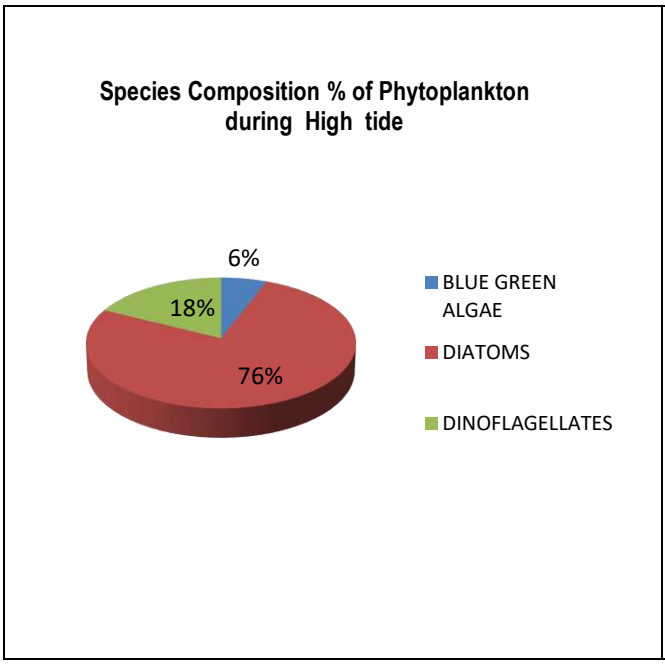
TABLE:-53 ABUNDANCE OF PHYTOPLANKTON SUBSURFACE SAMPLING STATIONS IN DPAOOT AT PATH FINDER CREEK, VADINAR & NEAR BY SPM, DURING SPRING TIDE IN NOVEMBER 2022

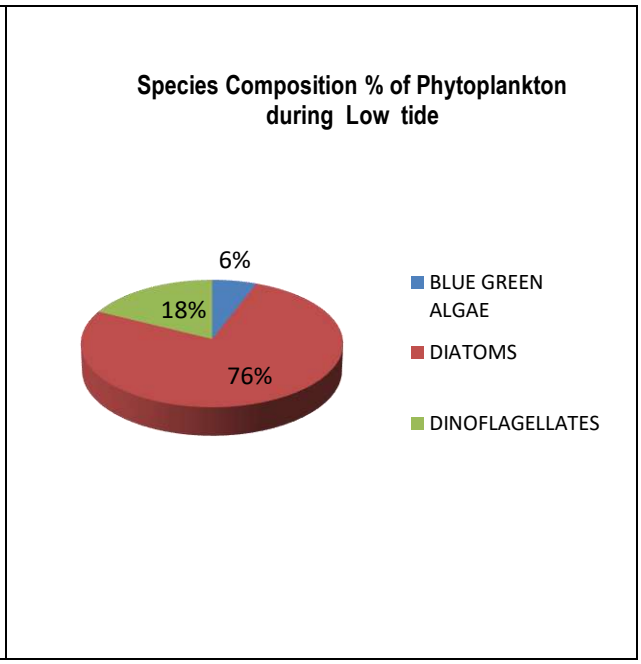
Tide	Surface	No of Sampling location	Group of phytoplankton	Phytoplankton Group range Units/L	Genera or species /total Phyto plankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	2	BLUE GREEN ALGAE	14-20	5/36	13.89
			DIATOMS	180-192	25/36	69.44
			DINOFLAGELLATES	3-6	6/36	16.67
			TOTAL PHYTO PLANKTON	**206-209**	**36**	
LOW TIDE	Sub surface	2	BLUE GREEN ALGAE	12-19	5/36	13.89
			DIATOMS	118-156	25/36	69.44
			DINOFLAGELLATES	1-2	6/36	16.67
			TOTAL PHYTO PLANKTON	**131-177**	**36**	

Table:- 54 ABUNDANCE OF PHYTOPLANKTON SUBSURFACE SAMPLING STATIONS IN DPA OOT AT PATH FINDER CREEK , VADINAR & NEAR BY SPM, DURING NEAP TIDE IN NOVEMBER 2022

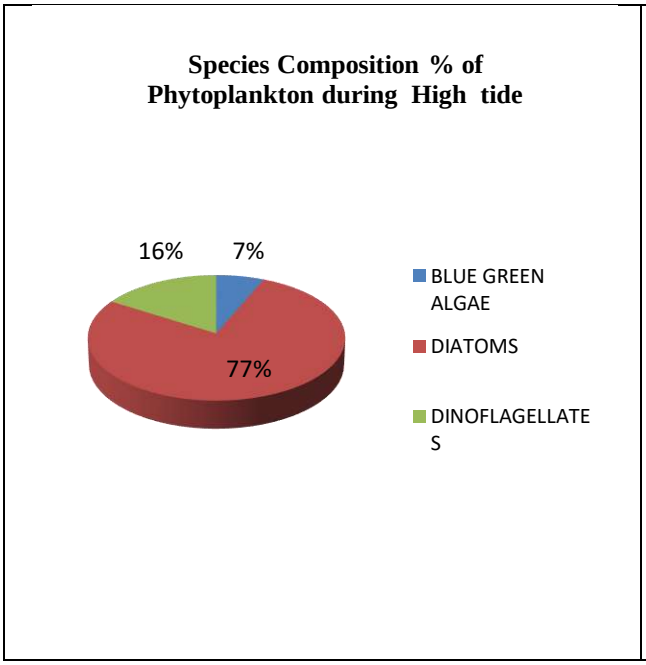
Tide	Surface	No of Sampling location	Group of phytoplankton	Phytoplankton Group range Units/L	Genera or species /total Phyto plankton	Species Composition % (Group level)
HIGH TIDE	Sub surface	2	BLUE GREEN ALGAE	5-7	4/42	9.52
			DIATOMS	238-248	32/42	76.19
			DINOFLAGELLATES	1-4	6/42	14.29
			TOTAL PHYTO PLANKTON	**244-259**		
LOW TIDE	Sub surface	2	BLUE GREEN ALGAE	4-8	4/42	9.52
			DIATOMS	194-282	32/42	76.19
			DINOFLAGELLATES	2-4	6/42	14.29
			TOTAL PHYTO PLANKTON	**200-294**		

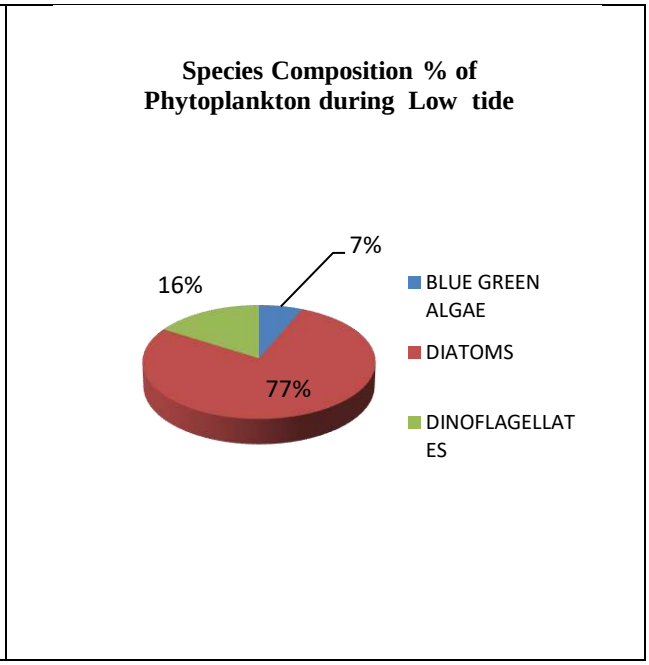
Species Composition % of Phytoplankton during High tide and Low tide period during spring tide in Kandla creek and nearby creeks



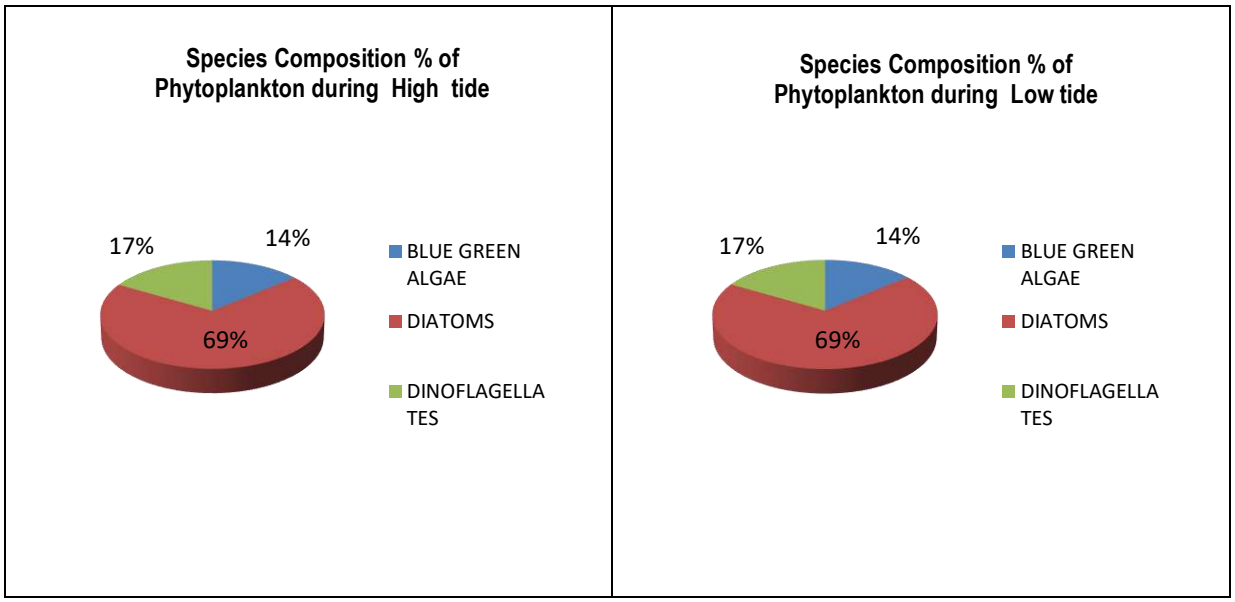


Species Composition % of Phytoplankton during High tide and Low tide period during Neap tide in Kandla creek and nearby creeks

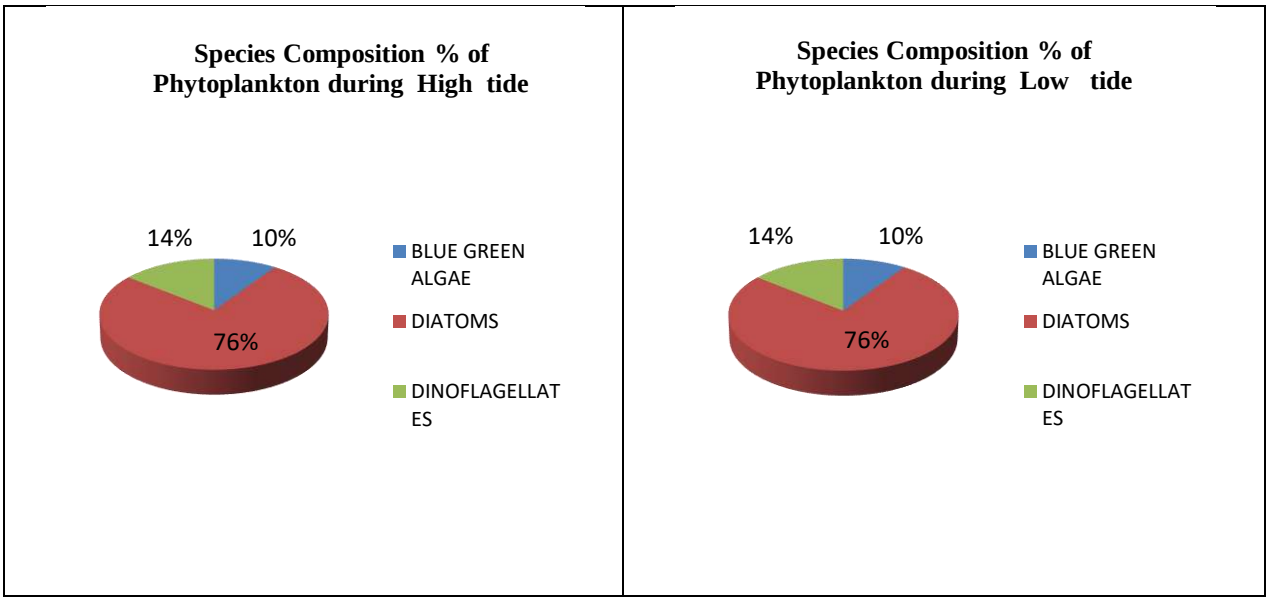




Species Composition % of Phytoplankton during High tide and Low tide period during spring tide in Path Finder Creek, Vadinar



Species Composition % of Phytoplankton during High tide and Low tide period during Neap tide in Path Finder Creek, Vadinar



ZOOPLANKTON POPULATION:

For the evaluation of the Zooplankton population in DPA harbour area and within the immediate surroundings of the port sampling was conducted from 6 sampling locations (3 in harbour area and two in Nakti creek and one in Khoricreek) during high tide period and low tide period of spring tide and Neap tide in November, 2022. The Zooplankton community of the sub surface water in the harbour and nearby creeks during spring tide was representedby mainly six groups;Tintinnids, Copepods,Arrow worms,Mysids, Urochordata,Ciliates and 8 larval forms.The Zooplankton community of the sub surface water in the harbour and nearby creeks during neap tide was represented by mainly six groups;Tintinnids, Copepods,Arrow worms, Mysids, Urochordata, Ciliatesand 6 larval forms.

Zooplankton of the sampling stations at sub surface layer in the DPA harbour area and nearby creek was varying from 25-128 $x10^3$ N/m^3 during high tide and 103-144$x10^3$ N/m^3 during low tide of Spring Tide period. Zooplankton of the sampling stations at sub surface layer in the DPA harbour area and nearby creek was varying from 19-114$x10^3$ N/m^3 during high tide and 76-106$x10^3$ N/ m^3 during low tide of Neap Tide period.

For the evaluation of the Zooplankton population in DPA OOT jetty area in Path Finder creek and SPM in Vadinar selected 2 sampling locations (1 in jetty area and one near SPM).

During spring tide sampling plankton sample were collected at Jetty area and near SPM during consecutive high tide period and low tide period. During Neap tide sampling Plankton samples were collected from jetty area and SPM during consecutive high tide period and low tide period.

The Zooplankton community of the sub surface water in the path finder creek during spring tide was represented by mainly four groups Tintinnids, Copepods, Urochordata, Ciliatesand 4 larval forms. While the Zooplankton community of the sub surface water in the path Finder creeks at Jetty region and SPM during neap tide was represented by four groups, Tintinnids, Copepods, Arrow worms, Urochordataand 5 larval forms.

Zooplankton of the sampling stations at sub surface layer in the DPA OOT Jetty area of path finder creek was 91$x10^3$ N/m^3 during high tide and 86$x10^3$ N/m^3 during low tide of Spring Tide period. Zooplankton of the sampling stations at sub surface layer in the DPA SPM area of path finder creek was 101$x10^3$ N/m^3 during high tide and 70$x10^3$ N/ m^3 during low tide of spring Tide period.

Zooplankton of the sampling stations at sub surface layer in the DPA OOT jetty area in path finder creek was recorded 87$x10^3$ N/m^3 during high tide and 65$x10^3$ N/ m^3 during consecutive low tide period of Neap tide. Zooplankton of the sampling stations at sub surface layer in the DPASPM area in path finder creek was recorded 64$x10^3$ N/m^3during high tide and 87$x10^3$ N/ m^3 during consecutive low tide period of Neap Tide.

Species Richness Indices and Diversity Indices:

Margalef's diversity index (Species Richness)

Margalef's diversity index (Species Richness) of Zooplankton communities in the stations Kandla creek region and nearby creeks was varying from 2.175- 5.186 with an average of 3.450 during the sampling conducted in High tide period. Margalef's diversity index (Species Richness) of Zooplankton communities varying from 2.373-3.823 with an average of 3.261 during the sampling conducted in low tide period during Spring tide.

Margalef's diversity index (Species Richness) of Zooplankton communities in the Kandla creek region and nearby creeks sampling stations were varying from1.358-3.858 with an average of 2.930 during the sampling conducted in high tide and varying from 2.289- 4.618 with an average of 3.513 during the sampling conducted in low tide during Neap tide period.

Margalef's diversity index (Species Richness) of Zooplankton communities in the sampling stationnear jettyat Path Finder Creek, Vadinar during the sampling conducted inconsecutive high tide period and low tide of spring tide was recorded as 1.995 and 1.796 respectively. Margalef's diversity index (Species Richness) of Zooplankton communities in the sampling station near SPM at Path Finder Creek, Vadinar during the sampling conducted in consecutive high tide period and low tide of spring tide was recorded as 2.600 and 2.118 respectively.

Margalef's diversity index (Species Richness) of Zooplankton communities near Jetty at Path finder creek were varying from 3.807 and 2.396 respectivelyduring the sampling conducted in consecutive high tide period and Low tide period of Neap tide. While Margalef's diversity index (Species Richness) of Zooplankton communities near SPM at Path finder creek were varying from 2.645-3.135 respectively during the consecutive high tide and low tide period.

Shannon-Wiener's index:

Shannon-Wiener's Index (H) of Zooplankton communities in the sampling stations in Kandla Harbour region and nearby creeks was in the range of 0.778-1.164 between selected sampling stations with an average value of0.939 during high tide period of spring tide. Shannon-Wiener's Index (H) of Zooplankton communities in the sampling stations in Kandla Harbour region and nearby creeks was in the range of 0.795-1.015 between selected sampling stations with an average value of0.938 during consecutive low tide period.

Shannon-Wiener's Index (H) of Zooplankton communities in the sampling stations in Kandla Harbour region and nearby creeks was in the range of 0.490-0.914 between selected sampling stations with an average value of 0.805 during high tide period of Neap tide. Shannon-Wiener's Index (H) of Zooplankton communities in the sampling stations in Kandla Harbour region and nearby creeks was in the range 0.797-1.041 of between selected sampling stations with an average value of 0.928 during consecutive low tide period.

Shannon-Wiener's Index (H) of Zooplankton communities in the sampling station near jetty at Path Finder Creek, Vadinar during the sampling conducted in consecutive High tide period and low tide of spring tide was recorded as 0.816-0.793 respectively. Shannon-Wiener's Index (H) of Zooplankton communities in the sampling station near SPM at Path Finder Creek, Vadinar during the sampling conducted in consecutive High tide period and low tide of spring tide was recorded as 0.834-0.808 respectively.

Shannon-Wiener's Index (H) of Zooplankton communities near jetty at Path finder creek was varying from 0.956-0.755 respectively during the sampling conducted consecutive high tide period and low tide period of Neap tide. While Shannon-Wiener's Index (H) of Zooplankton communities near SPM at Path finder creek was varying from 0.775-0.751during the consecutive high tide and low tide period.

Typical values are generally between 1.5 and 3.5 in most ecological studies, and the index is rarely greater than 4. The Shannon-Wiener's index increases as both the richness and the evenness of the community increase. This result indicates that diversity of Zooplankton of Kandla Harbour region and nearby creeks stations is slightly high with very minimum diverse population but very few opportunist organisms are really well adapted to this environment and thrive better than other species.

Simpson's diversity index:

Simpson diversity index (1-D) of Zooplankton communities was below 0.9 most of sampling stations in the Kandla Harbour region and nearby creeks during high tide and low tide of spring tide period except few stations, which was varying from 0.780-0.909 between selected sampling stations with an average of 0.837 during high tide period and was varying from 0.785- 0.864 with an average value of 0.837 between selected sampling stations during low tide.

Simpson diversity index (1-D) of Zooplankton communities was below 0.9 at all sampling stations in the Kandla Harbour region and nearby creeks during high tide and low tide period of Neap tide except few, which was varying from 0.591-0.827 between selected sampling stations with an average of 0.753 during high tide period and was varying from 0.793-0.852 with an average value of 0.820 between selected sampling stations during consecutive low tide. This species diversity suggests a relatively few successful species in this habitat during November, 2022 sampling.

Simpson diversity index (1-D) of Zooplankton communities in the sampling station near jetty at Path Finder Creek, Vadinar during the sampling conducted in consecutive High tide period and low tide of spring tide was recorded as 0.821 and 0.815 respectively. Simpson diversity index (1-D) of Zooplankton communities in the sampling station near SPM at Path Finder Creek, Vadinar during the sampling conducted in consecutive High tide period and low tide of spring tide was recorded as 0.812 and 0.828 respectively.

Simpson diversity index (1-D) of Zooplankton communities in the sampling station near jetty at Path Finder Creek, Vadinar during the sampling conducted in consecutive High tide period and low tide of Neap tide was recorded as 0.836- 0.766 respectively. Simpson diversity index (1-D) of Zooplankton communities in the sampling station near SPM at Path Finder Creek, Vadinar during the sampling conducted in consecutive High tide period and low tide of spring tide was recorded as 0.768 and 0.719 respectively.

TABLE:-55 ZOOPLANKTON VARIATION IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPA HARBOUR AREA AT KANDLA CREEK AND NEAR BY CREEKS DURING SPRING TIDEIN NOVEMBER 2022

Tide	Sampling Station	Abundance In $Nx10^3/m^3$	No of Species/groups observed /total species/group	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	1	124	26/33	78.79	5.186	1.164	0.9089
	2	114	18/33	54.55	3.589	0.8655	0.7802
	3	102	16/33	48.48	3.243	0.9207	0.8189
	4	128	17/33	51.52	3.298	0.9062	0.8124
	5	107	16/33	48.48	3.21	0.997	0.8686
	6	25	8/33	24.24	2.175	0.7777	0.83
LOW TIDE	1	117	16/33	48.48	3.15	0.9709	0.8609
	2	144	20/33	60.61	3.823	0.9468	0.8238
	3	121	19/33	57.58	3.753	1.015	0.8639
	4	108	16/33	48.48	3.204	0.9609	0.8505
	5	103	12/33	36.36	2.373	0.7949	0.7853

TABLE:-56 ZOOPLANKTON VARIATIONS IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPA HARBOUR AREAAT KANDLA CREEK AND NEAR BY CREEKS DURING NEAP TIDE INNOVEMBER 2022

Tide	Sampling Station	Abundance In No $x10^3/m^3$	No of Species/groups observed /total species/group	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	1	82	18/32	56.25	3.858	0.9017	0.7814
	2	99	16/32	50.00	3.264	0.9138	0.8273
	3	89	13/32	40.63	2.673	0.8264	0.7763
	4	114	18/32	56.25	3.589	0.8478	0.7645
	5	98	14/32	43.75	2.835	0.8503	0.7766
	6	19	5/32	15.63	1.358	0.4901	0.5906
LOW TIDE	1	79	11/32	34.38	2.289	0.797	0.7932
	2	76	21/32	65.63	4.618	1.041	0.8516
	3	106	21/32	65.63	4.289	1.026	0.8446
	4	90	15/32	46.88	3.111	0.9087	0.8177
	5	100	16/32	50.00	3.257	0.865	0.7939

Table:-57 ABUNDANCE OF ZOOPLANKTON IN SUBSURFACE SAMPLING STATIONS IN DPA HARBOUR AREAATKANDLA CREEK AND NEAR BY CREEKS DURING SPRING TIDE IN NOVEMBER 2022

Tide	Surface	No of Sampling locations	Group of Zooplankton	Abundance of Zooplankton $x10^3/ m^3$ Group Range	Genera or species /total Zooplankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	6	tintinnids	9-26	11/33	33.33
			Copepods	11-51	9/33	27.27
			Arrow worms	0-1	1/33	3.03
			Mysids	0-2	1/33	3.03
			Urochordata	1-6	2/33	6.06
			Ciliates	0-2	1/33	3.03
			Larval forms	4-50	8/33	24.25
			TOTAL ZOOPLANKTON N/ M^3	**25-128**	**33**	
LOW TIDE	Sub surface	5	Tintinnids	18-33	11/33	33.33
			Copepods	37-49	9/33	27.27
			Arrow worms	0-4	1/33	3.03
			Mysids	0-2	1/33	3.03
			Urochordata	0-2	2/33	6.06
			Ciliates	0-2	1/33	3.03
			Larval forms	41-65	8/33	24.25
			TOTAL ZOOPLANKTON N/M^3	**103-144**	**33**	

TABLE:-58 ABUNDANCE OF ZOOPLANKTON IN SUBSURFACE SAMPLING STATIONS IN DPA HARBOUR AREA IN KANDLA CREEK AND, NEAR BY CREEKS DURING NEAP TIDE IN NOVEMBER 2022

Tide	Surface	No of Sampling locations	Group of Zooplankton	Abundance of Zooplankton x10^{3}/ m^3 Group Range	Genera or species /total Zooplankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	6	Tintinnids	0-14	10/32	31.25
			Copepods	6-49	10/32	31.25
			Arrow worms	0	1/32	3.13
			Mysids	0-6	2/32	6.25
			Urochordata	0-4	2/32	6.25
			Ciliates	0-2	1/32	3.13
			Larval forms	13-50	6/32	18.74
			TOTAL ZOOPLANKTON N/M^3	**19-114**	**32**	
LOW TIDE	Sub surface	5	tintinnids	4-17	10/32	31.25
			Copepods	25-45	10/32	31.25
			Arrow worms	0-2	1/32	3.13
			Mysids	0-6	2/32	6.25
			Urochordata	0-5	2/32	6.25
			Ciliates	0-1	1/32	3.13
			Larval forms	27-47	6/32	18.74
			TOTAL ZOOPLANKTON N/M^3	**76-106**	**32**	

Table:-59 ZOOPLANKTON VARIATIONS IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPA OOT AREA AT PATH FINDER CREEK AND NEAR BY SPM DURING SPRING TIDE IN NOVEMBER 2022

Tide	Sampling Station	Abundance In x10^{3}N / m^3	No of Species/groups observed /total species/group	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	Jetty	91	10/20	50.00	1.995	0.816	0.821
	SPM	101	13/20	65.00	2.6	0.834	0.812
LOW TIDE	Jetty	86	9/20	45.00	1.796	0.793	0.815
	SPM	70	10/20	50.00	2.118	0.808	0.828

TABLE:-60 ZOOPLANKTON VARIATION IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPA OOT AREA AT PATH FINDER CREEK AND NEAR BY SPM DURINGNEAP TIDE IN NOVEMBER 2022

Tide	Sampling Station	Abundance In N$x10^3/m^3$	No of Species/groups observed /total species/group	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	Jetty	87	18/21	85.71	3.807	0.956	0.836
	SPM	64	12/21	57.14	2.645	0.775	0.768
LOW TIDE	Jetty	65	11/21	52.38	2.396	0.755	0.766
	SPM	87	15/21	71.43	3.135	0.751	0.719

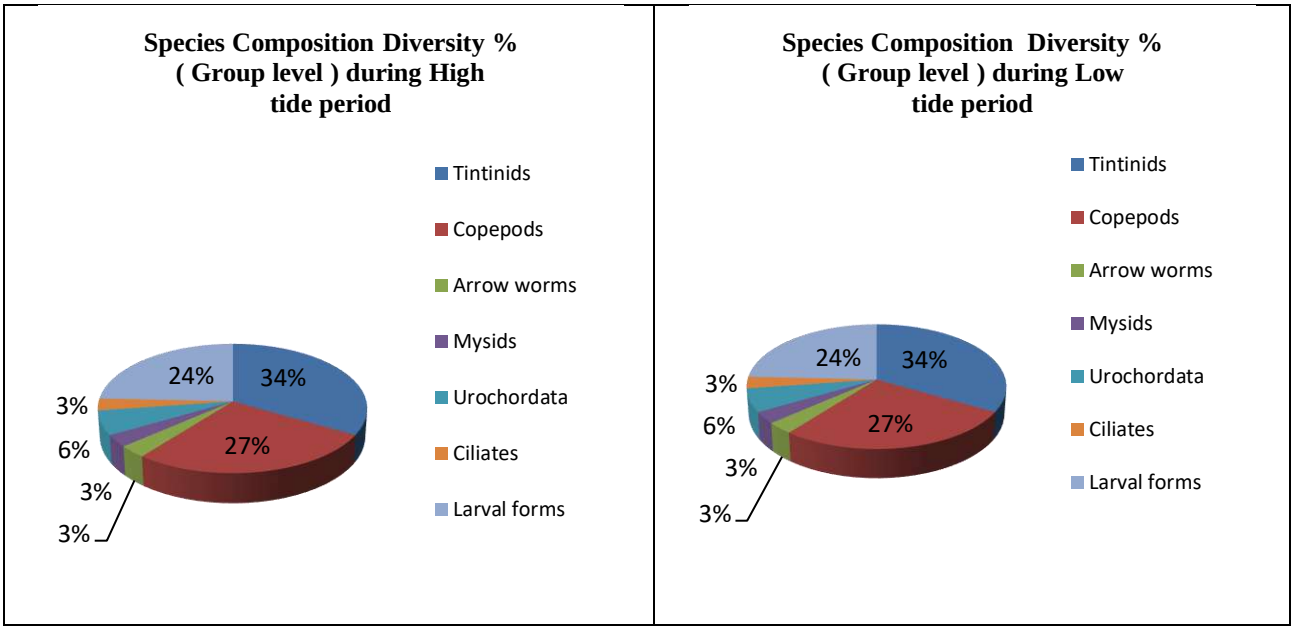
Table:-61 ABUNDANCE OF ZOOPLANKTON IN SUBSURFACE SAMPLING STATIONS IN DPA OOT AREAAND PATH FINDER CREEK AND NEAR BY SPM DURING SPRING TIDE IN NOVEMBER 2022

Tide	Surface	No of Sampling locations	Group of Zooplankton	Abundance of Zooplankton $x10^3/m^3$ Group Range	Genera or species /total Zooplankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	2	Tintinnids	24-32	5/20	25.00
			Copepods	28-38	8/20	40.00
			Urochordata	1-2	2/20	10.00
			Ciliates	0-1	1/20	5.00
			Larval forms	30-36	4/20	20.00
			TOTAL ZOOPLANKTON	**91-101**	**20**	
LOW TIDE	Sub surface	2	Tintinnids	17-21	5/20	25.00
			Copepods	30-37	8/20	40.00
			Urochordata	0	2/20	10.00
			Ciliates	0	1/20	5.00
			Larval forms	19-32	4/20	20.00
			TOTAL ZOOPLANKTON	**70-86**	**20**	

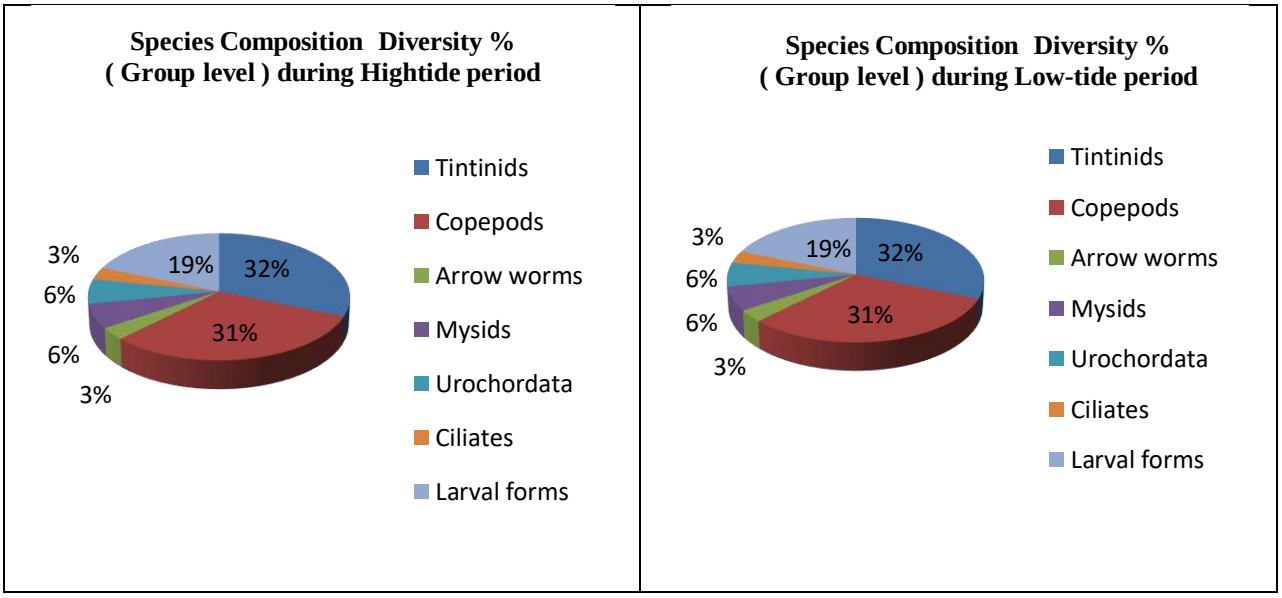
TABLE:-62 ABUNDANCE OF ZOOPLANKTON IN SUBSURFACE SAMPLING STATIONS IN DPA OOT AREA AT PATH FINDER CREEK AND NEAR BY SPM DURING NEAP TIDE IN NOVEMBER 2022

Tide	Surface	No of Sampling locations	Group of Zooplankton	Abundance of Zooplankton $x10^3/ m^3$ Group Range	Genera or species /total Zooplankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	2	tintinnids	9-16	7/21	33.33
			Copepods	23-34	6/21	28.57
			Arrow worms	0	1/21	4.76
			Urochordata	0-2	2/21	9.52
			Larval forms	32-35	5/21	23.82
			TOTAL ZOOPLANKTON	**64-87**	**21**	
LOW TIDE	Sub surface	2	tintinnids	6-9	7/21	33.33
			Copepods	29	6/21	28.57
			Arrow worms	0-1	1/21	4.76
			Urochordata	0-3	2/21	9.52
			Larval forms	27-48	5/21	23.82
			TOTAL ZOOPLANKTON	**65-87**	**21**	

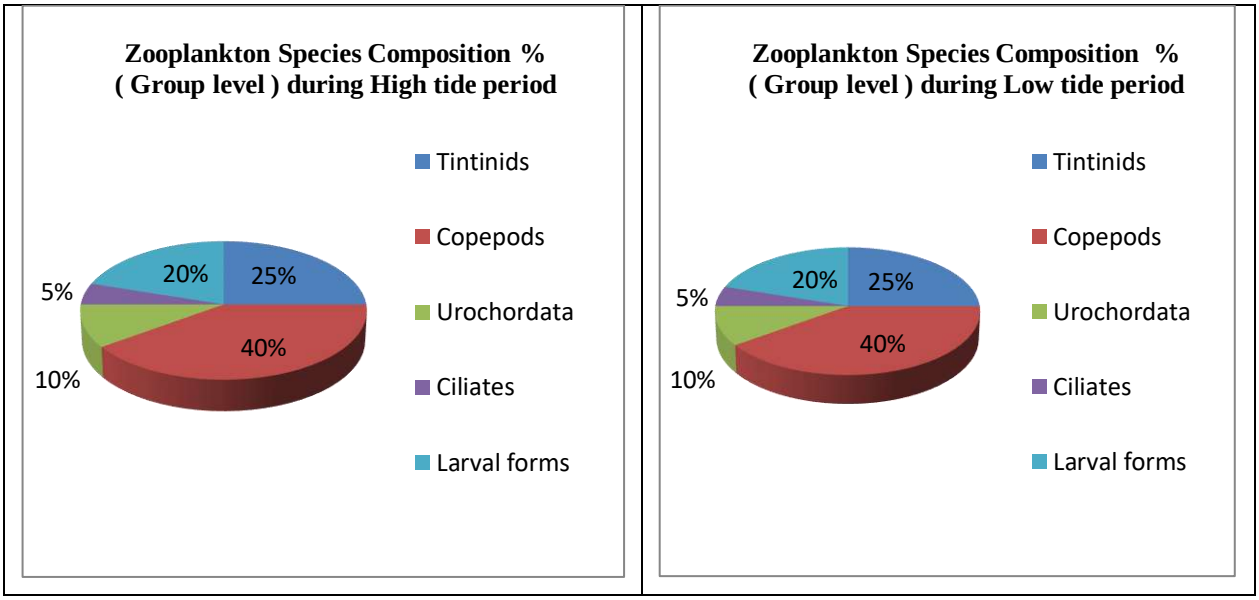
Species Composition % of Zooplankton during High tide and Low tide period of spring tide In Kandla Creek and nearby Creeks



Species Composition % of Zooplankton during High tide and Low tide period of Neap tide In Kandla Creek and nearby Creeks



Species Composition % of Zooplankton during High tide and Low tide period of Spring tide In Path Finder Creek and near Jetty



Species Composition % of Zooplankton during High tide and Low tide period of Neap tide In Path Finder Creek near jetty and nearby SPM

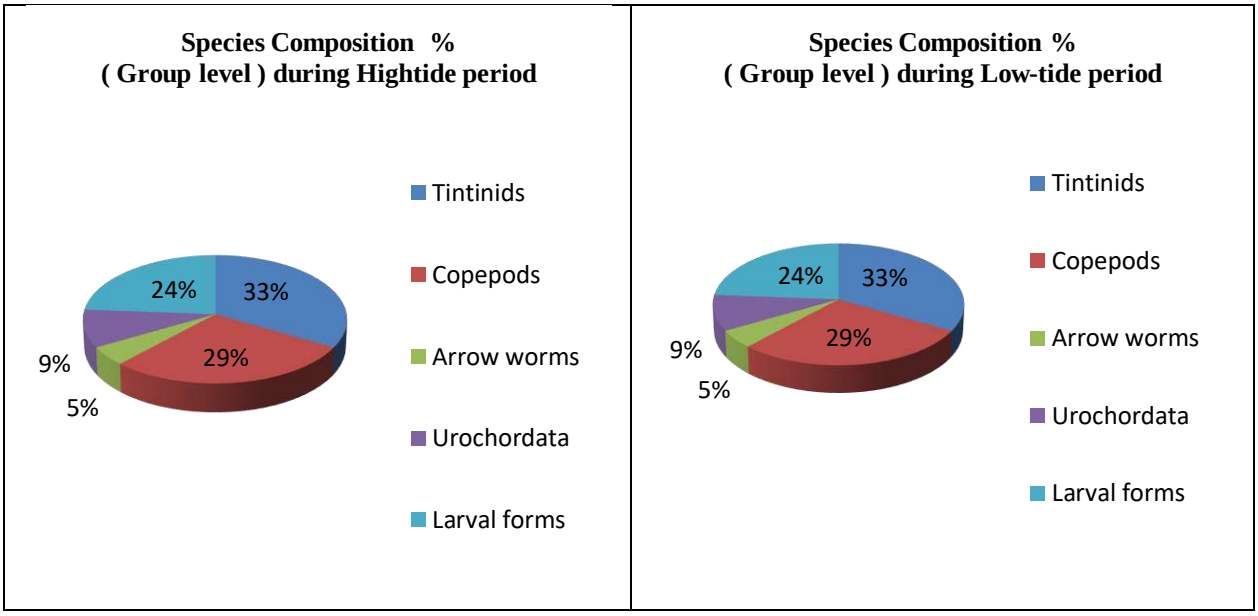


TABLE:-63 SYSTEMATIC ACCOUNT OF PHYTOPLANKTON IN THE SAMPLING LOCATIONS OF DPA HARBOUR AREA AT KANDLA CREEK AND NEARBY CREEKS DURING NEAP TIDE OF NOVEMBER 2022

CLASS	ORDER	FAMILY	GENUS/SPECIES	#	Relative Abundance
Cyanophyceae	Nostocales	Oscillatoriaceae	*Oscillatoria sp.*	B1	Very sparse
	Oscillatoriales	Phormidiaceae	*Planktothrix sp.*	B2	Very sparse
Coscinodiscophyceae	Biddulphiales	Biddulphiaceae	*Biddulphia*sp	D1	Abundant
	Chaetocerotales	Chaetocerotaceae	*Bacteriastrum sp*	D2	Very sparse
			Chaetoceros sp.	D3	Scattered
	Corethrales	Corethraceae	*Corethron* sp	D4	Very sparse
	Coscinodiscales	Coscinodiscaceae	*Coscinodiscus sp.*	D5	Dominant
	Hemiaulales	Bellerocheaceae	*Bellerochea* sp	D6	Very sparse
		Streptothecaceae	*Helicotheca sp*	D7	Very sparse
	Rhizosoleniales	Rhizosoleniaceae	*Rhizosolenia sp.*	D8	Sparse
	Lithodesmiales	Lithodesmiaceae	*Ditylum sp*	D9	Dominant
	Thalassiosirales	Thalassiosiraceae	*Planktoniella*sp	D10	Very sparse
		Skeletonemataceae	*Skeletonema*sp	D11	Abundant
	Triceratiales	Triceratiaceae	*Odontella* sp.	D12	Very sparse
			Triceratium sp.	D13	Very sparse
Bacillariophyceae	Bacillariales	Bacillariaceae	*Bacillaria* sp.	D14	Very sparse
			Nitzschia sp	D15	Sparse
			Pseudo-nitzschia sp.	D16	Very sparse
	Naviculales	Pleurosigmataceae	*Pleurosigma* sp.	D17	Very sparse
	Surirellales	Entomoneidaceae	*Entomoneis sp.*	D18	Very sparse
Fragilariophyceae	Fragilariales	Fragilariaceae	*Asterionellopsis sp*	D19	Scattered
			*Fragilaria*sp	D20	Very sparse
			*Synedra*sp	D21	Very sparse

	Striatellales	Striatellaceae	*Grammatophora sp*	D22	Very sparse
	Thalassionematales	Thalassionemataceae	*Thalassionema sp.*	D23	Sparse
			Thalassiothrix sp.	D24	Very sparse
Noctilucea / Noctiluciphyceae (Dinokaryota)	Noctilucales	Noctilucaceae	*Noctiluca* sp.	DF1	Sparse
Dinophyceae	Peridiniales	Protoperidiniaceae	*Protoperidinium sp.*	DF2	Very sparse
	Gonyaulacales	Pyrophacaceae	*Pyrophacus sp.*	DF3	Very sparse
		Ceratiaceae	*Ceratium furca*	DF4	Very sparse
			Ceratium tripos	DF5	Very sparse

TABLE:-64 SYSTEMATIC ACCOUNT OF PHYTOPLANKTON IN THE SAMPLING LOCATIONS IN OF DPA HARBOUR AREA AT KANDLA CREEK AND NEARBY CREEKS DURING SPRING TIDE OF NOVEMBER 2022:

CLASS	ORDER	FAMILY	GENUS/SPECIES	#	Relative Abundance
Cyanophyceae	Nostocales	Oscillatoriaceae	*Oscillatoria sp.*	B1	Very sparse
	Oscillatoriales	Phormidiaceae	*Planktothrix sp.*	B2	Very sparse
Coscinodiscophyceae	Biddulphiales	Biddulphiaceae	*Biddulphia*sp	D1	Sparse
	Chaetocerotales	Chaetocerotaceae	*Chaetoceros* sp.	D2	Abundant
	Corethrales	Corethraceae	*Corethron* sp	D3	Very sparse
	Coscinodiscales	Coscinodiscaceae	*Coscinodiscus sp.*	D4	Abundant
	Rhizosoleniales	Rhizosoleniaceae	*Rhizosolenia sp.*	D5	Sparse
	Leptocylindrales	Leptocylindraceae	*Leptocylindrus sp*	D6	Very sparse
	Lithodesmiales	Lithodesmiaceae	*Ditylum sp*	D7	Scattered
	Thalassiosirales	Thalassiosiraceae	*Planktoniella*sp	D8	Very sparse
		Lauderiaceae	*Lauderia* sp	D9	Very sparse
		Skeletonemataceae	*Skeletonema*sp	D10	Dominant
	Triceratiales	Triceratiaceae	*Odontella* sp.	D11	Very sparse
			Triceratium sp.	D12	Very sparse
Bacillariophyceae	Bacillariales	Bacillariaceae	*Bacillaria* sp.	D13	Very sparse
			Nitzschia sp	D14	Very sparse
			Pseudo-nitzschia sp.	D15	Very sparse
	Naviculales	Naviculaceae	*Navicula* sp.	D16	Very sparse
		Plagiotropidaceae	*Plagiotropis sp*	D17	Very sparse
		Pleurosigmataceae	*Pleurosigma* sp.	D18	Sparse
	Surirellales	Entomoneidaceae	*Entomoneis sp.*	D19	Very sparse
		Surirellaceae	*Surirella sp.*	D20	Very sparse
Fragilariophyceae	Fragilariales	Fragilariaceae	*Asterionellopsis sp*	D21	Sparse

			*Fragilaria*sp	D22	Very sparse
			*Synedra*sp	D23	Sparse
	Striatellales	Striatellaceae	*Grammatophora sp*	D24	Very sparse
	Thalassionematales	Thalassionemataceae	*Thalassionema sp.*	D25	Scattered
			Thalassiothrix sp.	D26	Sparse
Noctilucea / Noctiluciphyceae (Dinokaryota)	Noctilucales	Noctilucaceae	*Noctiluca* sp.	DF1	Sparse
Dinophyceae	Peridiniales	Protoperidiniaceae	*Protoperidinium sp.*	DF2	Very sparse
	Gonyaulacales	Ceratiaceae	*Ceratium breve*	DF3	Very sparse
			Ceratium furca	DF4	Very sparse
			Ceratium fusus	DF5	Very sparse
			Ceratium tripos	DF6	Very sparse

TABLE:-65 SYSTEMATIC ACCOUNT OF PHYTOPLANKTON IN THE SAMPLING LOCATIONS IN OF DPA OOT AREA AT PATH FINDER CREEK AND NEARBY SPM AT VADINARDURING NEAP TIDE OF NOVEMBER 2022:

CLASS	ORDER	FAMILY	GENUS/SPECIES	#	Relative Abundance
Cyanophyceae	Nostocales	Oscillatoriaceae	*Lyngbya sp.*	B1	Very sparse
			Oscillatoria sp.	B2	Very sparse
			Spirulina sp.	B3	Very sparse
	Oscillatoriales	Phormidiaceae	*Planktothrix sp.*	B4	Very sparse
Coscinodiscophyceae	Biddulphiales	Biddulphiaceae	*Biddulphia*sp	D1	Scattered
	Chaetocerotales	Chaetocerotaceae	*Chaetoceros*sp	D2	Scattered
	Corethrales	Corethraceae	*Corethron* sp	D3	Very sparse
	Coscinodiscales	Coscinodiscaceae	*Coscinodiscus sp.*	D4	Dominant
	Hemiaulales	Bellerocheaceae	*Bellerochea*sp	D5	Very sparse
		Hemiaulaceae	*Cerataulina sp.*	D6	Very sparse
			Eucampia sp	D7	Very sparse
		Streptothecaceae	*Helicotheca sp*	D8	Very sparse
	Leptocylindrales	Leptocylindraceae	*Leptocylindrus sp*	D9	Very sparse
	Lithodesmiales	Lithodesmiaceae	*Ditylumsp*	D10	Abundant
	Rhizosoleniales	Rhizosoleniaceae	*Dactyliosolen sp.*	D11	Very sparse
			Rhizosolenia sp.	D12	Sparse
	Thalassiosirales	Skeletonemataceae	*Skeletonema sp.*	D13	Abundant
		Lauderiaceae	*Lauderia sp*	D14	Very sparse
		Thalassiosiraceae	*Planktoniella*sp	D15	Very sparse
	Triceratiales	Triceratiaceae	*Odontellasp*	D16	Very sparse
			*Triceratium*sp	D17	Very sparse
Bacillariophyceae	Bacillariales	Bacillariaceae	*Bacillaria*sp.	D18	Abundant
			Nitzschia sp	D19	Very sparse

			*Pseudo-nitzschia*sp	D20	Scattered
	Naviculales	Naviculaceae	*Meuniera sp.*	D21	Very sparse
			Navicula sp	D22	Very sparse
		Pinnulariaceae	*Pinnulariasp*	D23	Very sparse
		Pleurosigmataceae	*Pleurosigma* sp	D24	Very sparse
	Surirellales	Entomoneidaceae	*Entomoneis sp.*	D25	Very sparse
		Surirellaceae	*Surirella*sp	D26	Very sparse
Fragilariophyceae	Climacospheniales	Climacospheniaceae	*Climacosphenia sp.*	D27	Very sparse
	Fragilariales	Fragilariaceae	*Asterionellopsis sp.*	D28	Very sparse
			Synedra sp.	D29	Very sparse
	Striatellales	Striatellaceae	*Striatella*sp	D30	Very sparse
	Thalassionematales	Thalassionemataceae	*Thalassionema sp.*	D31	Sparse
			Thalassiothrix sp.	D32	Sparse
Dinophyceae	Peridiniales	Protoperidiniaceae	*Protoperidinium sp.*	DF1	Very sparse
	Dinophysales	Dinophysaceae	*Dinophysis sp.*	DF2	Very sparse
	Gonyaulacales	Pyrophacaceae	*Pyrophacus sp.*	DF3	Very sparse
		Ceratiaceae	*Ceratium furca*	DF4	Very sparse
			Ceratium fusus	DF5	Very sparse
			Ceratium tripos	DF6	Very sparse

TABLE:-66 SYSTEMATIC ACCOUNT OF PHYTOPLANKTON IN THE SAMPLING LOCATIONS IN OF DPAOOT AREA AT PATH FINDER CREEKAND NEARBY SPM AT VADINAR DURING AND SPRING TIDE OF NOVEMBER 2022:

CLASS	ORDER	FAMILY	GENUS/SPECIES	#	Relative Abundance
Cyanophyceae	Chroococcales	Chroococcaceae	*Merismopedia sp.*	B1	Very sparse
	Nostocales	Oscillatoriaceae	*Lyngbya sp.*	B2	Very sparse
			Oscillatoria sp.	B3	Sparse
	Oscillatoriales	Phormidiaceae	*Planktothrix sp.*	B4	Very sparse
	Stigonematales	Stigonemataceae	*Stigonema sp.*	B5	Very sparse
Coscinodiscophyceae	Biddulphiales	Biddulphiaceae	*Biddulphia*sp	D1	Sparse
	Chaetocerotales	Chaetocerotaceae	*Chaetoceros* sp.	D2	Dominant
	Corethrales	Corethraceae	*Corethron* sp	D3	Very sparse
	Coscinodiscales	Coscinodiscaceae	*Coscinodiscus sp.*	D4	Abundant
	Hemiaulales	Bellerocheaceae	*Bellerochea* sp	D5	Very sparse
		Hemiaulaceae	*Cerataulina sp.*	D6	Very sparse
		Streptothecaceae	*Helicotheca sp*	D7	Very sparse
	Rhizosoleniales	Rhizosoleniaceae	*Rhizosolenia sp.*	D8	Scattered
	Leptocylindrales	Leptocylindraceae	*Leptocylindrus sp*	D9	Very sparse
	Lithodesmiales	Lithodesmiaceae	*Ditylum sp*	D10	Abundant
	Thalassiosirales	Thalassiosiraceae	*Planktoniella*sp	D11	Very sparse
		Lauderiaceae	*Lauderia* sp	D12	Very sparse
	Triceratiales	Triceratiaceae	*Odontella* sp.	D13	Sparse
			Triceratium sp.	D14	Very sparse
Bacillariophyceae	Bacillariales	Bacillariaceae	*Bacillaria* sp.	D15	Scattered
			Nitzschia sp	D16	Very sparse
			Pseudo-nitzschia sp.	D17	Sparse
	Naviculales	Pinnulariaceae	*Pinnulariasp*	D18	Very sparse

		Pleurosigmataceae	*Pleurosigma* sp.	D19	Very sparse
	Surirellales	Entomoneidaceae	*Entomoneis sp.*	D20	Very sparse
		Surirellaceae	*Surirella sp.*	D21	Very sparse
Fragilariophyceae	Fragilariales	Fragilariaceae	*Asterionellopsis sp*	D22	Sparse
			*Synedra*sp	D23	Very sparse
	Thalassionematales	Thalassionemataceae	*Thalassionema sp.*	D24	Sparse
			Thalassiothrix sp.	D25	Very sparse
Dinophyceae	Peridiniales	Protoperidiniaceae	*Protoperidinium sp.*	DF1	Very sparse
	Dinophysales	Dinophysaceae	*Dinophysis sp.*	DF2	Very sparse
	Gonyaulacales	Pyrophacaceae	*Pyrophacus sp.*	DF3	Very sparse
		Ceratiaceae	*Ceratium furca*	DF4	Very sparse
			Ceratium fusus	DF5	Very sparse
			Ceratium tripos	DF6	Very sparse

TABLE:-67 SYSTEMATIC ACCOUNT OF ZOOPLANKTON FROM THE SAMPLING LOCATIONS OF DPA HARBOUR AREA AT KANDLA CREEK AND NEARBY CREEKSDURING NEAP TIDE OF NOVEMBER 2022:

CLASS	ORDER	FAMILY	GENUS/SPECIES	#	RELATIVE ABUNDANCE
Spirotrichea	Tintinnida	Tintinnidiidae	*Leprotintinnussp.*	T1	Very sparse
		Codonellidae	*Tintinnopsis dadayi*	T2	Very sparse
			Tintinnopsisfailakkaensis	T3	Very sparse
			Tintinnopsis gracilis	T4	Very sparse
			Tintinnopsis mortensenii	T5	Very sparse
			Tintinnopsis radix	T6	Very sparse
			Tintinnopsis tocantinensis	T7	Very sparse
		Tintinnidae	*Amphorellopsis sp.*	T8	Very sparse
			Eutintinnus sp.	T9	Very sparse
		Xystonellidae	*Favella sp.*	T10	Very sparse
Crustacea Subclass: Copepoda	Calanoida	Paracalanidae	*Acrocalanus* sp.	C1	Sparse
			Parvocalanus sp.	C2	Very sparse
		Acartiidae	*Acartia sp.*	C3	Very sparse
		Clausocalanidae	*Clausocalanus sp.*	C4	Very sparse
		Centropagidae	*Centropages sp.*	C5	Very sparse
		Temoridae	*Temora sp.*	C6	Very sparse
	Cyclopoida	Oithonidae	*Oithona sp.*	C7	Abundant
	Harpacticoida	Ectinosomatidae	*Microsetella*sp.	C8	Scattered
		Euterpinidae	*Euterpina sp.*	C9	Sparse
	Poicilostomatatoida	Oncaeidae	*Oncaea sp.*	C10	Very sparse
Sagittoidea	Aphragmophora	Sagittidae	*Sagitta sp.*	A1	Very sparse
Malacostraca	Mysida, Decapoda	Penaeidae	*Metapenaeussp.*	M1	Very sparse
		Solenoceridae	*Solenocera sp.*	M2	Very sparse

Appendicularia		Fritillariidae	*Fritillaria sp.*	U1	Very sparse
		Oikopleuridae	*Oikopleura sp.*	U2	Very sparse
Oligohymenophorea	Sessilida	Zoothamniidae	*Zoothamnium sp.*	CI1	Very sparse
Copepoda			Nauplius larvae of copepods	L1	Dominant
Malacostraca Decapoda			Brachyuran zoea	L2	Very sparse
Maxillopoda Thecostraca			Cirripede larvae	L3	Very sparse
			Cyphonautes larvae	L4	Very sparse
			Ophiopluteus larvae	L5	Very sparse
Polychaeta			Trochophore larvae	L6	Very sparse

TABLE:-68 SYSTEMATIC ACCOUNT OF ZOOPLANKTON FROM THE SAMPLING OF DPA HARBOUR AREA AT KANDLA CREEK AND NEARBY CREEKSDURING SPRING TIDE OF NOVEMBER 2022:

CLASS	ORDER	FAMILY	GENUS/SPECIES	#	RELATIVE ABUNDANCE
Spirotrichea	Tintinnida	Tintinnidiidae	*Leprotintinnussp.*	T1	Scattered
		Codonellidae	*Tintinnopsis dadayi*	T2	Very sparse
			Tintinnopsisfailakkaensis	T3	Very sparse
			Tintinnopsis gracilis	T4	Very sparse
			Tintinnopsis mortensenii	T5	Very sparse
			Tintinnopsis radix	T6	Sparse
			Tintinnopsis tocantinensis	T7	Very sparse
		Metacylididae	*Metacylis*sp.	T8	Very sparse
		Tintinnidae	*Amphorellopsis sp.*	T9	Very sparse
			Eutintinnus sp.	T10	Very sparse
		Xystonellidae	*Favella sp.*	T11	Sparse
Crustacea Subclass: Copepoda	Calanoida	Paracalanidae	*Acrocalanus* sp.	C1	Scattered
			Parvocalanus sp.	C2	Very sparse
		Acartiidae	*Acartia sp.*	C3	Very sparse
		Clausocalanidae	*Clausocalanus sp.*	C4	Very sparse
		Centropagidae	*Centropages sp.*	C5	Very sparse
		Eucalanidae	*Subeucalanus sp.*	C6	Very sparse
	Cyclopoida	Oithonidae	*Oithona sp.*	C7	Abundant
	Harpacticoida	Ectinosomatidae	*Microsetella*sp.	C8	Sparse
		Euterpinidae	*Euterpina sp.*	C9	Sparse
Sagittoidea	Aphragmophora	Sagittidae	*Sagitta sp.*	A1	Very sparse
Malacostraca	Mysida, Decapoda	Solenoceridae	*Solenocera sp.*	M1	Very sparse

Appendicularia		Fritillariidae	*Fritillaria sp.*	U1	Very sparse
		Oikopleuridae	*Oikopleura sp.*	U2	Very sparse
Oligohymenophorea	Sessilida	Zoothamniidae	*Zoothamnium sp.*	CI1	Very sparse
Copepoda			Nauplius larvae of copepods	L1	Dominant
Malacostraca Decapoda			Brachyuran zoea	L2	Sparse
Maxillopoda Thecostraca			Cirripede larvae	L3	Very sparse
			Cyphonautes larvae	L4	Very sparse
			Ophiopluteus larvae	L5	Very sparse
Gastropoda Streptoneura			Opisthobranchia larvae	L6	Very sparse
Polychaeta			Trochophore larvae	L7	Sparse
Pelecypoda			Veliger larvae of bivalves	L8	Very sparse

TABLE:-69 SYSTEMATIC ACCOUNT OF ZOOPLANKTON FROM THE SAMPLING LOCATIONS OF DPA OOT AREA AT PATH FINDER CREEK AND NEARBY SPM AT VADINARDURING NEAP TIDE OF NOVEMBER 2022:

CLASS	ORDER	FAMILY	GENUS/SPECIES	#	RELATIVE ABUNDANCE
Spirotrichea	Tintinnida	Tintinnidiidae	*Leprotintinnussp.*	T1	Sparse
		Codonellidae	*Tintinnopsisfailakkaensis*	T2	Very sparse
			Tintinnopsis gracilis	T3	Very sparse
			Tintinnopsis radix	T4	Very sparse
			Tintinnopsis tocantinensis	T5	Very sparse
		Tintinnidae	*Amphorellopsis sp.*	T6	Very sparse
		Xystonellidae	*Favella sp.*	T7	Very sparse
Crustacea Subclass: Copepoda	Calanoida	Paracalanidae	*Acrocalanus* sp.	C1	Scattered
			Parvocalanus sp.	C2	Very sparse
	Cyclopoida	Oithonidae	*Oithona sp.*	C3	Abundant
	Harpacticoida	Euterpinidae	*Euterpina sp.*	C4	Very sparse
		Ectinosomatidae	*Microsetella*sp.	C5	Very sparse
	Poicilostomatatoida	Oncaeidae	*Oncaea sp.*	C6	Very sparse
Sagittoidea	Aphragmophora	Sagittidae	*Sagitta sp.*	A1	Very sparse
Appendicularia		Fritillariidae	*Fritillaria sp.*	U1	Very sparse
		Oikopleuridae	*Oikopleura sp.*	U2	Very sparse
Copepoda			Nauplius larvae of copepods	L1	Dominant
Maxillopoda Thecostraca			Cirripede larvae	L2	Very sparse
Gastropoda Streptoneura			Opisthobranchia larvae	L3	Very sparse
Polychaeta			Trochophore larvae	L4	Very sparse
Pelecypoda			Veliger larvae of bivalves	L5	Very sparse

TABLE:-70 SYSTEMATIC ACCOUNT OF ZOOPLANKTON FROM THE SAMPLING LOCATIONS OF DPA OOT AREA AT PATH FINDER CREEK AND NEARBY SPM AT VADINAR DURING SPRING TIDE OF NOVEMBER 2022:

CLASS	ORDER	FAMILY	GENUS/SPECIES	#	RELATIVE ABUNDANCE
Spirotrichea	Tintinnida	Tintinnidiidae	*Leprotintinnussp.*	T1	Abundant
		Codonellidae	*Tintinnopsisgracilis*	T2	Very sparse
			Tintinnopsis mortensenii	T3	Very sparse
			Tintinnopsis radix	T4	Very sparse
		Xystonellidae	*Favella sp.*	T5	Scattered
Crustacea Subclass: Copepoda	Calanoida	Paracalanidae	*Acrocalanus* sp.	C1	Sparse
			Parvocalanus sp.	C2	Very sparse
		Centropagidae	*Centropages sp.*	C3	Very sparse
		Tortanidae	*Tortanus sp.*	C4	Very sparse
	Cyclopoida	Oithonidae	*Oithona sp.*	C5	Abundant
		Euterpinidae	*Euterpina sp.*	C6	Very sparse
	Harpacticoida	Ectinosomatidae	*Microsetella*sp.	C7	Scattered
	Poicilostomatatoida	Corycaeidae	*Corycaeus sp.*	C8	Very sparse
Appendicularia		Fritillariidae	*Fritillaria sp.*	U1	Very sparse
		Oikopleuridae	*Oikopleura sp.*	U2	Very sparse
Oligohymenophorea	Sessilida	Zoothamniidae	*Zoothamnium sp.*	CI1	Very sparse
Copepoda			Nauplius larvae of copepods	L1	Dominant
Malacostraca Decapoda			Brachyuran zoea	L2	Very sparse
Gastropoda Streptoneura			Opisthobranchia larvae	L3	Very sparse
Pelecypoda			Veliger larvae of bivalves	L4	Very sparse

BENTHIC ORGANISMS:

Few Benthic organisms were observed in the collected sediments by using the Van-Veen grabs during the sampling conducted during spring tide period and Neap tide period from DPA harbour region and nearby creek. The Meio-benthic organisms during spring tide were represented by Polychaetes *Tharyx sp*and *Nereis sp.*, during Neap tide *by Neries sp.* and few Amphipods. Population of benthic fauna was varying from 10-60- N/m^2 during spring tide and 0-80 N/m^2 during Neap tide. The benthic communities at path finder Creek were represented by Polychaetes *Glycera* sp. *Cirratulus* sp. *Nereis sp*. and few Amphipods. Their population was varying as 60 N/m^2 at OOT jetty premises and 80 $N/m^{2\ near}$ the SPM area during spring tide and 50 N/m^2 at OOT jetty premises and 50 N/m^2 near the SPM area during Neap tide period.

Table:-71 BENTHIC FAUNA IN THE SAMPLING LOCATIONS IN DPA HARBOUR AREA CREEKS DURING SPRING TIDE IN NOVEMBER 2022

ABUNDANCE IN NO/M ^{2} DIFFERENT SAMPLING STATIONS						
REPRESENTATION BY GROUP	DPA HARBOUR			CREEKS		
Benthic fauna						
POLYCHAETES	DPA-1	DPA-2	DPA-3	DPA-4	DPA-5	DPA-6
Family : CIRRATULIDAE *Tharyxsp.*	20	10	10	0	0	NS
Family :NEREIDAE *Nereis sp.*	0	0	0	20	40	NS
AMPHIPODA	0	0	0		20	NS
TOTAL Benthic Fauna NUMBER/ M^2	20	10	10	20	60	NS

NS: No sample

Table:-72 BENTHIC FAUNA IN THE SAMPLING LOCATIONS IN DPA HARBOUR AREA CREEKS DURING NEAP TIDE IN NOVEMBER 2022

ABUNDANCE IN NO/M^2 DIFFERENT SAMPLING STATIONS						
REPRESENTATION BY GROUP	DPA HARBOUR			CREEKS		
Benthic fauna						
POLYCHAETES	DPA-1	DPA-2	DPA-3	DPA-4	DPA-5	DPA-6
Family :NEREIDAE *Nereis sp.*	0	0	0	40	60	NS
Amphipoda	0	20	10	10	20	NS
TOTAL Benthic Fauna NUMBER/M^2	0	20	10	50	80	NS

Table:-73 BENTHIC FAUNA IN THE SAMPLING LOCATIONS IN DPA OOT JETTY AREA, VADINAR DURING SPRING TIDE IN NOVEMBER 2022

ABUNDANCE IN NO/M ^{2} DIFFERENT SAMPLING STATIONS		
REPRESENTATION BY GROUP	OOT Jetty Area	SPM area
POLYCHAETES		
Family : Glyceride *Glycera*sp.	20	40
Family : CIRRATULIDAE *Cirratulus*sp.	0	20
Family: *NEREIDAE* *Nereis sp.*	30	10
Amphipoda	10	20
TOTAL Benthic Fauna NUMBER/ M^2	60	80

Table:-74 BENTHIC FAUNA IN THE SAMPLING LOCATIONS IN DPA OOT JETTY AREA, VADINAR DURING NEAP TIDE IN NOVEMBER 2022

ABUNDANCE IN NO/M ^{2} DIFFERENT SAMPLING STATIONS		
REPRESENTATION BY GROUP	OOT Jetty Area	SPM area
POLYCHAETES		
Family : Glyceridase *Glycera* sp.	20	40
Family: *NEREIDAE* *Nereis sp.*	30	10
TOTAL Benthic Fauna NUMBER/ M^2	50	50

CHAPTER-11

CONCLUSIVE SUMMARY & REMEDIAL MEASURES

11.0 Conclusive Summary and Remedial measures Suggested

- The AAQ monitoring of six locations at Deendayal Port Authority indicates that the mean PM_{10} and $PM_{2.5}$ values for four locations viz. Marine Bhavan, Oil Jetty, Estate Office and Coal storage area were found higher than the permissible limit (standards100 µg/m^3, 60 µg/m^3). The higher concentration of Particulate matter at Marine Bhavan may be due to vehicles emissions during loading-unloading of food grains and timbers; at Estate office due to construction work, vehicles emission produced from trucks, heavy duty vehicles that pass through the road outside Kandla port and Oil jetty area; while at Coal Storage area lifting of coal from grab yard and other coal handling processes. Moreover, the transportation of coal produces pollution from heavy vehicles. At Tuna Port location, concentration of PM_{10} varied from 88-175 µg/m^3 and mean value was observed 145 µg/m^3 which was exceed the prescribed standard limit (100 µg/m^3), concentration of $PM_{2.5}$ was ranged from 47-87 µg/m^3 and mean was found 71 µg/m^3 which was exceed the standard limit (60 µg/m^3). At Gopalpuri PM_{10} concentration ranged from 67-168 µg/m3 and mean was 127 µg/m3 while $PM_{2.5}$ concentration ranged from 34-94 µg/m3 and mean was 66 µg/m3 were found exceed standard limit prescribed by NAAQS.
- At Vadinar, the average concentration of PM_{10} was 114 µg/m^3 and $PM_{2.5}$ was 74 µg/m^3 at Admin Colony which was slightly exceed the standard limit while at Signal building the mean concentration PM_{10} was 100 µg/m3 and $PM_{2.5}$ was 61 µg/m^3 which were very close to standard limit.
- During winter, the concentration of PM_{10} and $PM_{2.5}$ has been slowly augmented and reached a peak in the evening due to surface inversion of temperature after sunset. Thus, the pollutants are subsequently trapped in the lower layer of the atmosphere due to high atmospheric air pressure.
- Further, precautionary measures and management strategies to minimize the effect of particulate as well as gaseous pollutants have also been suggested for achieving its ambient levels in and around Kandla Port and Vadinar Port, Gujarat, India.

- Drinking water at all the twenty locations was found potable and it was found within in line of BIS standards (IS: 10500-2012).
- Transportation systems are the main source of noise pollution in project areas. Noise sources in port operations include cargo handling, vehicular traffic, and loading / unloading

containers and ships. All sampling location were within the permissible limit day time 75 dB (A) and night time 70 dB (A) for the industrial area.

- The treated sewage water of Kandla STP, Deendayal Port Colony (Gopalpuri) STP and Vadinar were in line with the standards set by the Central Pollution Control Board.
- It was suggested to monitor the STP performance on regular basis to avoid flow of contamination / Polluted water into the sea.
- Good species diversity suggests a relatively successful species in this habitat. A greater number of successful species and a more stable ecosystem. More ecological niches are available and the environment is less likely to be hostile complex food webs environmental change is less likely to be damaging to the ecosystem as a whole.
- The results obtained from the study for biological and ecological parameters in marine water for Arabian Sea at surrounding area of Deendayal Port Authority (DPA) Kandla and Vadinar were not affected by Port activities.
- The mean day time temperature at Deendayal Port was 27.92 °C. The day-time maximum temperature was 32.9°C and minimum was 21.1 °C. The mean night time temperature recorded was 25.47 °C. The night-time maximum temperature was 29.7°C and minimum was 20.0 °C. The mean Solar Radiation in November month was 167.27 w/m^2. The maximum solar radiation was recorded 759 w/m^2 in 4th November, 2022 and the minimum solar radiation was recorded 1.80 w/m^2 in 30th November, 2022. The mean Relative humidity was 69.00 % for the month of November. Maximum Relative humidity was recorded 99.0 % and minimum Relative humidity was recorded 34.0 %. The average wind velocity for the entire month of November was 1.21 m/s. Maximum wind velocity was recorded 10.19 m/s. The wind direction was mostly North-East.
- The results obtained from the study for the month of November 2022 for biological and ecological parameters in marine water for Arabian Sea at surrounding area of Deendayal Port Authority (DPA) Kandla and Vadinar were not affected by Port activities.

Reasons for higher Values of PM_{10}

- The unloading of coal directly in the truck, using grabs cause coal to spread in air as well as coal dust to fall on ground. This settled coal dust again mixes with the air while trucks travel through it.

- Also, the coal loaded trucks were not always covered with tarpaulin sheets and these results in spillage of coal from trucks/dumpers during its transit from vessel to yard or storage site. This also increased PM values around marine Bhavan & Coal storage area.

Remedial Measures

The values of PM_{10} & $PM_{2.5}$ during the month of November, 2022 were beyond the standard limit at all locations (Coal Storage, Marine Bhavan, Oil Jetty and Estate office, Tuna Port) except Gopalpuri the concentration of particulate matter was slightly exceed. Given below are the remedial measures suggest to minimize the Air pollution.

- During November, 2022 overall ambient air quality of the DPA was within CPCB permissible limits except TSPM, PM_{10}, $PM_{2.5}$ at Coal storage area, Marine Bhavan, Oil Jetty and Estate Office. To improve air quality the port was using number of precautionary measures, such as maintained a wide expanse of Green zone, initiated Inter-Terminal Transfer (ITT) of tractor-trailers, Centralized Parking Plaza, providing shore power supply to tugs and port crafts, the use of LED lights at DPA area helps in lower energy consumption and decreases the carbon foot prints in the environment, time to time cleaning of paved and un paved roads, use of tarpaulin sheets to cover dumpers at project sites etc. are helping to achieve the cleaner and green future at port.

Solution towards the Green port:

Today, it is increasingly recognized that air pollution hurts human health. Consequently, efficient mitigation strategies need to be implementation for substantial environmental and health co-benefits.

The guidelines can be considered a basis for governments for the implementation of a strategic plan focused on the reduction of multi pollutant emission, as well as of the overall air pollution related risk.

- The plantation should be all along the periphery of the port and inside and outside the port along with the road. Trees having high dust trapping efficiency (*Azadirachta indica, Cassia fistula, Delonix regia, Ficus religiosa, Pterocarpus marsupium*) are to be grown alongside the roads.
- The water sprinkling should be use at each and every stage of transporting coal up the loading of truck to avoid generation of coal dust.

- The vehicles should be covered during transportation and the vehicle carrying the coal should not be overloaded by raising the height of carriage.
- The water sprinklers should be use during transportation of loaded heavy vehicles on raw road.
- It should be ensure that regular sweeping of coal internal, main road and space a free circulation.
- Practice should be initiated for using mask as preventative measure, to avoid Inhalation of dust particle- Mask advised in sensitive areas.
- Department for use maintenance should have a routine checkup noise level by replacing bearings, tights of all loose parts that can vibrate.
- Speed control is also an effective way to mitigate noise pollution, the lowest sound emission arise from vehicles moving smoothly.
- Use of renewable energy like solar energy should be optimal and ensure to work continuously.
- Keep neat and clean public transport and all basic items at public interaction places as much as possible.
- Technology like Electric cart, Inter-Terminal Transfer (ITT) are worthy selection to reduce Port operation efficiency and fuel cost.
- Conventional RTGCs should be altered as E-RTGCs counting inside the port completely.
- Initiate Natural Gas (CNG) as fuel by all buses and trucks.

Green Ports Initiative

- Deendayal Port is committed to sustainable development and adequate measures are being taken to maintain the Environmental well-being of the Port and its surrounding environs. Weighing in the environmental perspective for sustained growth, the Ministry of Shipping had started “Project Green Ports” which will help in making the Major Ports across India cleaner and greener. “Project Green Ports” will have two verticals - one is “Green Ports Initiatives” related to environmental issues and second is “Swachh Bharat Abhiyaan”.

- The Green Port Initiatives include twelve initiatives such as preparation and monitoring plan, acquiring equipments required for monitoring environmental pollution, acquiring dust suppression system, setting up of waste water treatment plants/ garbage disposal plant, setting up Green Cover area, projects for energy generation from renewable

energy sources, completion of shortfalls of Oil Spill Response (OSR) facilities (Tier-I), prohibition of disposal of almost all kind of garbage at sea, improving the quality of harbour wastes etc.

- Deendayal port has also appointed GEMI as an Advisor for "Making Deendayal Port a Green Port - Intended Sustainable Development under the Green Port Initiatives.
- Deendayal Port has also signed MOU with Gujarat Forest Department in August 2019 for Green Belt Development in an area of 31.942 Ha of land owned by Deendayal Port Trust. The plantation is being carried out by the Social Forestry division of Kachchh.

CHAPTER-12

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Annexure -E

Subject: Compliance of mitigation measures suggested in EIA report of "***Creation of water front facilities (Oil Jetties 8, 9, 10 & 11) and development of land of area 554 acres for associated facilities for storage at Old Kandla, Gandhidham, Kutch, Gujarat by M/s Deendayal Port Authority (Erstwhile Deendayal Port Trust)***"

Reference: Point No. XII of Environmental and CRZ Clearance granted by MoEF&CC, GoI vide letter vide file no. 10-1/2017-IA-III dated 20/11/2020.

Table 9.1: EMP for Construction Phase

S. No	Environmental Aspect	Project Activity and Source of Impact/ and Impacts	Mitigation Measures and Reporting and records check required to be in place	Responsibility	Compliances
	Air	**Construction of Jetty** Emissions from generator sets (NOx, SO_2, hydrocarbons and CO) for operation of barges; ▪ Emissions from other construction equipment and machinery (cranes, anchored piling barges etc.); ▪ Dust emissions from on land vehicular movement (PM);	Ensuring frequent water sprinkling on roads to reduce dust during vehicular movement on land;	Contractor & DPT	• DPA has installed Mist Canon at the Port area to minimize the dust. • To control dust pollution, regular sprinkling of treated water through tankers on roads and other area is being done.
			Minimization of movement of project vehicles at night and especially during peak hour traffic (9-11 am, 2-3 pm and 5-6 pm).		Point noted. it is relevant to mention here that, for diversion of port-related traffic and transportation, DPA has obtained Environmental & CRZ Clearance from SEIAA, GoG vide letter dated 19/06/2020 for construction of Interchange cum Road Over Bridge. The construction work of ROB is ongoing.
			Covering Vehicles / Barges with tarpaulin during transportation of construction material to site;		• In this regard, it is to state that, vehicles are being covered with tarpaulin during transportation of construction material to site.
			Ensuring that contractors are maintaining engines and that machinery deployed during construction are complying with emission standards;		DPA has included clause in the tender for the Contractor to ensure supply, use and maintenance of all construction plant and equipment for its efficient working. Relevant page of the tender is attached herewith as **Annexure 1**.

			The diesel generator (DG) sets will be provided with adequate stack height as per applicable regulations and will use low sulphur diesel in DG sets;		• DG sets are used only during power failure and vent of sufficient height are provided in line with the guidelines.
			Regular maintenance of diesel generators engines;		DPA has included clause in the tender for the Contractor to ensure supply, use and maintenance of all construction plant and equipment for its efficient working. Relevant page of the tender is attached herewith as **Annexure 1**.
			▪ Monitoring of stack emissions at intervals as specified in the CFE and its comparison with the emission standards as specified in CFE; and		Point noted
			▪ Regular Ambient air quality monitoring as per conditions stipulated in the CFE.		DPA has been conducting regular Monitoring of environmental parameters since the year 2016. The Environmental Monitoring Reports is enclosed with the EC compliance report.
			Documentation: ▪ Construction contractor will be required to prepare a Pollution Prevention and Control Plan to address the prevention and control of pollution, including exhaust emissions. ▪ Maintain Construction Equipment Maintenance Records. ▪ Inspection of Maintenance Records.		DPA has included clause in tender for the Contractor to maintain Construction progress Documentation comprising of Detailed Construction Sequence and Methodology, Daily site records, weekly progress reports, and environmental monitoring report. Relevant pages of the tender are attached herewith as **Annexure 2.**

		Capital Dredging ▪ Emissions from generators Sets (NOx, SO2, hydrocarbons and CO) for operation of dredgers/ rigs; ▪ Drilling Rig Engine Emissions;	▪ The dredging activities will be performed by the specialist contractors using purpose-built dredgers and under the active supervision of the port operator. ▪ Providing adequate stack height of diesel generators for proper dispersion of pollutants; ▪ Ensuring diesel generator sets are maintained and low sulphur content diesel is used; ▪ Monitoring of stack emissions at intervals as specified in the Consent for Establishment (CFE) and its comparison with the emission standards as specified in CFE; ▪ Ensuring that dredging contractors are maintaining equipment maintenance records; and Documentation: ▪ Inspection of condition of contractors dredging equipment before start of work. ▪ Inspection of Maintenance Records.	Contractor & DPT	Point noted Dredging activity not yet started

	Noise	**Construction of Jetty** Hammering during piling activity and noise generated from other construction equipment	▪ Regular Ambient Noise Monitoring as per conditions stipulated in the CFE at receptors and construction site. ▪ If noise levels are above acceptable limits, adequate measures will be implemented (eg. Use of sound dampening blanket, physical barriers etc.).	Contractor & DPT	• DPA has been conducting regular Monitoring of environmental parameters since the year 2016. The Environmental Monitoring Reports is enclosed with the EC compliance report. • DPA entrusted work of green belt development in and around the Port area to the Forest Department, Gujarat at Rs. 352 lakhs (Area 32 hectares), which can act as a natural barrier for attenuation of noise. The work is already completed. • Further, DPA has appointed the Gujarat Institute of Desert Ecology (GUIDE) for "Green belt development in Deendayal Port Authority and its Surrounding Areas, Charcoal site' (Phase-I)" vide Work Order No.EG/WK/4757/Part [Greenbelt GUIDE, dated 31st May 2022.

		Capital Dredging Noise generated from equipment's used during Dredging activity (Dredger-Mechanical/Hydraulic, generator, pumps etc.)	▪ Avoiding high noise activity during night time; ▪ Provide Diesel generators with acoustic enclosure; ▪ Use of ear plugs by personnel working onsite in high noise generating areas (above 75 dB (A); ▪ Encourage and support the workers to also use ear plugs during day time activities; ▪ Use of low speed rotary equipment; ▪ Use of high suction performance pump; ▪ Use of grease free bearings for all on board equipment; ▪ Maintenance of equipment used for dredging. ▪ Regular Ambient Noise Monitoring as per conditions stipulated in the CFE. *Documentation* ▪ Inspection of Maintenance Records ▪ Maintain Equipment Maintenance Records	Contractor & DPT	Point Noted. Dredging activity not yet started
	Surface/ Groundwater/ Marine Water	**Construction of Jetty**	▪ A method statement will be developed for the piling activity.		DPA has included clause in tender/ Concession agreement for the contractor to undertake piling installation in accordance with IS 2911 and maintain record of installation of Piles. Copy of the relevant page of the tender is attached herewith as **Annexure 3.**

		Capital Dredging ▪ Disturbance of seafloor, the suspension of fine sediments and the re-deposition of coarse factions causing turbidity in marine water; ▪ Siltation and erosion along the coastline resulting in change of coastal morphology; (this was not anticipated as an impact in the chapter 5) ▪ Turbidity in Marine water is expected to have an impact on Marine flora and fauna and other ecological issues	▪ Prior to dredging, dredge area co-ordinates will be delineated, climatic conditions will be noted, and condition of equipment etc. will be checked; ▪ Use of Sophisticated Dredgers to avoid or minimize scattering of dredge sediments during dredging; ▪ Controlled dredging operations during high tidal disturbances; ▪ Continuous monitoring of turbidity and suspended sediment concentration; ▪ Regular check on Turbidity Levels & Dissolved Oxygen levels;	Contractor & DPT	Point Noted. Dredging activity not yet started
	Biological Environment (Terrestrial & Marine)	**Construction of Jetty** Seabed disturbance due to piling activity, increased turbidity, and impact on benthic habitat.	▪ Regular monitoring of Marine Water & Sediment quality; ▪ Positioning of jack-up barge primarily in areas where the seabed has recently been dredged, rather than in previously less disturbed areas to avoid unnecessary disturbance to more established benthic habitat.	Contractor & DPT	• DPA has been conducting regular Monitoring of environmental parameters since the year 2016. The Environmental Monitoring Reports is enclosed with the EC compliance report. • Point noted for compliance

		Capital Dredging ▪ Siltation and erosion during dredging activity ▪ Increased in turbidity levels of sea ▪ Impact on fishing activity	▪ Use of sophisticated dredgers to avoid or minimize scattering of dredge sediments during dredging; ▪ Controlled dredging operations at the time of high tidal disturbances; ▪ Check sediment quality for presence of heavy metals; ▪ Disposal at approved dumping ground in the sea as per Central Water and Power Research Station (CWPRS).	Contractor & DPT	Point Noted. Dredging activity not yet started Dredged Material will be disposed of at designated location as identified by the CWPRS, Pune.
	Land / Soil	**Construction of Jetty** No impacts being offshore activity	-	-	--
		Capital Dredging No impacts being offshore activity	-	-	--

	Socio - economic and cultural	**Construction of Jetty** ▪ Damages to fishing nets ▪ Navigational problems to the fishing community ▪ Loss of marine species, especially fishes ▪ Immigration of construction workforce seeking proper facility	▪ Being an existing port, the fishing activity is very limited. ▪ Planned marine traffic management by the port authorities, ▪ If there is any loss of fishing net due to the said construction then same to be suitably compensated. ▪ Rest rooms with canteen facility and potable water to be provided to construction labour.	Contractor& DPT	• There is no fishing in the proposed project area, being no fishing zone. Kindly refer Point No. 13 of Standard Compliance under Compliance to the Terms of Reference specified in the EIA report. Copy of relevant page is attached herewith as **Annexure 4**. • Deendayal Port Authority had already installed and operates the Vessel Traffic Management System in the Gulf of Kachchh. • There is no fishing in the proposed project area, being no fishing zone. Kindly refer Point No. 13 of Standard Compliance under Compliance to the Terms of Reference specified in the EIA report. Copy of relevant page is attached herewith as **Annexure 4.** • DPA has included clause in the tender for the contractor to make arrangement for water requirement for labours and also make provisions for the construction labour with necessary infrastructure including canteen facility. Relevant pages of the tender is attached herewith as **Annexure 5**.

		Capital Dredging ▪ Damages to fishing nets ▪ Navigational problems to the fishing community ▪ Loss of marine species, especially fishes	▪ Prior to dredging, dredge area co-ordinates will be delineated, climatic conditions will be noted, and condition of equipment etc. will be checked; ▪ Controlled Dredging operations during at the time of high tidal disturbances; ▪ Any damages to nets and equipment would be promptly compensated after a fair negotiation; ▪ Any disruption of fishing movement will need to be communicated in a timely manner, and minimized during peak fishing season; ▪ The process of dredging and dumping to be taken by experienced personnel and should be carefully done to minimize impact on marine ecology; ▪ Regular monitoring of Marine Water and Sediment Quality especially for heavy metals for taking necessary corrective measures if significant changes are observed; ▪ Constant check on Turbidity Levels & Dissolved Oxygen levels;	Contractor & DPT	Point Noted. Dredging activity not yet started

9.4 Environmental Management Plan during Operation Phase

During the Operation phase, activities will include operation of jetties and maintenance dredging The EMP for the operational phase is summarized below in ***Table 9.2***.

Table 9.2: **EMP for Operation Phase**

S.No.	Environment al Aspect	Project Activity and Source of Impact/ and Impacts	Mitigation Measures and Reporting and records check required to be in place	Responsibility	Compliances
1	**Air**	**Maintenance Dredging** ▪ Emissions from generator sets (NOx, SO2, hydrocarbons and CO) for operation of dredgers/rigs; ▪ Drilling Rig Engine Emissions;	▪ Providing adequate stack height of diesel generators for proper dispersion of pollutants in compliance with CPCB standards; ▪ Use of Low sulphur diesel in DG sets; ▪ Regular maintenance of diesel generators engines; ▪ Monitoring of stack emissions at regular intervals as specified in Consent for Operation (CFO) and its comparison with the emission standards as specified in CFO; ▪ Regular Ambient air quality monitoring as per conditions stipulated in the CFO. ▪ Follow Dredging Management Plan; *Documentation:* ▪ Inspection of condition of contractors dredging equipment; ▪ Inspection of Maintenance Records	Dredging Contractor and DPT	Point noted. Construction phase ongoing for Oil Jetty No. 8
	Noise	**Maintenance Dredging** Noise generated from equipment's used during Dredging activity (Dredger-Mechanical/Hydraulic, generator, pumps etc.	Same as followed for Capital Dredging during construction phase Please refer to Table 9.1.	Dredging Contractor and DPT	Point noted. Construction phase ongoing for Oil Jetty No. 8

	Surface/ Groundwater/ Marine Water	**Maintenance Dredging** Turbidity in marine water is expected to have an impact on Marine fauna	▪ Same as for Capital Dredging. ▪ Use of sophisticated dredgers to avoid or minimize scattering of dredge sediments during dredging; ▪ Controlled dredging operations during high tidal disturbances; ▪ No open discharge of oily wastes in marine waters; ▪ Constant check on Turbidity Levels & Dissolved Oxygen levels; ▪ Inspection of Analysis Records. *Documentation* ▪ Wastewater Monitoring as per Monitoring Plan ▪ Inspection of Monitoring Records	Dredging Contractor and DPT	Point noted. Construction phase ongoing for Oil Jetty No. 8
	Socio-Cultural	**Maintenance Dredging** ▪ Damages to fishing nets ▪ Navigational problems to the fishing community ▪ Loss of marine species.	▪ Planned marine traffic management by the port authorities, and if any loss of fishing net occurs due to the dredging activity, then same to be suitable compensated. ▪ Dredging Plan to be followed	Dredging Contractor, DPT	Point noted. Construction phase ongoing for Oil Jetty No. 8

Annexure -1

5.54 SUB-SOIL DATA

In the area covered by the Kandla Port, the nature of sub-soil is indicated in relevant section for guidance only. The tenderer shall satisfy him of the character and volume of work under the items and expected surface and/or subsoil water to be encountered.

He must satisfy himself about the general conditions of the site and ascertain the existing and future obstruction likely to come up during the execution of the contract to carry out the work.

5.55 TIP LEVEL OF PILES

The pile tip is tentatively proposed to be taken upto - 34.00 / -36.00 m. However, the actual founding level will be decided by the technical advisor during the execution of work.

5.56 DECK LEVEL

Top deck level of jetty / Dolphins	(+) 9.14 m
Approximate existing average Bed level	(-) 10.00 m
Proposed Bed level	(-) 14.00 m

5.57 PLANT

The contractor shall be responsible for the supply, use and maintenance of all construction plant and equipment and he shall ensure that it is suitable for the work and is maintained in such a manner as to ensure its efficient working. The Nodal Officer or his nominee may direct that plant which is not efficient and is prejudicial to the quality of the work be removed from the site and replaced by plant to his satisfaction.

5.58 QUALIFIED PERSONNEL

Fully qualified and experienced concrete quality control Engineers shall be employed by the Contractor and shall be available on site at all times when important work is taking place. Operators for mechanical vibrators, mixers and foreman in charge of placing of concrete shall be fully trained and experienced in their classes of work.

Annexure -2

(d) The documents that each key personnel staff is authorized to sign on behalf of the Contractor.

A201.3.2 The Staff Organization shall cover the Contractor's key staff as well as other working-level staff, with a narrative of the authorities and responsibilities of each staff member in execution of the Works, whether on site or in office locations, or in deciding technical details of the Contractor's submittals.

A201.3.3 Each member in the Contractor's Staffing Proposal, including the Key Staff, shall be allocated to this Contract on a full-time basis on site until the activities that he is responsible for, have already been completed. Should it be necessary to replace Key Staff, before the activities he is responsible for have been completed, the Contractor shall submit the CV of the proposed substitute to obtain the Notice of No Objection from the Engineer, at least 30 days before the proposed change. The substitute shall not be less qualified or experienced than the person he is replacing.

A201.3.4 All the Key Staff should have minimum overall experience (in terms of years), minimum similar work experience (in terms of years).

A201.4 Contractors Emergency Contact Details

A201.4.1 Prior to commencement of construction Works, the Contractor shall provide to the Engineer, and all other relevant government agencies, the 24-hour contact telephone number of two (02) persons with authority over the Works during the construction period. The persons shall have authority to take immediate action to shut down any activity, or to affect any emergency measures as directed by the Engineer or any other relevant government agencies.

A202 Construction Progress Documentation

A202.1 Detailed Construction Sequence and Methodology

A202.1.1 The Contractor shall be responsible for scheduling, actions, personnel, materials and all other aspects of the works necessary to achieve completion of the whole of the Works within the Time for Completion and subject to the restrictions contained in this contract, including granting of Right of Access to the Site areas and use.

A202.1.2 Along with the submission of the detailed programme, the Contractor shall submit to the Engineer for approval, the Detailed Construction

Sequence and Methodology and the overall schedule from contract start to completion of all works.

A202.1.3 The Detailed Construction programme and Methodology shall be consistent with the overall sequencing of the construction methodology submitted in the Contractor's Tender and shall provide additional details of the Contractor's proposed method of construction and sequence of work.

A202.2 Submittals Schedule

A202.2.1 The Contractor shall submit all specified documentation in accordance with the requirements of the contract including the additional submission requirements detailed in this specification.

A202.3 Construction Progress Reporting

A202.3.1 During the performance of the Works, the Contractor shall submit to the Engineer, progress reports as defined in this specification and to the format required by the Engineer in both hard copy and in a digital format until the Contractor has completed all work known to be outstanding at the completion date stated in the Taking-over Certificate for the works.

Daily Site Records

A202.3.2 The Contractor shall maintain daily records of the number of each class of the Contractor's personnel and of each type of Contractors equipment on the site along with brief description of the actual construction activities undertaken each day.

A202.3.3 These records shall be kept in the form of separate pro-forma Daily Site Record Forms corresponding to each day throughout the works. The Contractor shall finalise the format of the Daily Site Record Form with the Engineer prior to the commencement of works on site.

A202.3.4 The Contractor shall present the Daily Site Record Form to the Engineer (or delegated representative) each day for acceptance. The Contractor and the Engineer shall both sign the Daily Site Record Form and each shall retain hardcopy of the signed form for record purposes. Joint signature of the Daily Site Record Form shall be the responsibility of the Contractor and if this is not signed for seven consecutive working days, the Engineer or his authorised representative shall have the right to suspend the work of the Contractor.

Weekly Progress Reports

A202.3.5 The Contractor shall submit at the end of each week to the Engineer a Weekly Progress Report summarizing significant progress or problems encountered during the preceding week in respect to all parts of the works under the contract.

A202.3.6 The Contractor shall finalise the format and content of the Weekly Progress Reports with the Engineer prior to the commencement of works on site.

A202.3.7 The Weekly Progress Report shall include a copy of the current approved contract programme outlining progress to date for the major items of the Works, including a statement of the Contractor's programme for the following week and without restricting the generality of the foregoing, shall include reasoned and detailed comments in respect to:

(a) Activities or items completed during the week, including dates of completion;

(b) Activities or items scheduled for completion during the week but not completed (showing details of intended remedial action and comments as to likely effects on the works programme);

(c) Changes to the critical path;

(d) Activities or items re-scheduled or re-estimated by the Contractor;

(e) Additional or deleted activities or items;

(f) Anticipated slippage or problems and proposed mitigation measures;

(g) Future up-to-date target dates for the finalisation of the items;

(h) Changes to the work programme duration;

(i) Planned percent complete;

(j) Actual percent complete;

(k) Date variance and percent variance.

A202.3.8 The Weekly Progress Report shall also include but not limited to:

(a) Progress for that week in terms of quantities and production rates;

(b) Key decisions required from the Engineer in the next week;

(c) Major events for the next week;

(d) S-curves for Actual Vs Planned;

(e) Records of manpower and equipment compared to programmed requirements;

(f) Approved Daily Site Record Forms applicable to that week as a separate appendix.

Monthly Progress Reports

A202.3.9 In addition to the Weekly Progress Reports, the Contractor shall submit each month within seven (7) days of the last day of the period or the agreed cut-off date with the Engineer, an overall Monthly Progress Report summarizing the contents of the submitted Weekly Progress Reports for that month in respect to all parts of the Works under the contract. The report shall indicate the progress and financial status of the works of the previous month. The report shall accurately estimate the work completed on each activity, including procurement and construction activities.

A202.3.10 The Contractor shall finalise the format and content of the Monthly Progress Reports with the Engineer prior to the commencement of the Works on site. The Monthly Progress Report shall also include but not limited to:

(a) Executive Summary of previous month's events including a clear summary statement of the current progress position;

(b) Describe current critical path;

(c) Total work progress as at the end of the previous month with progress chart showing progress achieved as a percentage against planned progress;

(d) State existing status, rate of progress, estimated time of completion and cause of any delay (if any);

(e) Description of work accomplished since submission of previous progress Programme;

(f) S-curves for physical progress against planned;

(g) Details of work for the next month;

(h) Safety and health performance reporting;

(i) Information regarding any design changes;

(j) Information regarding any variations;

(k) Details of inspections and approvals required to proceed with work;

(l) Records of manpower, equipment etc. compared to programmed requirements;

(m) Information required from the Employer;

(n) Environmental monitoring reporting, including separate waste management reporting;

(o) Weather records;

(p) Records of delays and stoppages with supporting reasons;

(q) Value of work done;

(r) Actual and anticipated cash flow;

(s) Changes or additions to Contractors supervisory personnel since the preceding progress report;

(t) Causes of any delays;

(u) Proposed actions by the Contractor to restore the programme, including what is being done or what is planned to be done in each problem area;

(v) Identify anticipated problems or changes and present plan to deal with them so as to minimize or prevent delays;

(w) Status of equipment and material deliveries;

(x) Submittals summary and status:

(i) Instructions summary and status;

(ii) Defects summary and status;

(iii) Schedule of warranties and guarantees;

(iv) Schedule of insurances and insurance claims;

(v) Subcontracts awarded in the previous month.

A202.3.11 Updates and revisions to required programme and reports shall not modify or limit in any way, the Contractor's obligations to meet the Time for Completion.

A202.3.12 Copies of the site progress photos for the month shall be provided in a separate appendix.

A202.4 Notice to the Engineer

A202.4.1 Unless specified otherwise elsewhere in this Specification, the Contractor shall give the Engineer not less than 24 hours' notice in writing of the intended time for commencement of any construction activities to enable the Engineer to make his arrangements for the inspection of operations on the Site.

A202.4.2 The Contractor shall also give the Engineer not less than seven (07) days' notice in writing of the commencement of any preparation, construction or manufacturing activity occurring at the manufacturer's or supplier's site, or at a location not within the manufacturer's or supplier's site, of any article or material to be used in the works, whether by the Contractor or any Subcontractor, stating the time and place of the works such that the Engineer may make his arrangements for the supervision or inspection of such works at the manufacturer's or supplier's site. The Contractor shall bear the costs for Engineer and/or Employer costs for inspections at manufacturers/suppliers sites.

A202.5 Photographic Documentation

A202.5.1 The Contractor shall arrange to take colour photographs throughout the Works for the purposes of recording the overall progress of the works and recording details of each aspect of the Works or as otherwise directed by the Engineer. The photographs shall be of acceptable quality and shall be taken by a professionally competent person with a digital camera having resolution in excess of 10 Megapixels and able to record the date of photographs taken in the prints.

Annexure -3

B308 Pile Foundations

B308.1 General

B308.1.1 This section of specification includes requirement for furnishing and placing/installation of reinforced concrete bored cast in-situ piles.

B308.1.2 The Contractor shall furnish materials, labour and equipment necessary to drill or bore and install bored piles in accordance with this specification.

B308.1.3 Unless specified the grade of concrete shall be minimum M40 conforming to IS:10262. The cement content for piling work shall be minimum 430 kg/m^3 and maximum water cement ratio shall be 0.45.

B308.1.4 The properties of cement, reinforcement and fine/coarse aggregates to be used for piles construction shall be in accordance with the specifications under 'Materials'.

B308.1.5 For piles temporary casing upto its required levels shall be provided.

B308.1.6 Construction of bored piles shall be carried out in accordance with the relevant sections of IS:2911 (Part I/sec 2) and only routine pile load test shall be conducted as per IS:2911 (Part 4) except where otherwise specified, described or directed by the Engineer.

B308.2 Programme and Method of Construction

B308.2.1 The Contractor must furnish to the Engineer, before commencing work, a detailed method of construction he intends to adopt for piling work together with the programme of construction.

B308.3 Boring

B308.3.1 Boring shall generally be carried out by recommended procedure as set out in IS:2911 by either rotary or percussion equipment, grabbing equipment or by reverse or direct mud circulation method. If the soil is found to be unstable, the boring tools should be such that suction effects are minimized. Walls of boreholes shall be stabilized by using removable bottom casings with or without drilling fluid depending upon the soil conditions. In soils liable to flow, the bottom casing should be kept ahead of the boring in all cases to prevent the entry of soil into the bore, so preventing the formation of cavities and settlements in the adjoining ground. Continuous pumping shall not be used for excavating inside the boreholes. While below sub-soil water level, precaution shall be taken so that no boiling of the bottom of the hole occurs due to the difference in hydrostatic head. The size of cutting tool shall not be less than the diameter of pile by more than 75 mm.

Annexure -4

		are given in fig no: 4.12.
11	Details of the layout plan including details of channel, breakwaters, dredging, disposal and reclamation	The master plan of Deendayal port trust is attached as **Annexure –XI** Approach channel of 160m wide up to Turning circle of ø450, Capital dredging envisaged in **16,56,058 M^3**. Finished level of the reclamation to be kept at +8.0m CD and a seawall shall be provided along the seaward end of the plot to cater for storm water elevation. The reclamation will be constructed using imported fill material from the local quarries. The reclamation will be constructed tipping the material by end-on method in layers and subsequently the reclaimed area will have to the consolidated using Rolling/dynamic compaction/preloading (with or without accelerated drainage).
12	Details of handling of each cargo, storage, transport along with spillage control, dust preventive measures	Details of cargo handling is given in chapter -2: Project Description under table: 2.5 and commodity wise traffic is attached as Annexure –X Water sprinklers shall be used for dust suppression.
13	Submit the details of fishing activity and likely impacts on the fishing activity due to the project.	There is no fishing in the proposed project area, being no fishing zone. Hence impact on fishing activity is not envisaged.
14	Details of oil spill contingency plan	Oil spill contingency plan is detailed in chapter -7: Additional studies under section -7.3
15	Details of bathymetry study	Mentioned in chapter -7: Additional studies

Annexure -5

Nominee or Proof Technical Advisor and the charges there of shall be borne by the Contractor.

5.17 Before commencement of work the Nodal officer or his nominee and the Contractor shall jointly survey and record all ground levels on the site if required. The Contractor shall supply all necessary equipment and attendance for carrying out such surveys. The contractor shall prepare record drawings showing the agreed levels which shall be signed by the Nodal Officer or his nominee and the Contractor.

5.18 As the work progresses, inspection of cement, aggregate, reinforcing steel and testing of the concrete strength will be done by the Contractor in the presence of the Nodal officer or his nominee. The Contractor's concrete plant and materials stores shall be made accessible to the Nodal officer or his nominee at all times for inspection and for taking samples. The Contractor shall facilitate in all possible ways the inspection and testing of samples by the lodal officer or his nominee, Labour shall be provided by the Contractor for carrying out the testing's.

5.19 SUPPLY OF WATER

[i] The contractor shall have to make his own arrangements for the water required for execution of work and for labours etc.

[ii] Water used for mixing and curing shall be clean and free from injurious amounts of oil, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to concrete or steel.

[iii] Unfiltered potable water is generally considered suitable for mixing and curing. Mixing and curing with sea water shall not be permitted in any case.

[iv] Periodically samples of water shall be tested as per IS-3025 and as a guide, the following concentrations represent the maximum permissible values:

[a] To neutralize 200 mi sample of water using Phenolphthalein as an indicator, it should not require more than 2 ml of 0.1 normal NaOH.
[b] To neutralize 200 mi sample of water using Methyl Orange as an indicator, it should not require more than 10 ml. of 0.1 normal HCL.

A403 Construction Facilities

A403.1 Contractor's Site Compound

A403.1.1 The entire Contractor's Site Compound including all Contractors site offices, sanitary and first aid facilities, labour camp (if any), car parking, field laboratory, security facilities, Engineer's Field Office and the like shall be confined within the area designated for the Contractor's site establishment.

A403.1.2 The Contractor shall take all necessary measures to reduce dust, including from bulk stockpiles by means of barriers or other suitable systems. Special precautions are to be taken during the monsoon period taking into account prevailing wind directions.

A403.1.3 The Contractor shall submit the proposed location and layout of the Contractor's Site Compound and labour camp (if any) to the Engineer for approval as part of his Site Establishment Plan.

A403.2 First Aid Facilities

A403.2.1 The Contractor shall provide, equip and maintain throughout the Contract Period, a medical room together with first aid equipment and stores and other suitable facilities and arrangements for the first aid treatment of all persons on the Site and the transportation of any injured persons to hospital.

A403.3 Sanitary Facilities

A403.3.1 The Contractor shall provide and maintain to the satisfaction of the Engineer sufficient sanitary facilities and ablutions for all personnel engaged on the Works who shall use these provided facilities exclusively. The Contractor shall be responsible for arranging for the proposed handling and disposal of sewage from the site and for obtaining all required permissions from the relevant authorities.

A403.3.2 No sewage or effluent shall be discharged into any river, creek or the waters of the Port. Sewage should be treated so as to achieve the required standards prescribed by the applicable regulatory agencies and reused/recycled within the Works to the extent feasible.

Annexure -F

Annexure C

CSR Activities at Deendayal Port Trust

Details of CSR

Sr. No	Year	Board Resolution For Budget Provision	Board Approved Budget Provision	Board Resolution for approval of the CSR activities	Board Approved Amount For CSR Activities	Actual Exp. Upto Nov'20 (Rs. In Lakhs)	Net balance (Rs. In Lakhs)	Remarks
1	2	3	4	5	6	7	6-7	
1	2011-2012	369 of 28.03.2012	3.00 Cr					
2	2012-2013	17 of 31.05.2012	4.00 Cr					
				61 of 30.08.2012	564.00 Lakh	564.00	Nil	Works completed
3	2013 -2014	99 of 30.09.2013	6.43 Cr					
4	2014-2015	322 of 21.11.2014	1.07 Cr	20 of 16.04.2015	236.22 Lakh	188.18	8.04	Works in progress
5	2015-2016	151 of 12.02.2016	1.50 Cr	48 of 12.08.2016	28.00 Lakh	5.00	23.00	Works in progress
6	2016-2017	138 of 06.01.2017	2.60 Cr	52 of 2.8.2017	140.30 Lakh	146.00	-5.70	Works completed
7	2017-2018	41 of 2.08.2017	7.02 Cr	15 of 04.05.2018	155.10 Lakh	115.37	39.73	Works in progress
8	2018-19	51 of 07.08.2019	6.70 Cr	111 of 4.12.2018	154.90 Lakh	50.50	104.40	Works in progress
					1278.52 Lakh	**1069.05**	**209.47**	
9	2019-20	58 of 10.10.2019	5.49 Cr	92 of 06.12.2019	1838.57 Lakh	Nil		MoS approval is awaited
		Total	**37.81 Cr**		**3117.09 Lakh**			
						Spent in PM Fund for COVID-19-800 Lakhs		

Year-wise details of CSR works undertaken by DPT during 2012 – 13 to 2019 – 20 are given in **Tables 7.3a, 7.3b, 7.3c, 7.3d, 7.3e, 7.3f** and **7.3g**.

Table 7.3a: CSR Works Undertaken by DPT during 2011-12 and 2012 – 13

Sl. No.	Name of Work	Cost (Rs. In lakhs)
1	Repair of road from Dr. Baba Saheb Ambedkar Circle to NH 8A (via Ganesh Nagar)	518
2	Repair of road from S.T. Bus Stand to Sunderpuri Cross Road via Collector Road	
3	Repair of road from NH 8A Railway Crossing to Maninagar (along railway track)	
4	Repair of road from Khanna Market Road (Collector Road) to Green Palace Hotel	
5	Construction of internal roads at "Shri Ram" Harijan Co-operative Housing Society (near Kidana)	
6	Construction of cremation ground and graveyard with other facilities at Vadinar	19.44
7	Providing cement concrete internal roads in Village Vadinar Stage - I	16.16
8	Approach road provided for developing tourism at Village Veera near Harsidhi Mata Temple	4.65
9	Water tank along with R.O. provided near developing tourism area	0.30
10	Creating facilities of flooring and steps surrounding lake to stop soil erosion and attract tourists at Village Veera.	4.80
	TOTAL	563.35

Table 7.3b: CSR Works Undertaken by DPT during 2014-15

Sl. No.	Name of Work	Cost (Rs. In lakhs)
1	Construction of community hall – cum – school at Maheshwari Nagar, Gandhidham	51.90
2	Renovation of "Muktidham" (cremation ground) at Kandla	10.65
3	Sunderpuri – 1 Valmiki Community Hall	5.00
4	Sunderpuri – 2 Valmiki Community Hall	5.00
5	Ganeshnagar Community Hall	10.00
6	Jagjivan Maheshwari Community Hall	10.00
7	Various works of road at Sapnanagar	99.19
8	Construction of compound wall in the dam of Jogninar Village	14.48
	TOTAL	206.22

Table 7.3c: CSR Works Undertaken by DPT during 2015-16

Sl. No.	Name of Work	Cost (Rs. In lakhs)
1	Construction of Bus Stand at Vadinar Village	10.00
2	Providing drainage system at Vadinar Village	6.00
3	Providing and laying of water supply lines in Vadinar Village	6.00
4	Road from Gandhidham Post Office to Merchantile Marine Department Office along with toilet facilities	60.00
5	Construction of toilets for girls / women at Khari Rohar, Village	3.00
6	Construction of toilets for girls at Mathak Primary School, Mathak, Village	3.00
	TOTAL	**88.00**

Table 7.3d: CSR Works Approved by DPT Board for 2016-17

Sl. No.	Name of Work	Cost (Rs. In lakhs)
1	RCC community hall at Harsidhi Mata Temple, Village Veera, Anjar Taluka	19.00
2	Fabricated Community Hall at Sanghad Village, Anjar Taluka	21.00
3	CSR Works for Shri Maheshwari Meghvad Samaj, Gandhidham at graveyard behind Redison Hotel	8.00
4	CSR Works for Shri Dhanraj Matiyadev Mukti Dham, Sector 14, Rotary Nagar, Gandhidham	30.50
5	CSR Works for Nirvasit Harijan Co-operative Housing Society, Gandhidham Health Cum Education Centre	41.00
6	CSR Works for Shri Rotary Nagar Primary School, Gandhidham	2.80
7	CSR Works at NU-4, NU-10(B) Sapnanagar & Saktinagar, Golden Jubilee Park at Gandhidham	18.00
	TOTAL	**140.30**

Table 7.3e: CSR Works Approved for 2017-18

Sl. No.	Name of Work	Proposal Received from / / Name of Organization / N.G.O	Cost (Rs. In lakhs)
1	CSR Works at Shri Ganesh Nagar High School, Gandhidham	Principal, Shri Ganesh Nagar Govt High School, Gandhidham	38.30 Lakhs
2	CSR Works for MOLANA AZAD Primary School, Kandla	Shri M L Bellani, Trustee, DPT, Shri Kandla Port Education Society, New Kandla	7.00 Lakhs
3	Grant financial contribution for facility of Army Cantonment for 50 nos. air coolers at Kutch Border Area	Shri Vinod L Chavda, MP	15 Lakhs
4	40% of the estimated cost of providing drainage lines at Tuna and Vandi villages under Swachh Bharat Abhiyan.	Shri Sarpanch, Tuna Village & Vandi village & Shri M L Bellani, Trustee, DPT	**Rs. 39.80 Lakhs** *Approx. estimated Cost Rs.99.50 Lakhs, of which 40% to be contributed by DPT.*
5	CSR works for S.H.N. Academy English School (managed by Indian Inst. Of Sindhology – Bharati Sindhu Vidyapeeth), Adipur	Director, S.H.N Academy English School	**40 Lakhs**
6	Construction of internal roads at Bhaktinagar Society, Kidana	Smt Maltiben Maheshwari, MLA	**15 Lakh**
		TOTAL	**155.10**

Table 7.3f: CSR Works Approved for 2018-19

Sl. No.	Name of Work	Proposal Received from / / Name of Organization / N.G.O	Cost (Rs. In lakhs)
1	CSR work to Donate 100 Nos of Computers to Daughters of Martyred Soldiers in the country under the "BETI BACHAO BETI PADHAO" program by Atharva Foundation, Mumbai	Chairman, Atharva Foundation, Mumbai	**24.00**
2	CSR work to Donate ONE (40 Seater) School Bus for Deaf Children Students for the Institute of Mata Lachmi Rotary Society, Adipur	Mata Lachmi Rotary Society, Adipur	**18.00**
3	CSR work to Providing One R.O Plant with Cooler at PanchyatPrathmikSala, Gadpadar Village for the ANARDE Foundation, Kandla&Gandhidham Center.	Dist. Rural Development Officer, Annarde Foundation-Kandla & Gandhidham	**1.50**
4	CSR work for Providing Drainage Line at MeghparBorichi village, AnjarTaluka	Shri Vasanbhai Ahir, MLA, Gujarat Govt	**25.00**
5	CSR work for Construction of Health Centre at Kidana Village	Shri Vinod L Chavda, MP	**13.00**
6	CSR work to provide 4 Nos. of Big Dust Bin for MithiRoharJuth Gram Panchayat.	Shri Sarapanch, Mithi RoharJuth Gram Panchayat	**3.40**

Sl. No.	Name of Work	Proposal Received from / / Name of Organization / N.G.O	Cost (Rs. In lakhs)
7	CSR work for Renovation & construction of shed at CharanSamaj, Gandhidham –Adipur.	Shri Vinod L Chavda, MP	**10.00**
8	CSR Work for Renovation/Repairing of Ceiling of School Building at A. P Vidhyalay, Kandla.	Smt Maltiben K. Maheshwary, MP, Gandhidham.	**10.00**
9	CSR work for Construction of Over Head Tank & Providing 10 Nos of Computers (for students) of NavjivanViklangSevashray, Bhachau, Kutch	Shri Jitendra Joshi, Founder Secretary, Shri Navjivan Viklang Sevashray, Bhachau, Kutch	**9.50**
10	CSR work to Provide Books & Tuition fees for Educational facilities to weaker section children of ValmikiSamaj, Kutch.	Shri Manohar Jala, Chairman of "National Commission of Safai Karamcharis"	**2.00**
11	CSR work to provide Water Purifier & Cooler for the ST. Joseph's Hospital, Gandhidham	Smt. Maltiben K Mahewari, MLA ,Gandhidham	**1.50**
12	CSR work for Construction of Second Floor (Phase – I) for Training Centre of "GarbhSanskran Kendra" "Samarth Bharat Abhiyan" of Kutch Kalyan Sangh, Gandhidham	Shri Vinod L Chavda, MP, Kutch	**37.00**
		TOTAL	**154.90**

Table 7.3g: CSR works approved for the year 2019-20 (approval from Ministry of Shipping still awaited)

Sl. No.	Name of Work	Proposal Received from / / Name of Organization / N.G.O	Cost (Rs. In lakhs)
1	CSR activities for Providing Drainage line at Nani Nagalpar village.	Sarpanch of Village:-Nani Nagalpar, Taluk: Anjar.	**3.00**
2	CSR activities for Development of ANGANWADI Building at School no- 12 at Ward no 3 & 6 at Anjar.	Shri Vasanbhai Ahir, MLA	**7.00**
3	CSR activities for Improving the facilities of Garden at Sapna Nagar(NU-4)& (NU-10 B),Gandhidham.	Shri K P Maheshwari, Resident Sapnanagar, Gandhidham	**18.00**
4	CSR activities for Providing of Plastic Shredding Machine to Mirror Charitable Trust, Gandhidham.	Mirror Charitable Trust ,Gandhidham	**4.75**
5	CSR activities for development of School premises of Shri Guru Nanak Edu. Society, Gim.	Shri Guru Nanak Education Society, Gandhidham.	**30.00**
6	CSR activities for the improvement of the facilities at St. Joseph Hospital & Shantisadan at Gandhidham	St. Joseph Hospital Trust, Gandhidham	**20.00**
7	CSR activities for the improvement of the facilities at SVP (SardarValabhbhai Patel) Multipurpose Hall at Gandhidham	Request from MarwadiYuva Munch & UNION Gandhidham	**500.00**
8	Consideration of Expenditure for running of St Ann's High School at Vadinar of last 5 years 2014 to 2019 under CSR.	Proposal from COM, OOT Vadinar, DPT	**825.00**
9	CSR activities for development of school premises of Shri Adipur Group Kanya Sala no-1 at Adipur	Principal, Shri Adipur Group KanyaSala, Adipur	**6.50**
10	CSR activities for development of school premises of Shri Jagjivan Nagar Panchyat Prathmiksala, Gandhidham.	Principal, Shri Jagjivan Nagar Panchyat Prathmiksala, Gandhidham.	**16.50**
11	CSR activities for development of school premises of Ganeshnagar Government high school, Gandhidham.	Shri Vinod L Chavda, MP, Kutch	**9.00**
12	CSR activities for improving greenery, increase carbon sequestration and beat Pollution at Kandla, DPT reg.	Work awarded to Forest Department , Bhuj	**352.32**
13	CSR activities for providing infrastructures facilities at "Bhiratna Sarmas Kanya Chhatralaya" under the Trust of Samaj Nav- Nirman at Mirjapur highway, Ta Bhuj.	SamajNav- Nirman at Mirjapur highway, Ta Bhuj.	**46.50**
		TOTAL	**1838.57**

List of CSR applications received from various NGOs , Organizations , Village Sharpanchs etc for the FY 2021-22 .

Sr.No	Name of Scheme	Proposal Received from / Name of Organization / N.G.O	Brief Details
1	CSR activities for the development of gardening at Sector -5 , Gim	Shri Sarvodaya Co-Operative Housing Society Ltd	**Appx Cost – Rs 25.00 Lakhs** **Cost for** – Comp wall, Benches, Plantation, walkway, other facilities (Land is reserved for Garden development only since from 50 years)
2	CSR activities for providing various facilities in SHRI GANESHNAGAR GOVT HIGHSCHOOL, GANDHIDHAM	Principal of School	**Appx cost –Rs 20.00 Lakhs** (Two times CSR works carried out at school by DPT)
3	CSR activities for the VadhiyarVankarSamajvaadi, NaviSunderpuriGim	SmtMaltiben K Maheswari, MLA	**Appx Cost Rs 6.00 Lakhs** Cost for Const. of Comp Wall
4	CSR activities for Construction work of Cabin at Oslo Area- Gim	SmtMaltiben& Shri VinadChavda	Cost not mentioned.
5	CSR activities & Land requirement forAkhil Kutch SamastaMeghvanshiGurjarmeghwal Charitable Trust ,Gim.	Shri Akhil Kutch SamastaMeghvanshiGurjarmeghwal Charitable Trust. Shri Dharmendra R Gohil	Cost Not mentioned. (demand of Land for development of SAMAJ VADI in Gandhidham)
6	CSR Activities for providing Water supply pipe line, Play ground and sports equipment, electric facilities, drinking water facilities for poor people & Fishermen at VANDI Village.	Shri R RKhambhra, PRO , Collector Office, Bhuj.	**Appx Cost Rs 51.00 Lakhs** (Last year also applied by village Sarpanch) & Recommended by Shri VASANBHAI AHIR, MLA, Shri V L Chavda, MP)
7	CSR activities for the Tuna village,	Sarpanch, Tuna village	**Appx Cost Rs. 25 Lakhs** **Cost for :-**

List of CSR applications received from various NGOs , Organizations , Village Sharpanchs etc for the FY 2021-22 .

Sr.No	Name of Scheme	Proposal Received from / Name of Organization / N.G.O	Brief Details
	Ta -Gim		2 No Fab shed 20'x20'x1250= 10 Lakh 2 Nos of Agnawadi =10 Lakh Fab shed for school=5 Lakh
8	CSR activities for the Global Vision India Foundation, Gim	Global vision India Foundation, G'dham	Requirement of Land –OR- Old building at Gandhidham for foundation of welfare activities.
9	CSR activities for the UNITED ORPHANAGE FOR THE DISABLED, TAMIL NADU	UNITED ORPHANAGE FOR THE DISABLED, TAMIL NADU	**Cost Rs 25,000.00** (Winter sweaters for children)
10	CSR activities for the Garden Development on already bounded area with Compound wall near Plot no 448 Sector-1/A, Gandhidham.	Residents, near Plot no 448, Sector-1/A, Gim.	**AppxCost Rs 20.00 Lakhs** (Requirement to provide benches, drinking water facility, plantation, lightings & walkways in side bounded area)
11	CSR activities for donation of Land for the Shri SUNDARPUI Govt Primary School, Gim	SmtMalti ben Maheshwari, MLA	(request for Land Requirement)
12	CSR activities for Extension of Adarsh Primary School building, Adipur	GandhidhamMatri Mandal, English Medium School, Adipur	**Appx Cost Rs. 40.00 Lakhs** (Construction for 4 Rooms extension) (Trust registered under Societies Registration Act XXI -1860, Reg No F-42 dtd 23.9.1965. Land belong to Trust)
13	CSR Activities for providing HD projector for KANYA MAHA VIDYALAYA, Adipur	Principal, KANYA MAHA VIDYALAYA, Adipur	**Cost Rs 1.50 Lakhs** (School Managed by G'dhamMaitry Mandal, Adipur)

List of CSR applications received from various NGOs , Organizations , Village Sharpanchs etc for the FY 2021-22 .

Sr.No	Name of Scheme	Proposal Received from / Name of Organization / N.G.O	Brief Details
14	CSR activities for DONATION various Medical Equipment for the Hospital of Gandhidham Jain SevaSamiti, Adipur	Gandhidham Jain SevaSamiti, Adipur	**Cost for** :- 1) Fresenius Haemodialysis Machine Rs 38.00 Lakh 2) Maltislice Helical CT Scanner- Rs 52.00 Lakhs 3) Others Rs 54.00 Lakhs (**Total Appx Cost Rs 144 Lakhs**)
15	CSR activities for SHRI VIDI JUTH GRAM PANCHAYAT, Vidi, Anjar	Sarpanch, Vidi Gram	**Appx Cost Rs 30.00 Lakhs** Cost for- Drainage , Garbage vehicle, and Cattle shed (Already applied earlier at Sr-5/12)
16	CSR activities for SOS CHILDRESN'S VILLAGES INDIA, Madhapar, Bhuj	Director, SOS Children's Village of India-Bhuj	**Appx Cost Rs 31.00 Lakhs** (request for Financial support towards parentless and abandoned Children Education support located at Bhuj) & support to women working in SOS.
17	Gujarat Biodiversity Board, Gandhinagar invites to involved National & Global endeavour of conservation of biodiversity by creating financial partnership with GBB under CSR programme of expenditure to be incurred 187 Lakh.	GUJARAT BIODIVERSITY BOAD, GANDHINAGAR	**Requirement-** Financial Support from DPT for **AppxRs 1.88 Cr.** (Cost for various meetings, collection of primary data from villagers , processing of documentation, printing , TA DA of Technical support &Miscexp for 150 Peoples Biodiversity Register (PBR).

List of CSR applications received from various NGOs , Organizations , Village Sharpanchs etc for the FY 2021-22 .

Sr.No	Name of Scheme	Proposal Received from / Name of Organization / N.G.O	Brief Details
18	CSR activities for providing furniture & Home appliances for ROJAVANAM TRUST at Madurai.	Shri Arul Kannan, Director	**Appx Cost Rs 30 Lakhs** (seeking help to provide facilities to Aged & Homeless people living in Trust and Purchasing of New Ambulance)
19	CSR activities for providing Dialysis Machine for treatment of Kidney patients at "ST JOSEPH'S HOSPITAL TRUST" at Gandhidham.	Sr. Franciline, Administrator of Hospital.	**Appx Cost Rs 31.36 Lakhs** (Cost of 5 Nos of Dialysis Machines for treatment of kidney patients)
20	CSR activities for providing facilities in Girls Hostel of Gasturba Gandhi BalikaVidhyalay, Gandhidham.	Shri Vinod L Chavda, MP	**Appx cost Rs 30 Lakhs.** (Cost of Comp Wall, Entrance gate, Girls toilets etc)
21	CSR works for providing Oxygen Generator Plant and 45 KV Silent Generator for COVID HOSPITAL at Swami LilashahKutia, Adipur.	Secretary, BHARAT VIKAS PARISHAD, Gandhidham	**Appx Cost Rs 80.00 Lakhs** (Facilities for 100 Beds of COVID patient which it to be extend upto 240 Beds)
22	CSR works for providing Two Numbers of Oxygen Concentrator and others medical equipment for the Trust ,Antarjal, Gim.	President SHRI SARV JEEV KALYAN TRUST, ANTARJAL, Gandhidham	**Appx Cost Rs21.50 Lakhs** (Facilities to be provided for the treatment of CORONA PATIENTS at their trust.)
23	CSR works for providing Fabricated Shed , Construction of Compound Wall and Land levelling for the Cattle of **GauSevaSamiti-Tappar** at Gram-Tappar, Ta Anjar.	Shri Vinod Chavda, MP &Presedent , GauSevaSamiti, village Tappar, Ta-Anjar	**Appx Cost Rs84 Lakhs** (Facilities to be provided for Cattle shelters at Village.) (Land belongs to Gram-panchayat)
24	CSR works for Construction of Auditorium Hall at RSETI (Rural Self Employment Training Institute) at	Shri Vinod Chavda, MP & Director of RSETI, Bhuj	**Cost not mentioned.** (Facilities to be provided

List of CSR applications received from various NGOs , Organizations , Village Sharpanchs etc for the FY 2021-22 .

Sr.No	Name of Scheme	Proposal Received from / Name of Organization / N.G.O	Brief Details
	Bhujodi-Bhuj.		for the people needs Self-employment activities.)
25	CSR works for Providing of Furniture for the School "SHRI GALPADAR PANCHAYAT PRATHMIC KUMAR GROUP SALA " atGalpadar Village Ta Gim.	Principal, SHRI GALPADAR PANCHAYAT PRATHMIC KUMAR GROUP SALA " atGalpadar Village Ta Gim.	**Cost not mentioned.** (Facilities to be provided for the Students of Workers & poor village people who study in the school.)
26	Construction of Shed, hall and Gate for the DADA Bhagwandas Charitable Trust, Adipur. (Sr no -4)	Shri Vinod Chavda, MP & DADA BHAGWANDAS CharitableTrust, Gandhidham	<u>As per CSR Guideline-</u> ➢ Promoting gender equality and empowering women ➢ Eradicating extreme hunger and poverty (Considered shed and hall) Fab Shelter Shed - 30'x100' x 1250=37.00 Lakh & RCC Hall – 20'x100'x1500=30.00 Lakh (**Appx Cost Rs67.00 Lakhs**) Land authority belongs to Trust given by GDA and NOC given by SRC.Doc submitted.
27	CSR work for reconstruction of the Internal Roads of the Sector-9B-C and Sector-10 area in Gandhidham.	President, Shri TejaKangad, The Gandhidham Chamber of Commerce and Industry, Gandhidham.	Cost not mentioned.

List of CSR applications received from various NGOs , Organizations , Village Sharpanchsetc for the FY 2021-22 .

Sr.No	Name of Scheme	Proposal Received from / Name of Organization / N.G.O	Brief Details
	CSR Applications kept pending in last year Agenda:-		
27	CSR Activities for providing Water supply pipe line, Play ground and sports equipment, electric facilities, drinking water facilities for poor people & Fishermen at VANDI Village. (Sr no-3)	Sarpanch ,Village-VANDI , Ta- Anjar (Recommd. By Shri VASANBHAI AHIR, MLA, Shri V L Chavda, MP)	As per CSR Guideline- ➢ Env Sustainability ➢ Eradicating extreme hunger and poverty (to be Consider for health Center ,Drainage line, Water sump etc activities) **(Appx Cost - 51.00 Lakhs)** (Land authorization of Gram Panchayat)
28	Construction of Shed, hall and Gate for the DADA Bhagwandas Charitable Trust, Adipur. (Sr no -4)	DADA BHAGWANDAS CharitableTrust, Gandhidham (Recommd. By Shri V L Chavda, MP)	As per CSR Guideline- ➢ Promoting gender equality and empowering women ➢ Eradicating extreme hunger and poverty (Considered shed and hall) Fab Shed - 30'x100' x 1250=37.00 Lakh & RCC Hall – 20'x100'x1500=30.00 Lakh (**Appx Cost Rs 67.00 Lakhs**) Land authority belongs to Trust given by GDA and NOC given by SRC. Doc submitted.
29	10 Nos of Computers required for ShirMaheswarinagar Panchayat Girls Primary School, Gandhidham& Boys Group School, Gandhidham. (Sr no-8)	Maheswarinagar Panchayat Primary Kanya Sala, Gandhidham (Contact no 9913903686)	**AppxRs 5.00 Lakhs** As per CSR Guideline- ➢ Promotion of Education (to be consider for 20 Computers)

List of CSR applications received from various NGOs , Organizations , Village Sharpanchsetc for the FY 2021-22 .

Sr.No	Name of Scheme	Proposal Received from / Name of Organization / N.G.O	Brief Details
			Visited the site. Land belongs to MahewariMeghwadSamaj given by SRC for school purpose, doc are awaited.
30	Construction of Shed and Roof at JeparMatiyadev, shamsanbhumi at Kidana village &Maheswari Community Hall at JuniSundarpuri ,Gandhidham. (Sr no-10)	Shri VINOD CHAVDA, MP	**AppxRs 15.00 Lakhs** (Land authorization not mentioned)
31	Drainage, road, Dust bins, & shed for Cattle shelters at VIDI Village, Ta –Anjar. (Sr no- 12)	Village- VIDI, Ta: Anjar	**AppxRs 30.00 Lakhs** As per CSR Guideline- ➢ Env Sustainability ➢ Eradicating extreme hunger and poverty (Consider for Garbage vehicle & Drainage Cost)
32	Education, Women empowerment and Primary health care services at Kutch area. (Sr no-13)	Light of Life Trust, **Mumbai.**	Cost not mentioned.
33	Request for Help Divyang persons to employment by providing machineries. (Sr no-14)	Kutch DivyangSangthan, Gandhidham.	Cost not mentioned
34	Construction of 2nd Floor of Shri MaheswariMeghwadSamaj, Gandhidham. (Sr no-20)	Shri MaheswariMeghwadSamaj, Gandhidham	**AppxRs. 15.00 Lakhs** (Visited the site and Land ownership documents awaited) (Name plate of DPT fixed at the Asset)

List of CSR applications received from various NGOs , Organizations , Village Sharpanchsetc for the FY 2021-22 .

Sr.No	Name of Scheme	Proposal Received from / Name of Organization / N.G.O	Brief Details
35	Installation of Mini Science Center at Anjar and Gandhidham. (Sr no-21)	STEM Learning Pvt Ltd, Mumbai.	Cost not mentioned.
36	CSR work for Shri Rampar Gram Panchayat. ➢ Wall Plastering for Cattles -7 Lakhs ➢ Shed for Cattel's-15 Lakhs (Sr no-25)	Shri Sarpanch, Rampar Village.	**AppxRs 22.00 Lakhs** (Land authorization of Gram Panchayat and under taking submitted by applicant)
37	CSR activities for the 45,000 Patients over the period of 3 years by "SMILE FOUNDATION", Mumbai. 1. Concept for Nutrition covering 3 years 2. Concept for Mobile Health Unit reaching beneficiaries for 3 years 3. Concept for Vocational Training with NGO (Sr no-29)	Proposal from "SMILE FOUNDATION " Mumbai.	Appx Cost- **Rs 539 Lakhs** for 3 years
38	Development of Park in Public utility plot in between Block "C" & "D" of Sapna Nagar (NU-4) , Gandhidham (Sr no -31)	Shri RAVI MAHESHWARI, DPT	Land belongs to DPT earmarked for recreational purpose. (Total Cost –Rs**88.75 Lakhs**)
39	CSR works for NariJanshsktiVikas Foundation at Gandhidham near Shakti Nagar. (Sr no-33)	NariJanshsktiVikas Foundation, Ahmedabad	➢ Promoting gender equality and empowering women ➢ Env Sustainability ➢ Under promotion of education (Consider for Computers with printers, Sewing machine & RO plant**Cost Rs 48 Lakhs**)

Annexure -G

DEENDAYAL PORT AUTHORITY

Administrative Office Building
Post Box NO. 50
GANDHIDHAM (Kutch).
Gujarat: 370 201.
Fax: (02836) 220050
Ph.: (02836) 220038

www.deendayalport.gov.in

NO.EG/WK/4751/Part (Greenbelt-GUIDE) 196 Dated : 31/5/2022

M/S Gujarat Institute of Desert Ecology,
P.O.Box No. 83,
Opp. Changleshwar Temple, Mundra Road,
Bhuj (Kachchh)- 370 001,Gujarat (India).
Tel.: 02832-329408, 235025.
Tele/Fax: 02832-235027
Email: desert_ecology@yahoo.com

Kind Attn.: Dr.V.Vijay Kumar, Director, M/s GUIDE, Bhuj.

Sub: Greenbelt Development in Deendayal Port Authority and its Surrounding Areas Charcoal site (Phase-I).

Ref.: M/s GUIDE, Bhuj offer vide letter no. M/s GUIDE, Bhuj vide communication no. GUIDE/DPA/GRN/080/2022-23 dated 24/5/2022.

Sir,

Your offer for the subject work submitted vide above referred letter dated 24/5/2022 amounting to Rs. 38,22,900.00 + applicable GST (Rupees Thirty-Eight Lakhs Twenty-Two Thousand and Nine Hundred Only Plus Eighteen Percent GST), with all terms & conditions mentioned in the offer letter, has been accepted **(Copy of offer letter M/s GUIDE attached)**.

2. Scope of work:

Development of Greenbelt in Charcoal site – Kandla, DPA and its surrounding areas. The activities under the Greenbelt Development include; inventory of suitable sites for greenbelt development in DPA, soil & Moisture conservation and management at Plantation sites, selection of suitable species of Plants for plantation, Procurement and plantation of plant saplings and seeds (5000 plants), along with management and monitoring of plantation, including drip/tanker water supply for a period 1 year.

.....Cont.....

3. Obligation of Deendayal Port Authority :

- Assistance regarding the statutory clearance from authorities concerned to be rendered by DPA for field visits/plantation activities.

4. The Terms of Payment:

1. 50% of the project budget to be paid to GUIDE within 15 days from the date of acceptance of Work order by GUIDE.
2. 20% of the project budget to be paid to GUIDE within 15 days from the date of completion of plantation works.
3. 20% of the project budget to be paid to GUIDE within 15 days from the date of submission Progress Report (December 2022).
4. 10% of the project budget to be paid to GUIDE within 15 days from the date of submission of Final Completion Report (May 2023).

5. Time Period : One year (from 5/6/2022 to 4/6/2023).

6. Kindly send the acceptance of this work order & start the work w.e.f. 5/6/2022 .

Thanking you.

Yours faithfully,

Superintending Engineer (PL) & EMC (I/c)
Deendayal Port Authority

Copy To :1) A.O.(W/A) - The proposal has been approved by the Board in its meeting held on 27/5/2022.

The expenditure shall be charged to the scheme Environmental Services & Clearance thereof (Allocation: 841/587/9744 WC – 5-13001).

2) TPA to CE for kind information of the Chief Engineer, please.

3) DA (PL) for further necessary action.

4) M/s Precitech Laboratorie ,Vapi, Environmental Management Cell to coordinate with M/s GUIDE,Bhuj.

5) RAO, DPA

Annexure -H

DEENDAYAL PORT TRUST

Office of the Chief Engineer
A.O. Building,
Gandhidham (Kutch)

No.EG/WK/4751/Part 243(B)

Dated : 03/09/2019

CIRCULAR

The Ministry of Environment, Forest & Climate Change, GoI vide G.S.R. 317 (E) dated 29/3/2016 had issued Notification to address in detail the management of Construction & Demolition Waste. In order to implement the said rules issued by the MoEF&CC,GoI in the Deendayal Port Trust, following instructions may kindly be followed:

- Proper management of Construction & demolition waste in accordance with the provisions of Construction and Demolition of Waste Management Rules, 2016.
- Records of generation and disposal of the waste is required to be maintained by the contractor/Lessees at source.
- All trucks before leaving the storage yards shall be covered with tarpaulin and not over loaded as well as there shall not be spillage during transportation.
- Appropriate containers shall be placed for collection of waste, removal at regular intervals, transportation to appropriate sites for processing and disposal.

This is issued with the approval of Competent Authority in DPT.

Chief Engineer
Deendayal Port Trust

1. All HoD's – For information and necessary action
2. Sr. PS to Chairman – For kind information of Chairman
3. PS to Dy. Chairman – For kind information of Dy. Chairman

Annexure -I

DEENDAYAL PORT TRUST

DETAILS OF MANGROVE PLANTATION ALREDY CARRIED OUT & Proposed To be Carried Out :

Sr. No.	Name of the Organization	Total Mangrove Plantation carried out in Hectares till date and place of plantation and agency	Cost incurred
	(A) MANGROVE PLANTATION ALREDY CARRIED OUT		
1	DEENDAYAL PORT TRUST (CRZ Recommendation 13th to 16th CB issued by the GCZMA) (Total 1000 ha.)	20 Hectares – 2005-06 Satsida Bet,Kandla, by GUIDE,Bhuj 50 Hectares – 2008-09 Nakti Creek,Kandla by Patel Construction 100 Hectares – 2010-11 Nakti Creek ,Kandla by GEC. (Board 29/1/2010) 200 Hectares – 2011-12 by Forest Department, GoG at Satsaida Bet 300 Hectares – 2012-13 by Forest Department, GoG at Satsaida Bet 330 Hectares – 2013-14 by Forest Department, GoG at Satsaida Bet **TOTAL 1000 HA.**	Rs. 8.8 lakhs Rs. 27.4 lakhs Rs.24.5 lakhs Rs. 66.5 lakhs Rs. 157.5 lakhs (total 630 hectares)
2	Creation of Berthing & allied Facilities off- tekra near Tuna (Outside Kandla Creek) – EC & CRZ Clearance. (Total 500 ha. – 250Ha. by DPT & 250 ha by Adani (concessionaire) MOU signed with GEC during Vibrant Gujarat Summit 2015 for 300 Ha.	300 Hectares – 2015-17 by GEC at Kantiyajal, Bharuch District	Rs. 90.0 lakhs
3.	EC & CRZ Clearance dated 19/12/2016 for Developing 7 integrated facilities (Condition 100 Ha)	100 Ha. –2018- 20 by GEC	Rs. 45 lakhs
TOTAL MANGROVE Plantation till date by DPT 1400 Ha. – Total 419.7 lakhs			

	(B) Proposed Mangrove Plantation		
1.	Development of Integrated facilities (Stage-II) within the existing Deendayal Port Trust (Erstwhile Kandla Port Trust) at District Kutch, Gujarat. (1. Setting up of Oil Jetty No.7 ; 2. Setting up of Barge jetty at Jafarwadi ; 3. Setting up of Barge port at Veera; 4. Administrative office building at Tuna Tekra; 5. Road connecting from Veera barge jetty to Tuna gate by M/s Deendayal Port Trust (Erstwhile : Kandla Port Trust) - Environmental & CRZ Clearance accorded by the MoEF&CC,GoI dated 19/12/2020.	**50 Ha. as per CRZ Recommendation issued by the GCZMA dated 29/6/2016.**	Rs. 45 lakhs
2.	Development of 3 Remaining Integrated Facilities (stage I) within the existing Deendayal Port Trust (Erstwhile : Kandla Port Trust) at Gandhidham, Kutch, Gujarat - Environmental & CRZ Clearance accorded by the MoEF&CC,GoI dated 18/2/2020.	**50 Ha. as per CRZ Recommendation issued by the GCZMA dated 29/6/2016. .**	

Annexure -J

DEENDAYAL PORT AUTHORITY

(Erstwhile Deendayal Port Trust)

Ministry of Ports, Shipping & Waterways, Govt. of India

Mech. Engg. Deptt.

Tel: (02836)220636 / 270184
FAX: (02836) 270184 / 270475
Email :- cmedpt @gmail.com
cme@deendayalport.gov.in

Office of the Chief Mechanical Engineer,
Port & Customs Building,
New Kandla (Kutch), Gujarat-370210

No. DD/WK/3050/Pt-I/ GIM | Pt-44 Date: 02.06.2022

Sir,

To,
Gujarat Ecology Commission
Forest & Environment Department
Block No. 18, First Floor, Udhyog Bhavan,
Gandhinagar, Gujarat

Sub: Work Order to carry out Mangrove Plantation-reg.

The Competent Authority, Deendayal Port Authority has been pleased to approve:

1. To carry out mangrove plantation in 100 Ha. area with consultation of concern Gujarat Ecology Commission and at tentative estimated cost amounting to Rs. 50,00,000/- (excluding GST) for the said mangrove Plantation to be carried out in an area of 100 Ha. as per the stages mentioned by them in the MoU as follows:

Sr. No.	Terms and Condition	Rs. (in lakhs)
1	50% of the project cost of 100 Ha. Mangrove Plantation after singing the MoU.	**Rs. 25.00**
2	40% of the project cost of 100 Ha Mangrove Plantation after nursery preparation.	**Rs. 20.00**
3	10% of the project cost of 100 Ha Mangrove Plantation after plantation and submission of First year progress report.	**Rs. 5.00**
	Total	**50.00**

2. To sign MoU with the Gujarat Ecology Commission, Government of Gujarat during the ensuing Vibrant Gujarat Summit 2022, regarding proposed Mangrove Plantation to be carried out in an area of 100 Hectares through the Gujarat Ecology Commission.
3. To authorize Dy. CME & CME (I/c) to sign MoU with the Gujarat Ecology Commission, Government of Gujarat during upcoming Vibrant Gujarat Summit 2022 for proposed Mangrove Plantation in an area of 100 Hectares through GEC.

The Expenditure shall be chargeable under Code 841/587/9744 WC-13001

Authority: Approved by Board vide Resolution No. 30 in the board meeting held on 27.05.2022

Chief Mechanical Engineer(I/c)
Deendayal Port Authority

Copy to:
1) SE(M)
2) A.O. (Works Audit)

Annexure -K

SHORELINE CHANGE STUDY

(DURING THE PERIOD 2009–2021) FOR DEENDAYAL PORT AUTHORITY, KANDLA, KACHCHH DISTRICT, GUJARAT.

Submitted to

Deendayal Port Authority,
Kandla, Kachchh District, Gujarat.

National Centre for Sustainable Coastal Management
Ministry of Environment, Forest and Climate Change
GOVERNMENT OF INDIA

SHORELINE CHANGE STUDY

(DURING THE PERIOD 2009–2021)
FOR DEENDAYAL PORT AUTHORITY, KANDLA, KACHCHH DISTRICT, GUJARAT.

Submitted to

Deendayal Port Authority,
Kandla, Kachchh District, Gujarat.

National Centre for Sustainable Coastal Management
Ministry of Environment, Forest and Climate Change
GOVERNMENT OF INDIA

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Figure 10: Zone 3 - Shoreline change map from Kandla creek to Hansthal creek 15

1 Introduction

Deendayal port authority also known as Kandla port is in Gandhidham, Kachchh district, Gujarat was constructed in 1950s is the chief seaport for serving western India. This being the first export processing zone and largest port in India has handled million tonnes of cargo. It is India's hub for exporting petroleum, chemicals, Iron and steel, grains and oil in the country. The study area is located at 23° 01¨ N latitude, 70° 13¨ E longitude situated in the Kandla creek and is 90 kms from the mouth of Gulf of Kachchch. Due to the development of various facilities in the port, dredging of dumping materials is proposed for maintenance of the port. Thus, Deendayal port has proposed 3 dumping sites, designated at i) 70° 10' 00" E, 22° 51' 00" N ii) 70° 13' 28" E, 23° 04' 28" N – Phang creek iii) 70° 13' 00" E, 22° 56' 31" N – shore channel. Any alteration in these study sites would change the shoreline morphology of the coast. This may eventually lead to coastal erosion and accretion at several sites. Therefore, it is necessary to study site specific short term shoreline change rate which will be estimated using satellite images for the year 2009-2021.

2 Data used and Methodology

Short-term shoreline change for the study is based on the analysis of five satellite images for the period between 2009 to 2021 respectively shown in **Table 1**.

Table 1: Data source for extraction of shoreline

Year of Pass	Satellite	Resolution
2009	Worldview/GeoEye/ Cartsosat PAN	2 m 2.5 m
2012	Aerial photo	9 cm GSD
2016	LISS IV	5 m
2019	WorldView3 / Sentinel	2 m 10 m
2021	Cartosat 2 series/3 MX LISS IV	2 m 5 m

The following figure 1 describes the flow diagram of shoreline change analysis.

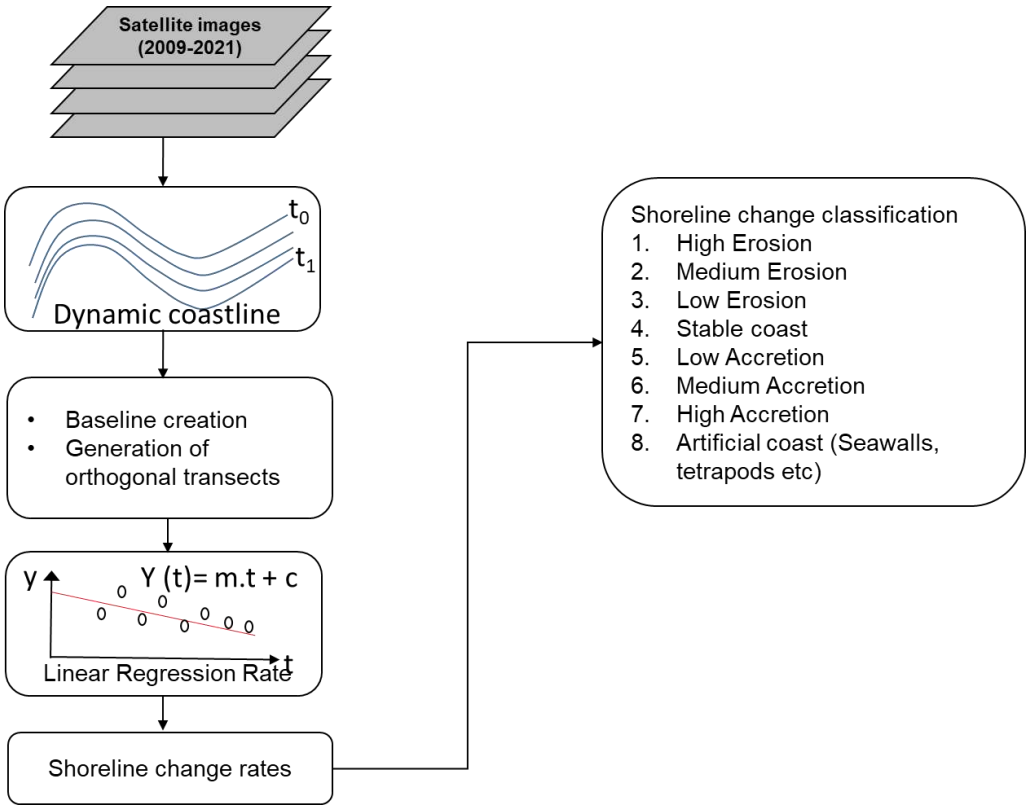

Figure 1: Workflow diagram for Shoreline change rate analysis

3 Pre-processing of Satellite Images

Extraction of shoreline positions from these data sources involves georeferencing of satellite images using aerial photos and subsequently digital image classification of shoreline positions. Rigorous geometric correction of the satellite images is done for the following systematic and non-systematic errors. Systematic errors are corrected through analysis of system characteristics and ephemeris such as scan skew, mirror-scan velocity variance, panoramic distortion, platform velocity, and earth rotation. Non-systematic errors are mainly corrected for variation in altitude and sensor platform attitude using Ground Control Points (GCPs) (Jensen, 1996). Rectification of Satellite images involves georeferencing process i.e. process of assigning map coordinates to image data. In this study image-to-image, registration was applied to rectify satellite images using orthophotos as reference image in ERDAS Imagine software. Georeferencing of all satellite images using orthophotos i.e to a common coordinate system is necessary in order to compare the historical images for analyzing the shoreline change rates of the entire Indian coast. The following steps were adopted for georeferencing the satellite images using orthophotos.

- Acquisition of images and preprocessing of metadata
- Acquisition of Ground Control Points (GCPs) in Image coordinates and map coordinates i.e for X, Y pairs.

- Computation of unknown parameters of mathematical functions used for the geometric correction model for the set of satellite images.
- Resampling technique used for image rectification.

4 Shoreline Extraction

The next step is to extract shoreline position from these georeferenced satellite images Shoreline indicators were used to identify the morphological features and non-morphological features using satellite images for the years 2009, 2012, 2016, 2019 and 2021.

4.1 Shoreline Indicator

Because of its dynamic nature of the idealized shoreline boundary, practically shoreline indicators are adopted in defining the boundary. A shoreline indicator is a feature used as a proxy (fig.1) to represent the true shoreline position (Boak et al, 2005). In this study different shoreline indicators were adopted based on morphological and non-morphological features: i) Morphological features include vegetation line, berm crest, and cliff toe ii) non-morphological features include wet/dry line, high water line and iii) Man-made Structures such as seawalls These are selected based on location, data source, and scientific preference used to analyse the shoreline change, (Hapke et al, 2010). Extraction of shoreline indicators have been processed through various image processing techniques.

4.2 Shoreline Proxies

Visual image interpretation technique for delineating shoreline was adopted manually for identifying the feature. Image interpretation is carried out using elements of visual interpretation techniques such as tone, size, shape, texture, pattern, colour and association. Using these elements, identified features like berm line, dune vegetation line, swash line, base of bluff/cliff, high water line, seawall and salt pan on the satellite images were mapped.

a) **Berm crest:** This is the nearly horizontal portion of the beach or backshore formed by the deposit of materials by wave action at the time of high tide. Some beaches have no berms; others have one or several. In the case of multiple berms, the most landward crest of the berm was chosen in the case of wide sandy beaches.

b) **Beach cusp:** The beach cusp is a crescent-shaped followed by accumulation of sand surrounding a semicircular depression on a beach. They are formed by swash action and the spacing of the cusps is related to the horizontal

extent of the swash motion. Coarser sediments are found on the steep-gradient, seaward pointing ‘cusp horns’.

c) **Dune Vegetation line**: Coastal sand dunes are ridges or a series of ridges that form at the rear of the beach. The toe of the foreshore face of the dune is considered as shoreline.

d) **High water line**: High water line (HWL) is considered as the best shoreline indicator by many researchers, because they mark the effective shoreline and is equivalent to "wet/dry line". HWL is the previous tide which is clearly identifiable from all images and is found most appropriate to analyse the shoreline changes.

e) **Onshore structures**: Visual image interpretation technique is used to identify Coastal engineering structures such as seawalls, embankments, fence line were identified from high resolution satellite images and aerial photos. Seawall towards landward was consider for shoreline mapping, so that major significant change in long and short term rates was computed.

5 Digital Shoreline System Analysis (DSAS) model

Multiple shorelines extracted from satellite images were used to calculate shoreline change rates using Digital Shoreline Analysis System (DSAS) model developed by United States Geological Survey (USGS) in an ArcGIS environment (Thieler and other, 2009). DSAS employs the single-transect method (ST) to calculate change rates and rate uncertainties at regularly spaced transects (measurement locations) alongshore. ST uses various methods (for example, end point rate, least squares, weighted least squares) to fit a trend line to the time series of historical shoreline positions at a transect. ST is the most commonly utilized method for calculating shoreline change (for example, see Fletcher and others, 2003; Morton and others, 2004; Morton and Miller, 2005; Hapke and others, 2006; Hapke and Reid, 2007).

To calculate the rate of change, statistical baselines were constructed on the landward side at a distance of ~100 m adjacent to the series of shoreline positions. Transects were spaced approximately at 100m intervals alongshore, roughly perpendicular to the trend of the shoreline. Rates of short-term (12 years) shoreline change were calculated using the linear regression method included in the Digital Shoreline Analysis

6 Computation Rates of erosion/ accretion using Linear Regression Rate (m/yr)

In this study, Linear Regression Rate (LRR) will be used for expressing the rate of change since it includes all the available time-series shorelines. A linear regression rate-of-change statistic was determined by fitting a least-squares regression line to all shoreline points for a particular transects. The regression line is placed so that the sum of the squared residuals (determined by squaring the offset distance of each data point from the regression line and adding the squared residuals together) is minimized. The linear regression rate is the slope of the line. The method of linear regression includes these features: 1) All the data are used, regardless of changes in trend or accuracy, 2) The method is purely computational, 3) The calculation is based on accepted statistical concepts, and 4) The method is easy to employ. Shorelines were not delineated nor change rates calculated for ports, breakwaters, groynes, seawalls, river deltas because of the high natural variability and complexity of these shoreline reaches.

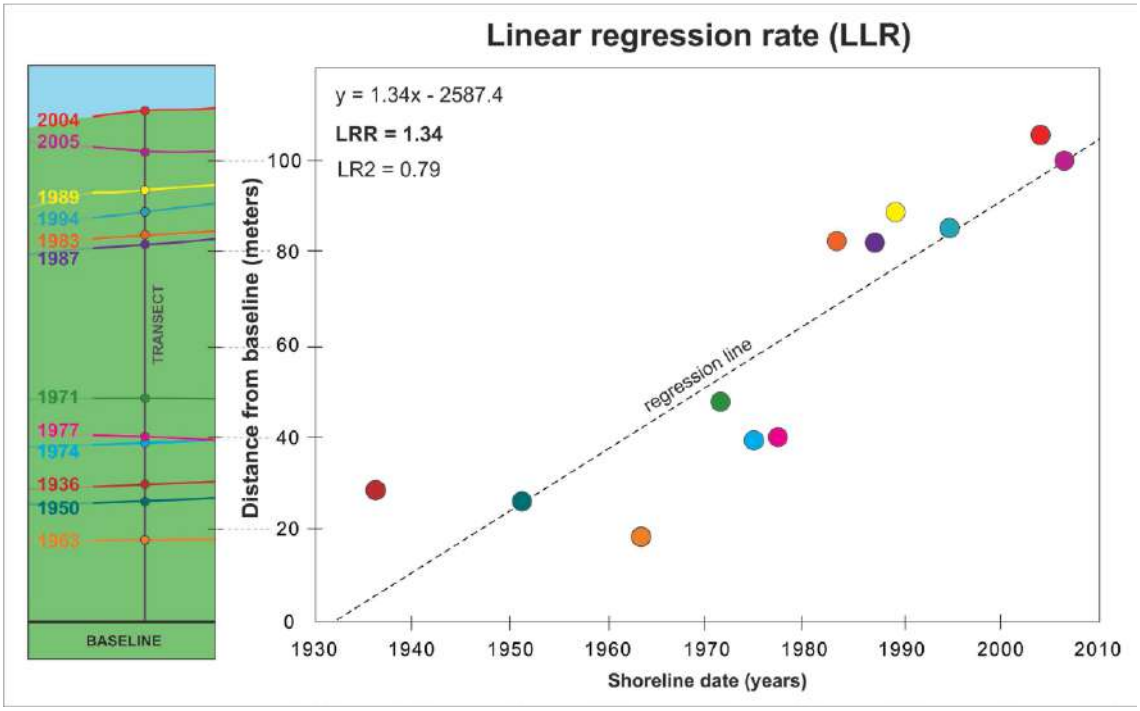

Figure 2: Shoreline position graph plot of the Linear Regression Rate transect (Source: Himmelstoss et al., 2018)

These shoreline change rates have been categorized into eight classes as erosion (high, medium and low erosion) and accretion (high, medium and low accretion), stable and artificial coast as shown in **Table 2.**

Table 2: Classification of Shoreline Change Rates

Categories	Rate of Erosion/Accretion (m/yr)
High Erosion	>= -5
Medium Erosion	-2 to -5
Low Erosion	-0.5 to -2
Stable Coast	-0.5 to 0.5
Low Accretion	0.5 to 2
Medium Accretion	2 to 5
High Accretion	>= 5
Artificial coast	*Presence of boulders, tetrapods, and other shore protection structures along the coast*

7 Results

The shoreline change analyzed for Deendayal port authority is about 150km in length. The high resolution satellite images reveal that the coast is now dominated by accretion. The coast experiences 20% erosion, 34% stable coast and remaining 46% accretion. Based on LRR calculations the coast is classified into 7 categories and out of 150 km, high erosion is occupied by 12 km (7.6%), medium erosion by 7 km (5%), low erosion by 10 km (7%). Almost 51 km of the coast showed no change. While, 50 km of the coast has high accretion, 11 km has medium accretion and 8 km has low accretion shown in **Table 3**.

Figure 3 depicts that i) the western region of the study is predominantly accreting while southern side of the Tuna jetty has high erosion. ii) mouth of Nakti creek has erosion for a stretch of about 5 km may be due to the river mouth dynamics. iii) about 4.4 km of the coast has erosion at the mouth of Kandla creek while the coast inside the creek and near Deendayal port has accretion and stable. iv) south of Hansthal creek has erosion for about 5 km. Thus the coast is less affected by erosion due to natural activities.

Table 3: Shoreline change statistics for Deendayal port (2009-2021)

Shoreline Classification	Length (km)	% of Erosion and Accretion	Cumulative % of Erosion and Accretion
Length of Coastline (km)	149.80		
High Erosion	12.37	8.26	
Medium Erosion	7.17	4.78	
Low Erosion Zone	10.28	6.86	19.91
Stable Coast	50.92	33.99	33.99

Shoreline Classification	Length (km)	% of Erosion and Accretion	Cumulative % of Erosion and Accretion
High Accretion	49.80	33.25	
Medium Accretion	11.48	7.66	
Low Accretion	7.77	5.19	46.10

The shoreline of this region is divided into 3 regions:

- Region1: Chela Nadi to South of Nakti Creek
- Region2: North of Nakti creek to South of Kandla creek
- Region3: North of Kandla creek to South of Hansthal creek

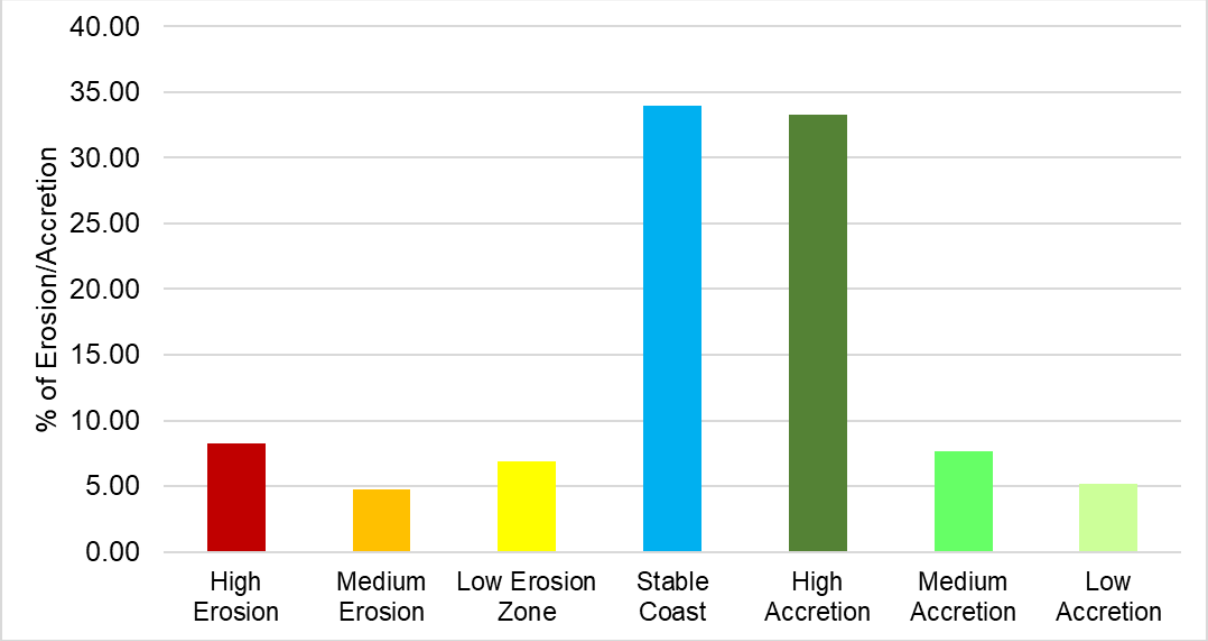

Figure 3: Percentage of erosion/accretion for the study area

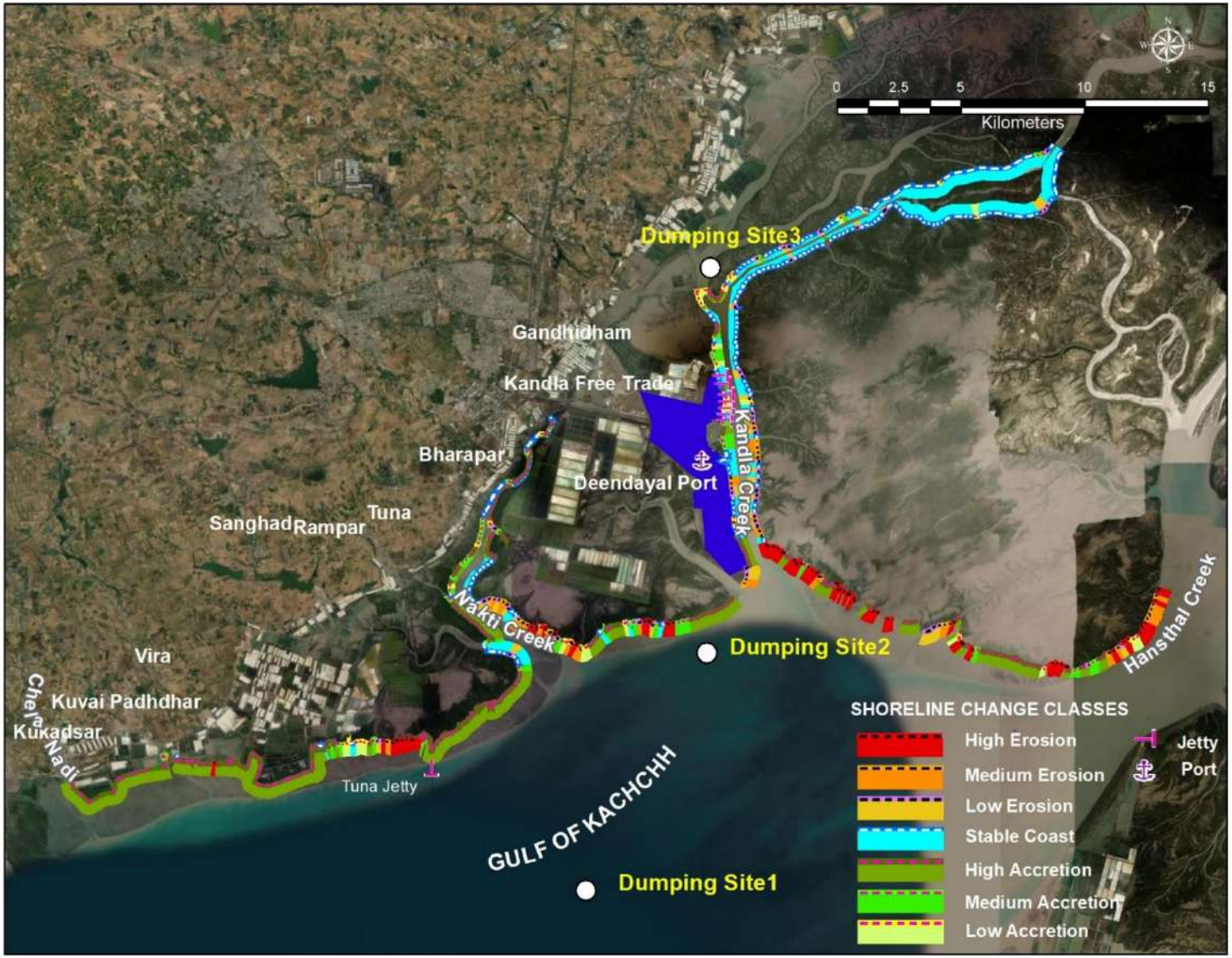

Figure 4: Shoreline change map in and around Deendayal Port Authority

I) From Chela Nadi to South of Nakti Creek:

This region has a shoreline length of about 45 km bounded by salt pan, mangroves and creeks. This area is dominated by accretion and has an average rate of 24 m/yr. Around 67% has high accretion, 11% medium accretion, 4% low accretion, 12% stable coast, 1% low erosion and 4% high erosion. Small patches of high erosion for a length of 2.5 km is found in the southern side of Tuna Jetty shown in Figure. And the rate of change were generally high along this region (ranges from -15 m/yr to -5 m/yr). This may be due to the construction of jetty that has deprived the sediment movement in the southern portion of jetty that has caused erosion in the southern side.

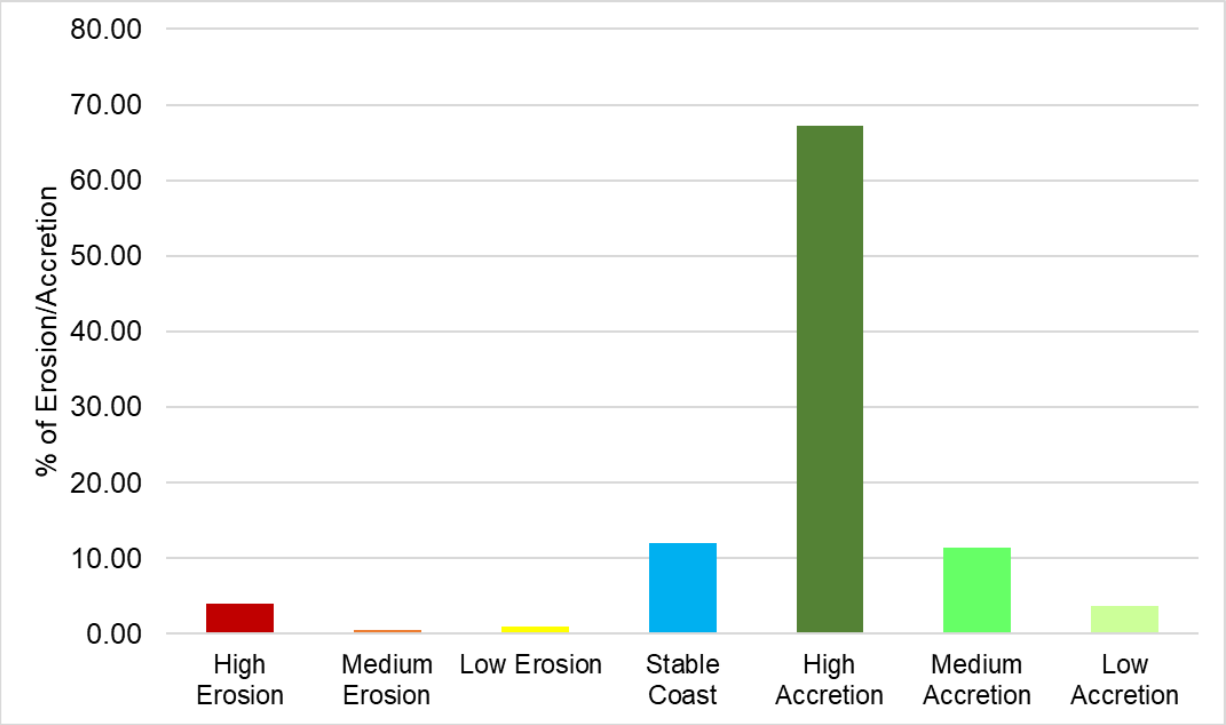

Figure 5: Percentage of erosion/accretion for the study area

Figure 6: Zone1: Shoreline change map from Chela Nadi to Nakti creek

II) North of Nakti Creek to South of Kandla creek:

This region has shoreline length of about 56 km and average accretion rate of 3.35 m/yr. Percentage of shoreline change shows 22% of high accretion, 9% medium and low accretion, 7% medium erosion, 6% low erosion and 4% high erosion. In this portion northern side of the Kandla creek shows patches of erosion due to inadequate supply of sediment from the creek towards the northern direction. High erosion is especially noticed in the mouth of the creek because of the high natural variability of these shoreline reaches. Rate of high erosion along the creek ranges from -10 m/yr to -5 m/yr that is associated with the migration of inlets

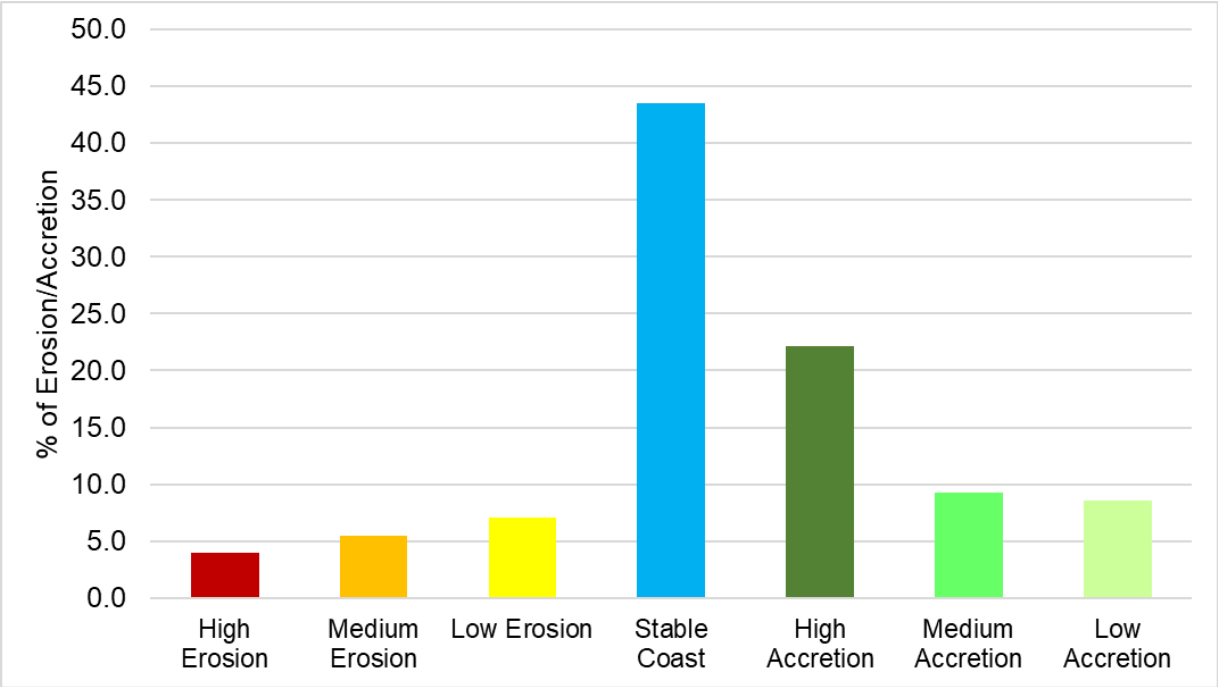

Figure 7: Percentage of erosion/accretion for the study area

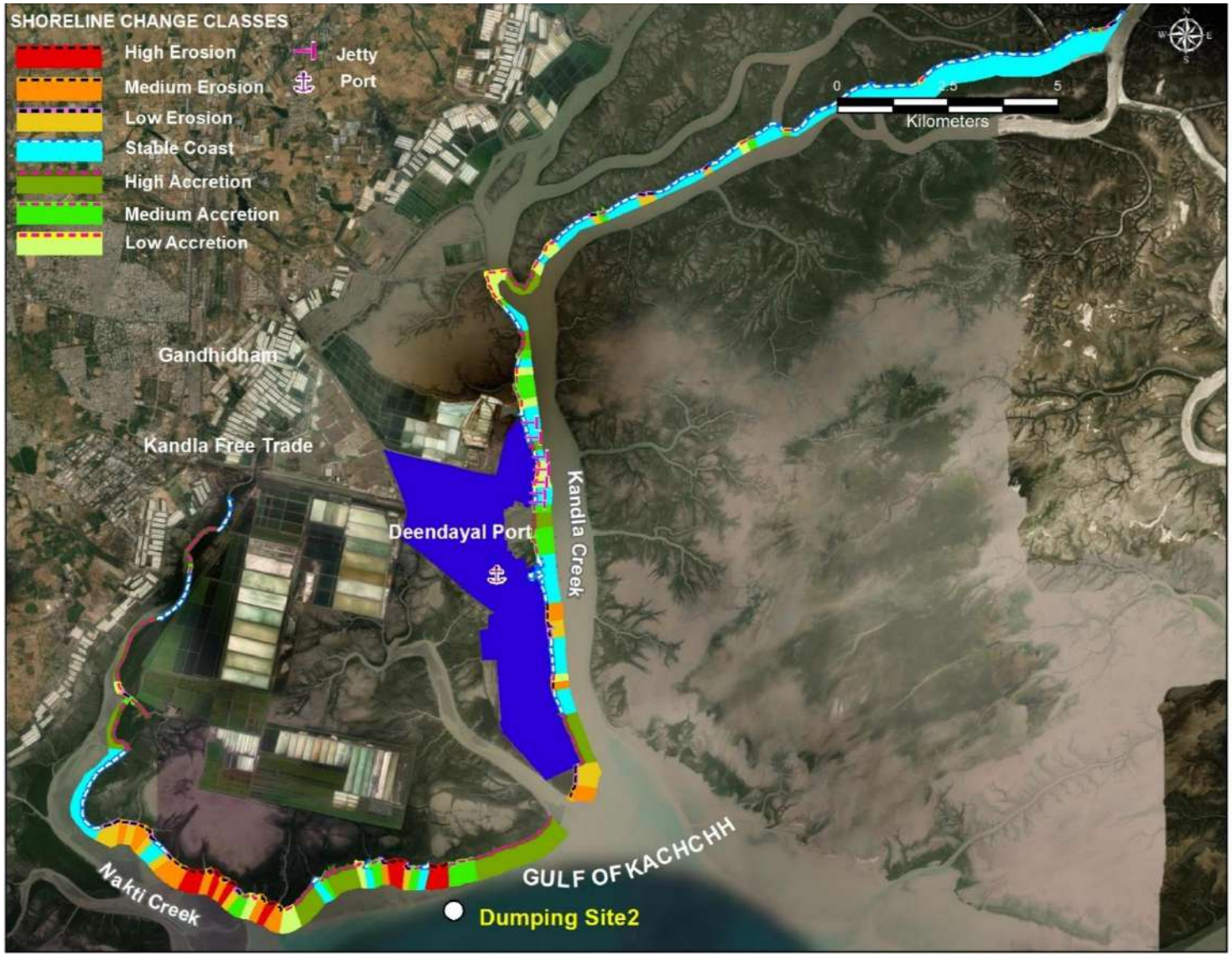

Figure 8: Zone 2 - Shoreline change map from Nakti creek to Kandla creek

III) North of Kandla creek to South of Hansthal creek:

This stretch of coast has a length of about 49 km and average erosion rate of -1.06 m/yr. This shoreline has 16% high accretion, 3% medium and low accretion, 43% stable coast, 12% low erosion, 8% medium erosion and 15% high erosion. This region is more erosion compared to other two zones and the rate of change varies significantly from -30 m/yr to -5 m/yr. Moreover, geomorphology of the coast is characterized by mudflat and there are only sparse mangrove patches found in this region. Hence this may be attributed to the natural effect of sediment variability along the river mouth and also due to tidal effect that are detrimental to the growth of the mangrove canopy.

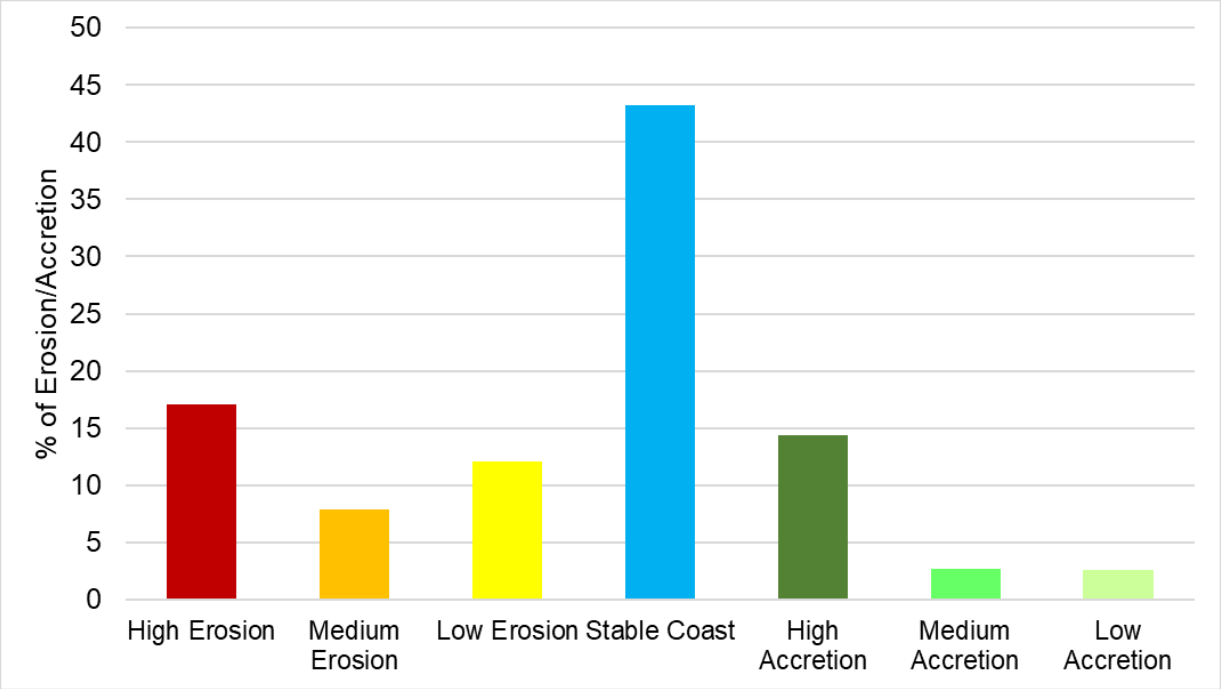

Figure 9: Percentage of erosion/accretion for the study area

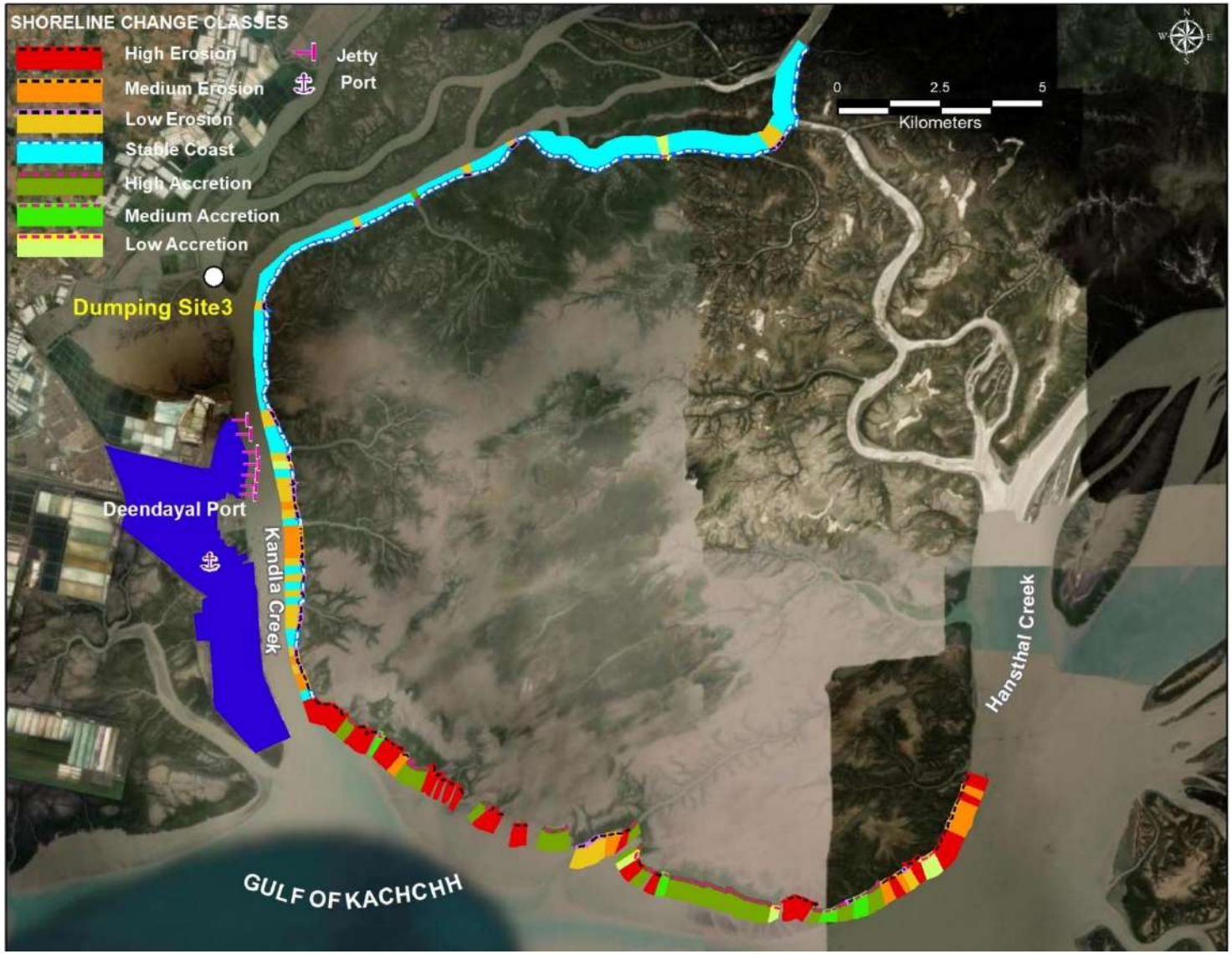

Figure 10: Zone 3 - Shoreline change map from Kandla creek to Hansthal creek

8 References

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Annexure -L

DEENDAYAL PORT TRUST

QHSE Policy

(Quality, Health, Safety & Environment Policy)

The Deendayal Port Trust, India's NO.1 Major Port strongly believes that Health, Safety, Environment & Quality is an integral part of our working culture and are core value for us.

We are strongly committed to maintain safe and healthy working environment for DPT employees, Port users, Customers & other stakeholders in port with the best quality of service as a port.

To achieve this target, DPT has set the following strategic o

* Minimize the adverse Environmental Impacts for sustainab port
* No Occupational injuries or Diseases
* No damage to property due to Fire and Explosion
* Ensure quality services

To achieve these objectives, the Deendayal Port is highly committed to follow the below actions :

* Comply with applicable laws and regulations related to port.
* Seek opportunities, beyond compliance requirements to prevent occupational injuries and diseases, reducing the risk to the environment and safety.
* Ensure protection of environment, protect biodiversity, ecosystem and mitigate the climate changes issues, with special focus on coastal environment. Adopt latest technology and training for protection of environment. Implement appropriate environmental monitoring programs to ensure that activities are not impacting negatively on environment.
* Conserve the natural resources and energy by adopting green energy initiatives, efficiency improvement and reduction & recycling of wastes.
* Ensure active participation and consultation of all stake holders for continual improvement to achieve QHSE objectives.
* To adopt best national and international practices, innovative ideas and technologies to sustain the No.1 major port position by best performance and customer satisfaction.

Place: KANDLA

Date: 11-03-2021

Shri S. K. Mehta, IFS

Chairman-Deendayal Port Trust

Annexure -M

DEENDAYAL PORT TRUST

Administrative Office Building
Post Box NO. 50
GANDHIDHAM (Kutch).
Gujarat: 370 201.
Fax: (02836) 220050
Ph.: (02836) 220038

www.deendayalport.gov.in

NO.EG/WK/4783/V/131 Dated : 05/02/2021

To,
M/s Precitech Laboratories Pvt Ltd,
1st Floor, Bhanujyot Complex,
Plot No C5/27, B/h Panchratna Complex,
Nr. GIDC Char Rasta,
VAPI-396195.

Sub: **Work order** for "STRENGTHENING OF EXISTING ENVIRONMENTAL MANAGEMENT CELL AT DEENDAYAL PORT TRUST: Appointment of environment experts for two years further extendable for one year"-**reg**.

Ref: 1) Tender dated 21.06.2019 submitted by M/s Precitech Laboratories Pvt.Ltd, Vapi.
2) Letter of Acceptance vide no-EG/WK/4783/V/100 dtd 01(04).01.2021
3) Letter from DPT no E/WK/4783/V/103 dtd 06.01.2021
4) Performance Guarantee submitted by M/s Precitech Laboratories Pvt Ltd in the form of Bank Guarantee of Rs. 3,60,000.00 vide Bank Guarantee no. 1102921BG0000016 dated 19.01.2021 issued by State Bank of India, Vapi.

Sir,

Kindly refer above cited Letter of Acceptance dtd 01(04).01.2021.

2) You shall have to provide Key Experts as per tender requirement during the entire contract period. Accordingly, you shall have to submit the qualification and experience certificates of the Key experts to be appointed at DPT, as per tender conditions for verification & approval.

3) Please submit the Agreement of contract as per tender conditions no 1.29.

4) Kindly commence the work on or before 15.02.2021.

……Cont……..

Please note that the time period for providing Consultancy services for the subject work will be initially for two years and further extendable for one year on mutual consent as per tender conditions.

Thanking you.

Yours faithfully,

Superintending Engineer (Design & EMC (i/c))
Deendayal Port Trust

Annexure -N

DEENDAYAL PORT TRUST

ISO 9001 : 2008 ; ISO 14001 : 2004

Ph. : 02836-220167
Fax: 02836-233172
website: deendayalport.gov.in
e-mail : secretary@deendayalportgov.in

General Administration Deptt.
Administrative Office Building,
Post Box No. 50,
Gandhidham (Kutch) 370 201

By Speed Post / E-mail

No. GA/PS/4292/HE(PF)/2017/ 304 Dated, 17 January, 2022

OFFER OF CONTRACTUAL ENGAGEMENT AS MANAGER(ENVIRONMENT), IN DEENDAYAL PORT TRUST.

With Reference to your application for contractual engagement as Manager – Environment, in response to the advertisement, inviting applications for the subject position, on assessment and interview before the Services Selection Committee on 06.01.2022, the Competent authority has been pleased to offer the contractual engagement as Manager (Environment) in Deendayal Port Trust, purely on contractual basis, subject to the following terms and conditions :

a) Roles & Responsibilities

- Develop, implement and manage long term port environmental programmes such as the Green Marine Programme, sustainability plan, air strategies, tenant environment plan and tenant lease management.
- Represent the Port in local, state and federal agency meetings.
- Assist in the development and updating of the Port's comprehensive scheme of Harbour improvements and strategic plan.
- Monitor and conduct regular mock drills to train the employees at different levels.

b) Remuneration :-

Your consolidated remuneration per month will be Rs.1,00,000/- (Rupees One Lakh Only). Suitable increase depending upon the performance and variation in the AICP index may be given after successful completion of yearly service. Applicable taxes will be deducted at the time of payment.

c) Period of Contract :

The contract will be for a period of 3 years, extendable by another two years, subject to satisfactory performance.

d) Duty Hours :

You may be posted at/under any department/authority of Deendayal Port Trust, as per requirement, Duty Hours are from 10.00 AM to 06.00 PM or as may be decided by the Administration from time to time. In case of requirement, you may have to work beyond the normal duty hours, for which no other compensation, monetary or otherwise will be considered.

Contd....

.....

(Mukkannawar Utkarsh Suresh)

You will normally be entitled to a weekly off on Sunday. If situation warrants, the weekly day of rest may be changed with prior intimation. For work on any weekly day off / declared national holiday in exigencies of work, a compensatory day of rest as per the convenience of the Administration, in lieu thereof, will be granted and for which no other compensation, monetary or otherwise will be considered.

Failure to report for duty will entail deduction of wages on pro-rata basis.

e) Medical facility : Only Outdoor Medical treatment facility for self and your spouse will be provided in the Port Trust Hospital. No other medical facilities will be provided to you/ your family.

f) Leave entitlement : 10 days leave in a year and National Holidays will be given. No other leave will be admissible and for any absence beyond the said leave, pro-rata deduction will be made from the consolidated remuneration.

g) Accommodation : Suitable accommodation, if available, may be provided, subject to recovery of charges under FR-45A, and the element of HRA excluded from the lumpsum remuneration.

h) Your engagement on contractual basis is subject to strict adherence to the norms and conduct.

i) The engagement can be terminated by giving one month's notice in writing from either side. However, in case of unsatisfactory performance or for any act considered derogatory/ detrimental to the interest of Deendayal Port Trust, this contractual engagement will be terminated forthwith.

j) If you leave without notice or without acceptance of notice of termination, the amount due i.e., consolidated remuneration payable will be forfeited.

k) You shall not claim any right/title/interest on par with the regular employees of the Port or otherwise.

l) You shall not have any claim/right whatsoever for regular appointment / absorption in Deendayal Port Trust under any circumstances.

m) Your contractual engagement is subject to verification of antecedents by the police. If any adverse report is received from the Police, your contractual services are liable to be terminated forthwith.

n) You will not be permitted to take any other assignment during the period of contract with Deendayal Port Trust.

Contd....

.....

(Mukkannawar Utkarsh Suresh)

l) On official tour outside Head Quarters, you will be entitled to TA/DA as admissible under the rules.

m) The terms and conditions shall be amended / modified depending upon the requirement of the Port. Any dispute(s)/difference(s) shall be decided solely by the Chairman, Deendayal Port Trust, which shall be final and binding.

n) You are required to submit discharge letter / relieving letter from your present employer at the time of joining Deendayal Port Trust, without you may not be allowed to join.

o) The contractual engagement is subject to your being found medically fit as per the requirements of Deendayal Port Trust.

2. You have to report for medical examination before the Medical Board of DPT at Gopalpuri Hospital on any working day between 10.00 hrs to 12.00 hrs.

3. If you agree to the above terms and conditions, you may convey acceptance by signing the duplicate of the letter in token of your acceptance and submit the same to this office and call at this office with all certificates and two copies of passport size photographs latest by 27th January, 2022 failing which the offer of contractual engagement stands automatically cancelled.

Secretary
Deendayal Port Trust

To
Shri. Mukkanawar Utkarsh Suresh,
21/1, Madhukunj Housing Society,
Near Canara Bank, Panchavati,
Pashan, Pune, Maharashtra – 411008.
Email : utkaish@gmail.com

I accept the above terms and conditions and will report for duty on _____.

Name :

Date :

Copy to: CMO – for conducting Medical Examination.

Annexure -O

NOTICES

NOTICE TO CONSIGNEES

HAMBURG SÜD

M.V.MAERSK BENTONVILLE 046I

IGM No. 2268132 dated 24.11.2020 Vessel Exch. Rate USD 1 = INR 75.33

The above vessel has arrived at MUNDRA on 26.11.2020 with following ICD/Transshipment/Local import cargo. Consignees are requested to kindly note the item nos filed against their bill of lading.

EX.VESSEL : MAERSK BENTONVILLE V. 046N

ITEM NO.	B/L NO.	DESTINATION
83	SUDU10001A8M3010	MUNDRA
84	SUDU10999A8M3059	MUNDRA
85	SUDU10999A8NL042	MUNDRA
86	SUDU60ITJ028445X	MUNDRA
87	SUDU60ITJ029348X	MUNDRA
88	SUDU60ITJ030160X	MUNDRA
89	SUDU70711ACYL013	MUNDRA
90	SUDU70711ACYL014	MUNDRA
91	SUDU70711ACYL018	MUNDRA
92	SUDU70711ACYL019	MUNDRA
93	SUDUA0FRA003821A	MUNDRA
94	SUDUA0HAM019204A	MUNDRA
95	SUDUA0HAM020456A	MUNDRA
96	SUDUA0HAM020463A	MUNDRA
97	EM20ITJ00757	MUNDRA
98	EM20ITJ00885	MUNDRA
99	DMCQHAM0053135	MUNDRA
100	SUDUA0DUS003965A	ICD JAIPUR(KANAKPURA)
102	SUDUC0ANR017417X	ICD KHODIYAR
103	SUDUC0ANR017863X	ICD KHODIYAR
104	SUDUA0FRA003819A	ICD LUDHIANA
107	SUDU50650A6UG166	ICD SAHNEWAL
108	SUDUA0DUS003972A	ICD SAHNEWAL

Consignees are requested to obtain the Delivery Orders on presentation of duly endorsed Original Bills of Lading and on payment of applicable charges within the free time to avoid detention charges being levied. Consignees are requested to note that all local clearance FCL containers will be moved enbloc from the terminal to the nominated SEABIRD CFS - MUNDRA (LDD) from where the delivery will be effected. Separate IGM will be lodged with respective ICD's, Mundra Customs for ICD's and Mundra Port Delivery. Carrier or its agents will not be responsible for any delay in CY-CFS movement due to port congestion. Consignees are also requested to note that carrier and / or their agents are not bound to send individual Cargo Arrival Notice (CAN) regarding the arrival of the vessel or goods. Incase of Perishable goods, if not cleared within 72 hours the cargo may be listed for auction at the sole discretion of the Customs Authorities, with all costs, risks and responsibility on the consignee. As per Indian Customs Regulations any / all containers / lying uncleared for more than 30 days are listed for the auction under Sec. 48 of Indian Customs Act 1962 under notice to Consignee by the Custodian, as per address stated in their respective Bill of Lading. The same will be auctioned or de-stuffed without any further information / notice to the consignee. However the Line reserves their right to recover / claim all cost or charges on such shipments from the consignee. Our surveyor at the CFS is M/s. Pinnacle Marine Services Pvt.Ltd, Add : Pota Cabin Rangoli Parking, Adani Port, Mundra-370 421, Kutch, Gujarat. **All import payments are to be made via RTGS/NEFT/IMPS in favour of M/s. Hamburg Sud India Private Limited.** Consignees are requested to send their Delivery Order request through Odex for all import shipments delivered at Mundra during the counter timings 9:30 am – 4:00 pm. OB/L can be submitted at Maersk CMS counter-Gandhidham timing 10.00 am to 3.30 pm. Please note IGM details can also be checked at our website : **www.hamburgsud-line.com**

Hamburg Sud India Private Limited

P.D. Plaza, 1st Floor, Plot No. 3, Sector 9/A Tagore Road,Gandhidham (Kutch), Gujarat – 370201

Phone : +91 9099 996 468 **CIN :** U74900MH2010FTC199423

Annexure -P

સૌરાષ્ટ્રના સમાચાર

ભુજમાં જુગાર સંચાલકોએ વેપારી પિતા-પુત્ર ઉપર હુમલો કર્યો

ગાંધીધામ : ભુજ શહેરના મોબાઈલ હબ ગણાતા એવા જનતા ઘર હોટેલની પાછળ લાંબા સમયથી ચાલતા ચકલા પોપટના જુગાર પર સ્થાનિક પોલીસની મીઠી નજરને કારણે લોહી રેડાયું હતું. કોમ્પ્લેક્ષમાં પેઢી ધરાવતા પિતા-પુત્ર પર જુગારના ગોરખ ધંધાર્થીઓએ હુમલો કરતા ચકચાર મચી ગઇ છે. પોલીસ સુત્રોમાંથી મળતી વિગતો મુજબ, જનતાઘર નીચે પેઢી ચલાવતા સામાજીક અગ્રણી એ. વાય. આકબાની અને તેના પુત્ર પર ચકલા પોપટના સંચાલકોએ હુમલો કર્યો હતો. લાંબા સમયથી ચાલતા આ જુગાર ધામને કારણે નીતનવા લોકો અહીં આવે છે જેથી સામાન્ય માણસ અને મહિલાઓને આ વિસ્તારમાં પસાર થવામાં મુંઝવણ ઉદભવે છે જેથી સામાજીક અગ્રણીએ વાંધો ઉઠાવ્યો હતો. જુગારના સંચાલકોએ મનદુઃખ રાખી ભરબપોરે આકબાની સાથે ઝપાઝપી કરીને મુક્કા મારી માર્યો હતો તો તેમના પુત્ર તૌશીફ આકબાનીને પથ્થર અને લાકડીથી માર મારતા લોહી રેડાયું હતું જેથી સારવાર માટે ખાનગી હોસ્પિટલમાં ખસેડાયો હતો. આ અંગે એ-ડિવિઝન પોલીસ મથકે ફરિયાદ નોંધાતા પોલીસે ભોલુ કુંભાર અને આરીફ ઘાંચીની મોડી રાત્રે અટકાયત કરી આગળની કાર્યવાહી હાથ ધરી હતી.

ભુજમાં ખિલખિલાટની વેન જજની કાર સાથે અથડાઇ

ગાંધીધામ : ભુજના જ્યુબિલી ગ્રાઉન્ડ નજીક રાજય સરકારની ખિલખિલાટ વાહનના ચાલકે બેદરકારી પુર્વક વાહન હંકારી અધિક સેશન્સ જજની કારને ટક્કર મારી નુકસાન પહોંચાડતા કમાન્ડોએ વાહન ચાલક સામે ફોજદારી નોંધાવી હતી. ભુજના અધિક સેશન્સ જજ ચિરાગકુમાર એમ. પવારના કમાન્ડો અને એએસઆઇ ગોપાલભાઇ ફફલે ખિલખિલાટ વાહનના ચાલક અનિલ હરીગીરી ગોસ્વામી (રહે. ગણેશનગર, ભુજ)વાળા સામે બી-ડિવિઝન પોલીસ મથકે ફોજદારી નોંધાવી હતી. સોમવારે બપોરે અઢી વાગ્યે જ્યુબિલી સર્કલ નજીક સેશન્સ જજની મારૂતી સ્વિફટને ખિલખિલાટ ઇકો વાહનના ચાલકે ટક્કર મારી ૩૦ હજારનું નુકસાન પહોંચાડયું હતું.

ભુજના મમુઆરા પાસે ટ્રક-બાઈક ટકરાતાં ત્રણ યુવાનના મોત

ગાંધીધામ : પશ્ચિમ કચ્છમાં બાઇક અકસ્માતમાં સતત બીજા દિવસે વધુ ત્રણ નવ યુવાનોના જીવ ગયા હતા. મમુઆરા ફાટક પાસે સાંજે ટ્રક અને બાઇક વચ્ચે થયેલા ગંભીર અકસ્માતમાં ઘાણેટી કંપનીમાં રહેતા પરપ્રાંતીય યુવાનોને કાળ આંબી ગયો હતો. પદ્ધર પોલીસે આગળની તજવીજ હાથ ધરી હતી. સુત્રોમાંથી જાણવા મળતી વિગતો મુજબ, મમુઆરાથી ઘાણેટી તરફ જીજે ૧૨ સીજે ૦૮૦૫ નંબરની બાઇકથી જઇ રહેલા સાગો ઉર્ફે સાગર જોતીયા ડામોર (ઉ.વ. ૨૫, રહે. જુલવાડીયા, તા. જાંબવા), કાલીયાભાઇ નારસીંગ ડામોર (ઉ.વ.૨૫, રહે. જુલવાડીયા, તા. જાંબવા) અને શંકરભાઇ કરશનભાઇ નીનામા ઉ.વ.૨૩ રહે. ઢેબર, તા. કલ્યાણપુર) હાલે ત્રણેય રહે. નાડાપા) વાળા કંપનીમાં જઇ રહ્યા હતા. ત્યારે મમુઆરા પાટીયા પાસે સામેથી આવતી ટ્રક નંબર જીજે ૧૨ એડબ્લ્યુ ૬૭૭૯ સાથે ટક્કર થઇ હતી, ત્રણેય યુવાનોને ગંભીર પ્રકારની ઇજાઓ પહોંચતા ત્રણેયના મોત નિપજયા હતા. એક જ બાઇક પર ત્રિપલ સવારી જઇ રહેલા પરપ્રાંતિય યુવાનો માટે આ ટ્રક કાળનો કોળીયો બની હતી. પદ્ધર પોલીસે નોંધ લઇ આગળની તજવીજ હાથ ધરી હતી.

માંડવીમાં એકતરફી પ્રેમમાં પાગલ યુવતીએ પરિણીતાને છરી ઝીંકી

ગાંધીધામ : માંડવી તાલુકાના મેરાઉ ગામે એકતરફી પ્રેમમાં પાગલ યુવતીએ અન્ય એક યુવતીને તેના પ્રેમી સાથે લગ્ન કરવાની ના પાડી હોવા છતાંય લગ્ન કરી લેતા યુવતીએ પરિણિતાને છરી ભોંકી દીધી હતી. બનાવને પગલે માંડવી પોલીસ મથકે ગુનો નોંધાવાયો હતો. પોલીસ સુત્રોમાંથી મળતી વિગતો મુજબ, રસીલાબેન કાંતીભાઇ કાનજીભાઇ માતંગ (ઉ.વ.૨૩, રહે. મેરાઉ તા. માંડવી)એ ફરીયાદ નોંધાવી હતી કે, પાડોશમાં રહેતી કૌશલ્યાબેન જગદીશ પુનશી કન્નર (રહે. મેરાઉ)વાળી તેના પતિ કાંતી સાથે એકતરફી પ્રેમમાં પાગલ હતી. કૌશલ્યાએ કહ્યું કે, તને કાંતી સાથે લગ્ન કરવાની ના પાડી છતાંય તે લગ્ન શા માટે કર્યા, પોતે કાંતીના પ્રેમમાં પાગલ છે તેમ કહી બોલાચાલી કરી છરીના ઘા ઝીંકી દીધા હતા. ફરિયાદીના લગ્ન આઠેક માસ અગાઉ થઇ ચુક્યા છે. રવિવારે બપોરના અરસામાં આરોપણા મહિલા ઘરે જઇ ફરિયાદીને ઘા ઝીંકી જાનથી મારી નાખવાની ધમકી આપતા માંડવી પોલીસ મથકે મહિલા વિરૂદ્ધ ફોજદારી નોંધાવાઇ હતી.

મુન્દ્રા સીએફએસમાં કલમારમાંથી કન્ટેનર પટકાતાં ચુવાન ચગદાયો

ગાંધીધામ : મુન્દ્રા સ્થિત સીએફએસમાં કલમારમાંથી કન્ટેનર નીચે પડતા ચુવાન ચગદાઇ ગયો હતો અને ઘટના સ્થળે જ કરૂણ મોત નિપજયું હતું. મૃતક યુવાનના ભાઇ ભાવેશ ભવાનજી સિંધલ (ઉ.વ.૨૭ રહે મૂળ કોઠારા-અબડાસા હાલે નદીવાળા નાકે-મુન્દ્રા)ની ફરીયાદને ટાંકીને પ્રાપ્ત અહેવાલ મુજબ ઉપરોકત બનાવ સ્થાનિકેના ઓલકાર્ગો સીએફએસ (કન્ટેનર ફ્રેઇટ સ્ટેશન)મધ્યે ગત રાત્રે ૧૦.૩૦ વાગ્યાના અરસામાં બન્યો હતો. જેમાં સીએફએસમાં કન્ટેનરની હેરફેર કરતા કલમાર નંબર એનએલ ૦૧ કે ૭૯૮૫ના ચાલકે બેદરકારી પૂર્વક કન્ટેનર ઉંચકતા કન્ટેનર કલમારમાંથી છટકી જેએસ રામદાસ સીએચએ પેઢીમાં ફરજ બજાવતા કુલદીપ ભવાનજી સિંધલ(રહે મૂળ કોઠારા-હાલે નદીવાળા નાકે-મુન્દ્ર પર ખાબકતા તે નીચે ચગદાઇ જવાથી તેને ગંભીર ઇજાઓ થવા પામી હતી બનાવને પગલે કુલદીપને તાત્કાલીક અદાણી કંપનીની એમ્બ્યુલન્સમાં સારવાર અર્થે સીએચસીમાં ખસેડાતા ત્યાં ફરજ પરના તબીબે તેને મૃત ઘોષિત કર્યો હતો.ઘટનાને લઇ મુન્દ્રા પોલીસે કલમાર ચાલક વિરૂદ્ધ બેદરકારી પૂર્વક વાહન ચલાવી અકસ્માત કર્યાનો ગુનો દર્જ કરી આગળની કાયદાકીય કાર્યવાહી હાથ ધરાઇ હતી.

નખત્રાણાના રતડિયામાં બે ટ્રક અથડાતાં મજૂરોને ઈજા

ગાંધીધામ : નખત્રાણા તાલુકાના રતડીયા-વિગોડીની વચ્ચે મધરાત્રે બે ટ્રકો ભટકાઇ હતી. અકસ્માતમાં બંને ટ્રકની કેબીનનો બુકડો બોલી ગયો હતો. જીજે ૧૨ એટી ૭૬૬૯ નંબરની ટ્રક રવાપર બાજુથી મગફળી ભરી આવી રહી હતી ત્યારે નખત્રાણા સાઇડથી આવી રહેલી જીજે ૧૨ એટી ૬૨૪૫ નંબર ટ્રક સામસામે ભટકાઇ હતી. બંને ડ્રાઇવર સાઇડનો બુકડો બોલી ગયો હતો અને ડ્રાઇવરોને ઇજાઓ પહોંચી હતી. મગફળી ભરીને જતી ટ્રકનો અકસ્માત થતા તેમાં સવાર મજુરોને પણ ઇજાઓ પહોંચી હોવાનું જાણવા મળ્યું છે. સવારે છ વાગ્યે પવનચક્કીના મોટા પાખડા લઇને જતા ટ્રેઇલરો રોડની સાઇડે હતા અને બીજીબાજુ આ અકસ્માત થતા થોડા સમય માટે ટ્રાફિક જામ થયો હતો.

પ્રભાસપાટણમાં અજાણ્યા શખસે માર મારતા યુવાન ગંભીર

પ્રભાસપાટણ : પ્રભાસ પાટણમાં સાઇન કોલોની વિસ્તારમાં રહેતા યુવાનને કોઇ અજાણ્યા શખ્સે કોઇ કારણોસર ગળાના ભાગે તીક્ષ્ણ હથીયારનો ઘા મારતા વેરાવળની ખાનગી હોસ્પીટલમાં સારવારમાં ખસેડેલ છે. આ બનાવની પોલીસમાંથી પ્રાપ્ત વિગત મુજબ પ્રભાસ પાટણમાં સાઇન કોલોની વિસ્તારમાં આવેલ નુરાની મસ્જીદ પાસે રહેતો મુસ્તકીમ હારૂનભાઇ કાલવણીયા ઉ.વ.૨૦ નામનો યુવાન બરોડા ખાતે અભ્યાસ કરતો હોય અને હાલ કોરોનાના હીસાબે પ્રભાસ પાટણ આવેલ હોય ત્યારે સવારના સમયે તેના ઘરેથી મસ્જીદ તરફ જઇ રહેલ તે વખતે કોઇ અજાણ્યા છોકરા જેવા શખ્સે આવી તું મુસ્તકીમ છો ? તેમ કહેતા હા પાડેલ અને શું કામ છે તેમ પુછતા કાઇ જવાબ આપેલ નહીં અને તેની પાસે રહેલ ધારદાર હથીયારથી ગળાના ભાગે મારતા વેરાવળની ખાનગી હોસ્પીટલમાં સારવારમાં ખસેડેલ છે. આ બનાવ અંગે પોલીસે અજાણ્યા છોકરા જેવા શખ્સ સામે કલમ ૩૨૬ મુજબ ગુન્હો નોંધી વધુ તપાસ પી.આઇ. રાઠવાએ હાથ ધરેલ છે.

વેરાવળના ગુણવંતપુર ગામે સાસરીયાના ત્રાસની ફરિયાદ

વેરાવળ તાલુકાના ગુણંવતપુર ગામે રહેતી કીરણબેન નિલેશભાઇ જોરા ઉ.વ.૨૪ ને તેના પતિ નિલેશભાઇ, સસરા કાનાભાઇ, સાસુ હીરૂબેન દ્વારા તને ઘરકામ આવડતું નથી તેમ કહી ચારીત્ર્ય ઉપર શંકા કુશંકા કરી માર મારી જાનથી મારી નાખવાની ધમકી આપેલ હોવાની ફરીયાદ જીલ્લા મહિલા પોલીસમાં નોંધાવતા પોલીસે ૪૯૮ (ક) સહીતની કલમો હેઠળ ગુન્હો નોંધી વધુ તપાસ પી.એસ.આઇ. રીનાબેન સુવાએ હાથ ધરેલ છે.

રાજુલા માર્કેટિંગ યાર્ડમાં વેપારી અને તેલીબિયા પેનલના ૬ સભ્યો બિનહરીફ

હવે ૪ ડિસેમ્બરે ખેડૂત વિભાગની ૧૦ બેઠકોની ચૂંટણીનું મતદાનઃ ૨૧ ઉમેદવારો મેદાનમાં

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આજરોજ રાજુલા માર્કેટિંગ યાર્ડ ખાતે યોજાનાર ચૂંટણીમાં વેપારી અને તેલીબિયાની વેપારી પેનલ બિનહરીફ થયેલ છે. જ્યારે હવે ખેડૂત વિભાગના ૧૦ સભ્યોની ચૂંટણી તા.૪-૧૨ના રોજ યોજાનાર છે. આ અંગે જાણવા મળતી વિગત મુજબ ગઇકાલે માર્કેટિંગ યાર્ડની ચૂંટણીમાં ફોર્મ પરત ખેંચવાની છેલ્લી તારીખ હતી જેમાં સહકારી ક્ષેત્રના ભિષ્મપિતામહ એવા દિલીપભાઈ સંઘાણી અને જિલ્લા ભાજપના પ્રમુખ કૌશિકભાઈ વેપરિયાની આગેવાની તથા સમજાવટથી અન્ય છ ફોર્મ પરત ખેંચાઈ જતાં તેલીબિયા અને વેપારી પેનલ બિનહરીફ થઈ છે. હવે તા.૧૪-૧૨ના રોજ ખેડૂત પેનલના ૧૦ સભ્યોની ચૂંટણીનું મતદાન યોજાશે તેમાં ૨૧ ઉમેદવારો મેદાનમાં છે. આગામી સમયમાં જોઈએ શું પરિણામ આવે છે.

સંઘાણી-વેકરિયાના પ્રયાસોને સફળતા

ગુજરાત ભાજપના આગેવાન અને સહકારી ક્ષેત્રના ભિષ્મપિતામહ ગણાતા એવા દિલીપભાઈ સંઘાણી, જિલ્લા ભાજપ પ્રમુખ વેકરિયા, ગુજરાત સરકારના પૂર્વ સંસદીય સચિવ અને રાજુલા, જાફરાબાદ, ખાંભાના પૂર્વ ધારાસભ્ય હિરાભાઈ સોલંકી, રાજુલા યાર્ડ અને સહકારી સંઘના ચેરમેન જીજ્ઞેશભાઈ પટેલ, જિલ્લા ભાજપના મહામંત્રી રવુભાઈ ખુમાણ તેમજ શહેર અને તાલુકા ભાજપ પ્રમુખ અને તેની ટીમ કાર્યકરોના અથાગ પ્રયત્નોને કારણે વેપારી વિભાગ અને તેલીબિયા વિભાગની ૬ બેઠકો બિનહરીફ કરવામાં સફળતા સાંપડી છે.

સાવરકુંડલાના યુવા પત્રકાર સોહિલ શેખનો જન્મદિવસ

સાવરકુંડલા યુવા પત્રકાર અને માનવતા ગ્રુપના ઉપપ્રમુખ સોહિલ શેખ પત્રકારિત્વ, સામાજિક, સેવાકીય અને રાજકીય ક્ષેત્રમાં સંકળાયેલા છે. જીવનના ૨૮ વર્ષ પૂર્ણ કરી ૨૯માં વર્ષમાં મંગલ પ્રવેશ કરનાર સોહિલ શેખને લોકોની સેવા અને સમસ્યા ઉકેલવાનો પોતાનો અંગત શોખ છે, યુવા સિપાહી સમાજના ઉપપ્રમુખ તરીકે પણ સમાજના નાના મોટા પ્રશ્નો ઉકેલવા લોકોની સેવા માટે જીવન સમર્પિત કરી દીધું હોવાથી ખાસ્સી લોકપ્રિયતા ધરાવે છે. સ્વભાવે ખૂબજ મિલનસાર અને આત્મિય ભાવથી તેમનો લોકસંપર્ક પણ બહોળો છે. સોહિલ શેખના જન્મદિવસ નિમિતે વિવિધ ક્ષેત્રના અગ્રણીઓ તેમના સગા સંબંધી મિત્રો વર્તુળોએ તેમના મોબાઈલ નંબર ૮૭૯૮૮ ૫૦૩૧૩ પર શુભેચ્છાઓનો ધોધ વરસાવ્યો છે.

જૂનાગઢઃ મરણોત્તરમાં ૫૦, લગ્નમાં ૧૦૦ વ્યક્તિની હાજરીની યાદી મંજૂર કરાવવી જરૂરી

સંક્રમણ વધી જતાં જિલ્લા કલેક્ટરની ઘોષણા

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કોરોનાની મહામારીને ધ્યાને લઈને જૂનાગઢ જિલ્લા કલેક્ટર ડો.સૌરભ પારધી દ્વારા દિશા નિર્દેશો જાહેર કરવામાં આવ્યા છે. જેમાં જિલ્લામાં લગ્ન પ્રસંગ કે મૃત્યની વિધીમાં મર્યાદીત લોકોની યાદી મામલતદાર કચેરી અને પોલીસ સ્ટેશન ખાતે મોકલવાની રહેશે

કોરોનાનું સંક્રમણ નિયંત્રણમાં રાખવાના હેતુસર રાજ્ય સરકાર દ્વારા નિયત થયેલ મર્યાદામાં કાર્યક્રમો યોજવા મંજુરી આપવામાં આવેલ છે. જેમાં લગ્ન/સત્કાર સમારંભ જેવી અન્ય ઉજવણીઓના કિસ્સામાં ખુલ્લા સ્થળોએ/બંધ સ્થળોએ, સ્થળની ક્ષમતાના ૫૦ ટકાથી વધુ નહીં પરંતુ

મહત્તમ ૧૦૦ વ્યકિત મર્યાદામાં સમારોહ, પ્રસંગના આયોજનને મંજુરી આપવાનું રાજ્ય સરકારે નક્કી કર્યુ છે તેમજ મૃત્યુના કિસ્સામાં અંતિમ ક્રિયા, ધાર્મિક વિધીના કિસ્સામાં મહત્તમ ૫૦ વ્યકિતઓની મર્યાદામાં મંજુરી આપવાનું રાજ્ય સરકારે નક્કી કર્યુ છે.

નિયત મર્યાદાથી વ્યકિતઓની સંખ્યા વધે નહી તે માટે પ્રસંગ આયોજકે આવા કાર્યક્રમો/પ્રસંગોની જાણ નિયત પ્રફોર્મમાં અગાઉથી જ લાગુ પોલીસ સ્ટેશનને તથા લાગુ મામલતદાર કચેરીને જાણ કરવાની રહેશે. નિયત પ્રફોર્મ અલગથી મામલતદાર કચેરી તથા પોલીસ સ્ટેશન ખાતે મોકલવામાં આવેલ છે. જે મામલતદાર અને પોલીસ સ્ટેશન ખાતેથી મેળવી શકાશે.

નિયત મર્યાદામાં પ્રસંગ યોજાય તથા સોશ્યલ ડિસ્ટન્સીંગ, સેનીટાઈઝેશન તથા કોવિડ-૧૯ અંતર્ગત સરકારની વખતો વખતની અન્ય તમામ સૂચનાઓનું પાલન થાય તે અંગે ખાસ તકેદારી રાખવાની રહેશે. જિલ્લા કલેક્ટરની અખબારી યાદીમાં જણાવ્યું છે.

વેરાવળમાં ધારાસભ્ય જીજ્ઞેશ મેવાણીની અધ્યક્ષતામાં સંવાદ કાર્યક્રમ યોજાયો

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વેરાવળ

વેરાવળ લોહાણા મહાજન વંડી ખાતે રાષ્ટ્રીય દલિત અધિકાર મંચના સંયોજક અને વડગામ ના યુવા ધારાસભ્ય જીજ્ઞેશભાઈ મેવાણી ની અધ્યક્ષતામાં આર્થિક સામાજીક તેમજ શૈક્ષણિક રીતે જરૂરત મંદ યુવાનોને મજબૂત કરવાના હેતુથી યુવા સંવાદ કાર્યક્રમ રાખવામાં આવેલ હતો. આ પ્રોગ્રામનું આયોજન સામાજિક કાર્યકર અફઝલ સર પંજા એ કરેલ હતું.

આ કાર્યક્રમમાં પોતાના તેજાબી વાણી દ્વારા જીજ્ઞેશભાઈ મેવાણી એ યુવાનો ને પોતાના સાહસ, મનોબળ અને મહેનત દ્વારા આગળ આવી પોતાનું સમાજનું દેશના દ્રેક કચડાયેલા લોકોનું તેમજ રાષ્ટ્રનું નવનિર્માણ કરવા હાકલ કરેલ હાલમાં કેન્દ્ર માં રહેલ ભાજપ ની મોદી સરકાર ઉપર પ્રહારો કરતા તેમણે એસ.ટી , ઓ.બી.સી, માયનોરિટી તેમજ સમાજના કચડાયેલા લોકોને આગળ આવી અને જેવી રીતે આઝાદીની લડતમાં એકતા અને ભાઈચારા સાથે અંગ્રેજોની સામે લડત લડી દેશને અંગ્રેજોની ચુંગાલમાંથી આઝાદ કરાવેલ તેવી જ રીત હાલની આ ભ્રષ્ટાચારી કોમવાદી તેમજ દેશદ્રોહી સરકાર સામે લડી દેશ ને આ ભ્રષ્ટાચારી

અને તાનાશાહી લોકોથી બચાવવા અને આવા લોકોને રસ્તો દેખાડવા સ્વ દેશવાસીઓને રસ્તા ઉપર ઉતરી જવા માટે આહવાન કરેલ અને આ કાર્યક્રમમાં ગીર સોમનાથ જિલ્લા કોંગ્રેસ માયનોરિટી ડીપાર્ટમેન્ટ ના ચેરમેન ફારૂક મલિક પેરેડાઈઝ, પ્રવીણભાઈ ગઢિયા, મહેશભાઈ મકવાણા, નરેશભાઈ ચાવડા, રફીકભાઈ મોલાના, સફીભાઈ મોલાના, હનીફ બાગડા, મુકેશભાઈ ચૌહાણ, રામજી ભાઈ ચાવડા, બશીરભાઈ સુમરા, અમઝદભાઈ પંજા, અમીનભાઈ પંજા, જાવીદ મુગલ, ઈકબાલભાઈ સફર, સલીમભાઈ સોડા, સલીમભાઈ કટોરી, મુસ્તકીમ વાઝા, તેમજ વિશાળ સંખ્યામાં લોકો ઉપસ્થિત રહેલ હતા.

વેરાવળમાં કોરોના વાયરસના ટેસ્ટ સેન્ટર કાર્યરત

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ગીર સોમનાથ જિલ્લામાં કોરોના વાયરસના સંક્રમણને અટકાવવા આરોગ્ય શાખા ગીર સોમનાથ દ્વારા વેરાવળમાં કોરોના વાયરસના ટેસ્ટ સેન્ટર કાર્યરત કરવામાં આવેલ છે. શંકાસ્પદ દર્દીઓને જે તે નજીકના ટેસ્ટ સેન્ટર પર ટેસ્ટ કરાવવા આવશ્યક છે. વેરાવળ બસ સ્ટેશને સવારે ૧૦.૩૦ થી બપોરે ૨ કલાક સુધી ત્યારબાદ બપોરે ૪ થી ૬ કલાક, કાશી વિશ્વનાથ મંદીર ખાતે, જૈન ટ્રેરાસર મંદિર ખાતે, હરસિધ્ધી અર્બન સેન્ટર ખાતે, બંદર રોડ અર્બન સેન્ટર ખાતે અને ભીડીયા અર્બન સેન્ટર ખાતે સવારે ૧૧ થી બપોરે ૩ કલાક સુધી કોરોના વાયરસના શંકાસ્પદ દર્દીઓના ટેસ્ટ કરવામાં આવશે. ઉપરાંત સી.એચ.સી.પ્રભાસ-પાટણ અને સિવિલ હોસ્પિટલ વેરાવળ ખાતે પણ ટેસ્ટ સેન્ટર કાર્યરત છે.

અંજારથી નીકળેલા ૫૬૦ એલઇડી ટીવીમાંથી ૨૩ ચોરાયા

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ગાંધીધામ

અંજારના ગળપાદર હાઈવે પર સ્થિત જીનસ કંપનીમાંથી ૫૬૦ એલઇડી ટીવીને કન્ટેનરમાં ભરીને મહારાષ્ટ્રના ભીવંડી મોકલવાનું નક્કી થયા બાદ નિયત સ્થળે તપાસ કરતા ૨૩ એલઈડી ઓછી આવી હોવાનું સામે આવતા મામલો સામે આવ્યો હતો. જે અંગે સતત થઈ રહેલા સમાધાનના પ્રયાસો અને ઘ્વા છતાં કાંઈ ફળીભૂત ન થતા અંતે ટ્રાન્સપોર્ટર જવાબદારી આપી હતી તે સર્વિસ ધારક અને ડ્રાઈવર વિરુદ્ધ ફરિયાદ નોંધાવી હતી.

અંજાર પોલીસ મથકે સુધીરભાઈ ચૌધરીએ ટ્રક નં. ડીએન ૦૯ આર ૯૩૭૬ના ડ્રાઈવર બજરંગ શીશપાલ અને ગુરુ કન્ટેનર સર્વિસના અલદીપ પુનીયા (રહે.હમીનપુર, ઝુઝનુ, રાજસ્થાન) વિરુદ્ધ ગુનો નોંધાવતા જણાવ્યું હતું કે જીનસમાંથી તેમને મળેલા આ ઓર્ડર અનુસાર તેમણે આરોપીને ટ્રકની જરૂરિયાત હોવા અંગે કહ્યું હતું. ત્યારબાદ નિયત સમય અનુસાર તા.૦૬/૧૧ના કુલ ૮૨,૯૬,૦૦૯ની કિંમતના થતા ૫૬૦ એલઈડી ટીવી લોડ કરીને મહારાષ્ટ્રના ભીવંડીના વીયુ ટેકનોલોજી પ્રા. લીમીટેડમાં જવા રવાના થયા હતા.

પરંતુ તા.૦૮/૧૧ના સવારે ડ્રાઈવરનો ફરિયાદી પર ફોન આવ્યો હતો કે કન્ટેનરનું શીલ તુટેલુ છે અને ૨૩ ટીવી ઓછા હોવાનું માલુમ પડે છે. જે અંગે જવાબદેહ ટ્રાન્સપોર્ટ દ્વારા સતત સમાધાનના ઘ્વાઓ કર્યા બાદ પણ કાંઈ ન થતા અંતે ૨૩ ટીવીના ૩,૪૦,૭૨૮નો વિશ્વાસઘાત કર્યાની ફરિયાદ બન્ને આરોપી વિરુદ્ધ નોંધાઈ હતી.

ગીર સોમનાથ જિલ્લામાં ૬ તબક્કામાં કોરોનાની તપાસ

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ગીર સોમનાથ

કોરોના વાયરસના સંક્રમણને અટકાવવા ગીર સોમનાથ જિલ્લા આરોગ્ય તંત્ર કટીબધ્ધ છે. જિલ્લામાં કોરોના વાયરસનું સંક્રમણ ન ફેલાય તે માટે ધનવંતરી આરોગ્ય રથના ૬ તબક્કામા લોકોને ઘર સુધી આરોગ્યની તપાસ કરવામાં આવી રહી છે. આરોગ્ય વિભાગની સાથે આયુર્વેદ શાખા દ્વારા જરૂરી દવા આપવામાં આવી રહી છે.

ગીર સોમનાથ જિલ્લાના વેરાવળ, સુત્રાપાડા, તાલાળા, કોડીનાર, ઉના અને ગીરગઢડા સહિત છ તાલુકામાં ૩૪ ધનવંતરી આરોગ્ય રથના માધ્યમથી લોકોના ઘર સુધી આરોગ્યની સવલત પુરી પાડવામાં આવી રહી છે. જેમાં પૈકી જિલ્લાના ૬૧૦૦ વિસ્તારના લોકોને આવરી લેવાની સાથે ૪૫૪૯૨૪ ઓ.પી.ડી. થયેલ છે. જિલ્લાના મોટાભાગના વિસ્તારમાં ધનવંતરી આરોગ્ય રથના માધ્યમથી તબીબ સહિત ૪ વ્યક્તિની ટીમ દ્વારા તાવ, ઉધરસ, શરદીના દર્દીઓને નિશુલ્ક આરોગ્યની સારવાર આપવામાં આવી હતી.

ધાંગધ્રાઃ દર્દીઓને ફળ વિતરણ અને ગરીબોને જમાડી જન્મદિનની ઉજવણી

સુરેન્દ્રનગર : ધ્રાંગધ્રા ખાતે પ્રદેશ ભાજપના ઉપપ્રમુખ આઇ.કે.જાડેજાએ તેમના જન્દીન નિમિતે સવારે સરકારી દવાખાને કાર્યકરો સાથે મુલાકાત લઇ દર્દીઓને ફળ વિતરત કર્યા હતા. જ્યારે સુરજ પાર્વતી ભોજનાલયમાં ગરીબ અને જરૂરીયાત મંદ લોકોને ભોજન કરાવવામાં આવ્યુ હતુ. ત્યારબાદ માસ્કનું વિતરણ કરાયુ હતુ. આ સેવાકાર્યમાં કિરીટસિંહ જાડેજા, મહામંત્રી સંજયભાઇ સહિત આગેવાનો અને કાર્યકરો ઉપસ્થિત રહ્યા હતા.

સોમનાથમાં વિકાસ પરિષદ દ્વારા રંગોળી સ્પર્ધા યોજાઇ

આજકાલ પ્રતિનિધિ
વેરાવળ

ભારત વિકાસ પરિષદની સોમનાથ શાખા દ્વારા નાન ગંગા સરસ્વતી વિદ્યાલય ખાતે બહેનો માટે રંગોળી હરીફાઇનું આયોજન કરવામાં આવેલ હતું.

આ સ્પર્ધા બે વિભાગમાં યોજાયેલ જેમાં ચિરોડી કલર અને કઠોળ અને ચિરોડી કલર વિભાગમાં ૨૦ અને કઠોળ વિભાગમાં ૩ સ્પર્ધકોએ ભાગ લીધેલ હતો. ચીરોડી વિભાગમાં પ્રથમ ક્રમે નીતાબેન દંદવાની, બીજા ક્રમે પૂજાબેન ત્રિવેદી તથા ભાવિકાબેન મહેતા (સંયુક્ત), ત્રીજા ક્રમે રીનાબેન પ્રસાદ અને કુમારી દ્રષ્ટિ ઘોડાસરાં (સંયુક્ત) તેમજ કઠોળ વિભાગમા

પ્રથમ ક્રમે કુમારી તેજલ વડોદરિયા વિજેતા બનેલ હતા.

ભારત વિકાસ પરિષદ સોમનાથ શાખાના મહિલા સંયોજીકા સંગીતાબેન ભટ્ટના માર્ગદર્શન હેઠળ સ્પર્ધા સંયોજીકા કાશ્મીરાબેન આનાંદપરાં અને સ્પર્ધા સહ સંયોજીકા ભારતીબેન તન્ના સહીતનાએ જહેમત ઉઠાવી કાર્યક્રમને સફળ બનાવેલ હોવાનું એક યાદીમાં જણાવેલ છે.

મોરબી જિલ્લામાં કોરોનાના નવા ૧૬ કેસઃ ૧૧ દર્દી સ્વસ્થ થતા રજા અપાઈ

આજકાલ પ્રતિનિધિ
મોરબી

મોરબી જિલ્લામાં કોરોનાના કેસો સતત વધી રહ્યા છે જેમાં આજે નવા ૧૬ કેસો નોંધાયા છે. જ્યારે વધુ ૧૧ દર્દીઓ સ્વસ્થ થયા છે.

આજના નવા કેસોમાં મોરબી તાલુકાના ૧૪ કેસોમાં ૭ ગ્રામ્ય અને ૭ શહેરી વિસ્તારમાં, હળવદનો ૧ કેસ ગ્રામ્ય પંથકમાં અને માળિયાનો ૧ કેસ ગ્રામ્ય પંથકમાં મળીને કુલ ૧૬ કેસ નોંધાયા છે. તો વધુ ૧૧ દર્દીઓ સ્વસ્થ થયા છે. નવા કેસો સાથે જિલ્લામાં કુલ કેસનો આંક ૨૫૬૩ થયો છે જેમાં ૧૫૫ એક્ટિવ કેસ છે. અત્યાર સુધીમાં કુલ ૨૨૫૯ દર્દીઓ સ્વસ્થ થયા છે.

Annexure -Q

DEENDAYAL PORT TRUST
(Erstwhile: KANDLA PORT TRUST)

Administrative Office Building
Post Box NO. 50
GANDHIDHAM (Kutch).
Gujarat: 370 201.
Fax: (02836) 220050
Ph.: (02836) 220038

www.deendayalport.gov.in

EG/WK/5202 (D)/Part (CRZ 2)

Date: 23/11/2020

To,
Shri C. P. Hirvaniya, Mamlatdar
Mamlatdar Office, Sector 1A,
Gandhidham- Kachchh.
Gujarat 370201.
Email : mam-gandhidham@gujarat.gov.in

R.D.Vyas, Taluka Development officer,
Gandhidham Taluka Panchyat
Gandhidham.(Email : tdo.gandhidham@gmail.com).

Chief Officer, Gandhidham Municipality
Plot no-35, Sector-9,
Gandhidham-kachchh (Email:np_gandhidham@yahoo.co.in)

Shri K B Chaudhary,
Regional Officer, GPCB (East Kachchh).
A.O.Buidling, Deendayal Port Trust, Gandhidham.

Sub: Creation of water front facilities (Oil Jetties 8, 9, 10 & 11) and development of land (1432 acres) for associated facilities for storage at Old Kandla, Gandhidham, Kutch, Gujarat by M/s Deendayal Port Trust – **Environmental & CRZ Clearance accorded by the MoEF&CC,GoI – Request to display copy of the same req.**

Ref. : EC & CRZ Clearance accorded by the MoEF&CC,GoI vide F.No. F.No. 10-1/2017-IA-III dated 20/11/2020.

Sir,

Kindly refer to the above cited reference for the subject mentioned above.

In this regard, it is to inform that, the Ministry of Environment, Forest & Climate Change, Government of India vide above mentioned reference dated 20/11/2020 has accorded EC & CRZ Clearance to the subject proposal of the Deendayal Port Trust.

.....Cont.....

In the said EC & CRZ Clearance letter dated 20/11/2020, under Miscellaneous Condition (ii), it is mentioned that, ***"The copies of the environmental clearance shall be submitted by the project proponent to the Heads of local bodies, Panchayats and Municipal Bodies in addition to the relevant offices of the Government who in turn has to display the same for 30 days from the date of receipt".***

Accordingly, kindly find attached herewith a copy of the EC & CRZ Clearance accorded by the MoEF&CC,GoI dated 20/11/2020 is attached herewith as **Annexure A** for ready reference & taking further necessary action for display of the same as required under the above condition.

Thanking you.

Yours faithfully,

Encl. : As above

26/11

Superintending Engineer (Design) & EMC (I/c)
Deendayal Port Trust

Annexure -R

DEENDAYAL PORT TRUST

Administrative Office Building
Post Box NO. 50
GANDHIDHAM (Kutch).
Gujarat: 370 201.
Fax: (02836) 220050
Ph.: (02836) 220038

www.deendayalport.gov.in

EG/WK/5202 (D)/Part (CRZ 2)/146

Dated: 10/2/2021
11/02/2021

The Deputy Director General of Forest (Central),
Ministry of Environment, Forests & Climate Change,
Regional Office, Western Region
Kendriya Paryavaran Bhavan
Link Road No.3,Ravi Shankar Nagar,
Bhopal- 462 016(M.P.).
Email : rowz.bpl-mef@nic.in, eccompliance-guj@gov.in

Sub: Creation of water front facilities (Oil Jetties 8, 9, 10 & 11) and development of land of area 554 acres for associated facilities for storage at Old Kandla, Gandhidham, Kutch, Gujarat by M/s Deendayal Port Trust – **Submission of detail w.r.t. Para B Standard Conditions - Point XI Miscellaneous (vii) of EC & CRZ Clearance accorded by the MoEF&CC,GoI reg.**

Ref.: Environmental & CRZ Clearance accorded by the Ministry of Environment, Forests & Climate Change, GoI vide F. no. 10-1/2017-IA-III dated 20/11/2020.

Sir,

It is requested to kindly refer above cited reference for the said subject.

In this connection, it is to state that, the MoEF & CC, GoI had accorded Environmental & CRZ Clearance for the subject proposal vide above referred letter dated 20/11/2020 **(Copy enclosed at Annexure A)**.

In this regard, it is to state that, in the above referred EC & CRZ Clearance, the MoEF &CC, GoI under Para B - Standard Conditions- Point No. XI : Miscellaneous (vii) had directed that ***"The project proponent 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, commencing the land development work and start of production operation by the project".***

Accordingly, w.r.t. project of Oil Jetty No. 8 (Jetty & allied facilities), the requisite details are mentioned as under:

1) Date of Financial Closure : Through Internal Resources of Deendayal Port Trust.
2) Final approval of the project : Board of DPT accorded approval dated 11/1/2019.

.....Cont.....

Now, after receipt of EC & CRZ Clearance dated 20/11/2020 from the MoEF&CC,GoI, out of total four Oil jetties, Deendayal Port Trust has issued work order to M/s Kargwal KM Joint Venture, Mumbai vide letter no. CN/WK/1571/Work/243 dated 3/2/2021 **(Copy – Annexure B)** for ***"Construction of Oil Jetty No. 8 at Kandla"*** and accordingly they may start the project implementation work. However, for balance Oil Jetties no. 9, 10 & 11 to be implemented on BOT/PPP Mode (under approval stage) and for development of Land (under approval stage), the requisite details will be communicated in due course.

This is for kind information please.

Yours faithfully,

10/02/2021

Encl. : As above.

O/c

Superintending Engineer (Design) & EMC (I/c)
Deendayal Port Trust

Copy to:

Shri Amardeep Raju,
Scientist E, Ministry of Environment, Forest and Climate Change,
& Member Secretary (EAC-Infra.1),
Indira Paryavaran Bhawan,
3rd Floor, Vayu Wing, Jor Bagh Road, Aliganj,
New Delhi- 110 003;
E-mail: ad.raju@nic.in

Copy also to : 1) TPA to CE
2) SE (Project)

Annexure -II

Monitoring the implemental Safe guards
Ministry of Environment, Forests & Climate Change
Regional office (WZ), Bhopal.
Monitoring Report (upto November, 2022)
DATA SHEET

Sr. No.	**Particulars**	**Reply**
1.	Project type: River valley/Mining/ Industry/thermal/ nuclear/Other (specify)	Infrastructure and Miscellaneous Projects + CRZ
2.	Name of the project	Creation of water front facilities (Oil Jetties 8,9,10 & 11) and development of land of area 554 acres for associated facilities for storage at Old Kandla, Gandhidham, Kachchh (Gujarat)
3.	Clearance Letter (s). OM no and date	The MoEF&CC, GoI New Delhi vide File No. 10-1/2017-1A-111 dated 20/11/2020 granted Environmental & CRZ Clearance.
4.	Location a) District (s) b) State (s) c) Location/latitude/longitude	 Dist: Kachchh State: Gujarat Location: Geo Coordinates: Latitude: 23.051704 N to 23.069488 N Longitude: 70.171017 E to 70.219725 E
5.	Address for Correspondence a) address of Concerned Project Chief Engineer (with pin code & telephone/telex/fax numbers b) Address of Executive project Engineer/manager/ (with pin code fax numbers)	Chief Engineer, Deendayal Port Authority, A.O. Building, Annex, Post Box No.-50, Gandhidham- Kutch. Gujarat Pin – 370201 Tel: 02836-233192, Fax-02836-220050. Superintending Engineer (Project), Office of the Superintending Engineer (P), Nirman Building, New Kandla (Kutch) pin 370 210. Gujarat .

6.	Salient features a) Of the Project	• The Capacity of each jetty is 3.5 MMTPA for handling of all types of Liquid Cargo (Total Capacity: 14 MMTPA – 3.5 MMTPA X 4 Oil Jetties). • Area to be developed for associated facilities for storage: 554 acres • Dimension of jetty: 110 m & 12.8 m (Main platform) and mooring dolphins. Connecting approach each: 90 m X 10 m to common approach trestle of length 1225 m. • Dredging Quantity and Draught: Draught 13 m in front of jetty & approach. Capital Dredging Requirement: 16, 56,058 M^3 (Berth basin + Patches in approach channel) and Maintenance Dredging of 1, 07,500 m3 Per annum. The dredged material will be disposed of at the designated dumping location identified based on the scientific study done by the CWPRS and approved by the MOEF&CC, GoI. • Tentative Tankage Capacity: 2.28 Lakhs KL
	b) Of the Environmental Management Plan	Salient Features of EMP as specified in the EIA/EMP report has already been communicated with the earlier compliance report submitted.
7.	Production Details during compliance period and (or) during the previous financial year	The work of Oil Jetty No. 8 & allied facilities has started (Under construction phase). However, for O.J. 9 to 11 (under bidding stage) and area development, no activity on project site has been started.
8.	Breakup of the project area: a) Submergence area: forest & non-forest b) Others	N/A. Project area is 554 acres

9.	Breakup of the project affected population with enumeration of those losing houses/dwelling units only agricultural land & landless laborer's/artisen a) SC. ST/Adivasis b) Others (please indicate whether these figures are based on any scientific and systematic survey carried out of only provisional figures, if a survey is carried out give details and years of survey).	N/A as the project is to be implemented in DPA area. N/A N/A
10.	Financial details a) Project cost as originally planned and subsequent revised estimates and the year of prices reference. b) Allocation made for environmental management plans with item wise and year wise break-up c) Benefit cost ratio/Internal rate of Return and the year of assessment Whether (c) includes the cost of environmental management plans so far. d) Actual expenditure incurred on the project. e) Actual expenditure incurred on the environmental management plans so far.	Estimated project cost is Rs. 1505.74 crores The allocation made under the scheme of "Environmental Services & Clearance thereof other related Expenditure" during BE 2022-23 is Rs. 345 Lakhs. IRR: 12.5.% OJ 8 & allied facilities : Rs. 44.58 crore Oil Jetties no. 9, 10 & 11 : Construction not yet started Development of Land (area 554 acres) : Construction not yet started The expenditure made under the scheme of "Environmental Services & Clearance thereof other related Expenditure" is Rs. 275.36 Lakhs for period up to November, 2022.

11.	Forest land requirement a) The status of approval for diversion of forest land for non-forestry use b) The status of clear felling c) The status of compensatory a forestation, if any d) Comments on the viability & sustainability of compensatory a forestation programmed in the light of actual field experience so far	Nil (Not Applicable) N/A N/A N/A N/A
12.	The status of clear felling in non-forest areas (such as submergence area of reservoir, approach roads), if any with quantitative information.	NA, no felling is required
13.	Status of construction: a) Date of commencement (Actual and/or planned) b) Date of completion (Actual and/or planned)	<u>OJ 8 & allied facilities</u> : Work order issued on 03.02.2021. The work is in progress <u>Oil Jetties no. 9, 10 & 11</u> : O.J.s 9 to 11 to be implemented on BOT/PPP Basis are under bidding stage. Construction not yet started. <u>Development of Land (area 554 acres)</u> : Construction not yet started <u>For OJ 8 & allied Facilities</u>: Date of completion as per work order is 03.08.2022, further extended upto December, 2023. <u>For OJ 9 to 11</u> : The project is under bidding stage. <u>For Development of Land (area 554 acres)</u> : Construction not yet started.
14.	Reasons for the delay if the Project is yet to start	The work of Oil Jetty No. 8 & allied facilities has started (Under construction phase). However, Other O.J.s 9 to 11 to be implemented on BOT/PPP Basis is under bidding stage. For area development work, LOA has been issued to the Contractor on 19/10/2022.

15.	Date of site visited a) The dates on which the project was monitored by the regional office on pervious occasion. if any b) The date site visit for this monitoring report	None
16.	Details of the correspondence with project authorities for obtaining action plans/information on status of compliance to safeguard other than the routine letters for logistic support for site visit. (The first monitoring report may contain the details of all the letters issued so far but the later reports may cover only the letters issued subsequently.)	Chief Engineer, Deendayal Port Authority, A.O. Building, Annex, Post Box No.-50, Gandhidham- Kutch. Gujarat Pin – 370201 Tel: 02836-233192, Fax-02836-220050.