PETRONET LNG LIMITED

Petronet LNG Limited

GIDC Industrial Estate, Plot No. 7/A, Dahej,
Taluka : Vagra, Dist. Bharuch (Gujarat) - 392130 (India)
Tel. : 02641 - 670200 / 257
www.petronetlng.com
CIN: L74899DL 1998PLC093073
GST No. : 24AAACP8148D1ZM

REF: PLL/DHJ/HSE/MoEF/2023/10

Date: 27th December 2023

To,

The Director,
Ministry of Env., Forest and Climate Change
Indira Paryavaran Bhawan,
Jorbagh Road,
New Delhi – 110 003

Sub : Six Monthly Compliance Report for the period April 2023 to September 2023 with respect to conditions stipulated by Ministry of Environment & Forests, Govt. of India and Department of Forests, Govt. of Gujarat for Setting up of Standby LNG jetty at Dahej, District Bharuch in Gulf of Khambhat, Gujarat by M/s Petronet LNG Ltd.

Ref : (a) J-17011/11/2000-IA-III dated 14th Nov, 2008
(b) ENV-10-2004-117-E dated 05th Sep, 2008

Dear Sir,

The six-monthly compliance report for the period April 2023 to Sept 2023 with respect to conditions stipulated by Ministry of Environment & Forests, Govt. of India and Department of Forests, Govt. of Gujarat for Setting up of Standby LNG jetty at Dahej, District Bharuch in Gulf of Khambhat, Gujarat by M/s Petronet LNG Ltd. is uploaded in "PARIVESH 2 portal.

This is for your information and reference.

Thanking you,
Yours faithfully,
For Petronet LNG Limited

27.12.23
Sanjay Kumar
GGM & President (Plant Head)

Petronet LNG Ltd. Dahej Terminal

Copy to:-

1) Director (Environment)
Forests & Environment Department,
Government of Gujarat,
Block No. 14, 8th Floor, Sachivalaya,
Gandhinagar – 382 010

2) MoEF & CC
Integrated Regional Office
Room No 407 & 409
Sector 10A
A Wing Aranya Bhawan
Gandhinagar-382010

3) Unit Head - Bharuch Division
Gujarat Pollution Control Board
Paryavaran Bhavan, Sector-10 A
GANDHINAGAR – 382 010 (Gujarat)

4) Regional Officer
Gujarat Pollution Control Board
C-1\119\3, GIDC, Phase – 2 , Narmadanagar
Bharuch – 392015 (Gujarat)

Your application has been Submitted with following details	
Proposal No	J-17011/11/2000-IA/III
Compliance ID	34917149
Compliance Number(For Tracking)	EC/M/COMPLIANCE/34917149/2023
Reporting Year	2023
Reporting Period	01 Dec(01 Apr - 30 Sep)
Submission Date	29-12-2023
IRO Name	Shrawan Kumar Verma
IRO Email	kr099.ifs@nic.in
State	GUJARAT
IRO Office Address	Budgam
Note:- SMS and E-Mail has been sent to Shrawan Kumar Verma, GUJARAT with Notification to Project Proponent.	

परिवेश
PARIVESH
(CPC GREEN)

पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय
Ministry of Environment, Forest and Climate Change

LiFE Lifestyle for Environment

आज़ादी का अमृत महोत्सव

सत्यमेव जयते

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View Compliance Report at Project Proponent

Proposal Details

Proposal No
J-17011/11/2000-IA/III
Category
INFRA-1
Proposal Name
Setting up of Second LNG Jetty at Dahej in Gulf of Khambhat by M/s Petronet LNG Limited
Plot / Survey/ Khasra No.
Village(s)
Sub-District(s)
State
GUJARAT
District
BHARUCH
MoEF File No
J-17011/11/2000-IA-III
Name of the Entity/
Corporate Office
Petronet LNG Limited, Dahej
Entity's PAN
NA
Entity Name as per PAN
NA
Entity details mentioned above is correct ?
Agree

Covering Letter

Covering Letter

Click to View

Compliance Reporting Details

Reporting Year
2023
Reporting Period
01 Dec(01 Apr - 30 Sep)
Remark(if any)
SIX MONTHLY COMPLIANCE REPORT (FOR THE PERIOD APRIL 23 TO SEPTEMBER 23) TO THE CONDITION MENTIONED IN MOE&F LETTER NO. J-17011/11/2000-IA-III, DATED: 14th NOVEMBER, 2008 (STAND BY JETTY)

Details of Production and Project Area

Date of Commencement of Project/Activity
29-11-2010

	Project Area as per EC Granted(ha.)	Actual Project Area in Possession(ha.)
Private	0	0
Revenue Land	0	0
Forest	0	0
Others	0	84.57
Total	0	84.57

PRODUCTION CAPACITY							
Sr.No.	Name of the Product	Units	As per EC Granted	As per CTO Granted	CTO ID	Valid Up To	Production during last financial year
1	RLNG	Million Tons per Annum (MTPA)	20 MMTPA				12.9335 MMTPA

Conditions

Specific Conditions

Sr.No.	Condition Type	Condition Details	Status of Compliance,Remarks/Reason and Supporting Documents	
1	MISCELLANEOUS	Adequate safety measures for the offshore structure	PPs Submission	All safety measures taken during Design

		and ship navigation shall be taken in view of the high current in the area.		Stage. Construction activities completed and Jetty is Operational since April 2014. Complied Attachment: NA
2	MISCELLANEOUS	The shoreline changes in the area shall be monitored periodically.	PPs Submission	Periodically monitoring is being done. Complied Attachment: NA
3	MISCELLANEOUS	The recommendation of the Scour study shall be incorporated in the design.	PPs Submission	Incorporated in Design. Construction activities completed and Jetty is Operational since April 2014. Complied Attachment: NA
4	MISCELLANEOUS	The recommendations of the risk assessment shall be implemented. Any change in the design of the project shall come before the committee for seeking necessary approval.	PPs Submission	Recommendations of risk study are implemented .Construction works completed without any change in the design of the Project. Complied Attachment: NA
5	MISCELLANEOUS	Mangrove plantation to be done in consultations with the GEER/GEC of Forest Department, a detailed plan shall be submitted within six months from the date of receipt of this letter.	PPs Submission	Following Mangrove Plantation Completed along the Gujarat Coast in consultation with GEC & Forest Dept.: Total Mangrove Plantation Completed : 1150 Hectares (2009-10, 2010-11, 2011-12, 2012-13, 2013-14,2014-15 & 2016-17) Please Refer Annexure ? V for Mangrove plantation. Complied Attachment: Click to View

6	MISCELLANEOUS	It shall be ensured that during construction and post construction of the proposed jetty the movement fishermen vessels of the local communities are not interfered with.	PPs Submission	The movement fishermen vessels of the local communities are not interfered due to proposed jetty. Complied Attachment: NA
7	Human Health Environment	Relocation of the fishermen community shall he done strictly in accordance with the norms prescribed by the State Government. The relocated fishermen community shall be provided with all facilities including health care, education, sanitation and livelihood.	PPs Submission	Complied. Construction activities completed and Jetty is Operational since April 2014. Complied Attachment: NA
8	Marine/Coastal	Marine ecology monitoring shall be done regularly during construction of Breakwater and dredging operation .	PPs Submission	Marine ecological monitoring study done periodically. Last study was conducted in June,2023 by GPCB authorized vendor M/s Unistar Environment and Research Labs Pvt. Ltd. Please Refer Annexure ? VII for Marine ecological study report Complied Attachment: Click to View
9	AIR QUALITY MONITORING AND PRESERVATION	Regular monitoring of air quality shall be done in the settlement areas around the project site and appropriate	PPs Submission	Construction activities completed and Jetty is Operational since April 2014. Air quality monitoring is being done through the GPCB approved agency and

		safeguard measures shall be taken to ensure that the population is not subjected to higher levels of air pollution		its report is attached as Annexure-II to this report. Complied Attachment: Click to View
10	WASTE MANAGEMENT	Sewage arising in the port area shall be disposed off after adequate treatment to conform to the standards stipulated by Gujarat State Pollution Control Board and shall be utilized/re-cycled for gardening, plantation and irrigation	PPs Submission	Sewage water treated in STP plant and treated water monitored regularly. Parameters are under GPCB norms Complied Attachment: NA
11	MISCELLANEOUS	Adequate plantation shall be carried out along the roads of the Port premises and a green belt shall be developed.	PPs Submission	Plantation is carried out along the roads of the Port premises and green belt are developed. The total Greenbelt area approximately 1,66,000 sq. meters has been allocated in and around periphery wall. In addition to this, the total lawns/ green cover developed & maintained till date is 30000 Sq.m. Greenbelt with a width of 10-m to 50-m has been developed around the project site outside the LNG handling area. Complied Attachment: NA
12	MISCELLANEOUS	There shall be no withdrawal of ground water in CRZ area, for this project.	PPs Submission	No ground water was used during project Complied Attachment: NA

13	MISCELLANEOUS	Specific arrangements for rainwater harvesting shall be made in the project design and the rain water so harvested shall be optimally utilized. Details in this regard shall be furnished to this Ministry's Regional Office at Bhopal within 3 months	PPs Submission	The LNG Jetty is being set up very near to the coastline at Dahej where water table is very high. Moreover, the sea water is brackish in that area. Preliminary investigation indicates that it might not be feasible to carry out rainwater harvesting in this area. The process water requirement in LNG terminal at Dahej is NIL. Complied Attachment: NA
14	LAND RECLAMATION	Land reclamation shall be carried out only to the extent that it is essential for this project.	PPs Submission	Agree and complied. Complied Attachment: NA
15	MISCELLANEOUS	No product other than those permissible in the Coastal Regulation Zone Notification, 1991 shall be stored in the Coastal Regulation Zone area.	PPs Submission	Agree and complied. Complied Attachment: NA

General Conditions

Sr.No.	Condition Heading	Condition Details	Status of Compliance,Remarks/Reason and Supporting Documents	
1	Statutory compliance	Construction of the proposed structures, if any in the Coastal Regulation Zone area shall be undertaken meticulously conforming to the existing Central/local rules and regulations including Coastal Regulation Zone Notification 1991 & its amendments. All the	PPs Submission	All required approvals are taken. The construction and commissioning of the facilities at Dahej completed and jetty is operational

		construction designs / drawings relating to the proposed construction activities must have approvals of the concerned State Government Departments / Agencies.		since April 2014. Complied Attachment: NA
2	MISCELLANEOUS	Adequate provisions for infrastructure facilities such as water supply, fuel, sanitation etc. shall be ensured for construction workers during the construction phase of the project so as to avoid falling of trees/mangroves and pollution of water and the surroundings.	PPs Submission	The construction and commissioning of the facilities at Dahej completed and jetty is operational since April 2014. Complied Attachment: NA
3	WASTE MANAGEMENT	The project authorities must make necessary arrangements for disposal of solid wastes and for the treatment of effluents by providing a proper wastewater treatment plant outside the CRZ area. The quality of treated effluents, solid wastes and noise level etc. must conform to the standards laid down by the competent authorities including the Central/State Pollution Control Board and the Union Ministry of Environment and Forests under the Environment (Protection) Act, 1986, whichever are more stringent	PPs Submission	No effluent treatment plant in CRZ area. Noise level and Ground water monitoring is being done and its report is attached as Annexure-II to this report. Complied Attachment: Click to View
4	Statutory compliance	The proponent shall obtain the requisite consents for discharge of effluents and emissions under the Water (Prevention and Control of Pollution) Act, 1974 and the Air (prevention and Control of Pollution)	PPs Submission	Necessary approval has been taken for existing terminal. Copy was submitted vide our letter no. PLL/DHJ/MoEF/009 dated 21.01.2014. Valid CC&A is

		Act, 1981 from the Gujarat Pollution Control Board before commissioning of the project and a copy of each of these shall be sent to this Ministry		taken from GPCB before commissioning of the project. Complied Attachment: NA
5	MISCELLANEOUS	The sand dunes, corals and mangroves, if any, on the site shall not be disturbed in any way.	PPs Submission	Not disturbed by any such things. The construction and commissioning of the facilities at Dahej completed and jetty is operational since April 2014. Complied Attachment: NA
6	MISCELLANEOUS	A copy of the clearance letter will be marked to the concerned Panchayat / local NGO, if any, from whom any suggestion/representation has been received while processing the proposal.	PPs Submission	Complied Complied Attachment: NA
7	MISCELLANEOUS	The funds earmarked for environment protection measures shall be maintained, in a separate account and there shall be no diversion of these funds for any other purpose. A year-wise expenditure on environmental safeguards shall be reported to this Ministry's Regional Office at Bhopal and the State Pollution Control Board. .	PPs Submission	The funds earmarked for environment protection measures is maintained and as follows. Rs 33.22 Lacs spent for development of green belt and mangrove plantation. during the year 2009-2010. Rs 50 Lacs spent for development of Green belt and Mangrove plantation during the year

2010-2011 Rs 93.31 Lacs spent for development of Green belt and Mangrove plantation during the year 2011-2012 Rs 109.57 Lacs spent for development of Green belt and Mangrove plantation during the year 2012-2013 Rs 95.20 Lacs spent for development of Green belt and Mangrove plantation during the year 2013-2014. Rs 81.68 Lacs spent for development of Green belt and Mangrove plantation during the year 2014-15. Rs 42.20 Lacs spent for development of Green belt and Mangrove plantation during the year 2015-16. Rs. 77.96 Lacs spent for development of Green Belt and Mangrove Plantation during the year 2016-17. Rs. 71.08 Lacs spent for development of Green Belt and Mangrove Plantation during the year 2017-18. Rs. 60.93 Lacs

spent for development of Green Belt and Mangrove Plantation during the year 2018-19. Rs. 51.10 Lacs spent for development & maintenance of Green Belt during the year 2019-20. Rs. 78.96 Lacs spent for development & maintenance of Green Belt during the year 2020-21. Rs. 76.26 Lacs spent for development & maintenance of Green Belt during the year 2021-22. Rs. 74.65 Lacs spent for development & maintenance of Green Belt during the year 2022-23 (For period April 22 to March 23). Rs. 196.86 Lacs spent for development & maintenance of Green Belt during the year 2023-24 (For period April 23 to September 23). STP operational cost is Rs. 7.76 Lacs FY 22-23 (For period April 22 to March 23). STP operations cost is Rs. 3.88 Lacs FY 23-24 (For period April 23 to September 23).

				Complied Attachment: NA
8	MISCELLANEOUS	Full support shall be extended to the officers of this Ministry's Regional Office at Bhopal and the officers of the Central and Sate Pollution Control Boards by the project proponents during their inspection for monitoring purposes by furnishing full details and action plans including the action taken reports in respect of mitigate measures and other environmental protection activities.	PPs Submission	PLL is committed to provide full support during site inspection of statutory agency and required data are provided. Complied Attachment: NA
9	MISCELLANEOUS	In case of deviation or alteration in the project including the implementing agency, a fresh reference shall be made to this Ministry for modification in the clearance conditions or imposition of new ones for ensuring environmental protection.	PPs Submission	No deviation or alternation during the project Complied Attachment: NA
10	MISCELLANEOUS	The ministry reserves the right to revoke this clearance, if any of re condition stipulated or not complied with to the satisfaction of this ministry.	PPs Submission	Agreed. No Such case till date. Complied Attachment: NA
11	MISCELLANEOUS	The ministry or any other competent authority may stipulate any other additional conditions subsequently if deemed necessary for environmental protection which shall be complied with	PPs Submission	Agreed and complied Complied Attachment: NA
12	MISCELLANEOUS	The project proponent shall advertise at least in two local newspapers widely circulated in the region around the project, one of which shall be in the vernacular language	PPs Submission	Agreed and complied. Project is completed. Jetty is under operation since

		of the locality concerned informing that the project has been accorded environmental clearance and copies of clearance letters are available with the State Pollution Control Board and may also be seen at Website of the Ministry of Environment & Forests at littp://www.envfornic.in. The advertisement shall be made within 7 days from the date of issue of the clearance letter and a copy of the same shall be forwarded to the Regional Office of this Ministry at Bhopal.		April-2014. Complied Attachment: NA
13	MISCELLANEOUS	The project proponents should inform the regional office as well as the ministry the date of financial closure and final approval of the project by the concerned authorities and the date of start of the land development work	PPs Submission	Project is completed. Jetty is under operation since April-2014. Complied Attachment: NA
14	MISCELLANEOUS	Any appeal against this environmental clearance shall lie with the National Environment Appellate Authority, if preferred, within a period of 30 days as prescribed under Section 11 of the National Environment Appellate Act, 1997	PPs Submission	Agreed. No such case Complied Attachment: NA

Document Upload

Last Site Visit Report (if available)
NA
Last Site Visit Report Date (if available)
Additional Attachment (if any)
Click to View

Additional Remarks (if any)
SIX MONTHLY COMPLIANCE REPORT TO THE CONDITION MENTIONED IN MOE&F LETTER NO. J-17011/11/2000-IA-III, DATED: 14th NOVEMBER, 2008 (STAND BY JETTY)

☑ I 'Petronet LNG Limited, Dahej' hereby give undertaking that the data and information given in the filed compliance and enclosures are true to be best of my knowledge and belief and I am aware that if any part of the data and information found to be false or misleading at any stage, the clearance given to the project will be revoked at our risk and cost. In addition to above, I hereby give undertaking that no activity such as change in project layout, construction, expansion, etc. has been taken up without due approval.

Cover Letter From IRO

Cover Letter From IRO

NA

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ANNEXURE-I

Compliance to conditions as conveyed by Department of Forests & Environment, Govt. of Gujarat, Letter No. ENV-10-2004-117-E, dated: September 5, 2008 as on 30.09.2023

Point-wise compliance statement for the subject environmental clearance is as below:

SR. NO.	CONDITIONS	STATUS
1	The provisions of CRZ notification of 1991 and subsequent amendments issued from time to time.	Noted for compliance.
2	All necessary permissions from different Government Departments / Agencies shall be obtained by PLL before commencing the expansion activities.	Complied. All the required statutory approval were obtained before commissioning.
3	No effluent or sewage shall be discharged into the sea / creek or in the CRZ area and shall be treated to confirm the norms prescribed by the Gujarat Pollution Control Board and would be reused / recycled within the plant premises.	Complied Domestic wastewater is treated through sock pit and STP and no process effluent generated. Treated water from STP is reused for gardening and horticulture purpose.
4	All the recommendations and suggestion given by the NIOT and WAPCOS in their Environment Impact Assessment reports shall be implemented strictly.	Complied. All the recommendation are complied.
5	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 PLL.	Complied. PLL agree to born cost of external agency appointed by this department.
6	The PLL shall have to contribute financially for any common study or project that may be proposed by this Department for environmental management / conservation / improvement for the Gulf of Khambhat or for Dahej region.	Complied. PLL agree to contribute financially for any common study proposed by this department.
7	The construction debris and any other type of waste shall not be discharged into the sea / creak or in CRZ areas. The debris shall be removed from the construction site immediately after construction is over.	Complied.

8	The construction camps shall be located outside the CRZ area and the construction labor shall be provided with necessary amenities, including sanitation, water supply and fuel and it shall be ensured that the environmental conditions are not deteriorated by construction labor.	
9	The PLL shall prepare and regularly update its local oil Spill Contingency plan and Disaster Management Plan in consonance with National Oil Spill and Disaster Contingency Plan	Complied. Oil spill contingency and Disaster management plan updated periodically. ERDMP plan updated and recertify on 12/10/2022 by PNGRB approved agency M/s Bosai Safety and valid up to 11/10/2025. Please Refer Annexure – IV for valid ERDMP certificate.
10	The Gujarat Maritime Board shall initiate for the Vessel Traffic Management System for the Gulf of Khambhat and would work out the modus operandi for cost sharing by different players in the Gulf including PLL. The PLL shall contribute for the same as may be decided by Gujarat Maritime Board.	Noted for compliance. Gujarat Maritime Board has established VTS System and PLL is complying with all norms as per Gujarat Maritime Board.
	General Conditions:	
11	The ground water shall not be tapped to meet with the water requirements in any case	Complied. Ground Water was not used in construction.
12	The PLL shall take up massive mangrove plantation activities in 100 ha. of area on Gujarat Coast line as well as greenbelt development activities in consultation with the Gujarat Institute of Desert Ecology / Forest department. .	Complied. Following Mangrove Plantation Completed along the Gujarat Coast in consultation with GEC & Forest Dept.: Completed : 1150 Hectares (2009-10, 2010-11, 2011-12, 2012-13, 2013-14, 2014-15 & 2016-17).
13	The PLL shall have to contribute financially for taking up the socio-economic upliftment activities in this region in consultation with the Forest and Environment Department and the District Collector / District Development Officer.	Noted for compliance. Compliance report is attached as Annexure III

14	Environmental Audit report indicating the changes, if any with respect to the baseline quality, in the coastal and marine environmental shall be submitted every year.	**Complied.** PLL is ISO 14001(Environment Management System) certified company. Procedures are adopted and followed strictly to protect the environment. Annual external environmental audit for ISO 14001 certification is carried out. Pls refer **Annexure VI** for ISO14001 certificate. Also, Monthly Environmental monitoring done through GPCB approved agency, and all parameters are under prescribed limit. Pls refer **Annexure II** for Environment monitoring data. Six Monthly Marine ecological monitoring is also carried out for monitoring marine ecological condition. Last Marine ecological monitoring was conducted on 9th June ,2023 by authorized vendor M/s Unistar Environment and Research Labs Pvt. Ltd.
15	A six monthly report on compliance of the conditions mentioned in this letter shall have to be furnished by the PLL on regular basis to this Department.	Noted for compliance. Half yearly compliance report submitted regularly.
16	Any other condition that may be stipulated by this Department from time to time for environmental protection / management purpose shall also have to be complied with by the PLL.	Agree and noted for compliance.

ANNEXURE - II - ENVIROMENT DATA

AMBIENT AIR QUALITY STATUS REPORT

All units are in µg/m^3.

Sr.no.	Month	PM10		PM2.5		SOx		NOx		HC as Methane CH_4	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
	NAAQ norms	100 µg/m^3		60 µg/m^3		80 µg/m^3		80 µg/m^3		Absent	
1	Jan-23	72.00	89.00	20.00	28.00	12.40	20.30	15.10	26.30	BDL	BDL
2	Feb-23	71.00	88.00	20.00	33.00	12.10	20.30	15.20	24.60	BDL	BDL
3	Mar-23	71.00	88.00	20.00	31.00	12.60	20.30	17.40	24.60	BDL	BDL
4	Apr-23	74.00	88.00	18.00	32.00	12.30	19.60	17.10	22.80	BDL	BDL
5	May-23	71.00	88.00	18.00	32.00	11.40	20.30	14.70	24.80	BDL	BDL
6	Jun-23	71.00	88.00	20.00	32.00	12.10	18.60	15.20	26.80	BDL	BDL
7	Jul-23	70.00	84.00	20.00	28.00	12.30	18.90	16.40	23.40	BDL	BDL
8	Aug-23	64.00	84.00	16.00	28.00	11.60	19.20	14.20	22.30	BDL	BDL
9	Sep-23	61.00	78.00	18.00	28.00	12.30	18.70	15.20	21.40	BDL	BDL
10	Oct-23									BDL	BDL
11	Nov-23									BDL	BDL
12	Dec-23									BDL	BDL
	Range (Jan-23 to Sept 23)	61-89		16-33		11.4-20.3		14.2-26.8		BDL	

STACK EMISSION AIR QUALITY STATUS REPORT

Sr.no.	Month	GTG		
		SPM	SO_X	NO_X
GPCB norms		150 mg/NM^3	100 ppm	50 ppm
1	Jan-23	BDL	BDL	17.10
2	Feb-23	BDL	BDL	16.30
3	Mar-23	BDL	BDL	17.20
4	Apr-23	Not monitored due to non operational GTGs		
5	May-23	Not monitored due to non operational GTGs		
6	Jun-23	BDL	BDL	16.80
7	Jul-23	BDL	BDL	17.20
8	Aug-23	Not monitored due to non operational GTGs		
9	Sep-23	BDL	BDL	16.50
10	Oct-23			
11	Nov-23			
12	Dec-23			
	Range (Jan-23 to Sept-23)	BDL	BDL	16.3-17.2

BDL: Below Detection Level.

NOISE LEVEL REPORT

Sr.no.	Location	Unit	Limit	Jan-23		Feb-23		Mar-23		Apr-23		May-23		Jun-23		Jul-23		Aug-23		Sep-23		Oct-23		Nov-23		Dec-23	
				L_{day}	L_{night}	L_{day}	L_{night}	L_{day}	L_{night}	L_{day}	L_{night}	L_{day}	L_{night}	L_{day}	L_{night}	L_{day}	L_{night}	L_{day}	L_{night}	L_{day}	L_{night}	L_{day}	L_{night}	L_{day}	L_{night}	L_{day}	L_{night}
1	North	decibel	Day-75 db Night-70db	52.6	43.6	51.3	44.6	52.3	46.3	54.6	48.4	55.2	48.5	54.1	47.6	55.3	48.3	51.2	47.2	52.6	58.4						
2	East	decibel	Day-75 db Night-70db	51.1	41.8	52.3	41.6	55.4	42.8	56.7	43.6	54.5	43.8	55.1	44.1	56.3	46.5	53.4	46.1	52.3	45.6						
3	West	decibel	Day-75 db Night-70db	52.6	42.5	55.4	42.8	56.3	44.1	58.1	46.1	57.2	45.7	56.9	46.8	55.2	44.8	51.7	42.5	50.4	40.7						
4	South	decibel	Day-75 db Night-70db	51.8	42.7	52.6	41.8	51.8	42.7	52.3	44.2	51.6	42.6	52.3	44.3	52.4	46.2	55.6	44.6	51.7	42.2						

GROUND WATER QUALITY STATUS REPORT

Sr.no.	Parameter	Unit	Mar-23		Jun-23		Sep-23		Dec-23	
			GW1	GW2	GW1	GW2	GW1	GW2	GW1	GW2
1	Temperature	*C	30	29	31	30	29	28		
2	PH	-	8.76	8.31	8.87	8.58	8.06	8.91		
3	Total Dissloved Solids (TDS)	mg/L	2040	2290	3206	3012	1406	1308		
4	Chlorides as CL	mg/L	589.4	570.5	906.1	553.3	36.6	36.8		
5	Sulphate as SO4	mg/L	164.2	392.6	210.5	350.5	158	220		
6	BOD (5 days @ 20^{o}C)	mg/L	BDL	BDL	3	4	BDL	BDL		
7	COD	mg/L	BDL	BDL	13.3	16.4	BDL	BDL		
8	Oil & Grease	mg/L	BDL	BDL	BDL	BDL	BDL	BDL		
9	Phenolic Compound	mg/L	BDL	BDL	BDL	BDL	BDL	BDL		
10	Zinc as Zn	mg/L	BDL	BDL	BDL	BDL	BDL	BDL		
11	Total Chromium as Cr+3	mg/L	BDL	BDL	BDL	BDL	BDL	BDL		
12	Lead as Pb	mg/L	BDL	BDL	BDL	BDL	BDL	BDL		
13	Cyanide as CN	mg/L	BDL	BDL	BDL	BDL	BDL	BDL		
14	Flouride as F	mg/L	1.6	0.94	1.9	1.9	1.2	1.4		
15	Copper as Cu	mg/L	BDL	BDL	BDL	BDL	BDL	BDL		
16	Insecticide	mg/L	Absent	Absent	Absent	Absent	Absent	Absent		
17	Pesticide	mg/L	BDL	BDL	BDL	BDL	BDL	BDL		
18	Mercury as Hg	mg/L	BDL	BDL	BDL	BDL	BDL	BDL		
	ND*: Not detected									

MARINE WATER QUALITY STATUS REPORT

Sr.no.	Parameter	Unit	Mar-23	Jun-23	Sep-23	Dec-23
			MW	MW	MW	MW
1	Temperature	*C	29	30	28	
2	PH	-	7.86	8.05	7.75	
3	Color	Co-pt	40	60	70	
4	Total Suspended Solids	mg/L	620	>1000	790	
5	Total Dissloved Solids (TDS)	mg/L	>10000	>10000	>10000	
6	Chlorides as CL	mg/L	>5000	>5000	>5000	
7	Sulphate as SO4	mg/L	>2000	>2000	>2000	
8	BOD (5 days @ 20^{o}C)	mg/L	110	44	40	
9	COD	mg/L	461.9	122.7	148.6	
10	Oil & Grease	mg/L	BDL	BDL	BDL	
11	Phenolic Compound	mg/L	BDL	BDL	BDL	
12	Zinc as Zn	mg/L	0.168	0.177	0.163	
13	Total Chromium as Cr+3	mg/L	0.084	0.096	0.084	
14	Lead as Pb	mg/L	BDL	BDL	BDL	
15	Cyanide as CN	mg/L	BDL	BDL	BDL	
16	Flouride as F	mg/L	BDL	4.95	2.2	
17	Copper as Cu	mg/L	0.066	0.082	0.074	
18	Insecticide	mg/L	Absent	Absent	Absent	
19	Pesticide	mg/L	BDL	BDL	BDL	
20	Mercury as Hg	mg/L	BDL	BDL	BDL	
21	Hexavalent Chromium as Cr+6	mg/L	BDL	BDL	BDL	
22	Nickel as Ni	mg/L	BDL	BDL	BDL	
	ND*: Not detected					

ANNEXURE –III

CSR DETAILS

PLL has constructed a temple at the site for the local people and has contributed towards infrastructure in the area for roads and drinking water.

Community development and welfare measures are taken. Village Luwara has been jointly adopted along with another nearby industry, as directed by PCPIR Welfare Society. Separate fund allocated for CSR.
Some of the schemes completed/under progress are Health Center (construction & operation), drainage and provision of street lights at Village Luwara. Rupees 75 lakh contributed to PCPIR Welfare Society. Two ladies from Luwara village sponsored for nursing course at Vidhyadeep Community college, Bharuch. Sponsored construction of Sanitation scheme at village Muller. Active participation in other Government initiated community development programs.

Installed 10 nos. Emergency solar lighting at prominent places in village Luwara. Donated Rs.1 lac for Bharuch District Civic centre development. Participated in Govt. scheme on KanyaKelvani. Installation of drainage crossings to remove accumulated water at 4 locations within the village Luvara at a cost of Rs. 0.8 lacs.Construction of approach road in village Lakhigaon, Dahej.

PLL has sponsored 'Mataria Talav drinking water project' of the Bharuch Municipality Corporation. This project is for the supply of sweet drinking water from the Narmada River to the residents of Bharuch city. MD&CEO handed over cheque for Rs. 25 Lacs to the Collector, Bharuch on 13/06/2011 and further, PLL added Rs. 20 Lacs for the 'MatariaTalav drinking water project'

PLL installed 50 nos. Emergency solar lighting at prominent places in village Luwara& 10 nos. Emergency solar lighting at prominent places in village Lakhigam of Vagra Taluka in Bharuch District. Provided School Bus to Primary School at Lakhigam Village and also running Primary Health Center at Luvara Village. PLL constructed Bus-stand and extended Gram Panchayat Bhavan building at Luvara Village.

PLL installed 25 Nos. of Solar lights at prominent places in village Lakhigam and Luwara. Contributed Rs. 20 Lakhs in Akshay Patra mid-day meal scheme at villages in and around Dahej location. Also, contributed Rs. 10.00 Lakhs in Gujarat Lion Conservation Society towards procurement of Vehicle.

Primary health services to Luvara village, Gynec health and Pulse Polio campaign (Pakhajan PHC). PLL supported noble cause of Construction of Storm water drainage at Shravan Chokdi to Jambusar by pass (over bridge) in Bharuch. This project is executed under District Collector office.

Request from CDHO (Chief District Health Officer) was received to participate in various health initiatives. PLL agreed during meeting with DM to provide the ambulance for PHC, Pakhajan Village of Vagra Taluka. PLL is supporting Luvara School for reference books, uniform, school picnic and creating awareness on environment, health, safety and security aspects through various programs regularly, rewarding bright students etc. PLL celebrated Shala Pravesh Utsav at Luvara School and distributed tool box to children.

Bharuch has problem of solid waste management and garbage disposal. To improve on cleanliness of the town, PLL is supporting initiative of GREEN BHARUCH CLEAN BHARUCH by donating two dumper placer worth Rs. 23.94 Lakh.

Due to delay in recruitment of teachers, primary schools in and around Dahej has 40% teaching staff. To support education by deploying young educated teachers, PLL sponsored 14 teachers in 4 schools of villages of Dahej, Lakhigam and Luvara.

PLL constructed 11hosues of homeless tribes in Luvara village at a cost of 25 Lakh. PLL initiated drive to make Luvara open defecation free by sponsoring toilets for 172 houses at a cost of Rs. 17.2 Lakh.

As a part of initiate for Swachh Bharat Abhiyan, PLL constructed five toilet blocks for school at Lakhigam, Luvara, Ambetha, Jageshwar & Dahej. Also, PLL has constructed 91 Toilet blocks at an estimated expenditure of Rs. 172 Lakhs for various schools in fifteen district of Assam in co-ordination with Rashtriya Madhiyamik Siksha Abhiyan (RMSA).

Cancer screening done (Pep and Breast) for female above 18 years at Luvara village. Establishment of equipment for Ultra Sonography Ward done at General/Civil Hospital, Bharuch. Motivational Awards (Academics and punctuality), School kit and reference books given for Luvara School students. Nutrition and clothing kit (105 nos.) was given to under nourished baby and mother.

PLL has sponsored Drawing competition, Educational tour and uniform distribution at Primary School Luvara. PLL sponsored Medical Equipment such as Eye sight testing, ECG Machine, Spirometer, Pulse Oxymeter etc. to Luvara Primary Health Centre. PLL also celebrated Swatch Bharat Pakhwada during 16th June, 2016 to 30th June, 2016 in co-ordination and consultation with neighboring villages, communities, schools etc.

The launch of Project Vidhyagam was organized in Luwara Primary School wherein a classroom library for std. 7 & 8 students is setup. About 130 books (syllabus and general reading including comics, biographies, story books, general knowledge, science fiction in Gujarati, Hindi and English language) has been kept in the library. The idea behind this project is that students develop interest in reading and thus studying. The PLL Disha Ladies Club organized for food and distribution of educational kits for 65 girls in the Orphanage in Bharuch on 11th Sept 2016. A focused group discussion on importance of hygiene and cleanliness was organized by Ladies club members as well.

Roofing item worth Rs. 2 Lacs was provided to the Gram Panchayat Office of Luwara Village for construction of house for 10 tribal families living below the poverty line. This material consisted of cement roof, channel, and hooks. It is expected that the construction of houses will be done by mid-January 2017.

Petronet LNG Limited celebrated the World Sight Day on 13th October 2016 by organizing the Eye Screening Camp for contractual labor at the company premises. The camp was organized in association with Wockhardt Foundation and about 200 labor and 60 employees participated in the same. During the camp; 125 specs and 60 unit of drops were distributed to beneficiaries based on assessment by Doctors.

On the occasion of 147th birth anniversary of Father of Nation Shri Mahatma Gandhi Health and Hygiene talk, Swachhta Selfie Campaign, Drawing Competition at Govt. High School, Lakhigam and other activities were organized as part of Swachh Bharat Abhiyaan.

It is observed that there is a shortage of regular teachers in local schools and severely hampering the quality of education of poor children in schools. To mitigate this problem, PLL has started supporting para teachers in local school and ensuring improvement in quality of education in local schools.

PLL CSR team participated in world school day celebration on 23 March, 2017. As a part of celebration PLL has distributed Uniforms to Std. 8th Students. It was decided to provide two pair of uniforms to all students in school. The uniforms were prepared by Sardar Mahila Vikas Mandal a group of tribal women for employment generation and livelihood opportunity. PLL provided work order worth of Rs. 2,23,980/-

As the students studying in primary schools are coming from BPL and poor families, most of the families are not able to afford educational tours for their children. Every year school is organizing such tour sponsored by PLL. Students will get exposures to various places and gain experience. About 150 students get benefit of this tour and

places covered like Dwarka, Somnath, Porbandar, Smruti Mandir, Naheru Planetorium, Sasan Gir etc.

PLL had sponsored community mass marriage of weaker community, participated in Shala Pravesh Utsav 2017, planted 150 of trees in nearby villages, distributed food packages during water logging observed at nearby villages, supported empowerment of Special children, engaged contractor for repair and maintenance of Toilets in nearby School, arranged cessions for awareness on solid waste management at school.

PLL supported 10th Special Olympics, Bharuch in January, 2018, sponsored project "Kaushal Setu" Skill Development Program with CIPET, Ahmedabad and trained 100 underprivileged youth, supported educational tour for Primary School of Luvara Village, provided para-teachers at school of nearby villages, sponsored community mass marriage of weaker community, supported "Startup Village" project towards Rural Youth Entrepreneurship Development Program, Supporting Swachh Bharat Abhiyan by District Administration Bharuch (Heritage Walk).

PLL signed MoA with Samagra Shiksha Abhiyan, Department of Education, Govt. of Gujarat on 23rd Jan. 2019 at Govt. Primary School, Luvara village for the Development of Primary School at Luvara Village. PLL supported District Level Special Olympics Games which was organized on 23rd February 2019. Around 250 special children, 150 volunteers including PLL volunteers and coaches participated during the event.

(July, 2019 to Dec. 2019)

PLL has signed MoU with ALIMCO to provide Aids and Equipment to disables of Bharuch District. PLL has signed MoU with Wockhardt Foundation to run Mobile Medical Unit (MMU) in nearby villages of PLL plant area. PLL has signed MoU with NHFDC to provide skill training to disable youth of Bharuch District. PLL has supported relief camp for affected community near Lakhigam during monsoon season.

(Jan.2020 to June 2020)

PLL has conducted assessment camps at Jambusar and Vagra Taluka of Bharuch Distrcit to Aids and Equipment to disables. Kaushal Setu Skill Training with CIPET Ahmedabad 78 candidates have complated the training and 90% of them got job with the salary range of Rs. 9000 to Rs. 12000. PLL has conducted District Level Special Olympics in parnership with Kalrav Trusy Bharuch and Special Olympics, Gujarat. As a part of COVID-19 pendemic response, PLL has contributed Rs. 34.00 lakhs to

Distrcit Health Office, Bharuch to proqure PPE Kits, Masks and Senitise materils for COVID-19 worriers. PLL has provides 4300 nos. of Ration kits worth of Rs. 25.00 lakhs to Migrant Labours, and Poor Families of nearby villages. Petronet LNG Limited (PLL) under its CSR initiatives aims at distributing 1,00,000 face masks to the migrant labor communities, slum dwellers, nearby hospitals, local police authorities & Government Offices to combat COVID-19 in the Bhaurch District of Gujarat.

(July 2020 to December 2020)

PLL has supported Construction of Priamry School, at Luvara village worth of Rs. 1,71 Crore. Construction is about to complete by March, 2021. PLL has distributed aids and equipment to about 250 disable beneficiaries at Jambusar and Vagra Taluka of Bharuch District. As a part of COVID-19 pandemic response, in addition to supporting District Health Office (CDHO) and Distributing Rations Kits to to Migrant Labours, and Poor Families of nearby villages, PLL has prepared 1,00,000 cotton masks through Women SHGs of Bharuch Distrcit. About 80 women got indirect employment during pandemic through this initiative. These masks were distributed among local communities of nearby villages, health workers, labour community, Nagarpalika Sawachhta Karmchari, Special Children and their families, Vegetable vendors, Local Police authorities, Government Offices, Security Guards, PLL employees also participated in mask distribution initiative. These masks were made of Cotton considering it environment aspect for reusable and bio-degradable properties.

(January, 2021 to June, 2021)

PLL/PLF has signed agreement with Wockhardt Foundation to run Mobile Medical Unit (MMU) in nearby villages of PLL plant area. This MMU is providing its services to nearby villages like Lakhigam, Navi Nagari, Luvara, Jageshwar, Ambetha. More than 5500 patients have been benefited during last six months. PLL/PLF has signed agreement with NHFDC to provide skill training to disable youth of Bharuch District. First batch of 30 candidate started from April, 2021. . PLL/PLF has signed agreement with MOKSHDA to install environment friendly green crematorium system to reduce excessive use of wood. The works are under progress, Construction of Govt. Primary School at Luvara village with 12 classrooms and modern amenities worth of Rs .1.71 Crs. and Construction of 24 Nos. of widow quarters for BSF worth of Rs. 5.87 Crs. are going to completed by end of July, 2021. PLL/PLF skill training partner CIPET, Ahmedabad has completed skill training of 75 candidates and remaining 25 candidates are under progress. Candidate have secured job of Rs. 10,000 per month to Rs. 15,000 per month post completion of training programme. Most of the CSR projects got delayed due COVID-19 restrictions.

(July, 2021 to December, 2021)

PLL/PLF has signed agreement with Wockhardt Foundation to run Mobile Medical Unit (MMU) in nearby villages of PLL plant area. This MMU is providing its services to nearby villages like Lakhigam, Navi Nagari, Luvara, Jageshwar, Ambetha. More than 8500 patients have been benefited during last six months. PLL/PLF has signed agreement with NHFDC to provide skill training to disable youth of Bharuch District. First batch of 30 candidate started from April, 2021 and second batch of 20 candidates started in August, 2021 and both batches have been completed during December, 2021. PLL/PLF has signed agreement with MOKSHDA to install environment friendly green crematorium system to reduce excessive use of wood. The works are under progress, Construction of Govt. Primary School at Luvara village with 12 classrooms and modern amenities worth of Rs .1.71 Crs. and Construction of 24 Nos. of widow quarters for BSF widow's worth of Rs. 5.87 Crs. are completed. PLL/PLF skill training partner CIPET, Ahmedabad has completed skill training of 93/100 candidates. Candidate have secured job of Rs. 10,000 per month to Rs. 15,000 per month post completion of training programme. PLL has signed agreement with Bharuch Nagarpalika to provide support for Disaster Management and Swachh Bharat Abhiyan, Bharuch Nagarpalika would procure one fire tender and Road sweeping machine with the financial support of Rs. 1.93 Cr. under PLL CSR Initiatives. PLL has signed an agreement with Gujarat CSR Authority (GCSRA) for construction of Panchayat Bhavan at Lakhigam village. PLL has supported Development of Green Zone beneath newly constructed flyover bridge at Bharuch City.

(January, 2022- June, 2022)

PLL/PLF has signed agreement with Wockhardt Foundation to run Mobile Medical Unit (MMU) in nearby villages of PLL plant area. This MMU-1 is providing its services to nearby villages like Lakhigam, Navi Nagari, Luvara, Jageshwar, Ambetha. More than 15000 patients have been benefited during last six months. PLL/PLF has signed agreement with NHFDC to provide skill training to disable youth of Bharuch District. First batch of 30 candidate started from April, 2021 and second batch of 20 candidates started in August, 2021 and both batches have been completed during December, 2021.This project benefited 50 disable persons with computer skill, Certificate distribution held during June, 2022. PLL/PLF has signed agreement with MOKSHDA to install environment friendly green crematorium system to reduce excessive use of wood. The works are under progress, Construction of Govt. Primary School at Luvara village with 12 classrooms and modern amenities worth of Rs .1.71 Crs. and Construction of 24 Nos. of widow quarters for BSF widow's worth of Rs. 5.87 Crs. are completed. PLL/PLF skill training partner CIPET, Ahmedabad has completed skill training of 93/100 candidates. Candidate have secured job of Rs. 10,000 per month to Rs. 15,000 per month post completion of training programme.

PLL has singed a new agreement with CIPET, Ahmedabad to train 400 candidates in CNC Machine and Plastic Product Manufacturing. First batch of 50 candidate enrolled and initiated. PLL has signed agreement with Bharuch Nagarpalika to provide support for Disaster Management and Swachh Bharat Abhiyan, Bharuch Nagarpalika would procure one fire tender and Road sweeping machine with the financial support of Rs. 1.93 Cr. under PLL CSR Initiatives. PLL has signed an agreement with Gujarat CSR Authority (GCSRA) for construction of Panchayat Bhavan at Lakhigam village with financial support of Rs. 1.13 Crs.. PLL has supported Development of Green Zone beneath newly constructed flyover bridge at Bharuch City with financial support of Rs. 5.00 lakhs. PLL has supported development of Sports facility by Police Department, Bharuch with financial support of Rs. 5.00 lakh. PLL has supported Medical Equipments to Kasturba Hospital, Seva Rural Jhagadia with financial support of Rs. 5.00 lakh. PLL has provided support to Seva Yagaya Samiti for Strengthening of Facilities for Orphan/destitute Old Age Patients at Civil Hospital, Bharuch for Rs. 5.00 lakh. PLL has partnered with National Youth Foundation to Support for School Health Check-Up Program' at 48 Schools of Vagra Taluka, Dist. Bharuch Gujarat for Rs. 19.92 lakh.

(July, 2022- December, 2022)

PLL/PLF has signed agreement with Wockhardt Foundation to run Two Mobile Medical Unit (MMU) in nearby villages of PLL plant area. This MMU-1 is providing its services to nearby villages like Lakhigam, Navi Nagari, Luvara, Jageshwar, Ambetha. MMU-2 is providing services to Dahej, Suva, Rahiyad, Vav, Vadadla, Kadodar and Sambheti More than 30000 patients have been benefited during last six months. PLL has singed a new agreement with CIPET, Ahmedabad to train 400 candidates in CNC Machine and Plastic Product Manufacturing. First batch of 50 candidates and second batch of 45 candidates enrolled and initiated. PLL skill training partner CIPET, Ahmedabad has completed skill training of 39 candidates. Candidate have secured job of Rs. 10,000 per month to Rs. 15,000 per month post completion of training programme. PLL has signed an agreement with Gujarat CSR Authority (GCSRA) for construction of Panchayat Bhavan at Lakhigam village with financial support of Rs. 1.13 Crs. The Construction works are under progress. PLL has partnered with National Youth Foundation to Support for School Health Check-Up Program' at 48 Schools of Vagra Taluka, Dist. Bharuch Gujarat for Rs. 19.92 lakh. This programme successfully completed about 6500 students benefited from this initiative. PLL had partner with Blind People's Association and Torch It to distribute 1000 assistive devises to Divyang Jans of Gujarat State, The Project successfully completed with distribution in various interior districts of Gujarat State.

PLL has celebrated Swachhta Pakhwada 2022 with Say no to Plastic theme, distributed about 20,000 cotton bags prepared by SHGs and various awareness initiatives in local villages. PLL has celebrated Har Ghar Tiranga 2022 Abhiyan, and distributed about 10,000

National Flags prepared by SHGs in local villages. PLL has supported Installation of Dishwasher Machine at Asmita Vikas Kendra, Tralsa (Bharuch) worth of Rs. 4.75 Lakhs.

(January, 2023- September, 2023)

PLL has signed agreement with Wockhardt Foundation to run Two Mobile Medical Unit (MMU) in nearby villages of PLL plant area. This MMU-1 is providing its services to nearby villages like Lakhigam, Navi Nagari, Luvara, Jageshwar, Ambetha. MMU-2 is providing services to Dahej, Suva, Rahiyad, Vav, Vadadla, Kadodar and Sambheti More than 60000 patients have been benefited during last six months.

PLL has singed a new agreement with CIPET, Ahmedabad to train 400 candidates in CNC Machine and Plastic Product Manufacturing. PLL skill training partner CIPET, Ahmedabad has completed skill training of 110 candidates. 90% Candidates have secured job of Rs. 10,000 per month to Rs. 15,000 per month post completion of training programme.

PLL has signed an agreement with Gujarat CSR Authority (GCSRA) for construction of Panchayat Bhavan at Lakhigam village with financial support of Rs. 1.13 Crs. The Construction works are under progress.

PLL has signed an agreement with Gujarat CSR Authority (GCSRA) for construction of Govt. Primary School Building at Lakhigam village with financial support of Rs.2.41 Crs. The building plan, design and estimates preparation under progress.

PLL has signed an agreement with Vikas Centre for Development for Pond Redevelopment at Luvara village with project cost of Rs. 95.00 lakh. This project would ensure preservation of natural resources, ground water recharged and reduce salinity in this area.

PLL has signed an Agreement with Ekal Gramothan Foundation to Support Basic Computer Education in Interior Tribal Villages of Narmada and Bharuch District. About 300 youth gets trained on basic computer education.

PLL has singed an MoU with District TB Office, Bharuch and Seva Yagya Samiti for Pradhan Matri TB Mukt Bharat Abhiyan. PLL is supporting nutrition kit for 300 TB patients of Bharuch Taluka for six month with project cost of Rs. 18.00 lakh.

PLL has supported District Level Special Olympics for Special Children in Bharuch District. Every Year about 250 special children participate in 25 different sports games. Winners gets chance to represent at State and Nation event.

PLL has supported Development of Sprots Ground at Govt. High School, Lakhigam. PLL has supported women empowerment through livelihood support for Papad making Gruh udhyog. PLL has supported development of Garden and Recreation area at Luvara village.

PLL has supported fisherman community in local area through distribution of Fishing Kit which is useful for seasonal fishing activities for local community.

PLL CSR & HSE Team has conducted Community Awareness Program on Industrial Safety, and Fire Safety in local Schools and Villages.

PLL has celebrated Swachhta Pakhwada 2023 and conducted various awareness programs on Health and Sanitation, Medical Check ups in Schools and Villages, Swachhta Pledge, Wall Painting in villages, Nukkad Natak, Employee Quiz, Painting Competition, Reels Competition, Beach Cleaning etc. It was 15 days long celebration involving 35 stakeholders and more than 1700 participants.

PLL has extended support for flood affected area of Bharuch district by providing Mobile Medical Unit and 500 Ration Kits to District Administration, Bharuch.

PLL supported two Mobile Medical Unit in partnership with Wockhardt Foundation is providing its services in 10 nearby villages on daily basis and facilitated medical services free of cost to more than 3000 patients on monthly basis.

<u>CSR Activities Glimps of July, 2022-December, 2022</u>.

Widow Quarters 24 Nos. at BSF, Gandhinagar

Construction of Primary School Luvara Village

Kaushal Setu Skill Training – CIPET Ahmedabad, MOA Signed (P-III)

Mobile Health Unit (MHU) (Wockhardt Foundation)

Promote fitness and encouragement of sports activities by Police Department, Bharuch

Agreement Signed with GCSRA for Construction of Panchayat Bhavan at Lakhigam village

Swachh Bharat with Bharuch Nagarpalika

Visit of Seva Rural Jhagadiya

Distribution of 1000 Saarthi Assistive Devices to 1000 Blind persons in Gujarat State


torch-it
torch-it


રાષ્ટ્રીય અંધજન મંડળ


સારથી


સારથી

Certificate Distribution for NHFDC Skill Training for Disables

Handover Old age care facility to Seva Yagya Samiti

Visit of Ashmita Vikas Kendra, Tralsa

Construction of Panchayat Bhavan, Lakhigam

Visit of IIT-Gandhinagar

Skill Development Workshop on for promotion of Art & Culture

Har Ghar Tiranga Celebrations

Free School Health Care Camps at 48 Govt, Schools of Vagra Taluka

CSR Activities Glimpse from January 2023, to September, 2023.

Kaushal Setu Skill Training – CIPET Ahmedabad, MOA Signed (P-III)	
	
	

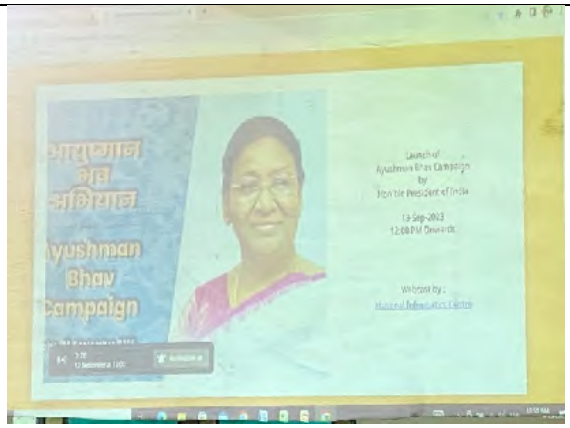
Mobile Health Unit (MHU) (Wockhardt Foundation)

Ekal on Wheel, Ekal Gramothan Foundation

TB Mukt Bharat Abhiyan


WORLD TB DAY 2
YES! WE CAN E


Ministry of Health and Family Welfare,



Distribution of Fishing Kits at Luvara Village

MoA for Construction of Govt. Primary School, Lakhigam Village

Safety Awarness at Luvara Village

Redevelopment of Pond at Luvara Village

Swachhta Pakhwada 2023

Swachhta Hi Seva - 2023

MMU Services in Flood Affected Areas

Ration Kit Handover to District Administration, Bharuch


माखन
भोग
शुद्ध आटा
PETRONET
LNG
LIMITED
TATA
Salt
fortune

Bosai Safety

Certificate of Conformity

Standard: Petroleum and Natural Gas Regulatory Board (Codes of Practices for Emergency Response and Disaster Management Plan (ERDMP) Regulations, 2010 and 2020.

Certificate Number: **BOSAI/0157**

Certificate Holder: Petronet LNG Ltd., Dahej LNG Terminal.

Scope: **Review and implementation of ERDMP as per the PNGRB Regulations**

This is to certify that **BOSAI SAFETY PRIVATE LIMITED**, approved TPIA by PNGRB vide Registration No. PNGRB/Tech/11-TPIA/(3)/2021(P-3506) dated 09.11.2021 have reviewed and assessed the **ERDMP document prepared by Petronet LNG Ltd., Plot No 7/A, GIDC Industrial Estate, Dahej - 392130** and found the same in conformity with the **Petroleum and Natural Gas Regulatory Board (Codes of Practices for Emergency Response and Disaster Management Plan (ERDMP) Regulations, 2010 and 2020.**

The audit team conducted site assessment visit on 29.09.2022 & 30.09.2022 at **Petronet LNG Ltd., Dahej LNG Terminal** to review implementation of ERDMP as per the requirement and found the same to be compliant.

This certificate is being issued to **Petronet LNG Ltd., Dahej LNG Terminal** for their compliance of ERDMP documents as per PNGRB Regulations. 2010 and 2020.

Issued on:12/10/2022, Valid till:11/10/2025

Dinesh Kumar Singh
Digitally signed by Dinesh Kumar Singh
Date: 2022-10-12 16:48:37 +05'30'

(D.K. SINGH)
Chief Executive Officer

BOSAI SAFETY PVT. LTD. NOIDA

(Note: This Certificate is valid for maximum 3 years from the date of issue or till any major Modification/ Revamp in the facility or as per directives of PNGRB whichever is earlier.)

G-405, C58/23, INDIAN OIL APARTMENT, NOIDA-201309, Mob: 9868920846, bosaisafety@gmail.com

Mangroves planted in 50 ha. area at NADA Coast during 2009-10

Mangroves planted in 100 ha. area at Ankalva Coast during 2010-11

Mangroves planted in 200 ha. area at Ankalva Coast during 2011-12

Mangroves planted in 200 ha. area at Ankalva Coast during 2012-13

Mangroves planted in 100 ha. area at Bhavnagar Coast during 2012-13

Mangroves planted in 200 ha. area at Bhavnagar Coast during 2013-14

Mangroves planted in 200 ha. area at Bhavnagar Coast during 2014-15

Mangroves planted in 50 ha. area at at Kentiyajal Coast during 2014-15

Mangroves planted in 50 ha. area at Gadhula, Talaja Coast during 2016-17

Bureau Veritas Certification

PETRONET LNG LTD.

PETRONET LNG LIMITED

PLOT NO. 7/A, GIDC INDUSTRIAL ESTATE, DAHEJ, TALUKA : VAGRA,
DISTRICT: BHARUCH – 392 130, GUJARAT, INDIA.

Bureau Veritas Certification Holding SAS – UK Branch certifies that the Management System of the above organization has been audited and found to be in accordance with the requirements of the Management System Standards detailed below.

Standards

ISO 9001:2015, ISO 14001:2015 & ISO 45001:2018

Scope of certification

PORT OPERATION, RECEIPT, STORAGE, RE-GASIFICATION OF LNG, DISPATCH OF RLNG & LNG

Original cycle start date for ISO 9001 & ISO 14001: **21 January 2005**

Original cycle start date for ISO 45001: **11 March 2021**

Recertification cycle start date: **31 July 2022**

Subject to the continued satisfactory operation of the organization's Management System, this certificate expires on: **30 July 2025**

Certificate No. **IND.22.6844/IM/U** Version: **1** Revision date: **31 July 2022**

Signed on behalf of BVCH SAS UK Branch
Jagdheesh N. MANIAN
Director – CERTIFICATION, South Asia
Commodities, Industry & Facilities Division

UKAS MANAGEMENT SYSTEMS
0008

Certification body address: *5th Floor, 66 Prescot Street, London, E1 8HG, United Kingdom.*

Local office: *Bureau Veritas (India) Private Limited (Certification Business) 72 Business Park, Marol Industrial Area, MIDC Cross Road "C", Andheri (East), Mumbai – 400 093, India.*

Further clarifications regarding the scope of this certificate and the applicability of the management system requirements may be obtained by consulting the organization. To check this certificate validity please call **+ 91 22 6274 2000.**

MARINE ECOLOGICAL MONITORING REPORT

FOR

M/s.PETRONET LNG LIMITED., DAHEJ

JUNE 2023

PREPARED BY: M/S.UNISTAR ENVIRONMENT AND RESEARCH LABS PVT. LTD.

PREFACE

The Company had set up South East Asia's first LNG Receiving and Regasification Terminal with an original nameplate capacity of 5 MMTPA at Dahej, Gujarat. The infrastructure was developed in the shortest possible time and at a benchmark cost. The capacity of the terminal has been expanded in phases which is currently 17.5 MMTPA and the same is under expansion to 22.5 MMTPA in two phases. The terminal has 6 LNG storage tanks and other vaporization facilities. The terminal is meeting around 40% of the total gas demand of the country.

The terminal has two LNG Jetties at Dahej. While the first jetty can handle berthing of up to Q-Flex vessels, the second jetty can handle berthing of up to Q-Max vessels.

Dahej terminal is the largest single location LNG storage and regasification terminal in the country and has recently achieved the milestone of handling 3000th LNG cargo on 7th July 2022. The terminal is also offering tolling services to Off takers & Bulk customers. To cater the small customers who are not having gas pipeline connectivity, Dahej is supplying LNG to such customers which is transported through cryogenic trucks.

PLL Dahej is first terminal to start loading of LNG in trucks for supply of LNG to the areas where pipelines have not reached and today has 04 truck loading bays and hub for development of Small-Scale LNG business. PPL has entrusted the work of carrying out Marine Ecological Monitoring to **M/s.UniStar Environment and Research Labs Pvt. Ltd.**

These Marine Ecological Monitoring reports provide a data obtained from monitoring and analysis activities undertaken on dated.09.06.2023. (June 2023)

Date: 06/07/2023

M/s.UniStar Environment and Research Labs Pvt. Ltd.
White house, Char Rasta, Vapi-396 191

Approved by

Manager - Operations
(Jaivik Tandel)

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❖ INTRODUCTION

1.1 Background:

The Marine Ecological Monitoring involves Physico-chemical and biological analysis of Marine water. Marine water quality of Sub-tidal and Intertidal regions, Flora and Fauna analysis in marine water area and Benthos in inter-tidal and sub-tidal analysis for the Petronet LNG Ltd. (Dahej LNG Terminal). Water sample are collected from different location (station) and Benthos sample are collected from High water and low water transect area. Samples are brought to the laboratory by field sampling team and the analysis was carried out in our laboratory and the results are presented in this report.

1.2 Objectives:

The primary objectives of this study are,

a) To evaluate the physico-chemical parameters of seawater for better understanding of water quality in study region.
b) To assess the marine biological status of the study region with quantitative and qualitative data of marine organisms (phytoplankton, zooplankton, and macrobenthos).
c) To recommend adequate marine environmental management measures.

1.3 Scope of work

Sample collection on spatial basis for the Petronet LNG Ltd. (Dahej LNG Terminal) to evaluate the following parameters:

a) Mrine Biological Water quality sample analysis from subtidal region

Water quality will be assessed for Temperature, pH, Turbidity, Total suspended solids, salinity, Oil & grease, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Calcium Carbonate, Alkanity, Petroleum Hydrocarbons (PHc), Total Phosphate, Nitrate, Ammonical nitrogen, Total nitrogen and Total coliform.

b) Biological Analysis of collected sample with respect to phytoplankton, zooplankton, Chlorophyll from subtidal region

c)Sampling of benthic communities from subtidal region between Low tide and high tide

d)Intertidal flora/fauna Qualitative and quantitative estimations: phytoplankton, pollutation and generic diversity,primaery productivity, zooplankton standing stock, miceobenthic standing stock subtidal region,sea grass,algae,sea weeds,crustaceans,fishes mangroves and migratory birds etc.

1.4 Sampling strategy

To evaluate the influence of activity at the Petronet LNG Ltd. (Dahej LNG Terminal), sedimentary parameters and marine biota present sampling was carried out on dated.09.06.2023

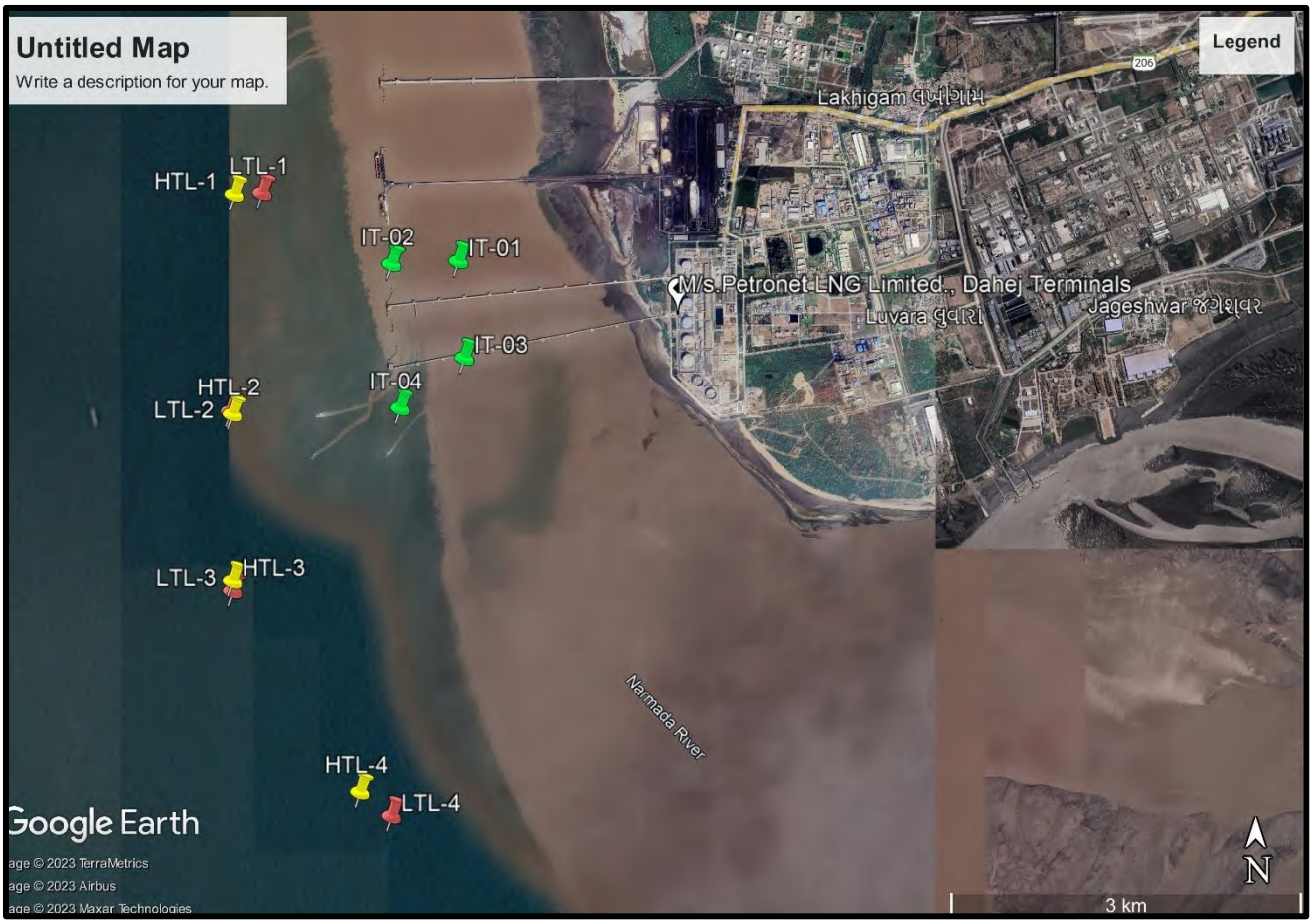
Table 1: Co-ordinates of subtidal and intertidal sampling stations

Stations			Co-ordinates	
Sub-tidal (ST)	ST-1	HTL	21°40.880'N	72°29.807'E
		LTL	21°40.887'N	72°29.948'E
	ST-2	HTL	21°39.867'N	72°29.799'E
		LTL	21°39.880'N	72°29.790'E
	ST-3	HTL	21°39.100'N	72°29.800'E
		LTL	21°39.055'N	72°29.801'E
	ST-4	HTL	21°38.130'N	72°30.432'E
		LTL	21°38.020'N	72°30.587'E
Intertidal (IT)	IT-01		21°40.572'N	72°30.921'E
	IT-02		21°40.559'N	72°30.586'E
	IT-03		21°40.128'N	72°30.950'E
	IT-04		21°39.896'N	72°30.629'E

a) Sampling frequency:

All Sampling subtidal stations were monitored during flood to ebb. Water samples were collected in Triplicate (surface, Middle and bottom) for assessing water quality and marine biological characteristics. Intertidal sampling was completed during low tide, for assessed Macro benthic fauna samples were collect in duplicate from each transects.

Figure 1. Sampling locations of Subtidal and intertidal at M/s.Petronet LNG Limited., Dahej Terminals



b) Sampling methodology:

➢ **Water quality:** Surface water samples were collected using the clean polyethylene bucket. Niskin water sampler (5-liter capacity) with a mechanism for closing at a desired depth using messenger was used for collecting sub-surface (bottom) water samples (~1m above the sea floor).

➢ **Sediment sampling:** For estimation of sedimentary parameters samples were collected from subtidal stations using Van-Veen type grab (area of 0.1 m^2), while intertidal samples were collected using metal quadrant (0.25 m^2 area).

➢ **Biological characteristics:** Samples for chlorophyll and phytoplanktons were collected using clean plastic bucket and Niskin water samples. The samples for chlorophyll were immediately preserved with ice and kept in ice box till further analysis whereas the phytoplankton samples were fixed with Lugol's iodine and few drops of 3% buffered formaldehyde solutions, while for zooplankton oblique hauls were made at water surface using Heron Tranter net (mesh size 0.33 mm, mouth area 0.25 m^2) attached with calibrated flow meter (General Oceanic). The samples were preserved in 5% buffered formaldehyde solutions. Samples for macrobenthos were collected using Van-Veen type of grab covering an area of 0.1 m^2 and sieving through 500 um mesh size. The samples were preserved with 5% formaldehyde Rose Bengal solutions.

1.5 Team Members

This Marine Ecological Monitoring work presented in this report is done by M/s. UniStar Environment and Research Labs Pvt. Ltd. With active co-operation from M/s. Petronet LNG Ltd. for this Marine Ecological Sampling and Analysis UERL team members as follows.

- **Sampling team members:**

1. Dr. Sushant Vilas Sanaye (Marine Scientist)
2. Mr. Jaivik S. Tandel (Manager-Operations)
3. Mr. Bhavin Patel (Environmental Engineer)
4. Mr. Pravin Singh (Environmental Engineer)
5. Mr. Vijay Thanki (Environment Chemist)

- **Laboratory members**

1. Dr. Ashwini Pawar-Sanaye, (Marine Scientist)
2. Dr. Sushant Vilas Sanaye (Marine Scientist)
3. Ms. Shweta A. Rana (Sr. Microbiologist)
4. Mr. Nilesh Patel (Sr. Chemist)

❖ WATER QUALITY

2.1 Marine Water quality:

Seawater samples have been collected during June 2023.

2.2 Physico chemical Water analysis result:

All the water sampled, which is collected by sampling team is brought to the lab for Physico chemical analysis. The marine water quality at different collected stations are measured during this investigation is presented in Table No.2.1 and its method of analysis is present in Table No.2.0

Table: 2.0 Methodology of Physico chemical Water Analysis

Sr.No.	Parameters	Test Method
1	pH @ 25 °C	IS 3025 (Part 11)1983
2	Temperature (^{0}C)	IS 3025 (Part 9)1984
3	Turbidity	IS 3025 (Part 10)1984
4	Total Suspended Solids	APHA 23rd Ed.,2017,2540- D
CHEMICAL QUALITY		
1	Biochemical Oxygen Demand (BOD)	IS 3025 (Part 44)1993
2	Oil & Grease	IS 3025 (Part 39) 2021
3	Ammonical Nitrogen	APHA 23rd Ed.,2017,4500- NH3 B
4	Salinity	By Calculation
5	Dissolved Oxygen	APHA 23rd Ed.,2017,4500-O, B
6	Total Alkalinity as $CaCO_3$	IS 3025 (Part 23)1986
7	Phosphate	APHA 23rd Ed.,2017,4500-P, D
8	Nitrate	APHA 23rd Ed.,2017,4500 NO3-B
9	Calcium Carbonate	APHA 23rd Ed.,2017,3500 Ca. B
10	Petroleum Hydrocarbon (PHc)	GC Method
MICROBIOLOGY QUALITY		
1	Total Coliform	APHA 23rd Ed.2017,9222-B

Table: 2.1 Physico chemical Water Analysis Result

Sr.No.	Parameters	Unit	Station 1			Station 2		
			Surface	Middle	Bottom	Surface	Middle	Bottom
PHYSICAL QUALITY								
1.	pH @ 25 °C	--	8.01	7.82	7.81	7.90	7.97	8.04
2.	Temperature	(^{0}C)	29	29	28	29	30	29
3.	Turbidity	NTU	50	10	50	50	10	10
4.	Total Suspended Solids	(mg/l)	784	624	521	740	724	536
CHEMICAL QUALITY								
1.	Biochemical Oxygen Demand	mg/L	4.4	4.8	3.8	4.1	3.6	3.4
2.	Oil & Grease	mg/L	BDL (MDL:5.0)	BDL (MDL:5.0)	BDL (MDL:5.0)	BDL (MDL:5.0)	BDL (MDL:5.0)	BDL (MDL:5.0)
3.	Ammonical Nitrogen	mg/L	1.02	1.1	1.08	1.17	1.13	1.31
4.	Salinity	ppt	31.0	30.6	29.8	30.2	29.8	29.8
5.	Dissolved Oxygen	mg/L	5.8	5.9	5.4	5.7	5.8	5.9
6.	Total Alkalinity as $CaCO_3$	mg/L	131.3	126.3	131.3	136.4	136.4	141.4
7.	Phosphate	mg/L	0.19	0.28	0.18	0.19	0.24	0.36
8	Nitrate	mg/L	1.0	1.0	0.9	1.0	1.0	0.7
9	Calcium Carbonate	mg/L	989.4	999.6	969	918	989.4	958.8
10	Petroleum Hydrocarbon (PHc)	ppb	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
MICROBIOLOGY QUALITY								
1.	Total Coliform	CFU/ 100ml	46	20	Absent	44	18	Absent

Note: MDL = Minimum Detection Limit (MDL: 0.01) and N.D. = Not detectable

Table: 2.2 Physico chemical Water Analysis Result

Sr.No.	Parameters	Unit	Station 3			Station 4		
			Surface	Middle	Bottom	Surface	Middle	Bottom
PHYSICAL QUALITY								
1.	pH @ 25 °C	--	7.90	8.00	7.87	7.87	7.78	7.82
2.	Temperature	(^{0}C)	29	28	28	29	29	28
3.	Turbidity	NTU	50	50	10	50	50	50
4.	Total Suspended Solids	(mg/l)	902	836	632	840	864	538.6
CHEMICAL QUALITY								
1.	Biochemical Oxygen Demand	mg/L	4.6	2.2	4.8	4.1	3.8	3.5
2.	Oil & Grease	mg/L	BDL (MDL:5.0)	BDL (MDL:5.0)	BDL (MDL:5.0)	BDL (MDL:5.0)	BDL (MDL:5.0)	BDL (MDL:5.0)
3.	Ammonical Nitrogen	mg/L	1.24	0.82	1.66	1.26	1.17	1.29
4.	Salinity	ppt	30.6	31.0	29.4	31.0	31.5	30.6
5.	Dissolved Oxygen	mg/L	5.9	6.0	5.9	6.0	5.7	6.0
6.	Total Alkalinity as $CaCO_3$	mg/L	141.4	131.3	136.4	131.3	126.3	131.3
7.	Phosphate	mg/L	0.21	0.30	0.35	0.25	0.34	0.48
8	Nitrate	mg/L	0.9	0.7	0.8	1.2	0.6	0.8
9	Calcium Carbonate	mg/L	958.8	938.4	989.4	999.6	948.6	979.2
10	Petroleum Hydrocarbon (PHc)	ppb	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
MICROBIOLOGY QUALITY								
1.	Total Coliform	CFU/ 100ml	56	36	Absent	41	24	Absent

Note: MDL = Minimum Detection Limit (MDL: 0.01) and N.D. = Not detectable

❖ BIOLOGICAL CHARACTERISTICS (BIODIVERSITY STUDIES):

Marine ecosystems are subject to a multitude of direct human pressures, such as overexploitation, eutrophication, pollution, and species introductions. These stressors can have synergistic effects on marine ecosystems, altering its functioning. Anthropogenic involvements constantly compromise the health of the marine ecosystem by disturbing the ecological balance. Hence the assessment of the biotic components along with abiotic factors is an integral part of environmental assessment and monitoring study. During the present investigation at Petronet LNG, Dahej, the abundance and distribution of marine organisms (Plankton and benthos) were studied as part of routine environmental monitoring.

3.1 Planktonic Forms:

The name plankton is derived from the Greek word “planktons”, meaning “wanderer” or “drifter”. While some forms of plankton are capable of independent movement and can swim up to several hundred meters in a single day, their position is primarily determined by currents in the body of water they inhabit. As per definition, organisms classified as "plankton" are unable to resist ocean currents. Plankton is primarily divided into two broad functional groups i.e., Phytoplankton and Zooplankton.

3.1.1 Phytoplankton

Phytoplankton are microscopic, single-celled photosynthetic organisms that live suspended in all water niches, including oceans, freshwater, and marine niche. Like the terrestrial ecosystem where plants are an integral part of the ecosystem, phytoplankton play key role in the biogeochemistry of the oceans. As they are dependent on sunlight for energy, they mostly inhabit the euphotic zone. Therefore, they are responsible for production of half of the atmosphere’s oxygen and more than half of the primary production in the oceans. There are many species of phytoplankton, each of which has a characteristic shape, size, and function. Marine species of phytoplankton grow abundantly in oceans around the world and are the foundation of the marine food chain. Marine phytoplankton are the producing (autotrophic) component in the ocean. There are fourteen classes of phytoplankton. Each class of phytoplankton contains unique attributes in size, cell structure, nutrients, and function.

3.1.2 Zooplankton:

Zooplankton occupies second position in the food web of the marine niche. They are the primary consumer’s organisms and generally feed on phytoplankton or small, microscopic group of organisms for they are nutritional needs. They are incapable of making their own food from sun-light or inorganic compounds, and feed on organisms or the remains of other organisms to get the energy necessary for survival.

- **SIGNIFICANCE OF PHYTO- AND ZOOPLANKTONS**

Phytoplankton are vital to marine ecosystems. They are producers, or autotrophs, that form the foundation of most marine food webs. As photosynthetic organisms, they can convert solar energy into chemical energy and store it in form of sugars. They are responsible for half of the photosynthetic activity on the planet. The significance of zooplanktons is found in their role of transferring biological production from phytoplankton to large organisms in the marine food web and the seafloor. The microscopic protozoan, tunicates, copepods, and other crustaceans graze upon many phytoplankton species. These in turn become food for other animals further linking the food web. Therefore, variability in reproduction of copepods would affect the survival of young fish that feeds on them.

Table 3: Test methods for phytoplankton, Zooplankton, Chlorophyll a and Pheophytin, Macro benthos analysis

Sr. no.	Test performed	Method
1	Phytoplankton	APHA, Edition 23, Part 10000, 10200 F
2	Chlorophyll *a* and Pheophytin	APHA, Edition 23, Part 10000, 10200 H (with some modification)
3	Zooplankton	APHA, Edition 23, Part 10000, 10200 G
4	Macro benthos	APHA, Edition 23, Part 10000,10500 A-10500 D

3.2 ZOOPLANKTON DIVERSITY

Zooplankton includes arrays of organisms, varying in size from the microscopic protozoans of a few microns to some jellyfish-like organisms with tentacles several meters long. By virtue of sheer abundance and intermediate role between phytoplankton and fish, zooplankton is considered as the chief index of the utilization of aquatic biotopes at the second trophic level.

Zooplankton standing stock in terms of population and biomass revealed substantial variation within all Subtidal (4 stations) and inter-tidal (4 stations) stations (Table 4 and Table 5) in the study area of Petronet LNG jetty, Dahej during June 2023. In the sub-tidal area, the maximum zooplankton population density (19209 nos./100 m^3) and biomass (3.16 ml/ 100 m^3) was recorded at Station 1 during high tide level and minimum zooplankton population density (9352 nos./100 m^3) and biomass (1.03 ml/100 m^3) were recorded at Station 3 during low tide level (Figure 1). In the inter-tidal area, the maximum zooplankton population density (12807 nos./100 m^3) and biomass (1.51 ml/100 m^3) were recorded at Station IT-4 and the minimum zooplankton population (9851 nos./100 m^3) and biomass (1.10 ml/100 m^3) were recorded at Station IT-2 (Figure 2). A total of 12 groups of zooplankton including Copepods, Copepod nauplii, crab larvae, Chaetognaths, Decapod larvae, fish and shellfish eggs, fish larvae, gastropod larvae, Polychaetae larvae, Siphonophora, Ostracods and Oikopleura were identified during this study (Table 4 and 5). Among these identified groups Copepods (72.89%) and Copepod nauplii (9.32%) were most dominant (Figure 3). Chaetognaths (3.61%) and Crab larvae (2.97%) were also the dominant groups in the zooplankton population (Figure 3). As well as fish and shell eggs, polychaetae larvae also were another observed group during the present study.

Table 4: Population (nos./100 m³) and biomass (ml/100 m³) of various zooplankton groups in the sub-tidal area at the Petronet LNG, Dahej during June 2023.

Zooplankton Groups	High Tide level				Low Tide level			
	St-1	St-2	St-3	St-4	St-1	St-2	St-3	St-4
Copepods	13563	13281	12826	13943	8869	7363	6948	10991
Copepod nauplii	2667	2792	1837	2073	1322	936	722	653
Crab larvae	784	698	696	617	261	349	186	392
Chaetognaths	1063	736	553	514	452	386	392	467
Decapod (shrimps)	70	57	71	51	17	37	21	19
Fish and shell fish eggs	209	396	321	343	87	129	144	112
Fish larvae	0	19	36	0	17	18	0	0
Gastropod larvae	70	19	54	34	35	0	41	19
Polychaete larvae	174	264	214	240	70	73	474	56
Siphonophora	70	94	54	86	70	55	21	56
Ostracods	35	19	36	51	17	18	41	19
Oikopleura	17	0	18	51	17	0	0	0
Population (nos./100 m³)	**19209**	**18839**	**17677**	**17782**	**11524**	**9865**	**9352**	**12137**
Biomass (ml./100 m³)	**3.16**	**2.24**	**1.67**	**2.68**	**1.74**	**1.03**	**1.03**	**1.63**

Table 5: Population (nos./100 m³) and biomass (ml/100 m³) of various zooplankton groups in the inter-tidal area at the Petronet LNG, Dahej during June 2023.

Zooplankton Groups	Inter tidal stations			
	IT-1	IT-2	IT-3	IT-4
Copepods	10262	8793	9044	10433
Copepod nauplii	886	865	720	657
Crab larvae	318	335	233	277
Chaetognaths	351	441	447	467
Decapod (shrimps)	0	35	19	17
Fish and shell fish eggs	117	194	136	156
Fish larvae	17	0	0	17
Gastropod larvae	17	0	19	17
Polychaete larvae	150	194	97	52
Siphonophora	50	35	58	52
Ostracods	17	0	39	17
Oikopleura	0	18	19	0
Population (nos./100 m³)	**10501**	**9851**	**10774**	**12807**
Biomass (ml./100 m³)	**1.57**	**1.10**	**1.58**	**1.51**

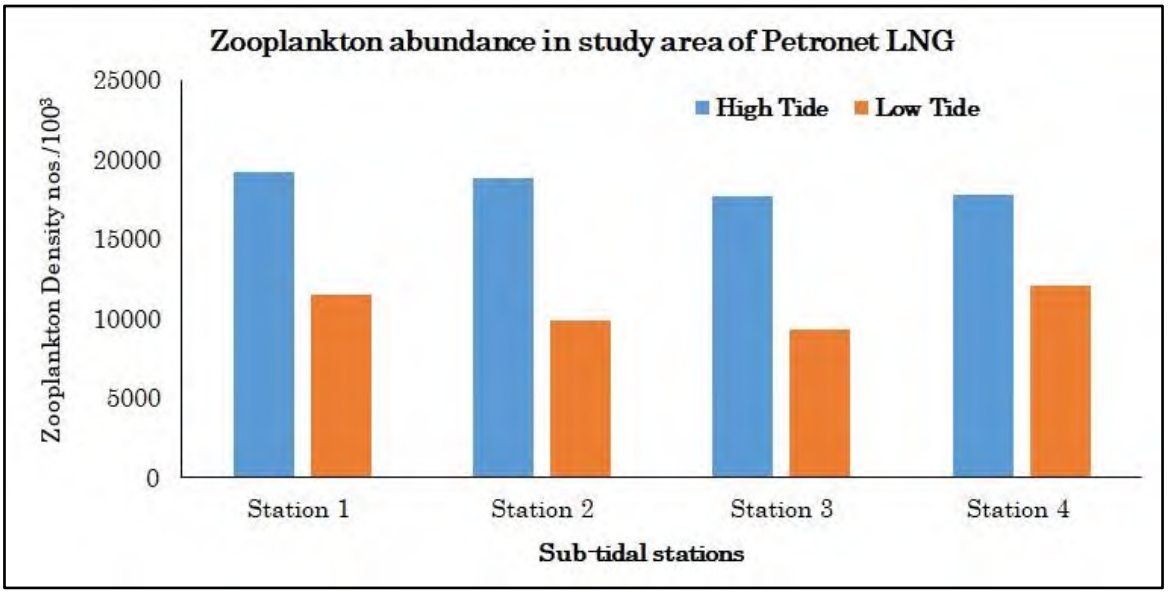


Figure 2: Zooplankton population (nos./100 m³) recorded in the sub-tidal waters along the Petronet LNG, Dahej during June 2023.

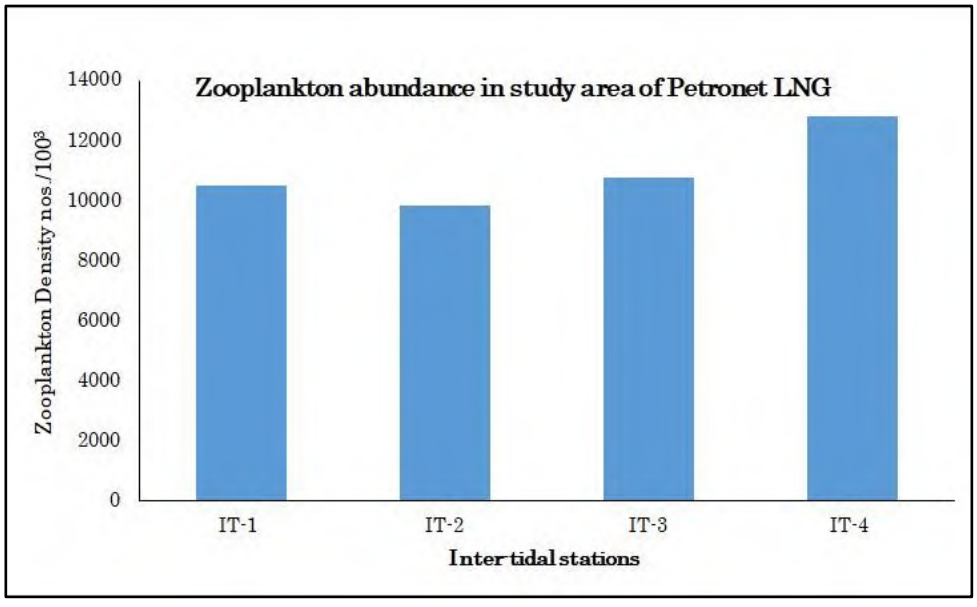


Figure 3: Zooplankton population (nos./100 m³) recorded in the inter-tidal waters along the Petronet LNG, Dahej during June 2023.

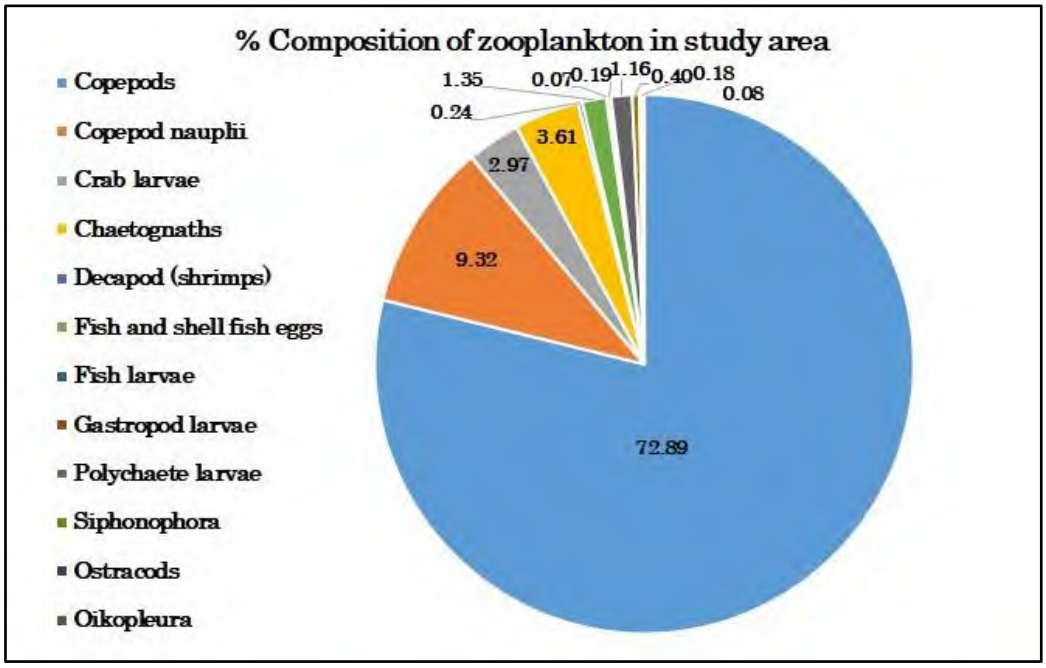
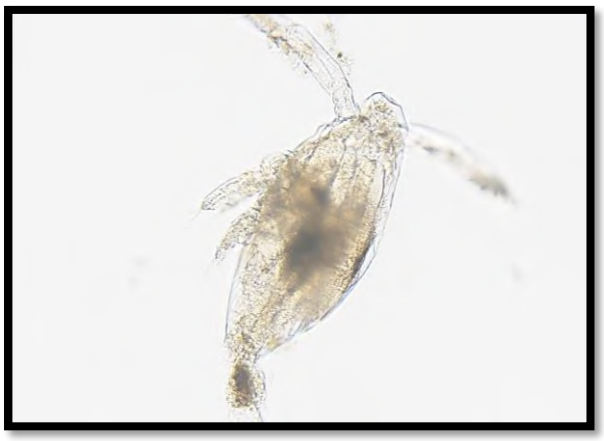


Figure 3: Dominant groups of Zooplankton reported from study area of Petronet LNG, Dahej during June 2023.



Copepod

Copepod Nauplius

Figure 4: Microphotographs of zooplanktons reported in the coastal waters of Petronet LNG, Dahej during June 2023

3.3 MACRO-BENTHIC FAUNA

The benthic zone is the lowest ecological zone of a water body which usually involves the sediments on the seafloor. The number of phyla and species of benthic animals exceeds those of pelagic species, at least partly because of the greater physical variety of benthic habitats. Benthic animals are separated into in faunal and epifaunal species, depending upon whether they live within sediments or on the surface of the seafloor, respectively. Size categories of the zoobenthos consist of the larger macrofauna (>1.0 mm), the small meiofauna which is characteristically found in sand and mud, and the microfauna which is made up mostly of protozoans.

Benthic organisms are morphologically different from those planktonic organisms. Many are adapted to live on the substrate (bottom). In benthic habitats, they can be considered dominant creatures. These organisms adapted to deep-water pressure so cannot survive in the upper parts of the water column. Since light does not penetrate very deep ocean water, the benthic organisms often depend on the organic matter falling from the upper water column as their main energy source. This dead and decaying matter sustains the benthic food chain. The most benthic organisms are scavengers or detritivores. These organisms under being relatively stationary, are constantly exposed to changes undergoing in overlying water, and hence, respond very well to aquatic pollution. The macro benthos population is very sensitive to environmental perturbation and is highly influenced by the physicochemical characteristics of water, the nature of the substratum, food, predation, and other factors. The density of benthic invertebrates also fluctuates widely with the changes in the season.

- **Significance of macrobenthic organisms**

The biomass of microbenthic organisms in estuaries and coastal embayment is often high. Burrowing and tube-building by deposit-feeding benthic organisms (bioturbations) help to mix the sediment and enhance the decomposition of organic matter. Nitrification and denitrification are also enhanced because a range of oxygenated and anoxic micro-habitats are created. Macro fauna is also important constituents of fish diets and thus are an important link for transferring energy and nutrients between trophic levels, also driving pelagic fish and crustacean production. For these reasons, the benthic organisms are extremely important indicators of environmental change.

3.4 BENTHIC DIVERSITY

3.4.1 Subtidal region:

During the present study, macrobenthos abundance and biomass were recorded at sub-tidal stations during high and low tide levels at Petronet LNG, Dahej (Table 6). The macrobenthos density ranged from 340 nos./m^2 to 460 nos./m^2 at sampling stations (Table 6; Figure 5) and comprising of 4 different groups (mollusks, Sipuncula, annelids and foraminifera). The biomass of the macrobenthic community in the study region ranged from 1.37 g/m^2 to 1.82 g/m^2. The maximum abundance of benthic microorganisms was reported at Station 3 (460 nos./m^2) during high tide levels and mainly contributed by the dominance of polychaete worms. The highest biomass of macrobenthic species was observed at Station 3 (1.82 g/ m^2) during high tide levels with the dominance of Polychaetas. The least density (340 no/m^2) and biomass (1.4 g/m^2) was observed at Station 4 during high tide tide level. In species composition, Annelida is the first largest group observed at all the stations during the present study where Polychaete species (Phylum Annelida) belonging to the family Paraonidae, Pilargidae, Capitillidae, Cossuridae, Spionidae, Nereidae, Eunicidae, were abundant. Secondly, bivalves & gastropods, foraminifera and sipunculids were present at all the sampled stations.

Table 6: Faunal composition, density (nos./m^2) and biomass (g/m^2) of the macrobenthos community in the sub-tidal region at Petronet LNG, Dahej during June 2023.

Benthos Faunal Groups	High tide Level				Low tide Level			
	St-1	St- 2	St- 3	St- 4	St- 1	St- 2	St- 3	St- 4
Phylum Mollusca								
Bivalves and gastropods	20	20	10	20	20	20	30	20
Phylum Sipuncula								
Sipunculids	10	10	10	10	20	20	20	10
Nemertine	40	30	20	10	0	20	10	10
Phylum Annelida								
Polychaetes	210	150	230	140	140	140	180	150
Phylum Retaria								
Foraminifera	160	150	190	160	180	200	160	150
Density (nos./ m^2)	**440**	**360**	**460**	**340**	**360**	**400**	**400**	**344**
Biomass (gm/m^2)	**1.75**	**1.55**	**1.82**	**1.4**	**1.47**	**1.7**	**1.68**	**1.37**

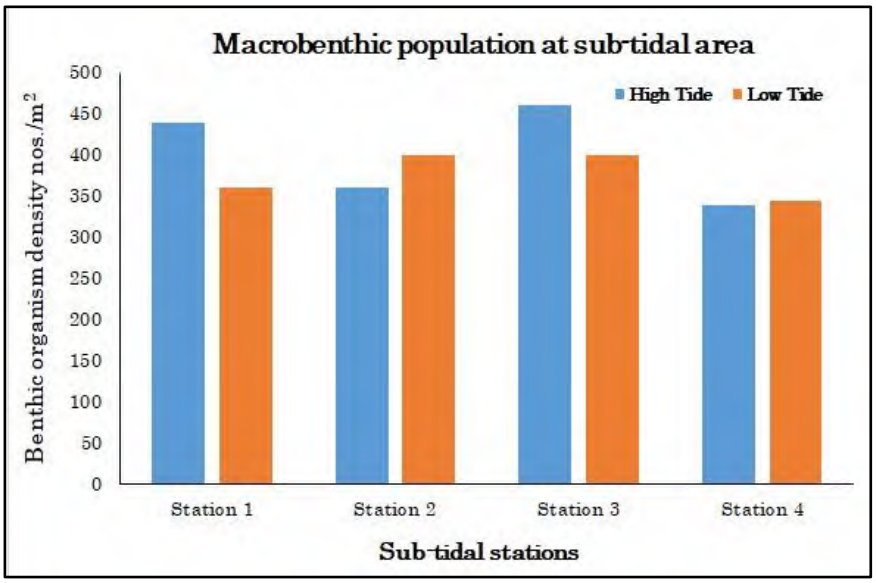


Figure 5: Subtidal macrobenthos abundance (nos./m²) during high tide and low tide at different sampling stations at Petronet LNG, Dahej during June 2023.

3.4.2 Intertidal region:

The muddy and sandy substratum with moderate organic matter supports the occurrence of the microbenthic community in the intertidal region. The macrobenthos biomass was measured in between 1.48 g/m² to 2.15 g/m² in the intertidal region at the Petronet LNG, Dahej (Table 7). The lowest density and biomass of macrobenthic organisms were reported at station IT-1 (384 nos./m² and 1.48 g/m², respectively), whereas the highest density was reported at Station IT-3 (494 nos./m² and 2.15 g/m², respectively) (Table 7 and Figure 6). In the inter-tidal area, Foraminifera (47%) and Polychaete (43%) species were contributed to the total macrobenthic abundance at these stations followed by bivalves and gastropods (4.81%). Some photographs of benthic fauna are shown in Figure 8.

Table 7: Faunal composition, density (nos./m²) and biomass (g/m²) of the macrobenthos community in the inter-tidal region at Petronet LNG, Dahej during June 2023.

Benthos Faunal Groups	Inter-tidal stations			
	IT-1	IT- 2	IT- 3	IT- 4
Phylum Mollusca				
Bivalves and gastropods	20	20	20	10
Phylum Sipuncula				
Sipunculids	0	10	10	10
Nemertine	20	10	10	10
Phylum Annelida				
Polychaetes	160	160	220	180
Phylum Arthropoda				
Decapod larvae (crab)	4	4	4	0
Phylum Retaria				
Foraminifera	180	190	230	180
Density (nos./ m²)	**384**	**394**	**494**	**390**
Biomass (gm/m²)	**1.48**	**1.7**	**2.15**	**1.65**

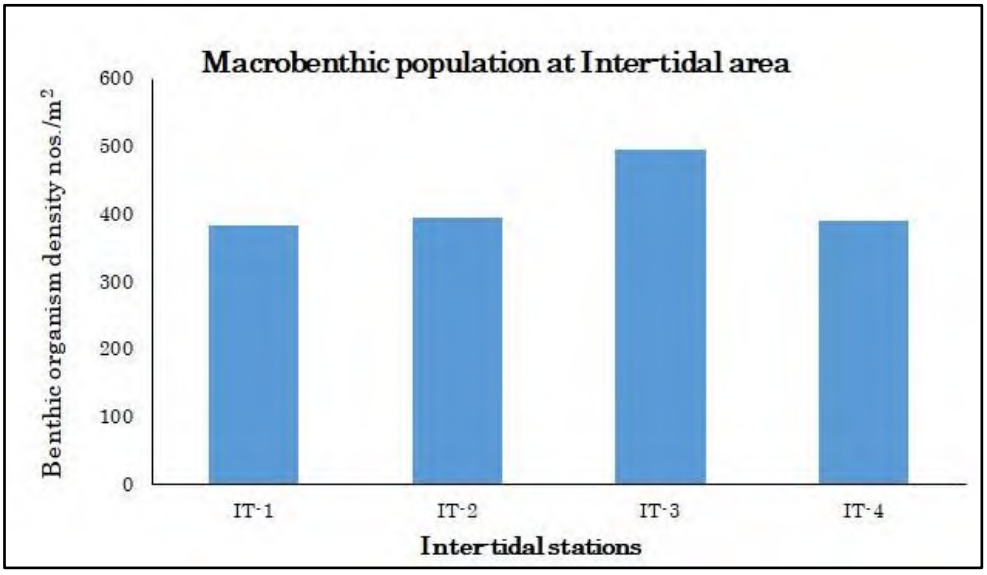


Figure 6: Inter-tidal macro benthos abundance (nos./m²) at different sampling stations at Petronet LNG, Dahej during June 2023.

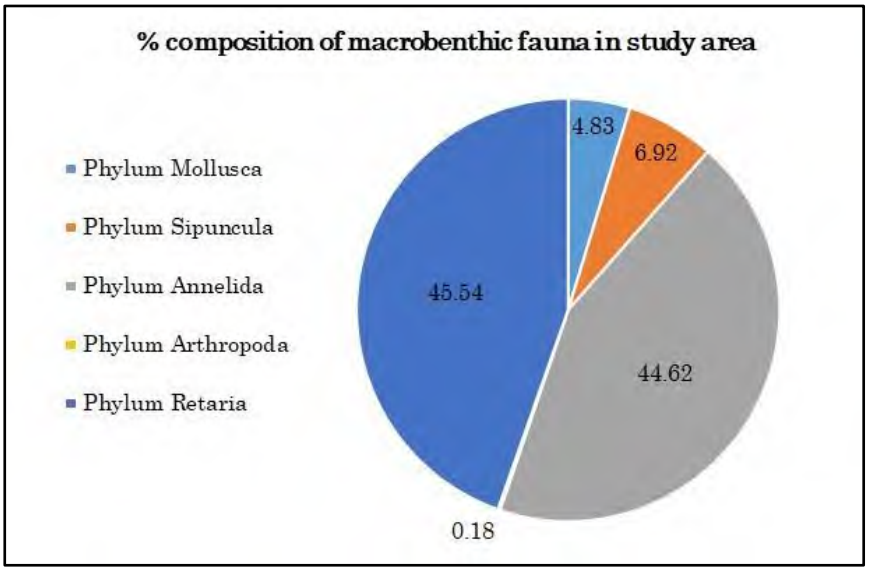
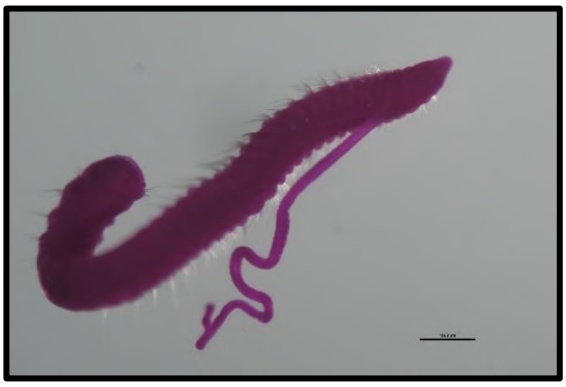


Figure 7: Percent composition of Subtidal benthic taxa from the marine waters of Petronet LNG, Dahej during June 2023

Capitallidae

Spoinidae

Pilargidae



Cossuridae

Figure 8: Microphotographs of microbenthic organisms observed in the sediment samples collected in the vicinity of Petronet LNG, Dahej during June 2023

3.5 AVIFAUNAL DIVERSITY

Due to their importance in the ecosystem for various roles such as scavengers, pollinators for crops, seeds dispersal agents and also predators of insect pests, the avifaunal diversity study of a given region is a major indicator to evaluate habitats both qualitatively and quantitatively. Due to anthropogenic activities along with climate changes, the global diversity of birds is rapidly decreasing. IUCN Red List of endangered birds has already recognized 1226 bird species as threatened globally and whereas, 88 bird species are found in India.

Coastal and estuarine waters are always been important habitats for many bird species, including many migratory birds. Mudflats and sandy beaches are important feeding grounds for coastal birds and nearby mangrove forests and land trees provide shelter and breeding habitats. During the present study, an overview of the avifaunal diversity present in the study area has been taken. Due to the restricted approach to mudflats and shores directly for security reasons, only available bird species are listed in Table 8.

Table 8: List of bird species observed in the study area.

Sr. No.	Scientific name	Common name	IUCN category
1.	*Actitis hypoleucos*	Common sandpiper	Least concern (LC)
2.	*Ardeola grayii*	Indian pond Heron	Least concern (LC)
3.	*Bubulcus ibis*	Cattle egret	Least concern (LC)
4.	*Casmerodius albus*	Great egret	Least concern (LC)
5.	*Columba livia*	Rock dove	Least concern (LC)
6.	*Charadrius leschenaultii*	Sand plover	Least concern (LC)
7.	*Egretta gularis*	Western reef egret	Least concern (LC)
8.	*Milvus migrans*	Black kite	Least concern (LC)
9.	*Vanellus indicus*	Red-wattled Lapwing	Least concern (LC)

Most of the bird species were observed foraging in the inter-tidal mud flats during low tide. Rock doves were observed to make nests in jetties and building structures. All the avifaunal species found in the study area are common in appearance and in the least concern (LC) category of the IUCN red list of threatened species. All species are observed to be resident species in Indian region.

3.6 MANGROVES

Mangroves are a very specialised group of plants found only in the transitional zone between land and the sea. The mangrove species are adapted to the salty water, less oxygen in sediments as well as daily tidal variation. The mangrove species developed a special kind of roots called 'Pneumatophores' which enables them for intake of air for plants in the water filled muddy soil. These breathing roots help mangrove trees to absorb oxygen from air and therefore thrive them into oxygen less muddy soil.

Mangrove plants generate a variety of natural resources and ecosystem services that are vital to subsistence economies and sustain local and national economies. During many natural calamities like cyclones, storm surges, heavy flooding and tsunamis they act as barriers and protect the land from erosion and reduce the effect on living resources. The value of mangroves as a carbon sink and the efficiency with which they can remove carbon from the atmosphere put them center stage in the context of increasing global concerns about climate change and sea level rise. They also maintain the stability of the shoreline and prevent the release of toxic wastes into the coastal waters. The mangrove ecosystem is also a rich of nutrients in the coastal waters. The falling leaves from the mangrove area become the primary source of a food chain, which goes on to feed microorganisms, larvae and the adults of many invertebrates and fishes. These roots also harbor the number of fish species which use this area as their breeding grounds. It is estimated that over 70% of commercially important fishes depend on mangroves for their nutrient cycle and nursery breeding. This fish reach habitat attracts the number of birds and animals in the area thus making the mangroves a biodiversity reach habitat.

During the present study, scattered patches of mangroves mainly *Avicennia* species were found towards the northwest side of Petronet LNG jetties. All observed patches are shrub type and may be because of the high tidal amplitude in the Gulf of Khambhat.

3.7 PHYTOPLANKTON DIVERSITY:

The phytoplankton are vast array of minute and microscopic plants passively drifting in natural waters and mostly confined to the illuminated zone. In an ecosystem these organisms constitute primary producers forming the first link in the food chain. The phytoplankton have long been used as indicators of water quality. Some species flourish in highly eutrophic waters, while others are very sensitive to organic and/or chemical wastes. Because of their short life cycles, plankton responds quickly to environmental changes. Hence, their standing crop in terms of biomass, cell counts and species composition are more likely to indicate the quality of the water mass in which they are found. Phytoplankton composition also varies considerably. Thus, a very few species may be overwhelmingly common during blooms, while a large number of species may occur without clear dominance under normal conditions.

Phytoplankton sampling was carried out at 4 stations from three levels i.e., Surface, Middle and Bottom at HTL (High Tide Level), LTL (Low Tide Level) and IT (Intertidal zone). During the sampling period (June 2023) the phytoplankton population in the coastal waters of Petronet LNG, Dahej was diverse and represented with a total of 33 phytoplankton genera (Table 9) belonging to diatoms (29 genera) and dinoflagellates (4 genera). Diatoms Species belonged to *Amphora* sp., *Amphorprora* sp., *Asterionella* sp., *Bacillaria* sp., *Chaetoceros* sp. *Corethron* sp., *Coscinodiscus* sp., *Cyclotella* sp., *Cylindrotheca* sp., *Cymbella* sp., *Diploneis* sp., *Ditylum* sp., *Guinardia* sp., *Gyrosigma* sp., *Lauderia* sp., *Leptocylindrus* sp., *Licmophora* sp., *Lithodesmium* sp., *Navicula* sp., *Nitzschia* sp., *Odontella* sp., *Paralia* sp., *Pinnularia* sp., *Pleurosigma* sp., *Pseudo-nitzschia* sp., *Rhizosolenia* sp., *Synedra* sp., *Thalassiosira* sp. and *Thalassionema* sp.

The phytoplankton abundance in the study region was ranged from 78 to 198 cells×10^2/L (Table 9, Figure 9) at HTL. The highest phytoplankton abundance was observed at Station 4 in the surface (198 nos.×10^2/L) and lowest at Station 1 in bottom water (78 nos.×10^2/L). The phytoplankton abundance was ranged from 72 to 173 nos.×10^2/L (Table 9, Figure 9) at LTL. The highest phytoplankton abundance at LTL was (173 nos.×10^2/L) was observed at Station 4 in surface water and lowest was at station 3 bottom water (72 nos.×10^2 / L). The phytoplankton abundance was ranged from 98 to 116 nos.×10^2/L (Table 9, Figure 9) at Intertidal zone. The highest phytoplankton abundance at IT was (116 nos.×10^2/L) was observed at Station 1 and lowest was at station 2 (98 nos.×10^2 / L). The study shows that the marine water around was enriched with the diverse phytoplankton population.

Table 9: Phytoplankton abundance (cells×10²/L) at different sampling stations during High Tide Level (HTL) in the coastal waters of Petronet LNG, Dahej during June 2023.

Note: S=surface; M= Middle; B=bottom; HTL= High Tide Level; St=station

Phytoplankton Genera	Sampling Stations (HTL)											
	St-1			St-2			St-3			St-4		
	S	M	B	B	M	B	S	M	B	S	M	B
Diatoms												
Amphora sp.	1	0	0	4	2	1	4	0	0	4	2	1
Amphorprora sp.	0	0	0	2	1	2	1	1	0	1	0	1
Asterionella sp.	22	18	15	16	14	12	21	19	15	26	18	14
Bacillaria sp.	2	1	1	3	3	2	2	0	4	9	4	4
Chaetoceros sp.	1	1	1	1	1	0	2	1	1	5	2	1
Corethron sp.	1	0	0	0	2	0	2	1	0	2	1	0
Coscinodiscus sp.	22	18	12	21	18	10	25	15	10	22	16	12
Cyclotella sp.	0	0	0	1	0	4	2	2	1	5	4	2
Cylindrotheca sp.	1	0	0	1	3	1	0	4	0	2	0	2
Cymbella sp.	0	0	0	1	1	0	0	0	1	2	1	1
Diploneis sp.	0	1	1	1	1	1	1	0	0	4	2	0
Ditylum sp.	5	2	2	1	0	1	5	3	1	1	1	0
Guinardia sp.	4	2	2	8	6	3	7	8	6	6	4	4
Gyrosigma sp.	5	3	0	0	2	0	0	0	0	0	0	0
Lauderia sp.	0	2	1	0	0	1	0	0	0	2	1	1
Leptocylindrus sp.	3	0	1	2	1	2	1	1	0	4	0	3
Licmophora sp.	1	0	0	0	0	1	0	2	3	1	3	0
Lithodesmium sp.	5	0	0	1	2	1	2	1	4	3	2	0
Navicula spp.	15	11	10	16	14	12	16	11	6	14	11	6
Nitzschia spp.	9	6	4	8	4	1	8	7	5	10	8	5
Odontella sp.	6	5	2	1	1	4	7	5	3	9	8	7
Paralia sp.	4	1	0	5	8	6	10	5	3	11	8	4
Pinnularia sp.	5	0	2	1	0	0	5	0	2	6	4	1
Pleurosigma spp	8	6	4	5	2	2	11	8	5	12	6	2
Pseudo-nitzschia sp.	4	1	2	2	0	1	3	4	2	0	0	0
Rhizosolenia sp.	5	2	2	6	3	3	8	5	2	10	6	3
Synedra sp.	2	1	0	0	0	1	2	0	2	3	1	0
Thalassionema sp.	10	9	7	8	8	7	5	3	1	11	4	2
Thalassiosira sp.	8	4	3	7	2	0	6	6	5	8	0	1
Dinoflagellates												
Alexandrium sp.	1	0	1	1	0	1	1	0	2	1	0	1
Gymnodinium sp.	1	2	2	1	1	2	0	2	4	1	0	1
Prorocentrum sp.	2	0	2	0	4	1	1	0	1	2	1	1
Protoperidinium sp.	1	2	1	1	1	1	1	0	1	1	1	0
Total Phytoplankton (nos. x 10²/L)	**154**	**98**	**78**	**125**	**105**	**84**	**159**	**114**	**90**	**198**	**119**	**80**

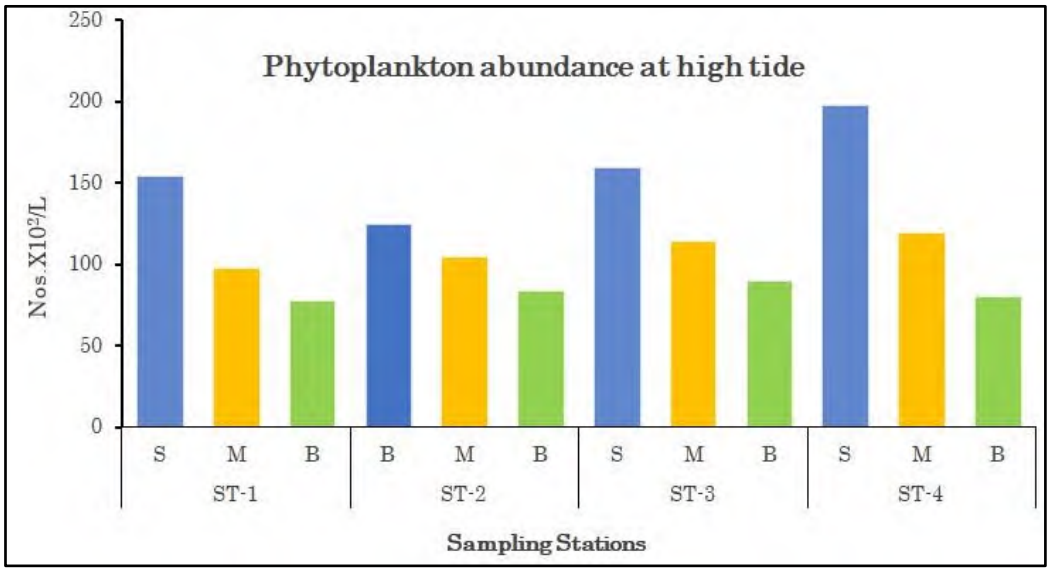


Figure 9: High Tidal Level (HTL) phytoplankton abundance (no. x10²/ L) at different sampling stations at Petronet LNG, Dahej during June 2023

Table 10: Phytoplankton abundance (cells×10²/L) at different sampling stations during Low Tide Level (LTL) in the coastal waters of Petronet LNG, Dahej during June 2023.

Note: S=surface; M= Middle; B=bottom; LTL= Low Tide Level; St=station

Phytoplankton Genera	Sampling Stations (LTL)											
	St-1			St-2			St-3			St-4		
	S	M	B	B	M	B	S	M	B	S	M	B
Diatoms												
Amphora sp.	1	0	0	3	2	1	1	0	1	8	7	0
Amphorprora sp.	0	1	0	0	1	2	4	1	1	1	0	0
Asterionella sp.	19	17	15	12	12	11	11	8	7	21	19	11
Bacillaria sp.	1	0	0	4	3	1	2	0	4	9	4	4
Chaetoceros sp.	1	1	3	6	4	2	2	2	1	7	6	4
Corethron sp.	1	0	0	1	2	1	0	0	0	1	0	1
Coscinodiscus sp.	20	18	17	14	13	7	11	8	7	25	19	13
Cyclotella sp.	1	2	3	2	2	2	0	0	1	5	0	1
Cylindrotheca sp.	1	1	1	0	3	1	0	4	0	2	0	2
Cymbella sp.	1	0	0	2	1	1	0	0	0	0	0	0
Diploneis sp.	1	0	0	0	1	0	0	0	0	4	0	1
Ditylum sp.	5	2	2	1	1	1	11	6	1	1	1	1
Guinardia sp.	3	2	1	7	5	4	8	7	6	0	0	0
Gyrosigma sp.	1	1	1	0	2	0	0	0	0	0	0	0
Lauderia sp.	0	1	0	0	0	0	0	0	0	2	0	0
Leptocylindrus sp.	2	0	1	5	4	3	0	1	0	5	0	0
Licmophora sp.	0	1	1	0	0	1	0	2	3	1	3	0
Lithodesmium sp.	3	0	0	1	1	1	3	3	2	1	4	1
Navicula spp.	16	12	10	14	9	7	8	5	2	13	11	9
Nitzschia spp.	10	8	7	12	10	8	6	4	2	15	13	8
Odontella sp.	5	4	2	4	2	1	15	8	4	15	14	7
Paralia sp.	3	0	0	6	3	2	11	6	2	2	2	2
Pinnularia sp.	4	0	1	2	0	0	7	5	4	3	2	2
Pleurosigma spp	6	3	2	2	2	2	9	9	7	7	4	2
Pseudo-nitzschia sp.	1	0	1	1	0	1	3	4	1	0	0	0
Rhizosolenia sp.	2	1	2	8	5	4	1	8	3	11	7	6
Synedra sp.	1	1	0	0	0	1	2	0	1	3	2	1
Thalassionema sp.	8	5	4	1	6	5	5	5	5	7	5	4
Thalassiosira sp.	7	6	5	10	7	4	3	0	2	1	0	0
Dinoflagellates												
Alexandrium sp.	2	1	1	0	0	0	1	0	1	0	0	1
Gymnodinium sp.	1	2	0	1	3	4	1	4	2	1	4	2
Prorocentrum sp.	2	0	0	0	1	2	1	0	1	1	0	0
Protoperidinium sp.	2	1	1	0	1	1	0	0	1	1	1	0
Total Phytoplankton (nos. x 10²/L)	**131**	**91**	**81**	**119**	**106**	**81**	**126**	**100**	**72**	**173**	**128**	**83**

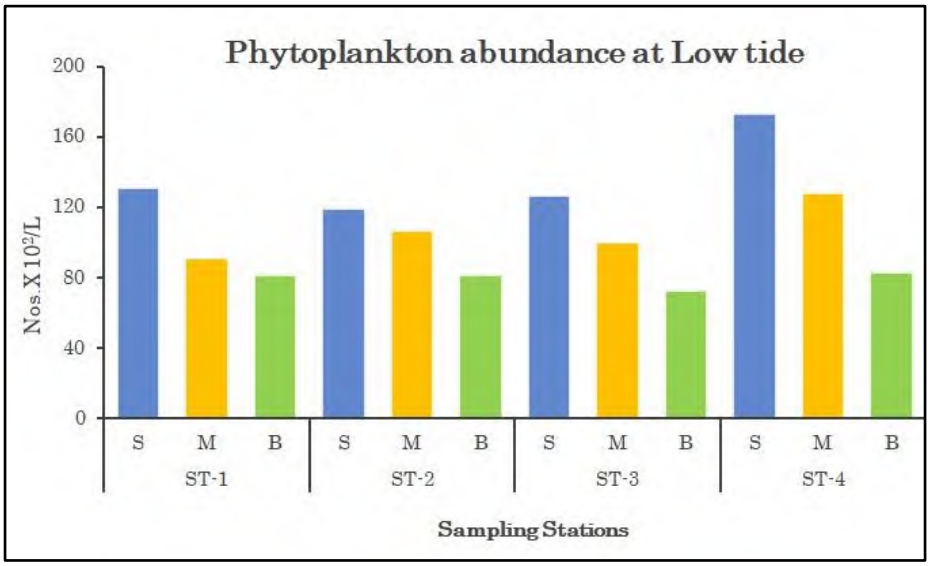


Figure 10: Low Tidal Level (LTL) phytoplankton abundance (no. x10²/ L) at different sampling stations at Petronet LNG, Dahej during June 2023

Table 11: Phytoplankton abundance (cells×10²/L) at different sampling stations during Intertidal zone of Petronet LNG, Dahej during June 2023.

Phytoplankton Genera	Sampling stations			
	IT1	IT2	IT3	IT4
Diatoms				
Amphora sp.	1	0	1	3
Amphorprora sp.	1	0	0	0
Asterionella sp.	12	15	19	13
Bacillaria sp.	2	1	0	4
Chaetoceros sp.	2	1	1	1
Corethron sp.	0	0	0	0
Coscinodiscus sp.	14	24	22	17
Cyclotella sp.	1	2	2	0
Cylindrotheca sp.	1	0	0	0
Cymbella sp.	1	1	1	1
Diploneis sp.	0	1	0	0
Ditylum sp.	4	5	1	1
Guinardia sp.	5	5	9	20
Gyrosigma sp.	2	1	3	0
Lauderia sp.	0	2	1	0
Leptocylindrus sp.	4	0	0	3
Licmophora sp.	0	3	2	0
Lithodesmium sp.	0	0	2	1
Navicula spp.	11	1	0	1
Nitzschia spp.	4	7	6	8
Odontella sp.	8	8	1	1
Paralia sp.	1	0	4	10
Pinnularia sp.	8	0	0	2
Pleurosigma spp	2	8	0	2
Pseudo-nitzschia sp.	5	0	1	1
Rhizosolenia sp.	1	1	11	9
Synedra sp.	1	0	0	0
Thalassionema sp.	18	8	2	1
Thalassiosira sp.	1	1	15	10
Dinoflagellates				
Alexandrium sp.	1	1	1	0
Gymnodinium sp.	1	0	1	1
Prorocentrum sp.	0	1	0	0
Protoperidinium sp.	4	1	1	1
Total Phytoplankton (nos. x 10²/L)	**116**	**98**	**107**	**111**

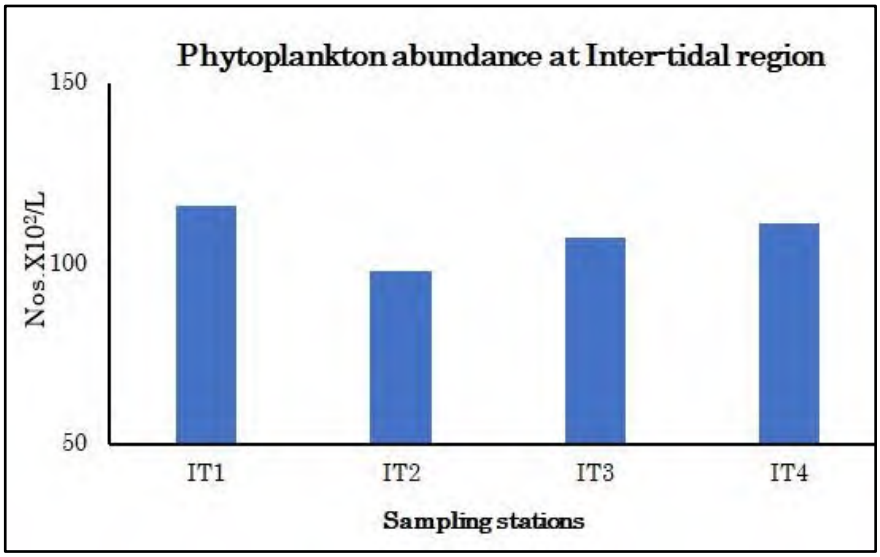
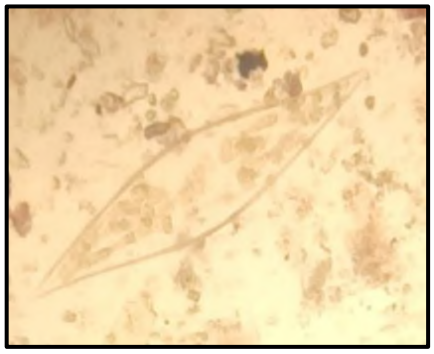
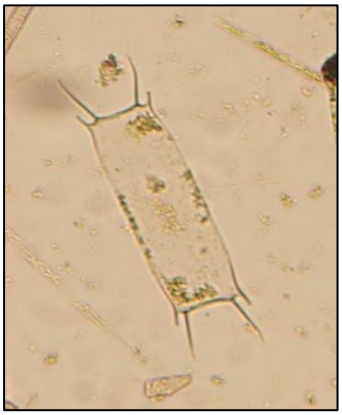


Figure 11: Inter-tidal phytoplankton abundance (no. x10²/ L) at different sampling stations at Petronet LNG, Dahej during June 2023.



Navicula sp.



Odentella sp.

Fig. 12- Microphotographs of phytoplankton reported in the coastal waters of Petronet LNG, Dahej during June 2023.

3.8 PHYTOPLANKTON PIGMENTS (CHLOROPHYLL *a* AND PHEOPHYTIN):

Marine phytoplankton contains essential as well as accessory pigments like that of terrestrial plants. Phytoplankton pigments capture sunlight. The resulting photosynthesis and its products, especially the oxygen and organic compounds, all rely on the light energy captured by the different phytoplankton pigments. Chlorophyll *a* is the major pigment for light harvesting, and plays a significant role in photosynthesis and photoprotection, by extending the light collection window and protecting the cell from the damage of high irradiance levels or high ultraviolet light exposure.

Algal chlorophyll forms a series of degradation products upon degradation. In addition to Chlorophyll the naturally occurring pigments in algal cells. The nature of these degradation products depends on which part of the chlorophyll molecule is affected. As chlorophyll degrades, the initial step is either the loss of the magnesium from the center of the molecule or the loss of the phytol tail. This results in the formation of the molecule, phaeophytin. Depending on the parent molecule several distinct molecules like phaeophytins, chlorophyllides, and pheophorbides can be produced. Thus, in addition to Chlorophyll *a* filtered seawater contains color degradation products of phytoplankton pigments.

3.9 CHLOROPHYLL *a* AND PHAEOPHYTIN CONCENTRATIONS

The phytoplankton biomass distribution expressed in terms of Chlorophyll *a* (Chl-*a*) and Pheophytin at selected stations in the coastal region of Petronet LNG, Dahej during June 2023. The samples for chlorophyll *a* and pheophytin is analysed for High Tide Level (HTL), Low tide level (LTL) and Inter-tidal zone (IT). For HTL and LTL samples collected from surface, middle and bottom and for IT samples collected only form surface water. The Chl-*a* concentrations in the HTL surface water were ranged from 1.16 mg/m^3 to 1.57 mg/m^3. The Pheophytin content was ranged from 0.44 mg/m^3 to 0.54 mg/m^3. The Chl-*a* concentrations in the HTL middle water were ranged from 1.05 mg/m^3 to 1.20 mg/m^3. The Pheophytin content was ranged from 0.30 mg/m^3 to 0.38 mg/m^3. The Chl-*a* concentrations in the HTL bottom water were ranged from 1.00 mg/m^3 to 1.10 mg/m^3. The Pheophytin content was ranged from 0.21 mg/m^3 to 0.32 mg/m^3. The Chl-*a* concentrations in the IT water were ranged from 0.87 mg/m^3 to 1.11 mg/m^3. The Pheophytin content was ranged from 0.29 mg/m^3 to 0.42 mg/m^3.

The Chl-*a* concentrations in the LTL surface water were ranged from 1.20 mg/m^3 to 1.35 mg/m^3. The Pheophytin content was ranged from 0.31 mg/m^3 to 0.42 mg/m^3. The Chl-*a* concentrations in the LTL middle water were ranged from 1.00 mg/m^3 to 1.26 mg/m^3. The Pheophytin content was ranged from 0.24 mg/m^3 to 0.32 mg/m^3. The Chl-*a* concentrations in the LTL bottom water were ranged from 1.01 mg/m^3 to 1.11 mg/m^3. The Pheophytin content was ranged from 0.21 mg/m^{3}to 0.30 mg/m^3.

Table 12: Chlorophyll *a*, Pheophytin concentrations in the surface marine water of Petronet LNG, Dahej at High Tide level (HTL) and Inert-tidal zone (IT) during June 2023.

Sr. No.	Parameters	Unit	High Tide Level (HTL)							
			Surface Water							
			St.1	St.2	St.3	St.4	IT1	IT2	IT3	IT4
1.	Chlorophyll *a*	mg/m^3	1.43	1.57	1.16	1.32	1.11	1.03	0.87	0.94
2	Pheophytin	mg/m^3	0.49	0.54	0.44	0.47	0.41	0.42	0.32	0.29

Table 13: Chlorophyll *a*, Pheophytin concentrations in the middle marine water of Petronet LNG, Dahej at High Tide level (HTL) during June 2023.

Sr. No.	Parameters	Unit	High Tide Level (HTL)							
			Middle Water							
			St.1	St.2	St.3	St.4	IT1	IT2	IT3	IT4
1.	Chlorophyll *a*	mg/m^3	1.10	1.20	1.05	1.11	-	-	-	-
2	Pheophytin	mg/m^3	0.32	0.38	0.30	0.35	-	-	-	-

Table 14: Chlorophyll *a*, Pheophytin concentrations in the bottom marine water of Petronet LNG, Dahej at High Tide level (HTL) during June 2023.

Sr. No.	Parameters	Unit	High Tide Level (HTL)							
			Bottom Water							
			St.1	St.2	St.3	St.4	IT1	IT2	IT3	IT4
1.	Chlorophyll *a*	mg/m^3	1.00	1.10	1.00	1.08	-	-	-	-
2	Phaeophytin	mg/m^3	0.21	0.32	0.31	0.30	-	-	-	-

Table 15: Chlorophyll *a*, Pheophytin concentrations in the surface marine water of Petronet LNG, Dahej at Low Tide level (LTL) and Inert-tidal zone (IT) during June 2023.

Sr. No.	Parameters	Unit	Low Tide Level (LTL)			
			Surface Water			
			St.1	St.2	St.3	St.4
1.	Chlorophyll a	mg/m^3	1.20	1.35	1.21	1.34
2	Pheophytin	mg/m^3	0.31	0.42	0.38	0.40

Table 16: Chlorophyll *a*, Pheophytin concentrations in the middle marine water of Petronet LNG, Dahej at Low Tide level (LTL) during June 2023.

Sr. No.	Parameters	Unit	Low Tide Level (LTL)			
			Middle Water			
			St.1	St.2	St.3	St.4
1.	Chlorophyll a	mg/m^3	1.06	1.26	1.00	1.00
2	Pheophytin	mg/m^3	0.24	0.32	0.26	0.27

Table 17: Chlorophyll *a*, Pheophytin concentrations in the bottom marine water of Petronet LNG, Dahej at Low Tide level (LTL) during June 2023.

Sr. No.	Parameters	Unit	Low Tide Level (LTL)			
			Bottom Water			
			St.1	St.2	St.3	St.4
1.	Chlorophyll a	mg/m^3	1.01	1.11	1.02	1.07
2	Pheophytin	mg/m^3	0.21	0.30	0.25	0.30

3.9 SEA GRASS AND MACRO ALAGE (SEA WEEDS)

During the present study, no occurrence of sea grasses and sea weeds in the inter-tidal area was observed.

4.0 CONCLUSION

4.1 Chemical Analysis of Water Sample

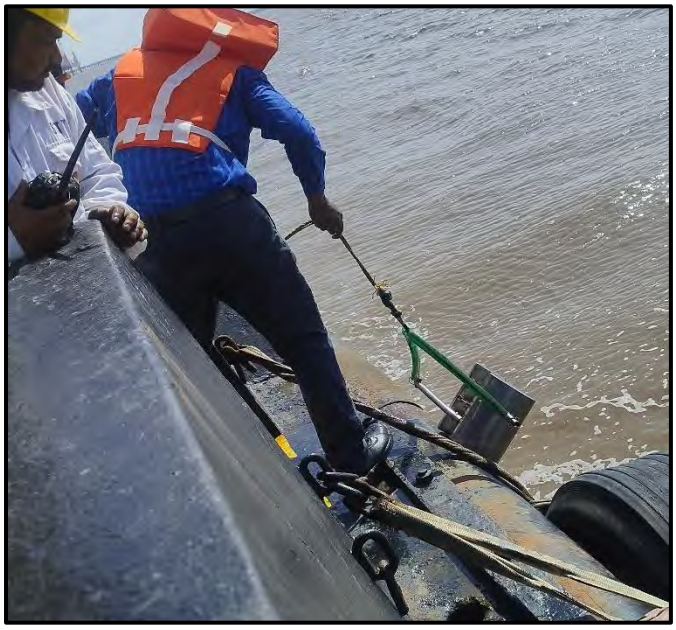
- pH at all Subtidal region Sampling Station was observe between rang in 7.78 to 8.04
- Temperature at all Subtidal region Sampling Station was observed around 28.8°C
- Turbidity at all Subtidal region Sampling Station was observed between 10 to 50 NTU
- Total Suspended Solids at all Subtidal region Sampling Station was observed between 521 to 902 mg/L
- Biochemical Oxygen Demand (BOD) Solids at all Subtidal region Sampling Station was observed between 2.2 to 4.8 mg/L
- Oil & Grease at all Subtidal region Sampling Station was observed under below detection limit.
- Ammonical Nitrogen at all Subtidal region Sampling Station was observed between 0.8 to 1.7 mg/L
- Salinity at all Subtidal region Sampling Station was observed between 29.4 to 31.5 ppt
- Dissolved Oxygen at all Subtidal region Sampling Station was observed between 5.4 to 6.0 mg/L
- Total Alkalinity as $CaCO_3$ at all Subtidal region Sampling Station was observed between 126.3 to 141.4 mg/L
- Phosphate at all Subtidal region Sampling Station was observed between 0.20 to 0.50 mg/L
- Nitrate at all Subtidal region Sampling Station was observed between 0.6 to 1.2 mg/L
- Calcium Carbonate at all Subtidal region Sampling Station was observed between 918 to 999.6 mg/L
- Petroleum Hydrocarbon (PHc) at all Subtidal region Sampling Station was Not detected.
- In microbiological parameter Total Coliform at all Subtidal region Sampling Station was observed between Absent to 56 CFU/100ml

4.2 Biological parameters of water samples

- The Chl-*a* and Pheophytin concentrations were more in the surface water as compared to the bottom water. The variations observed between the surface and bottom waters could be due to several natural biological variability.
- During the sampling period (June 2023) the phytoplankton population in the coastal waters of Petronet LNG, Dahej was diverse and represented with a total of 33 phytoplankton genera (Table 9) belonging to diatoms (29 genera) and dinoflagellates (4 genera).
- In the sub-tidal area, more density and species were reported in the surface water than middle and bottom waters. This difference could be attributed to the depth of water as surface water are more productive due to more penetration of light which deceases as increase in depth of water.
- The occurrence of copepods and their nauplii together with decapods and fish larvae/eggs in zooplankton samples highlights the fair production potential of live food resources (organisms) to support the fish and crustacean population in the study region.

- Difference in zooplankton abundance during high tide level and low tide level in the sub-tidal area was observed during the present study. Increased levels of suspended solids and the apparent increase in turbidity of water as well as high current during low tide will be considered as a possible reason for low zooplankton abundance during low tide levels.
- Compared to sub-tidal stations, in inter-tidal region zooplankton abundance was observed to be less and higher turbidity and current caused by the lower depth of water in inter-tidal areas also possible reasons for the same.
- During present study, two groups of organisms i.e. Foraminifera contributed to the 45% and Polychaete worms contributed to the 43% of total benthic organisms. Overall, the presence of Polychaete and Sipuncula worms suggests the availability of food organisms for benthic predators in the area. Due to presence of sand in the study area, foraminiferans are more abundant.
- Mangrove species *Avicennia* sp. is very sparse.
- Avifauna present in the study area is most common type.
- Overall, considering biological parameters of the study area, the study area is showed healthy environment contributing good production of phytoplankton, zooplankton and benthic organisms.

- Different Types of Sampling Photographs



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