

2024-25-MOEFCC-EC-05

27th Nov 2024

To
Deputy Director General of Forests (C)
Ministry of Environment, Forest and Climate Change,
Integrated Regional Office, Gandhi Nagar,
A-Wing – 407 & 409, Aranya Bhawan,
Near CH-3 Circle, Sector-10A,
Gandhi Nagar – 382010

Sir/Madam,

Sub: Six-monthly progressive Environmental Compliance Report from April 2024 – September 2024 for integrated developments in CB/OS-2 offshore block and onshore facilities in the Gulf of Khambhat, Gujarat.

References:

1. J-11011/55/2000-IA II, dated 21st November 2000 and amended J-11011/55/2000 IA-II, dated 22nd December 2000- Drilling of exploratory/appraisal wells (CB-OS/2) in the Gulf of Khambhat
2. J-11011/21/2001-IA. II, dated 06/07/2001 and amended J-11011/21/2001-IA II, dated 07/08/2001- Integrated Development of CB/OS-2 block (Phase I) in the Gulf of Khambhat
3. J-16011/12/2003-IA-III, dated 10th November, 2003- Drilling of Exploratory/ Appraisal Wells (CB/OS-2) in the Gulf of Khambhat
4. J11-14/2004-IA-III, dated 04.08.2005- Development of Oil production in the CB/OS-2 Block, Gulf of Khambhat, Gujarat
5. J11-32/2005-IA-III, dated 04.08.2005- Oil and Gas development in Transition Zone of CB/OS-2 Block in Gulf of Khambhat, Gujarat
6. ENV-102004-41-P, dated 2nd December 2005- CRZ Clearance for Oil Production in the Block CB-OS-2, Gulf of Khambhat by the Cairn Energy India Private Limited.
7. J-11011/109/2005-I.A.II (I), dated. 25.01.2006- Development of Oil production in the CB/OS-2 Block off-shore area in Gulf of Khambhat, Gujarat
8. WLP/13/32/A/29/5-17/2005-06, fax dated 11th February 2006- Proposed oil and development in Transition zone of CB/OS-2 Block in Gulf of Khambhat, Gujarat
9. J-11011/20/2005 - IA II (I), dated 03.04.2006- Oil and Gas development in Transition Zone of CB/OS-2 Block in Gulf of Khambhat, Gujarat.

Please find the enclosed herewith the status reports on the progressive compliance to the conditions enlisted in the above referred Environmental Clearance accorded by MoEF&CC with respect to the exploration, developments and production in CB/OS-2 offshore Block and the onshore facilities at the Gulf of Khambhat, Gujarat for the period April 2024 – September 2024.

VEDANTA LIMITED

Cairn Oil & Gas : Survey No 232 I Village – Suvali I Surat-Hazira Road I Surat - 394510, Gujarat, India
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CIN: L13209MH1965PLC291394

Sensitivity: Internal (C3)

Thanking you.

Yours faithfully,



Samarth Kaji
Installation Manager
Cairn Oil & Gas, Vedanta Limited



Enc.: Environment Clearance Compliance Report, Apr'24-Sept'24.

Copy to:

1. In-charge Zonal Office Vadodara- West Zone, Central Pollution Control Board
2. Unit Head, Gujarat Pollution Control Board, Gandhinagar
3. Regional Officer, Gujarat Pollution Control Board, Surat

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CIN: L13209MH1965PLC291394

Sensitivity: Internal (C3)

COMPLIANCE STATUS OF CONDITIONS OF MOEF&CC DURING ENVIRONMENTAL CLEARANCE OF THE PROJECT

Name of the Project: Drilling of exploratory/appraisal wells (CB-OS/2) in the Gulf of Khambhat

Clearance Letter No: J-11011/55/2000-IA II dated 21st November 2000
 J-11011/55/2000 IA-II dated 22nd December 2000

Period of Compliance Report: Progressive EC Compliance Reporting period is April 2024- September 2024

The average production details for the reporting period: The details are as follows:

In total three offshore Platforms installed with 29 numbers of wells drilled. The facility has obtained Environmental Clearance to produce up to 25,000 BOPD crude and 150 MMSCFD-- natural gas.

S. No		Units	Average production per day
1	Crude Production	BOPD	3284
2	Associated Gas Production	MMSCMD	0.26

All the conditions mentioned in this EC are being complied. Refer below for the point wise compliance details:

S. No.	EC Condition	Compliance Status
A.	Specific Conditions	
1	The schedule of commencement of drilling operation should be intimated at least one month in advance to the Wildlife Warden having jurisdiction over the nearest coastal area so as to enable him to monitor its impact, if any, as on the wildlife.	Noted for compliance. However, no drilling activities have been carried out during reporting period.
2	Approval from DG Shipping under Merchant Shipping Act prior to commencement of the drilling operations should be obtained.	Noted for compliance. However, no drilling activities have been carried out during reporting period.
3	Only water-based drilling fluid/mud should be used for the drilling operation. As reflected in the EMP, the drilling fluid should be reused/recycled. There will be no discharge of drilling fluid/mud/cuttings into sea. The entire drill cuttings/mud will be disposed off onshore in a secured landfill site approved by GPCB.	Only water-based drilling fluid/mud is used for the drilling operation. Drilling fluid/mud/cuttings are disposed offshore as per GSR 546(E) Guidelines of EPA. No drilling activities have been carried out during reporting period.
4	In case the commercial viability of the project is established, the company will prepare a detailed plan for development of oil and gas fields in CB-OS/2 in the Gulf of Khambhat and obtain fresh clearance from Ministry	Since the commercial viability of gas production was established in the Project, NOC and separate production EC were obtained from GPCB and MOEF&CC respectively for development project in the Block.
5	Adequate infrastructural facilities should be provided near the offshore installations, so that booms, skimmers and chemical dispersants could be deployed immediately in case of oil leakage from the installations. Efforts should be made to curtail the oil slick within 500 m of the installation and accordingly, action plan and facilities to check the oil slick beyond 500 m should be provided.	Oil Spill Response and Contingency Plan has been prepared as per the NOS-DCP guidelines. Refer Annexure – 5 .
6	Even though the proposed site is not part of National Park or wildlife sanctuary, it is seen that degraded mangrove forests, coral reefs and some avifauna exists in the region. No drilling well should be located in such mangrove location. Also the company should	MoU was signed on 9 th August 2012 between Cairn (herein after referred to as Vedanta Ltd (Cairn Oil & gas)) and Gujrat Ecology Commission to act as an implementing agency for "Restoration, Plantation and Conservation of 50 hectares mangroves for Rs. 11.95

S. No.	EC Condition	Compliance Status
A.	Specific Conditions	
	submit a plan/scheme for mangrove regeneration/compensatory development in consultation with the local Forest/Wildlife office	Lakhs at Karanj Village of Olpad Taluka of Surat district". Another MoU was signed on 20 th October 2022 with the Gujarat Forest Division for development and protection of 60 Ha. mangrove at Surat coastal region. Another MoU has been signed on 09 th November 2023 with the Gujarat Forest Division for development and protection of 130 Ha. Mangroves at Surat coastal region. Refer Annexure – 4 for details.
7	The project proponent shall also comply with the environmental protection measures and safeguards recommended in the EIA/EMP report as well as the recommendations of the public hearing panel.	Noted and being complied with the requirements. Refer Annexure- 6 for Compliance to EMP.
B.	General Conditions	
i.	The project authority must strictly adhere to the stipulations made by the Central Government as part of the international conventions and Merchant Shipping Act	Stipulations made by the Central Government and Merchant Shipping Act are being adhered to as per the following: 1. The Merchant Shipping Act. 1958, as amended & applicable. 2. MARPOL 1973/1978 as amended & applicable.
ii.	The project authorities must strictly adhere to the stipulations made by the Gujarat State Pollution Control Board	Noted and being complied with the requirements.
iii.	No further expansion or modifications in the plant should be carried out without prior approval of the Ministry of Environment and Forests. In case of deviations or alterations in the project proposal from those submitted to this Ministry for clearance, a fresh reference should be made to the Ministry to assess the adequacy of conditions imposed and to add additional environmental protection measures required, if any.	Noted and no activities presently being carried out without any EC requirements. Amendments/ fresh environmental clearances are periodically obtained from MoEF&CC for future expansion and modification projects as per the requirements.
iv.	The project must strictly adhere to the regulations made by MARPOL convention 1973/78 for setting limits for discharges from offshore oil/gas exploration and production activities	Complied.
v.	The project authorities must strictly comply with the rules and regulations under Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 as amended on 3 rd October 1994. Prior approvals from Chief Inspectorate of Factories, Chief Controller of Explosives, Fire Safety Inspectorate etc, must be obtained where ever applicable.	Noted and being complied with the requirements. Unit is not a major accident hazard unit as regulation, however emergency response plan is in place. All the prior approval were obtained, and licences are in place as per applicable regulations.
vi.	The project authorities must comply with the rules and regulations with regard to handling and disposal of hazardous wastes in accordance with the Hazardous Wastes (Management & Handling) Rules, 1989 wherever applicable. Authorisation from the State Pollution Control Board must be obtained for collection/treatment/storage/disposal of hazardous	Complied. The Facility has obtained Hazardous Waste Authorization from GPCB and conditions are being complied with.

S. No.	EC Condition	Compliance Status
A.	Specific Conditions	
	wastes.	
vii.	The overall noise levels in and around the rig area should be kept well within the standards (85 dBA) by providing noise control measures including acoustic hoods, silencers, enclosures etc. on all sources of noise generation. The ambient noise levels should conform to the standards prescribed under EPA Rules, 1989 viz, 75 dBA (day time) and 70 dBA (night time).	Noise levels maintained within the standards.
viii.	A separate environment management cell equipped with full-fledged laboratory facilities must be set up to carry out the environment monitoring functions.	Dedicated environmental support is available at site and at Corporate office. The site has established laboratory to monitor the key parameters of STP, ETP and noise. However a third party laboratory accredited by NABL and MoEF&CC, has been hired to carry out the environmental monitoring as per Environment monitoring plan
ix.	The project authorities will provide adequate funds both recurring and non-recurring to implement the conditions stipulated by the MOEF as well as the state government along with the implementation schedule for all the conditions stipulated herein. The funds so provided should not be diverted for any other purpose.	Annual budgetary provisions are made for the environmental related expenses such as ETP & STP operation & maintenance, greenbelt development & maintenance, environmental monitoring, hazardous waste disposal, environmental audits etc. An amount of INR 7508525 was spent towards environment and related expenses during the reporting period.
x.	The implementation of the project vis-à-vis environmental action plans will be monitored by Ministry's regional office at Bhopal, State Pollution Control Board and Central Pollution Control Board. A six-monthly compliance status report should be submitted to the monitoring agencies.	Noted and complied. Compliance reports are submitted within the stipulated time to the monitoring agencies.
xi	The project proponent should inform the public that the project has been accorded environmental clearance by the Ministry and copies of the clearance letters are available with the State Pollution Control Board/Committee and may also be seen at Website of the MOEF at http://WWW.envfor.nic.in . This should be advertised in at least two local newspapers that are widely circulated in the region of which one shall be in the vernacular language of the locality concerned	Environmental clearance of the project was advertised in the newspapers as per the MOEF guidelines and copies of the same were also submitted.

Sub: Compliance to the conditions of Environmental Clearance by MoEF

Period of reporting: Progressive EC Compliance Reporting period is April 2024 to September 2024

Ref: letter no . : J-11011/55/2000-IA II dated 21st November 2000

J-11011/55/2000 IA-II dated 22nd December 2000 **on dispensation for disposal of drill cuttings**

S. No.	Condition	Remarks
1	The water-based muds must have low toxicity (i.e 96 LC50 value > 30,000 ppm). The project authority should ensure that only low toxicity chemical additives shall be used for preparation of drilling fluids.	Noted for compliance. No drilling activities have been carried out during reporting period.
2	The disposal point should be atleast 5 Km away from the shoreline and ecologically sensitive areas.	Noted for compliance. No drilling activities have been carried out during reporting period.
3	At disposal point, the sea bed currents should have a minimum velocity of 60 Cm/second sea depth of 50 m minimum must be available for proper dilution and dispersion.	Noted for compliance. No drilling activities have been carried out during reporting period.
4	The drill cuttings should be discharged intermittently to avoid turbidity and reduction in transmittance.	Noted for compliance. No drilling activities have been carried out during reporting period.
5	Company should submit well-wise data on the quantity of water-based muds/cuttings used/generated along the slurry volume and properties.	Noted for compliance. No drilling activities have been carried out during reporting period.
6	Company should monitor the sea surface water quality in terms of oil content around the well and submit reports to the Ministry on a monthly basis during the period of drilling operations.	Noted for compliance. No drilling activities have been carried out during reporting period.

COMPLIANCE STATUS OF CONDITIONS OF MOEF&CC DURING ENVIRONMENTAL CLEARANCE OF THE PROJECT

Name of the Project: Integrated Development of CB/OS-2 block (Phase I) in the Gulf of Khambhat

Clearance Letter No: J-11011/21/2001-IA. II, Dated 06/07/2001
 J-11011/21/2001-IA II, Dated 07/08/2001

Period of Compliance Report: Progressive EC Compliance Reporting period is April 2024 - September 2024.

The average production details for the reporting period: The details are as follows:

In total three offshore Platforms installed with 29 numbers of wells drilled. The facility has obtained Environmental Clearance to produce up to 25,000 BOPD and 150 MMSCFD.

S. No		Units	Average production per day
1	Crude Production	BoPD	3284
2	Associated Gas Production	MMSCMD	0.26

All the conditions mentioned in this EC are being complied. Refer below for the point wise compliance details:

S. No.	EC Condition	Compliance Status
A.	Specific Condition	
1.	The schedule for commencement of the drilling operations should be intimated at least one month in advance to the wildlife warden having jurisdiction over the nearest coastal area so as to enable him to monitor its impact, if any, on the wild-life.	Noted for compliance. No drilling activities have been carried out during reporting period.
2.	Approval from DG Shipping under the Merchant Shipping Act prior to commencement of the drilling operations should be obtained. At least 30 days prior to the commencement of drilling, the exact location should be intimated to the Director General Shipping, Mumbai and Company should abide by any direction he may issue regarding ensuring the safety of navigation in the area.	Noted for compliance. No drilling activities have been carried out during reporting period.
3.	Only water-based drilling fluids/mud should be used for the drilling operation, Ministry hereby grants provisional permission for one year for disposal of the residual water based drilling fluids and drill cuttings after proper washing subject to the following conditions: <ul style="list-style-type: none"> – The water based muds must have low toxicity (i.e. 96 Hr LC-50 value > 30,000 ppm). The project authority should ensure – that only low toxicity chemical additives shall be used for preparation of drilling fluids. – The disposal point should be located at least 5 KM away from the shoreline and ecologically sensitive areas. – At the disposal point, the seabed currents should have a minimum velocity of 60cm/sec and sea depth of 50 meter minimum must be available for proper dilution and dispersion. – The drill cuttings should be discharged intermittently to avoid turbidity and reduction in transmittance. – Company should submit well-wise data on the quantity of water-based muds/cuttings used/generated along with slurry volume and properties (particle size 	Noted for compliance. No drilling activities have been carried out during reporting period.

S. No.	EC Condition	Compliance Status
A.	Specific Condition	
	distribution etc.) – Company should monitor the sea surface water quality in terms of oil content around the well and submit reports to the ministry on a monthly basis during the period of drilling operations.	
4.	The company should monitor the heavy metal concentration in the marine fish species before taking up the exploratory drilling activities	Complied. Heavy metal concentration is monitored in the marine fish. Refer Annexure 8 for the report.
5.	Even though the proposed site is not part of any National Park or Wildlife Sanctuary, it is seen that degraded mangrove forests exists in the region. The company should submit a plan/ scheme for mangrove regeneration/ compensatory development in consultation with the local forest/ wildlife office.	MoU was signed on 9 th August 2012 between Cairn (herein after referred to as Vedanta Ltd (Cairn Oil & gas)) and Gujarat Ecology Commission to act as an implementing agency for “Restoration, Plantation and Conservation of 50 hectares mangroves for Rs. 11.95 Lakhs at Karanj Village of Olpad Taluka of Surat district”. Another MoU signed with the Gujarat Forest Department on 20 th October 2022 to develop 60 Ha of mangrove at Surat coastal region. The schedule of activities for plantation and protection of the mangrove forest is over a span of ten years. Another MoU signed with the Gujarat Forest Department on 09 th November 2023 to develop 130 Ha of mangrove at Surat coastal region. The schedule of activities for plantation and protection of the mangrove forest is over a span of ten years. Refer Annexure – 4 for details.
6.	Adequate infrastructure facilities should be provided near the offshore installations so that booms, skimmers, chemical dispersant could be deployed immediately in case of oil leakage from the installations. Efforts should be made to curtail the oil slick within 500 meters of the installation and accordingly, action plan and facilities to check the oil slick beyond 500 meters should be provided.	Oil Spill Response and Contingency Plan has been prepared as per the NOS-DCP guidelines. Refer Annexure – 5 for the details.
7.	The project proponent shall also comply with the environmental protection measures and safeguards recommended in the EIA/EMP/Risk analysis report as well as the recommendations of the Public Hearing panel.	The environmental protection measures and safeguards recommended in EIA-EMP & Quantity Risk assessment (QRA) are being implemented. Refer Annexure – 6 for point wise compliance to the EMP.
B.	General Conditions	
i	The project authority must strictly adhere to the stipulations made by the Central Government as part of any international convention(s) or Merchant Shipping Act.	Stipulations made by the Central Government and Merchant Shipping Act are adhered to. Merchant Shipping Act are being adhered to as per the following: 1. The Merchant Shipping Act. 1958, as amended & applicable. 2. MARPOL 1973/1978 as amended & applicable.

S. No.	General Condition	Compliance Status
ii	The project authorities must strictly adhere to the stipulations made by the Gujarat Pollution Control Board and the State Government	Being complied. The stipulations and norms prescribed by GPCB are being complied with. Environment monitoring reports are regularly submitted to GPCB.
iii	No further expansion or modifications in the plant should be carried out without prior approval of the Ministry of Environment & Forests. In case of deviations or alterations in the project proposal from those submitted to this Ministry for clearance, a fresh reference should be made to the ministry to assess the adequacy of conditions imposed and to add additional environmental protection measures required, if any	Noted and no activities presently being carried out without any EC requirements. Amendments/ fresh environmental clearances are periodically obtained from MoEF&CC for future expansion and modification projects as per the requirements. CTE Amendment 115638 is obtained and is valid upto 16/07/2026.
iv	The project must strictly adhere to the regulations made by MARPOL convention 1973/1978 for setting limits, for discharges from offshore oil/gas exploration and production activities	Being complied. MV Coastal Aabhar is deputed as Production Support Vessel at offshore. This Vessel complies to the requirements of the MARPOL convention.
v	The project authorities must strictly comply with the rules and regulations under Manufacture Storage and Import of Hazardous Chemicals Rules, 1989 as amended on 3 rd October, 1994. Prior approvals from Chief Inspectorate of Factories, Chief Controller of Explosives, Fire Safety Inspectorate etc. must be obtained wherever applicable.	Noted and being complied with the requirements. Unit is not a major accident hazard unit as regulation, however for emergency, all the prior approvals were obtained and licences are in place as per applicable regulations..
vi	The project authorities must strictly comply with the rules and regulations with regard to handling and disposal of hazardous wastes in accordance with the Hazardous Waste (Management & Handling) Rules, 1989 wherever applicable. Authorisation from the State Pollution Control Board must be obtained for collection/treatment/disposal of hazardous wastes.	Noted for compliance. CCA No. AWH 128541 obtained and is valid up to 30/06/2028.
vii	The overall noise levels in and around the rig area should be kept well within the standards (85 dBA) by providing noise control measures including acoustic hoods, silencers, enclosures, etc. on all sources of noise generation. The ambient noise levels should conform to the standards prescribed under EP Rules, 1989 viz. 75 dBA (night time)	Noted for compliance. Please refer Annexure-1 for the detailed noise monitoring reports on site.
viii	A separate environment management cell equipped with full-fledged laboratory facilities must be set up to carry out the environmental management and monitoring functions.	Dedicated environmental expertise support is available both at the facilities and at Corporate office. The site has established laboratory to monitor the key parameters of STP, ETP and noise. However, for detailed and regular monitoring, a third-party laboratory accredited by NABL and MoEF&CC has been hired to carry out the environmental monitoring requirements of the facility and offshore every month.

S. No.	EC Condition	Compliance Status
A.	Specific Condition	
ix	The project authorities will provide adequate funds both recurring and non-recurring to implement the conditions stipulated by the Ministry of Environment & Forests as well as the State Government along with the implementation schedule for all the conditions stipulated herein. The funds so provided should not be diverted for any other purpose.	Annual budgetary provisions are made for the environmental related expenses such as ETP & STP operation & maintenance, greenbelt development & maintenance, environmental monitoring, hazardous waste disposal, environmental audits etc. An amount of INR 7508525 was spent towards environment and related expenses during the reporting period.
x	The implementation of project vis-à-vis environmental action plans will be monitored by Ministry's Regional Office at Bhopal, State Pollution Control Board/Central Pollution Control Board. A six-monthly compliance status report should be submitted to the monitoring agencies.	Noted and being complied with the requirements. Compliance reports are submitted within the stipulated time to the monitoring agencies.
xi	The project proponent should inform the public that the project has been accorded environmental clearance by the Ministry and copies of the clearance letter are available with the State Pollution Control Board/Committee and may also be seen at website of the Ministry of Environment & Forests at http://www.envfor.nic.in . This should be advertised in at least two local newspapers that are widely circulated in the region of which one shall be in the vernacular language of the locality concerned.	Environmental clearance of the project was advertised in the newspapers as per the MOEF guidelines and copies of the same were also submitted.

SIX-MONTHLY REPORT OF PROGRESSIVE COMPLIANCE TO ENVIRONMENTAL CLEARANCE CONDITION

Name of the Project: Drilling of Exploratory/ Appraisal Wells (CB/OS-2) in the Gulf of Khambhat

Clearance Letter No: J-16011/12/2003-IA-III dated 10th November, 2003

Period of Compliance Report: Progressive EC Compliance Reporting period is April 2024 – September 2024.

Project activity during reporting period: No drilling activities were carried out during the reporting period of compliance report.

The average production details for the reporting period: The details are as follows:

In total three offshore Platforms installed with 29 numbers of wells drilled. The facility has obtained Environmental Clearance to produce up to 25,000 BOPD and 150 MMSCM.

S. No		Units	Average production per day
1	Crude Production	BoPD	3284
2	Associated Gas Production	MMSCMD	0.26

All the conditions mentioned in this EC are being complied. Refer below for the point wise compliance details:

S. No.	EC Condition	Compliance Status
A.	Specific Conditions	
1.	The Schedule for commencement of the drilling operation should be intimated at least one month in advance to the Wildlife Warden/Member Secretary, Gujarat Coastal Zone Management Authority and the Coast Guards having jurisdiction over the nearest coastal areas so as to enable them to monitor its impact, if any, on the wildlife and the coastal waters/coastal zone.	Noted for compliance. No drilling activities have been carried out during reporting period.
2.	Approval from DG Shipping under the Merchant Shipping Act prior to commencement of the drilling operations should be obtained.	Noted for compliance. No drilling activities have been carried out during reporting period.
3.	Use of diesel base mud is prohibited. Only water-based drilling fluids / mud should be used for drilling operation. As reflected in the EMP the drilling fluid should be recycled to a maximum extent. There should be no discharge of drilling fluid / mud / cuttings into sea. The unusable drilling fluid and entire drill cuttings should be disposed off onshore in a well-designed pit-lined with impervious liner. The disposal pit should be provided with leakage collection system. Design details of the waste disposal pit, capping of disposal pit should be approved by the Gujarat Pollution Control Board. The waste pit after it is filled up should be covered with impervious liner over which, a thick layer of native soil with proper slope should be provided	Noted for compliance. Water-based drilling fluid is used during drilling. Drilling fluid/mud/cuttings are disposed offshore as per GSR 546(E) Guidelines of EPA. No drilling activities have been carried out during reporting period.
4.	The chemical additives used for preparation of drilling fluid (DF) should have low toxicity i.e., 96 hr LC50 > 30,000 mg/1 as per mysid toxicity test conducted on locally available sensitive sea species. The chemicals used (mainly organic constituent) should be bio-degradable.	Noted for compliance. No drilling activities have been carried out during reporting period.
5.	Barite used in preparation of DF should not contain Hg>1mg/kg and Cd>3g/kg	Noted and complied No drilling activities have been carried out during reporting period. Refer Attachment 8 for offshore monitoring reports.
6.	Drilling waste-water including drill cuttings generated from each well from any recognized laboratory for its characteristics and results should be submitted to Ministry of Environment & Forests / CPCB / Gujarat Pollution Control Board periodically	Noted for compliance. No drilling activities have been carried out during reporting period.
7.	The Company should get analyzed the drill cuttings generated from each well from any recognized laboratory for its characteristics and results should be submitted to	Noted for compliance. No drilling activities have been carried out during reporting period.

S. No.	EC Condition	Compliance Status
	Ministry of Environment & Forests / CPCB / Gujrat Pollution Control Board periodically.	
8.	The used Oil generated from drill site should be collected and sold to registered recyclers having environmentally sound management facility.	The used oil generated is re-processed with crude within the terminal.
9.	In case environmentally acceptable methods for disposal of drill waste such as (a) injection to a formation through casing annulus, if conditions allow (b) Land farming at suitable location (c) Bio-remediation (d) Incinerator or (e) Solidification should be considered in that case company should submit proposal to Gujarat Pollution Control Board / Ministry of Environment & Forests for approval.	Drilling waste is disposed offshore as per GSR 546(E) Guidelines of EPA. No drilling activities have been carried out during reporting period.
10.	In case the commercial viability of the project is established the company will prepare a detailed plan for development of oil and gas fields in CB/OS-2 in the gulf of Khambhat and obtain fresh clearance from the Ministry.	Since the commercial viability of gas production was established in the Project, NOC and separate production EC were obtained from GPCB and MOEF&CC respectively for development project in the Block.
11.	Adequate Infrastructure facilities should be provided near the offshore installations so that booms, skimmer, chemical dispersants could be deployed immediately in case of oil leakage from installation. Appropriate Oil Spill Management Plan should be drawn and efforts should be made to curtail the oil slick within 500m of the installation and accordingly action plan and facilities to check the oil slick beyond 500m should be provided	Oil Spill Response and Contingency Plan has been prepared as per the NOS-DCP guidelines. Refer Annexure – 5 for the details.
12.	No drilling well should be located in Mangrove Area.	Noted for compliance. No drilling activities have been carried out during reporting period.
13.	It shall be ensured that during movement of man and material no obstruction of mangroves is carried out.	Noted for compliance. No drilling activities have been carried out during reporting period.
14.	No ground water shall be tapped for the project.	Complied. The water requirement is sourced from GIDC supply.
15.	The Solid Waste generated during the drilling process and from the equipment should be disposed of safely in consultation with Gujarat State Pollution Control Board.	Noted for compliance. Drilling Waste is disposed offshore as per GSR 546(E) Guidelines of EPA. No drilling activities have been carried out during reporting period.
16.	No landfill site should be located in coastal Regulation zone area. The solid waste generated during the drilling process and from the equipment should be disposed of safely in consultation with Gujarat State Pollution Board.	Noted for compliance. No drilling activities have been carried out during reporting period.
17.	No Camp sites for labours should be set up in Coastal Regulation Zone area. The toilets to be constructed in coastal regulation zone areas should have septic tank and soak pit.	Noted for compliance.
18.	The Waste-water generated from the project shall be treated and disposed of as per the norms laid down by Gujarat State Pollution Control Board.	Noted for compliance. Sewage generated from the terminal activities is treated through the aeration process in the STP installed within the onshore terminal. The treated sewage is used for the greenbelt development activities within the onshore area and thus no discharge is carried out beyond the terminal premises. The produced water separated from the hydrocarbon well fluids is treated through onshore ETP installed

S. No.	EC Condition	Compliance Status
		<p>within the terminal area. The treated effluent after meeting the marine discharge standards as prescribed by GPCB is discharged into sea through marine outfall located about 500 m from Low Tide Level (as recommended by NIO after carrying out the study).</p> <p>Periodic environmental monitoring is being carried out for the treated sewage and the treated effluents. Refer Annexure 1 for monitoring details.</p>
19.	Oil blow-out preventing device to be provided against to be checked and prevented.	<p>Complied with.</p> <p>Blow out valves are installed in the producing wells.</p>
20.	Hydrocarbon leak due to loss of containment to be checked and prevented.	The crude oil storage tanks are provided with the adequate bunds to contain any leakage. These tanks and bunds are continuously monitored to check for any leakages.
21.	The project proponent shall also comply with the environmental protection measures and safeguards recommended in the EIA / EMP / DMP report.	The environmental protection measures and safeguards recommended in EIA-EMP & Quantity Risk assessment (QRA) are being implemented during construction and operation phase. Site specific Disaster Management Plan has been developed.
B.	General Conditions:	
i.	The Project authority must strictly adhere to the stipulation made by the central government as part of any International Convention(s) or Merchant Shipping Act.	<p>Stipulations made by the Central Government and Merchant Shipping Act are adhered to. Merchant Shipping Act are being adhered to as per the following:</p> <ol style="list-style-type: none"> 1. The Merchant Shipping Act. 1958, as amended & applicable. 2. MARPOL 1973/1978 as amended & applicable.
ii.	The Project authorities must strictly adhere to the stipulations made by the Gujarat State Pollution Control Board and the State Government	<p>Being complied.</p> <p>All the conditions mentioned in the CCA (Consolidated Consent Authorization) is being complied and periodic reports are being submitted to the Gujarat State Pollution Control Board.</p>
iii.	No further expansion or modification in the plant should be carried out without prior approval of Ministry of Environment and Forests. In case of deviations or alterations in the project proposal from those submitted to this Ministry for clearance a fresh reference should be made to the Ministry to assess the adequacy of conditions imposed and to add additional environmental protection measures required, if any	Noted for compliance and no activities being carried out without obtaining the necessary approvals.
iv.	The project must strictly adhere to regulations made by MARPOL convention 1973/1978 for setting limits, for discharges from offshore oil/gas exploration and production activities	Complied
v.	The project authorities must strictly comply with the rules and regulations under Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 as amended on 3 rd October 1994. Prior approvals from Chief Inspector of Factories, Chief Controller of Explosives, Fire Safety Inspectorate etc. must be obtained wherever applicable	<p>Noted and being complied with the requirements.</p> <p>Unit is not a major accident hazard unit as regulation, however during emergency, all the prior approval are obtained and licenses are in place as per applicable regulations.</p>
vi	The project authorities must strictly comply with the rules and regulations with regard to handling and disposal of Hazardous wastes in accordance with the Hazardous Wastes (Management and Handling) Rules, 1989/2003 wherever applicable. Authorization from the State Pollution Control Board must be obtained for	<p>Being complied.</p> <p>The Facility has obtained Hazardous Waste Authorization from GPCB and conditions are being complied.</p>

S. No.	EC Condition	Compliance Status
	collections/treatment/storage/disposal of hazardous wastes.	
vii	The overall noise level in and around the rig area should be kept well within the standards (85 dBA) by providing noise control measures including acoustic hoods, silencers, enclosures etc. on all sources of noise generation. The ambient noise level should conform to the standards prescribed under EPA Rules, 1989 viz. 75 dBA (day time) and 70 dBA (night time)	Noted for compliance No drilling activities have been carried out during reporting period.
viii	A separate environmental management cell equipped with full fledged laboratory facilities must be set up to carry out the environmental management and monitoring functions.	Dedicated environmental expertise support is available both at the facilities and at Corporate office. The site has established laboratory to monitor the key parameters of STP, ETP and noise. However, for the detailed and regular monitoring, third-party laboratory accredited by NABL and MoEF&CC has been hired to carry out the environmental monitoring requirements of the facilities and offshore.
ix.	The project authorities will provide adequate funds both recurring and non-recurring to implement the conditions stipulated by the Ministry of Environment and Forests as well as the State Government along with the implementation schedule for all the conditions stipulated herein. The funds so provided should not be diverted for any other purpose	Annual budgetary provisions are made for the environmental related expenses such as ETP & STP operation & maintenance, greenbelt development & maintenance, environmental monitoring, hazardous waste disposal, environmental audits etc. An amount of INR 7508525 was spent towards environment and related expenses during the reporting period.
x.	The implementation of the project vis-à-vis environmental action plans will be monitored by Ministry's Regional Office at Bhopal/State Pollution Control board/Central Pollution Control Board. A six-monthly compliance status report should be submitted to the monitoring agencies.	Being complied. Six monthly EC compliance report is submitted regularly.
xi.	The Project Proponent should inform the public that the project has been accorded environmental clearance by the Ministry and copies of the clearance letter are available with the State Pollution Control Board/Committee and may also be seen at Website of the Ministry and Forests at http://www.envfor.nic.in . This should be advertised within seven days from the date of issue of clearance letter in at least two local newspapers that are widely circulated in the region of which one shall be in the vernacular language of the locality concerned.	A public notice informing the grant of EC by MOEF for the off-shore oil development in CB/OS-2 Block, Gulf of Khambhat and availability of its copies was published in the following newspapers: 1. Indian Express (English) dt 26-08-2005 2. Gujarat Mitra (Gujarati) - dt 26-08-2005

SIX-MONTHLY REPORT OF PROGRESSIVE COMPLIANCE TO ENVIRONMENTAL CLEARANCE CONDITION

Name of the Project: Development of Oil production in the CB/OS-2 Block, Gulf of Khambhat, Gujarat

Clearance Letter No: J11-14/2004-IA-III dated 04.08.2005

Period of Compliance Report: Progressive EC Compliance Reporting period is April 2024- September 2024.

Project activity during reporting period: No drilling activities were carried out during the reporting period of compliance report.

The average production details for the reporting period: The details are as follows:

In total three offshore Platforms installed with 29 numbers of wells drilled. The facility has obtained Environmental Clearance to produce up to 25,000 BOPD and 150 MMSCFD.

S. No		Units	Average production per day
1	Crude Production	BOPD	3284
2	Associated Gas Production	MMSCMD	0.26

All the conditions mentioned in this EC are being complied. Refer below for the point wise compliance details:

S. No.	EC Condition	Compliance Status
	Specific Conditions	
i.	All the conditions stipulated by the Forests and Environment Department, Government of Gujarat vide their letters NO.ENV-102000-41-P, dated 8.7.2004 should be strictly implemented.	Complied.
ii.	All the conditions stipulated by the Gujarat Pollution Control Board vide their letter No. PC/NOC/SRT-1392/5064, dated 3.6.2004 should be strictly implemented.	Complied.
iii.	The Schedule for commencement of the drilling operation should be intimated at least one month in advance to the Wildlife Warden/ Member Secretary, Gujarat Coastal Zone Management Authority and the Coast Guards having jurisdiction over the nearest coastal area so as to enable them to monitor its impact, if any, on the wildlife and the coastal waters/ coastal zone.	Noted for compliance. However, no drilling activity was carried out during the reporting period.
iv.	Approval from DG Shipping under the Merchant Shipping Act prior to commencement of the drilling operations should be obtained.	Noted for the compliance. However, no drilling activity was carried out during the reporting period.
v.	Use of diesel base mud is prohibited. Only water based drilling fluids / mud should be used for the drilling operation. As reflected in the BMP the drilling fluid should be recycled to a maximum extent. There should be no discharge of drilling fluid / mud / cuttings into sea. The unusable drilling fluid and entire drill cuttings should be disposed off onshore in a well designed pit lined with impervious liner. The disposal pit should be provided with leakage collection system. Design details of the waste disposal pit, capping of disposal pit should be approved by the Gujarat Pollution Control Board. The waste pit after it is filled up should be covered with impervious liner over which, a thick layer of native soil with proper slope should be provided.	Noted for compliance. However, no drilling activity was carried out during the reporting period.
vi.	The chemical additives used for preparation of drilling fluid (DF) should have low toxicity i.e., 96 hr LC50 > 30,000 mg/1 as per mysid toxicity test conducted on locally available sensitive sea	Noted for compliance. However, no drilling activity was carried out during the reporting period.

S. No.	EC Condition	Compliance Status
	species. The chemicals used (mainly organic constituent) should be bio-degradable	
vii.	Barite used in preparation of DF should not contain Hg >1 mg/ kg and Cd > 3mg/ kg	Noted for compliance. However, no drilling activity was carried out during the reporting period.
viii.	Drilling waste water including drill cuttings wash water should be collected in the disposal pit, evaporated and treated and should comply with notified standards for onshore disposal.	Noted for compliance. However, no drilling activity was carried out during the reporting period.
ix.	The company should get analyzed the drill cuttings generated from each well from any recognized laboratory for its characteristics and results should be submitted to Ministry of Environment & Forests/CPCB/Gujarat Pollution Control Board periodically.	Noted for compliance. However, no drilling activity was carried out during the reporting period.
x.	The used oil generated from drill site should be collected and sold to registered recyclers having environmentally sound management facility	Noted for compliance No drilling activity has taken place in the reporting period under the scope of this EC
xi.	In case, environmentally acceptable methods for disposal of drill waste such as (a) injection to a formation through casing annulus, if conditions allow (b) land farming at suitable location (c) bio-remediation (d) incinerator or (e) solidification should be considered, in that case company should submit proposal to Gujarat Pollution Control Board/ Ministry of Environment & Forests for approval	Noted for compliance. However, no drilling activity was carried out during the reporting period.
xii.	In case the commercial viability of the project is established, the company will prepare a detailed plan for development of oil and gas fields in CB-OS/2 in the Gulf of Khambhat and obtain fresh clearance from the Ministry	Cairn has established commerciality of project based on the earlier obtained drilling Environmental Clearances (EC) and this EC is obtained to produce hydrocarbon.
xiii.	Adequate infrastructure facilities should be provided near the off-shore installations so that booms, skimmers, chemical dispersants could be deployed immediately in case of oil leakage from the installation. Appropriate Oil Spill Management Plan should be drawn and efforts should be made to curtail the oil slick within 500 meters of the installation and accordingly, action plan and facilities to check the oil slick beyond 500 meters should be provided.	Oil Spill Response and Contingency Plan has been prepared as per the NOS-DCP guidelines. Refer Annexure – 5 for details.
xiv.	No drilling wells or facilities other than those permitted under the Coastal Regulation Zone Notification, 1991 should be located in mangrove area	Noted for compliance.
xv.	It shall be ensured that during movement of man and material no destruction of mangroves is carried out	Noted for compliance.
xvi.	No groundwater should be tapped for the project in Coastal Regulation Zone areas	Complied. The water requirement is fulfilled through rain-water harvesting on the terminal and GIDC supply.
xvii.	The solid waste generated during the drilling process and from the equipment should be disposed of safely in consultation with Gujarat State Pollution Control Board	Noted for compliance. However, no drilling activity was carried out during the reporting period.

S. No.	EC Condition	Compliance Status
xviii.	No landfill site should be located in Coastal Regulation Zone area. The solid waste generated from the drill cutting, solar evaporated drilling mud sediments should be disposed off in Gujarat Enviro Protection and Infrastructure Limited (GEPIL) hazardous waste facility located at Gabheri Taluk Choryasi, Surat	Noted for compliance. However, no drilling activity was carried out during the reporting period.
xix.	No camp sites for labours should be set up in Coastal Regulation Zone area. The toilets to be constructed in Coastal Regulation Zone areas should have septic tank and soak pit	Complied
xx.	The waste water generated from the project shall be treated and disposed off as per the norms laid down by Gujarat State Pollution Control Board	Sewage generated from the terminal activities is treated through the aeration process in the STP installed within the onshore terminal. The treated sewage is used for the greenbelt development activities within the onshore area and thus no discharge is carried out beyond the terminal premises. The produced water separated from the hydrocarbon well fluids is treated through onshore ETP installed within the terminal area. The treated effluent after meeting the marine discharge standards as prescribed by GPCB is discharged into sea through marine outfall located about 500 m from Low Tide Level (as recommended by NIO after carrying out the study). Periodic environmental monitoring is being carried out for the treated sewage and the treated effluents. Refer Annexure- 1 for environmental monitoring details.
xxi.	Oil blow out preventing device should be provided against the hazard of oil blow out	Complied with. Blow out valves are installed in the producing wells.
xxii.	Hydrocarbon leak due to loss of containment to be checked and prevented	The crude oil storage tanks are provided with adequate bunds to contain any leakage. These tanks and bunds are continuously monitored to check for any leakages.
xxiii.	The project proponent shall also comply with the environmental protection measures and safeguards recommended in the EIA/ EMP/ DMP report	The environmental protection measures and safeguards recommended in EIA-EMP & Quantity Risk assessment (QRA) are being implemented during construction and operation phase.
	General Conditions:	
i.	The Project authority must strictly adhere to the stipulations made by the Central Government as part of any International Convention(s) or Merchant Shipping Act	Stipulations made by the Central Government and Merchant Shipping Act are adhered to. Merchant Shipping Act are being adhered to as per the following: 1. The Merchant Shipping Act. 1958, as amended & applicable. 2. 2. MARPOL 1973/1978 as amended & applicable.
ii.	The project authorities must strictly adhere to the stipulations made by the Gujarat State Pollution Control Board and the State Government.	Being complied. All the conditions mentioned in the CCA (Consolidated Consent Authorization) is being complied and periodic reports are being submitted to the Gujarat State Pollution Control Board.
iii.	No further expansion or modifications in the plant should be carried out without prior approval of the Ministry of Environment & Forests. In case of deviations or alterations in the project proposal from those submitted to this Ministry for clearance, a fresh reference should be made to the Ministry to assess the adequacy of conditions	Noted for the compliance and no activities being carried out without obtaining the necessary approvals.

S. No.	EC Condition	Compliance Status
	imposed and to add additional environmental protection measures required, if any.	
iv.	The project must strictly adhere to the regulations made by MARPOL convention 1973/1978 for setting limits, for discharges from offshore oil/ gas exploration and production activities	Being complied
v	The project authorities must strictly comply with the rules and regulations under Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 as amended on 3rd October 1994. Prior approvals from Chief Inspectorate of Factories, Chief Controller of Explosives, Fire Safety Inspectorate etc. must be obtained wherever applicable.	Noted and being complied with the requirements. Unit is not a major accident hazard unit as regulation, however for emergency, all the prior approval were obtained and licenses are in place as per applicable regulations.
vi	The project authorities must strictly comply with the rules and regulations with regard to handling and disposal of hazardous wastes in accordance with the Hazardous Wastes (Management & Handling) Rules, 1989/2003 wherever applicable. Authorization from the State Pollution Control Board must be obtained for collections/ treatment/ storage/ disposal of hazardous wastes	Being complied. The Facility has obtained Hazardous Waste Authorization from GPCB and conditions are being complied.
vii	The overall noise level in and around the rig area should be kept well within the standards (85 dB(A)) by providing noise control measures including acoustic hoods, silencers, enclosures etc. on all sources of noise generation. The ambient noise levels should conform to the standards prescribed under EPA Rules, 1989 viz. 75 dB(A) (daytime) and 70 dB(A) (nighttime)	Being Complied No rig operation during the reporting period
viii	A separate environmental management cell equipped with full-fledged laboratory facilities must be set up to carry out the environmental management and monitoring functions	Dedicated environmental support is available at site and at Corporate office. The site has established laboratory to monitor the key parameters of STP, ETP and noise. However, third-party laboratory accredited by NABL and MoEF & CC, has been hired to carry out environmental monitoring every month as per Environment monitoring plan
ix	The project authorities will provide adequate funds both recurring and non-recurring to implement the conditions stipulated by the Ministry of Environment & Forests as well as the State Government along with the implementation schedule for all the conditions stipulated herein. The funds so provided should not be diverted for any other purpose	Annual budgetary provisions are made for the environmental related expenses such as ETP & STP operation & maintenance, greenbelt development & maintenance, environmental monitoring, hazardous waste disposal, environmental audits etc. An amount of INR 7508525 was spent towards environment and related expenses during the reporting period.
x	The implementation of the project vis-a-vis environmental action plans will be monitored by Ministry's Regional Office at Bhopal/State Pollution Control Board/ Central Pollution Control Board. A six-monthly compliance status report should be submitted to the monitoring agencies	Being complied. Six monthly EC compliance report is submitted regularly.

S. No.	EC Condition	Compliance Status
xi	The Project Proponent should inform the public that the project has been accorded environmental clearance by the Ministry and copies of the clearance letter are available with the State Pollution Control Board/Committee and may also be seen at Website of the Ministry and Forests at http://www.envfor.nic.in . This should be advertised within seven days from the date of issue of the clearance letter in at least two local newspapers that are widely circulated in the region of which one shall be in the vernacular language of the locality concerned.	A public notice informing the grant of EC by MOEF for the off-shore oil development in CB/OS-2 Block, Gulf of Khambhat and availability of its copies was published in the following newspapers: <ol style="list-style-type: none">1. Indian Express (English) dt 26-08-20052. Gujarat Mitra (Gujarati) - dt 26-08-2005

COMPLIANCE STATUS OF CONDITIONS OF MOEF&CC DURING CRZ CLEARANCE OF THE PROJECT

Name of the Project: Oil and Gas development in Transition Zone of CB/OS-2 Block in Gulf of Khambhat, Gujarat

Clearance Letter No: J11-32/2005-IA-III dated 04.08.2005

Period of Compliance Report: Progressive CRZ Compliance Reporting period is April 2024 – September 2024.

Project activity during reporting period: No additional facilities installed and no drilling activities under the scope of this EC were undertaken during the reporting period of compliance report.

The well under the scope of this EC was abandoned and therefore there was no production in the reporting period.

All the conditions mentioned in this CRZ clearance are being complied. Refer below for the point wise compliance details:

S. No	CRZ condition	Compliance status
	A. Specific Conditions	
(i)	All the conditions stipulated by the Forest and Environment Department, Government of Gujarat vide their letters No. ENV -10-2004-85-P, dated 23.2.2005 should be strictly implemented.	Being complied.
(ii)	All the conditions stipulated by the Gujarat Pollution Control Board vide their letter No. PC/NOC/SRT-1392/1414/16263, dated 3.6.2004 should be strictly implemented.	Being complied.
(iii)	Extensive mangroves development should be taken up in identified area with Forest Department	MoU was signed on 9 th August 2012 between Cairn (herein after referred to as Vedanta Ltd (Cairn Oil & gas)) and Gujrat Ecology Commission to act as an implementing agency for "Restoration, Plantation and Conservation of 50 hectares mangroves for Rs. 11.95 Lakhs at Karanj Village of Olpad Taluka of Surat district". Another MoU was signed on 20 th October 2022 with the Gujarat Forest Department for the development of 60 Ha mangroves at Gujarat coastal region. Another MoU was signed on 09 th November 2023 with the Gujarat Forest Department for the development of 130 Ha mangroves at Gujarat coastal region. Refer Annexure – 4 for details.
(iv)	Necessary arrangements should be made to provide drinking water to the local public since the area has water scarcity problem	Water supply arrangements have been provided to Suvali village with a capital investment of Rs. 10 lakhs. Under the project Jeevan Amrit, we have installed ATW unit at Suvali RO plant so that people from the village can get drinking water 24x7 through ATW card.
(v)	No chemicals or products should be stored within the Coastal Regulation Zone area other than those permissible under the Coastal Regulation Zone Notification, 1991	Being complied. Chemicals are stored in Chemical storage yard which is not present in the CRZ area.
(vi)	No effluent discharge/ waste disposal should be done in CRZ area	Being complied. Effluents are not discharged in the CRZ area. Sewage generated from the terminal activities is treated through the aeration process in the STP installed within the onshore terminal. The treated sewage is used for the greenbelt development activities within the onshore area and thus no discharge is carried out beyond the terminal premises. The produced water separated from the hydrocarbon well fluids is treated through onshore ETP installed within the terminal area. The treated effluent after meeting the marine discharge standards as prescribed by GPCB is discharged

S. No	CRZ condition	Compliance status
		into sea through marine outfall located about 500 m from Low Tide Level (as recommended by NIO after carrying out the study). Periodic environmental monitoring is being carried out for the treated sewage and the treated effluents. Refer the Annexure - 1 for the details.
(vii)	The schedule for commencement of the drilling operation should be intimated at least one month in advance to the Wildlife Warden/ Member Secretary, Gujarat Coastal Zone Management Authority and the Coast Guards having jurisdiction over the nearest coastal area so as to enable them to monitor its impact, if any, on the wild life and the coastal waters/ coastal zone.	No drilling activities under the scope of this CRZ Clearance were undertaken during the reporting period. However, all the stipulated conditions are being complied with and CIL shall continue to comply during any drilling activities in the future.
(viii)	Approval from DG Shipping under the Merchant Shipping Act prior to commencement of the drilling operations should be obtained	Noted for compliance. However, no drilling activities under the scope of this CRZ Clearance were undertaken during the reporting period.
(ix)	Use of diesel base mud is prohibited. Only water based drilling fluids / mud should be used for the drilling operation. As reflected in the BMP the drilling fluid should be recycled to a maximum extent. There should be no discharge of drilling fluid/ mud/ cuttings into the sea. The unusable drilling fluid and entire drill cuttings should be disposed off onshore in a well designed pit lined with impervious liner. The disposal pit should be provided with leakage collection system. Design details of the waste disposal pit, capping of disposal pit should be approved by the Gujarat Pollution Control Board. The waste pit after it is filled up should be covered with impervious line over which, a thick layer of native soil with proper slope should be provided.	Noted for compliance. The drilling is managed as per the requirements specified in the GSR 546 (E) and as per the Gujarat Pollution Control Board requirements. However, no drilling activities under the scope of this CRZ Clearance were undertaken during the reporting period.
(x)	The chemical additives used for preparation of drilling fluid (DF) should have low toxicity i.e., 96 hr LC50 > 30,000 MG/L as per mysid toxicity test conducted on locally available sensitive sea species. The chemicals used (mainly organic constituent) should be bio-degradable	Noted for compliance. However, no drilling activities under the scope of this CRZ Clearance were undertaken during the reporting period.
(xi)	Barite used in preparation of DF should not contain Hg>1mg/kg and Cd>3mg/kg.	Noted for compliance. However, no drilling activities under the scope of this CRZ Clearance were undertaken during the reporting period.
(xii)	Drilling wastewater including drill cuttings wash water should be collected in the disposed pit, evaporated and treated and should comply with notified standards for onshore disposal.	Noted for compliance. However, no drilling activities under the scope of this CRZ Clearance were undertaken during the reporting period.
(xiii)	The company should get analyzed the drill cuttings generated from each well from any recognized laboratory for its characteristics and results should be submitted to Ministry of Environment and Forests/ CPCB/ Gujarat Pollution Control Board periodically.	Noted for compliance. However, no drilling activities under the scope of this CRZ Clearance were undertaken during the reporting period.
(xiv)	The used oil generated from drill site should be collected and sold to registered recyclers having environmentally sound management facility	The used oil generated from the process equipment's are being reprocessed with crude at the onshore terminal.

S. No	CRZ condition	Compliance status
(xv)	In case, environmentally acceptable methods for disposal of drill waste such as (a) injection to a formation through casing annulus, if conditions allow (b) land farming at suitable location (c) bioremediation (d) incinerator or (e) solidification should be considered, in that case company should submit proposal to Gujarat Pollution Control Board/ Ministry of Environment & Forests for approval	Noted for compliance No drilling activities under the scope of this CRZ clearance were undertaken during the reporting period
(xvi)	In case the commercial viability of the project is established, the company will prepare a detailed plan for development of oil and gas fields in CB-OS/2 in the Gulf of Khambhat and obtain fresh clearance from the Ministry	Vedanta Ltd. (Cairn Oil & Gas) has established commerciality of project and this EC is for the production of crude oil and gas.
(xvii)	Adequate infrastructure facilities should be provided near the off-shore installations so that booms, skimmers, chemicals dispersants could be deployed immediately in case of oil leakage from the installation. Appropriate Oil Spill Management Plan should be drawn and efforts should be made to curtail the oil slick within 500 meters of the installation and accordingly, action plan and facilities to check the oil slick beyond 500 meters should be provided.	Oil Spill Response and Contingency Plan has been prepared as per the NOS-DCP guidelines. Refer Annexure – 5 for the details.
(xviii)	No drilling well should be located in mangrove area	Noted for compliance No drilling activities under the scope of this CRZ clearance were undertaken during the reporting period
(xix)	It shall be ensured that during movement of man and material no destruction of mangroves is carried out	Noted for compliance No drilling activities under the scope of this CRZ clearance were undertaken during the reporting period
(xx)	No groundwater should be tapped for the project	Complied. The water requirement is sourced from GIDC and rain-water harvesting facility at the terminal.
(xxi)	The solid waste generated during the drilling process and from the equipment should be disposed of safely in consultation with Gujarat state Pollution Control Board	Noted for compliance No drilling activities under the scope of this CRZ clearance were undertaken during the reporting period
(xxii)	No landfill site should be located in Coastal Regulation Zone area. The solid waste generated from the drill cutting, solar evaporated drilling mud sediments should be disposed off in Gujarat Enviro Protection and Infrastructure Limited (GEPIL) hazardous waste facility located at Gabheri Taluk Choryasi, Surat	Noted for compliance No drilling activities under the scope of this CRZ clearance were undertaken during the reporting period
(xxiii)	No camp sites for labours should be set up in Coastal Regulation Zone area. The toilets to be constructed in Coastal Regulation Zone areas should have septic tank and soak pit	Noted for compliance No drilling activities under the scope of this CRZ clearance were undertaken during the reporting period
(xxiv)	The waste water generated from the project shall be treated and disposed off as per the norms laid down by Gujarat State Pollution Control Board	Sewage generated from the terminal activities is treated through the aeration process in the STP installed within the onshore terminal. The treated sewage is used for the greenbelt development activities within the onshore area and thus no discharge is carried out beyond the terminal premises. The produced water separated from the hydrocarbon well fluids is treated through onshore ETP installed within the terminal area. The treated effluent after meeting the marine discharge standards as prescribed by GPCB is discharged into sea through marine outfall located about 500 m from Low Tide Level

S. No	CRZ condition	Compliance status
		(as recommended by NIO after carrying out the study). Periodic environmental monitoring is being carried out for the treated sewage and the treated effluents. Refer the Annexure 1 for the monitoring details.
(xxv)	Oil blow out preventing device should be provided against the hazard of oil blow out	Blow out Preventers (BOP) is an integral part of drilling machine and Vedanta Ltd. (Cairn Oil & Gas) ensures that BOP is in place during drilling operations
(xxvi)	Hydrocarbon leak due to loss of containment to be checked and prevented	The crude oil storage tanks are provided with adequate bunds to contain any leakage. These tanks and bunds are continuously monitored to check for any leakages.
(xxvii)	The project proponent shall also comply with the environmental protection measures and safeguards recommended in the EIA/EMP/DMP reports	The environmental protection measures and safeguards recommended in EIA-EMP & Quantity Risk assessment (QRA) are being implemented during construction and operation phase. Refer Annexure – 6 for compliance to the EMP points with respect to EC No. J-11011/109/2005-I.A.II(I)
(xxviii)	No activities should be carried out in the forest area without obtaining forest clearance from the Forest Department	Noted for compliance.
General Conditions		
(i)	The Project authority must strictly adhere to the stipulations made by the Central Government as part of any International Convention(s) or Merchant Shipping Act	Stipulations made by the Central Government and Merchant Shipping Act are adhered to. Merchant Shipping Act are being adhered to as per the following: 1. The Merchant Shipping Act. 1958, as amended & applicable. 2. MARPOL 1973/1978 as amended & applicable.
(ii)	The project authorities must strictly adhere to the stipulations made by the Gujarat State Pollution Control Board and the State Government	Being complied. All the conditions mentioned in the CCA (Consolidated Consent Authorization) is being complied and periodic reports are being submitted to the Gujarat State Pollution Control Board.
(iii)	No further expansion or modification in the plant should be carried out without prior approval of the Ministry of Environment & Forests. In case of deviations or alterations in the project proposal from those submitted to this Ministry for clearance, a fresh reference should be made to the Ministry to assess the adequacy of conditions imposed and to add additional environmental protection measures required, if any.	Noted for the compliance and no activities being carried out without obtaining the necessary approvals.
(iv)	The project must strictly adhere to the regulations made by MARPOL convention 1973/1978 for setting limits, for discharges from offshore oil/gas exploration and production activities.	Complied
(v)	The project authorities must strictly comply with the Rules and regulations under Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 as amended on 3 rd October 1994. Prior approvals from Chief Inspectorate of Factories, Chief Controller of Explosives, Fire Safety Inspectorate etc. must be obtained wherever applicable.	Noted and being complied with the requirements. Unit is not a major accident hazard unit as regulation, however for emergency, all the prior approvals were obtained, and licenses are in place as per applicable regulations.
(vi)	The project authorities must strictly comply with the rules and regulations with regard to handling and disposal of hazardous wastes in accordance with the Hazardous Wastes (Management & Handling) Rules, 1989/2003	Being complied. The authorization for the Hazardous Waste Handling and Management has already been obtained from the GPCB and the management of wastes is being undertaken accordingly.

S. No	CRZ condition	Compliance status
	wherever applicable. Authorization from the State Pollution Control Board must be obtained for collections/treatment/storage/disposal of hazardous wastes.	
(vii)	The overall noise level in and around the rig area should be kept well within the standards (85 dB(A)) by providing noise control measures including acoustic hoods, silencers, enclosures etc. on all sources of noise generation. The ambient noise levels should conform to the standards prescribed under EPS Rules, 1989 viz. 75 db(A) (day time) and 70 dB(A) (night time).	Complied No rig operation during the reporting period.
(viii)	A separate environmental management cell equipped with full-fledged laboratory facilities must be set up to carry out the environmental management and monitoring functions.	Dedicated environmental support is available at site and at Corporate office. The site has established laboratory to monitor the key parameters of STP, ETP and noise. Also, third party laboratory accredited by NABL and MoEF & CC has been hired to carry out the environmental monitoring as per Environment monitoring plan.
(ix)	The project authorities will provide adequate funds both recurring and non-recurring to implement the conditions stipulated by the Ministry of Environment & Forests as well as the State Government along with the implementation schedule for all the conditions stipulated herein. The funds so provided should not be diverted for any other purpose.	Annual budgetary provisions are made for the environmental related expenses such as ETP & STP operation & maintenance, greenbelt development & maintenance, environmental monitoring, hazardous waste disposal, environmental audits etc. An amount of INR 7508525 was spent towards environment and related expenses during the reporting period.
(x)	The implementation of the project vis-à-vis environmental action plans will be monitored by Ministry's Regional Office at Bhopal / State Pollution Control Board/Central Pollution Control Board. A six monthly compliance status report should be submitted to the monitoring agencies.	Noted and being complied. Six monthly compliance report is being submitted regularly.
(xi)	The Project Proponent should inform the public that the project has been accorded environmental clearance by the Ministry and copies of the clearance letter are available with the state pollution control Board/Committee and may also be seen at Website of the Ministry and Forests at http://www.envfor.nic.in . This should be advertised within seven days from the date of issue of the clearance letter in at least two local newspapers that are widely circulated in the region of which one shall be in the vernacular language of the locality concerned.	A public notice informing the grant of EC by MOEF for the off-shore oil development in CB/OS-2 Block, Gulf of Khambhat and availability of its copies was published in the following newspapers: 1) Indian Express (English) dt 26-08-2005 2) Gujarat Mitra (Gujarati) - dt 26-08-2005
(xii)	The Ministry may revoke or suspend the clearance, if implementation of any of the above conditions is not satisfactory	Noted.
(xiii)	The Ministry reserves the right to stipulate additional conditions if found necessary. The company will implement these conditions in a time bound manner.	Noted.

SIX-MONTHLY REPORT OF PROGRESSIVE COMPLIANCE TO CRZ CLEARANCE CONDITION

Name of the Project: CRZ Clearance for Oil Production in the Block CB-OS-2, Gulf of Khambhat by the Cairn Energy India Private Limited.

Clearance Letter No: ENV-102004-41-P dated 2nd December 2005

Period of Compliance Report: Progressive EC Compliance Reporting period is April 2024 – September 2024.

Project activity during reporting period: No drilling activities were carried out during the reporting period of compliance report.

The average production details for the reporting period: The details are as follows:

In total three offshore Platforms installed with 29 numbers of wells drilled. The facility has obtained Environmental Clearance to produce up to 25,000 BOPD and 150 MMSCM.

S. No		Units	Average production per day
1	Crude Production	BoPD	3284
2	Associated Gas Production	MMSCMD	0.26

All the conditions mentioned in this CRZ Clearance are being complied. Refer below for the point wise compliance details:

S. No.	CRZ Condition	Compliance Status
Specific Conditions		
1.	The Cairn Energy India Private Limited (CEIPL) shall strictly comply with the CRZ Notification, 1991 as amended from time to time.	Being complied.
2.	The CEIPL shall obtain separate recommendation from this Department for their phase II to V activities after obtaining the NOC from the Gujarat Maritime Board for their proposed oil development activities	Being complied.
3.	The project proponents shall prepare and submit the comprehensive EIA and Risk Assessment reports and shall implement all the suggestions / recommendations given in the said reports.	EIA and QRA studies are conducted periodically based on the project approval requirements. The recommendations and EMP are being implemented.
4.	The CEIPL shall contribute for any common study or facilities to be proposed by this department for the Gulf of Khambhat or for the Hazira region.	Company will support studies and/or facilities proposed in the Hazira region by Forests and Environment Department, Government of Gujarat.
5.	The CEIPL shall not tap the groundwater in any case	Complied. No ground water is tapped. Water is sourced from rain-water harvesting facility or from GIDC.
6.	The CEIPL shall implement all the suggestions / recommendations given by their consultant viz. ERM in their Environment Impact Assessment report.	Noted and being complied with.
7.	No activity shall be carried out in the forest-land or in the areas having mangroves or in the area which are ecologically sensitive and important	Noted and being complied with.
8.	The CEIPL shall bear the cost of the external agency that may be appointed by this department for carrying out supervision and/or monitoring of the construction and / or operation activities.	Company will bear the cost related to monitoring of the construction and / or operation activities proposed by Forests and Environment Department, Government of Gujarat.
9.	All necessary precautions shall be taken by the CEIPL to ensure that there is no change in the hydrology due to proposed activities.	The hydrocarbon wells are deep offshore wells beyond 1000 m depth. The hydrocarbon is abstracted from the confined zone and thus there will no change in the hydrology.
General Conditions:		

S. No.	CRZ Condition	Compliance Status
10.	The construction camps shall be located outside the CRZ area.	Noted and no construction camps will be set up in the CRZ area.
11.	The CEIPL shall ensure that the drilling/construction labours are provided with the necessary amenities, including fuel, water supply and sanitation to ensure that there is no negative impact on the existing environmental condition of the region	Noted for compliance. However, no drilling activity was carried out during the reporting period.
12.	It shall be ensured by the CEIPL that there will be no disposal of sullage and sewage generated from construction camps, surface run-off from construction sites, and oil and grease spillage from construction equipment into the sea or the CRZ area.	Noted for compliance. However, no drilling activity was carried out during the reporting period.
13.	The site shall be restored to its original condition once the operation is completed, and all debris / waste shall be removed and disposed off at the site authorized for the said purpose in consultation with the Gujarat Pollution Control Board.	Noted for the compliance. The entire drilling will be carried out in the offshore area only, thus restoration may not be applicable till the operation phase is completed.
14	The project proponents shall carry out mangrove plantation in the region in consultation with the forest department and shall also develop and implement the greenbelt development plan.	MoU was signed on 9 th August 2012 between Cairn (herein after referred to as Vedanta Ltd (Cairn Oil & gas)) and Gujrat Ecology Commission to act as an implementing agency for "Restoration, Plantation and Conservation of 50 hectares mangroves for Rs. 11.95 Lakhs at Karanj Village of Olpad Taluka of Surat district". Another MoU was signed on 20 th October 2022 with the Gujarat Forest Department for the development of 60Ha of mangroves at Surat coastal region. Another MoU was signed on 09 th November 2023 with the Gujarat Forest Department for the development of 130Ha of mangroves at Surat coastal region. Refer Annexure – 4 for details.
15.	The project proponents shall implement the socio-economic upliftment program in consultation with the District Collector / DDO.	Cairn perseveres for holistic development of local community by focusing on all segments of the households across five thematic areas: Health, Water, Sanitation, Education, Sustainable livelihood (farm and vocational skill) as well as renewable energy. Refer Annexure – 2 for the CSR related programs.
16.	No activity shall be carried out before obtaining all necessary clearances under various acts/rules from different Govt. department / agencies	Noted for compliance and no activities being carried out without obtaining the necessary approvals.
17.	The CEIPL shall contribute financially in consultation with this Department to support the National Green Corps Scheme being implemented in Gujarat by the GEER Foundation	Noted for Compliance.
18.	The project proponents shall have to comply with any other condition as may be stipulated by this department from time to time.	Noted for Compliance.
19.	The CEPIL shall strictly adhere to the undertakings submitted to this Department and mentioned herein above.	Noted for Compliance.
	Others	

S. No.	CRZ Condition	Compliance Status
1.	To implement all the suggestions and recommendations given by the consultant in their EIA and Risk Assessment reports	EMP is being implemented as part of the EIA study report. Refer Annexure 6 .
2.	To bear the cost of the external agency to be appointed by the Forests and Environment Department, GOG, for supervision/ monitoring of the proposed activities.	Noted for compliance
3.	To carryout Comprehensive Environmental Impact Assessment and Risk Assessment reports.	Continuous onshore environmental monitoring is being carried out for the onshore facilities and seasonal offshore monitoring is being carried out to determine the environmental attributes. The environmental protection and risk mitigation measures and safeguards recommended in the various studies including HAZOP (Hazard and Operability), HAZID (Hazard Identification) and COMAH (Control of Major Accident Hazards) are implemented during the project and operation stages. Recommendations mentioned in the Risk Assessment and Disaster Management Plan is followed and practiced through periodic drills.
4.	To participate financially and technically in Vessel Traffic Management System that may be proposed by the Gujarat Maritime Board or any other institute for the Gulf of Khambhat	Noted for compliance.
5.	To take a lead and provide necessary support and assistance for development of the mutual aid system with other major players in the Hazira region and for the Gulf of Khambhat for mitigating risk and disaster management in the Hazira region	Noted for compliance.
6.	The ground water shall not be tapped to meet with the water requirements during Construction and operational stages.	Complied. No ground water is tapped.
7.	The construction labour shall be provided with adequate amenities including the water Supply, sanitation and fuel to ensure that they do not ruin the existing environment.	Noted and complied
8.	The camps of the construction labour shall be located outside the CRZ areas and no waste including the construction debris shall be disposed off in the sea / creek or into the CRZ area	Noted and complied
9.	The socio-economic upliftment programme shall be implemented in consultation with the District Collector / District Development Officer.	Cairn perseveres for holistic development of local community by focusing on all segments of the households across five thematic areas: Health, Water, Sanitation, Education, Sustainable livelihood (farm and vocational skill) as well as renewable energy. Refer Annexure – 2 for the CSR related programs.
10.	The greenbelt development programme shall be implemented in consultation with the Forests Department	Suvali terminal is around 82.28 Acres and out of this, greenbelt cover is 23% of total facilities area, which is around 19 Acres. Refer Annexure – 3 for details.
11.	To support financially the National Green Corps Scheme being implemented by the GEER Foundation in Gujarat in consultation with the Forests and Environment Department	Noted for compliance.
12.	You are further directed to furnish us the six-monthly compliance reports with respect to the conditions	Progressive EC compliance report is submitted once every six months.

S. No.	CRZ Condition	Compliance Status
	stipulated by the MOEF. GOI, as well as the above-mentioned conditions stipulated by this Department in the months of January and July of every year, without fail.	

COMPLIANCE STATUS OF CONDITIONS OF MOEF&CC DURING ENVIRONMENTAL CLEARANCE OF THE PROJECT

Name of the Project: Development of Oil production in the CB/OS-2 Block off-shore area in Gulf of Khambhat, Gujarat

Clearance Letter No: J-11011/109/2005-I.A.II (I), dtd. 25.01.2006

Period of Compliance Report: Progressive EC Compliance Reporting period is April 2024 – September 2024

The average production details for the reporting period: The details are as follows:

In total three offshore Platforms installed with 29 numbers of wells drilled. The facility has obtained Environmental Clearance to produce up to 25,000 BOPD and 150 MMSCM.

S. No		Units	Average production per day
1	Crude Production	BoPD	3284
2	Associated Gas Production	MMSCMD	0.26

All the conditions mentioned in this EC are being complied. Refer below for the point wise compliance details:

S. No.	EC Condition	Compliance Status
A.	Specific Conditions	
i.	The international 'Good Practices' adopted by the petroleum industry, viz. International Norms to safeguard marine biodiversity would be implemented by M/s. CEIPL and monitored by the Indian Coast Guard to safeguard the marine biodiversity as per the decision conveyed by the Ministry of Environment & Forests vide its D.O. letter No.J-11011/90/2002-IA..II (I) dated 30 th September, 2005 to the Ministry of Petroleum and Natural Gas. The expenditure towards monitoring by Indian Coast Guard shall be borne by M/s CEIPL	Being complied with. Cairn is implementing and practicing oil & gas upstream sector specific international and national standards and guidelines. Cairn is periodically carrying out the monitoring of the marine water quality, marine sediment quality, biota and fish tissues. Efforts are made to protect Marine biodiversity against any contamination.
ii.	M/s CEIPL shall get the monitoring done regarding the impact of developmental activities on the marine environment through National Institute of Oceanography or National Institute of Ocean Technology or any other reputed organization and submit periodical reports to the Ministry, and Chief Wild life Warden and GSPCB.	Being complied with. Marine offshore seasonal environmental monitoring is carried out periodically through NABL accredited laboratories. Refer Annexure 8 for offshore monitoring details.
iii.	The schedule for commencement for the drilling operation shall be intimated at least one month in advance to the Wildlife Warden having jurisdiction over the nearest coastal area so as to enable him to monitor its impact, if any, on the wildlife.	Noted for compliance. However, no drilling activity was carried out during the reporting period.
iv.	Approval from DG Shipping/ Ministry of Defense under the Merchant Shipping Act prior to commencement of the drilling operations shall be obtained. At least, 30 days prior to the commencement of drilling, the exact location should be intimated to the Director General of Shipping, Mumbai and the company should abide by any direction he may issue regarding ensuring the safety of navigation in the area.	Noted for compliance. However, no drilling activity was carried out during the reporting period.
v.	M/s CEIPL shall ensure that the oil spill contingency plan is in place and no oil spill takes place during mobilization, drilling and operations and there shall not be any damage to mangrove/coastal ecosystem	Oil Spill Response and Contingency Plan has been prepared as per the NOS-DCP guidelines. Refer Annexure – 5 for the details.
vi.	The schedule for commencement of the drilling operation shall be intimated at least one month in advance to the Wildlife Warden having jurisdiction over the nearest coastal area so as to enable him to monitor its impact, if any, on the wild life.	Noted for compliance. However, no drilling activity was carried out during the reporting period.

S. No.	EC Condition	Compliance Status
vi.	Disposal of Drill Cuttings (DC) and Drilling Fluids (DF) for offshore installations:	Noted for compliance. However, no drilling activity was carried out during the reporting period.
(a)	Use of diesel base mud is prohibited. Only Water Base Mud (WBM) is permitted for offshore drilling. If the operator intends to use low toxicity Oil Based Mud (OBM) or synthetic base mud (SBM) to mitigate specific whole problems in the formation, it should be intimated to the Ministry and Gujarat State Pollution Control Board. The low toxicity OBM should have aromatic content < 1%.	Noted for compliance. However, no drilling activity was carried out during the reporting period.
(b)	The toxicity of chemical additives used in the DF (WBM or OBM or SBM) should be biodegradable (mainly organic constituents) and should have toxicity of 96 hr LC 50 value >30,000 mg/1 as per mysid toxicity or toxicity test conducted on locally available sensitive sea species.	Noted for compliance. However, no drilling activity was carried out during the reporting period.
(c)	Hexavalent Chromium compound shall not be used in DF. Alternate chemical in place of chrome lignosulfonate should be used in DF. In case, chrome compound is used, the DF/DC should not be disposed offshore.	Noted for compliance. However, no drilling activity was carried out during the reporting period.
(d)	Bulk discharge of DF in offshore is prohibited except in emergency situations.	Noted for compliance. However, no drilling activity was carried out during the reporting period.
(e)	WBM/OBM should be recycled to a maximum extent. Unusable portion of OBM should not be discharged into sea and shall be brought to onshore for treatment and disposal in an impervious waste disposal pit.	Noted for compliance. However, no drilling activity was carried out during the reporting period.
(f)	Thoroughly washed DC separated from WBM/SBM and unusable portion of WBM/ SBM having toxicity of 96 hr LC 50>30,000 mg/1 shall be discharged off-shore into sea intermittently, at an average rate of 50 bbl/hr/well from a platform so as to have proper dilution and dispersion without any adverse impact on marine environment. WBM/ SBM should be recycled to the maximum extent.	Noted for compliance. However, no drilling activity was carried out during the reporting period.
(g)	Drill cuttings of any composition should not be discharged in sensitive areas notified by Ministry of Environment and Forests.	Noted for compliance. However, no drilling activity was carried out during the reporting period.
(h)	In case of specific hole problem, use of OBM will be restricted with zero discharge of DC. Zero discharge would include re-injection of the DC into a suitable formation or to bring to shore for proper disposal. In such a case, use of OBM for re-injection should be recorded and made available to the Ministry and Gujarat State Pollution Control Board. Such low toxic OBM having aromatic content less than 1% should be made available at the installation.	Noted for compliance. However, no drilling activity was carried out during the reporting period.
(i)	In case, DC is associated with high oil content from hydrocarbon bearing formation, then disposal of DC should not have oil content >10 gm/kg.	Noted for compliance. However, no drilling activity was carried out during the reporting period.
(j)	The DC wash water should be treated to confirm limits notified under the Environment (Protection) Act, 1986 before disposal into sea. The treated effluent should be monitored regularly.	Noted for compliance. However, no drilling activity was carried out during the reporting period.
(k)	Discharge of DC from the installation located within 5 km. away from shore should ensure that there is no adverse	Noted for compliance. However, no drilling activity was carried out during

S. No.	EC Condition	Compliance Status
	impact on marine eco-system and on the shore. If, adverse impact is observed, then the company has to bring the DC onshore for disposal in an impervious waste disposal pit.	the reporting period.
(l)	The Company should get analyzed the drill cuttings generated from each well from any recognized laboratory for its characteristics and results be submitted to MoEF/CPCB/SPCB periodically.	Noted for compliance. However, no drilling activity was carried out during the reporting period.
(m)	M/s CEIPL are required to record daily discharge of DC and DF to offshore and also to monitor daily the effluent quality, and submit the compliance report once in every six months to MoEF.	Noted for compliance. However, no drilling activity was carried out during the reporting period.
(n)	Company should monitor the sea surface water quality in terms of oil content around the well and submit reports to the Ministry on a monthly basis during the period of drilling operations.	Noted for compliance. However, no drilling activity was carried out during the reporting period.
(o)	The DC wash water should be treated to conform to limits notified under the Environment (Protection) Act, 1986, before disposal into sea. The treated effluent should be monitored regularly.	Noted for compliance. However, no drilling activity was carried out during the reporting period.
(p)	Barite used in preparation of DF shall not contain Hg>1 mg/kg & Cd> 3 mg/kg.	Noted for compliance. However, no drilling activity was carried out during the reporting period.
(q)	If any, environment friendly technology emerges for substitution of DF and disposal technology, it may be brought to the notice of MoEF and regulatory agencies. If the operator desires to adopt such environment friendly technology prior approval from MoEF shall be taken.	Noted for compliance. However, no drilling activity was carried out during the reporting period.
(r)	The Company shall monitor the petroleum hydrocarbons and heavy metals concentration in the marine fish species regularly and submit report to the Ministry.	Being complied with. Cairn is periodically carrying out the monitoring of the marine water quality, marine sediment quality, biota and fish tissue. Efforts are made to protect Marine biodiversity against any contamination. Refer Annexure 8 for offshore monitoring details.
viii.	Treated wastewater (produced water or formation water or sanitary sewage) should comply with the marine disposal standards (for oil & Gas at <40 mg/1) notified under the Environment (Protection) Act, 1986.	Sewage generated from the terminal activities is treated through the aeration process in the STP installed within the onshore terminal. The treated sewage is used for the greenbelt development activities within the onshore area and thus no discharge is carried out beyond the terminal premises. The produced water separated from the hydrocarbon well fluids is treated through onshore ETP installed within the terminal area. The treated effluent after meeting the marine discharge standards as prescribed by GPCB is discharged into sea through marine outfall located about 500 m from Low Tide Level (as recommended by NIO after carrying out the study). Periodic environmental monitoring is being carried out for the treated sewage and the treated effluent. Refer Annexure - 1 for the details.
ix.	Requisite infrastructure facilities should be provided near the offshore installations so that booms and skimmers/ chemical dispersants could be deployed immediately in	Oil Spill Response and Contingency Plan has been prepared as per the NOS-DCP guidelines. Refer Annexure – 5 for the details.

S. No.	EC Condition	Compliance Status
	case of oil leakage from the installations. Efforts should be made to curtail the oil slick within 500 meters of the installation and accordingly, action plan and facilities to check the oil slick beyond 500 meters should be provided.	
x.	The project proponent shall also comply with the environmental protection measures and safeguards recommended in the EIA/EMP/risk assessment report as well as the recommendations of the public hearing panel	The environmental protection measures and safeguards recommended in EIA-EMP & Quantity Risk assessment (QRA) are being implemented. Refer Annexure – 6 for point wise compliance to the EMP.
xi.	The used oil generated from drill site shall be collected and sold to the registered re-processors having environmental sound facility	The used oil generated from the process equipment are being blended along with the crude oil for further processing.
xii.	M/s. CEIPL shall facilitate to set up a monitoring unit at the headquarters of State Wildlife Organization. The user agency shall also provide adequate infrastructure facilities to the visiting scientists and monitoring agency near their onshore/ offshore installations off and along the Gujarat Coast	Noted for compliance.
xiii.	M/s. CEIPL shall comply with the specific and general conditions stipulated by the Ministry's environmental clearance letter under Coastal Regulation Zone (CRZ) Notification dated 4 th August, 2005.	Being complied.
xiv.	M/s. CEIPL shall strictly comply with all the recommendations of the Chief Wildlife Warden, Gujarat regarding impact of the project on marine environment communicated vide letter no. WLP/12/32/A/1618/20/2005-06 dated 26.09.2005.	Being complied.
	General Conditions	
i.	The project authority must strictly adhere to the stipulations made by the Central Government as part of an International Convention(s) or Merchant Shipping Act	Being complied. Stipulations made by the Central Government and Merchant Shipping Act are being adhered to as per the following: 1. The Merchant Shipping Act. 1958, as amended & applicable. 2. MARPOL 1973/1978 as amended & applicable
ii.	The project authority must strictly adhere to the stipulations made by the Gujarat State Pollution Control Board and the State Govt.	Being complied. The stipulations and norms prescribed by GPCB are followed. Compliance reports are being submitted regularly to GPCB regarding the Consent and Authorization conditions.
iii.	No further expansion should be carried out without prior approval of the Ministry of Environment and Forests. In case of deviations or alterations in the project proposal from those submitted to this Ministry for clearance, a fresh reference should be made to the Ministry to assess the adequacy of conditions imposed and to add additional environmental protection measures required, if any.	Noted for compliance and no activities being carried out without obtaining the necessary approvals.
iv.	The project authorities must strictly comply with the rules and regulations under Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 as amended on 3 rd October, 1994 and 6 th January, 2000. Prior approvals from Chief Inspectorate of Factories, Chief Controller of	Noted and being complied with the requirements. Unit is not a major accident hazard unit as regulation, however during emergency, all the prior approvals were obtained and licenses are in place as per applicable regulations.

S. No.	EC Condition	Compliance Status
	Explosives, Fire Safety Inspectorate etc. must be obtained wherever applicable.	
v.	The project authorities must strictly comply with the rules and regulations with regard to handling and disposal of hazardous wastes in accordance with the Hazardous Wastes (Management & Handling) Rules, 1989 as amended in 2003, wherever applicable. Authorization from the State Pollution Control Board must be obtained for collections/ treatment/ storage/disposal of hazardous wastes.	Being complied. The Facility has obtained Hazardous Waste Authorization from GPCB and conditions are being complied.
vi.	The overall noise levels in and around the rig area should be kept well within the standards (85 dB(A) by providing noise control measures including acoustic hoods, silencers, enclosures etc. on all sources of noise generation. The ambient noise levels should conform to the standards prescribed under EPA Rules, 1989 viz. 75 dB(A) (day time) and 70 dB(A) (night time).	Being complied. No rig operation was carried out during the reporting period.
vii.	A separate environmental management cell equipped with full-fledged laboratory facilities must be set up to carry out the environmental management and monitoring functions.	Dedicated environmental expertise support is available both at the site and at Corporate office. The site has established laboratory to monitor the key parameters of STP, ETP and noise. However, for the detailed and regular monitoring, the third-party laboratory accredited by NABL and MoEF&CC has been hired to carry out the environmental monitoring requirements of the at the facilities and offshore.
viii.	The project authorities shall earmark an amount of Rs. 3.50 Crores during phase-I and Rs. 20.00 Crores during Phase- H, ID, IV and V as mentioned in Question No. XDC of the Questionnaire towards implementation of specific conditions stipulated by the Ministry of Environment and Forests as well as the State Government along with the implementation schedule for all the conditions stipulated herein. The funds so provided should not be diverted for any other purpose.	Annual budgetary provisions are made for the environmental related expenses such as ETP & STP operation & maintenance, greenbelt development & maintenance, environmental monitoring, hazardous waste disposal, environmental audits etc. An amount of INR 7508525 was spent towards environment and related expenses during the reporting period.
ix.	The implementation of the project vis-a-vis environmental action plans will be monitored by Ministry's Regional Office at Bhopal/ State Pollution Control Board/ Central Pollution Control Board. A six monthly compliance status report should be submitted to the monitoring agencies.	Being complied. Six monthly EC compliance report is submitted regularly.
x.	The Project Proponent should inform the public that the project has been accorded environmental clearance by the Ministry and copies of the clearance letter are available with the State Pollution Control Board/ Committee and may also be seen at Website of the Ministry of Environment and Forests at http://envfor.nic.in . This should be advertised within seven days from the date of issue of the clearance letter at least in two local newspapers that are widely circulated in the region of which one shall be in the vernacular language of the locality concerned and a copy of the same should be forwarded to the Regional office.	A public notice informing the grant of EC by MOEF for the offshore oil development in CB/OS-2 Block, Gulf of Khambhat and availability of its copies was published in the following newspapers and copy was submitted to Ministry's Regional Office: 1. Indian Express (English) - dtd. 06-03-2006 2. Gujarat Mitra (Gujarati) - dtd. 04-03-2006

SIX-MONTHLY REPORT OF PROGRESSIVE COMPLIANCE TO CHIEF WILDLIFE WARDEN RECOMMENDATIONS

Name of the Project: Proposed oil and development in Transition zone of CB/OS-2 Block in Gulf of Khambhat, Gujarat

Wildlife Clearance Letter No: WLP/13/32/A/29/5-17/2005-06, fax dated 11th February 2006

Period of Compliance Report: Progressive EC Compliance Reporting period is April 2024- September 2024.

Project activity during reporting period: No additional facilities installed and no drilling activities under the scope of this EC were undertaken during the reporting period of compliance report.

The well under the scope of this EC was abandoned and therefore there was no production in the reporting period.

All the conditions mentioned in this clearance are being complied with. Refer below for the point wise compliance details:

S. No.	Condition	Compliance Status
Specific Conditions		
i.	The flaring of gas should be done in such a period of the day when the movement of the coastal birds are at minimum. This would probably be between 12.00 pm to 13.00 pm (15.00 Hrs.) or in early hour before sunrise.	No excess gas flaring is carried out. All the separated gas is being exported through the gas grid pipeline. Only operational flare is being carried out at Suvali Terminal. This flare is continuous and only minimum amount of the gas flaring is being carried out as per the safe operational philosophy of the Terminal.
ii.	Except Flaring, leakage of gas or liquid or oil waste or drilling waste should be prevented at all cost.	Being complied. The Suvali terminal is being monitored through various gas detection system continuously, so in case of emergency any such leakages can be immediately controlled. The crude oil is stored inside the bund to contain any such leakages. Drill cutting waste are appropriately disposed as per the requirements specified in the GSR 546 (E). Periodic fugitive emission leakage detection study is carried out.
iii.	No Synthetic based mud generated during drilling shall be disposed in sea. The waste residual muds and drill cuttings shall be disposed in GPCB approved landfill sites only and no case in the sea water.	The drilling is managed as per the requirements specified in the GSR 546 (E) and as per the Gujarat Pollution Control Board requirements.
iv.	Green belt of mangroves should be created in the possible areas of the project and green belt along the pipeline with other species should be created by the company	MoU was signed on 9 th August 2012 between Cairn (herein after referred to as Vedanta Ltd (Cairn Oil & gas)) and Gujrat Ecology Commission to act as an implementing agency for "Restoration, Plantation and Conservation of 50 hectares mangroves for Rs. 11.95 Lakhs at Karanj Village of Olpad Taluka of Surat district". Another MoU was signed on 20 th October 2022 with the Gujarat Forest Department for development of 60Ha of mangrove at Surat coastal region. Another MoU was signed on 09 th November 2023 with the Gujarat Forest Department for development of 130Ha of mangrove at Surat coastal region. Refer Annexure – 4 for details.
v.	After phase-I, the provision as per EIA should be maintained and in no case flaring of gas may be permitted.	No excess gas flaring is carried out. Only operational flare is being carried out at Suvali Terminal.
vi.	The company should have a Watch tower from where they should observe the congregation of the bird and if the congregation is large in numbers the flaring if possible be avoided for that period/days or make some arrangements to keep the bird away from the area.	No excess gas flaring is carried out. Only operational flare is being carried out at Suvali Terminal.

S. No.	Condition	Compliance Status
vii.	The monitoring regime be developed for air and water quality and reports be submitted to concerned officials including the Chief Wildlife Warden of the state at a decided frequency. Minimum two monitoring per year for overall environmental impact should be done. This may be reviewed by a committee of experts.	Regular monitoring by third-party laboratory accredited by NABL and MoEF&CC is being carried out, refer Annexure -1 for trends in Environmental Monitoring Report.
viii.	It is informed by the company during presentation to the committee that drilling Waste and lubricant shall be brought on land and disposed using suitable Mechanism, thereby causing no pollution in the sea. The same may be strictly observed and enforced.	Noted for compliance. However, no drilling activity was carried out during the reporting period.
ix.	While company shall undertake all efforts to ensure safe development and production free from any spillage and pollution of the site, it shall faithfully report any spillage accidental or otherwise and take remedial measure as prescribed immediately.	Oil Spill Response and Contingency Plan has been prepared as per the NOS-DCP guidelines. Refer Annexure – 5 for the details.
x.	The company shall have an elaborate environment audit mechanism and reports of same shall be made available to the concerned officials of Government including the Chief Wildlife Warden	The company has established Environmental management System in place as per ISO 14001: 2015. Also environmental audit is carried out periodically by 3 rd Party institution / Consultant nominated by Gujarat Pollution Control Board.
xi.	Officials of state forest department including those specially designated by the Chief Wildlife Warden depending on exigencies shall be allowed to inspect the Project activities and project area and the company shall facilitate such inspections.	Noted for Compliance
xii.	The company shall abide by any additional conditions that may be prescribed by the Chief Wildlife Warden and/or by the State Government in the interest of conservation of flora and fauna in the region.	Noted for Compliance

COMPLIANCE STATUS OF CONDITIONS OF MOEF&CC DURING ENVIRONMENTAL CLEARANCE OF THE PROJECT

Name of the Project: Oil and Gas development in Transition Zone of CB/OS-2 Block in Gulf of Khambhat, Gujarat

Clearance Letter No: J-11011/20/2005 - IA II (I) dated 03.04.2006

Period of Compliance Report: Progressive EC Compliance Reporting period is April 2024- September 2024.

Project activity during reporting period: No additional facilities installed and no drilling activities under the scope of this EC were undertaken during the reporting period of compliance report.

The well under the scope of this EC was abandoned and therefore there was no production in the reporting period.

All the conditions mentioned in this EC are being complied. Refer below for the point wise compliance details:

S. No.	EC Conditions	Compliance status
A.	Specific Conditions	
i.	The company shall comply with the guidelines for disposal of solid waste, drill cutting and drilling fluids for onshore drilling operation notified vide GSR.546 (E) dated 30 th August, 2005.	Noted for compliance. However, no drilling activity was carried out during the reporting period.
ii.	Drilling wastewater including drill cuttings wash water shall be collected in disposal pit lined with HDPE lining evaporated or treated and shall comply with the notified standards for on-shore disposal.	Noted for compliance. However, no drilling activity was carried out during the reporting period.
iii.	Effluent generated from Group Gathering Station (GGS) and other sources shall be treated to conform to standards under E (P) Act, 1986 and subsequent amendments.	The produced water separated from the hydrocarbon well fluids is treated through onshore ETP installed within the terminal area. The treated effluent after meeting the marine discharge standards as prescribed by GPCB is discharged into sea through marine outfall located about 500 m from Low Tide Level (as recommended by NIO after carrying out the study). Periodic environmental monitoring is being carried out for the treated sewage and the treated effluents. Refer Annexure -1 for the details.
iv.	The company shall not draw ground water to meet the water requirement	Complied. The water requirement is sourced from GIDC supply or rainwater harvesting facility at the terminal.
v	The Company shall take necessary measures to prevent fire hazards, containing oil spill and soil Remediation as needed. At place of ground flaring, the overhead flaring stack with knockout drums shall be installed to minimize gaseous emissions during Flaring	All storage tanks and process vessels have been installed with SIL (In simple terms, SIL is Safety Integrity Level, which is a measurement of performance required for a safety instrumented function) rated instrument systems including high, high-high and low, low-low alarms for information to DCS (Digital Control System) panel engineers for immediate intervention. Also, the process systems are installed with Emergency Shut Down Devices (ESDs)/valves to isolate the supply during any leaks and prevent spills. Oil spill contingency plan is prepared and implemented at sites. Secondary containment has been provided at all hydrocarbon storage areas in accordance with OISD standards. The process vessels have been provided with kerbs to contain accidental spills. Full-fledged 24x7 oil spill response team is stationed providing coverage to the operation, backed up fire services team consisting of trained professionals. Firefighting measures include hydrant system, foam system, portable fire extinguishers, water spray systems, fireproof electrical fittings, and fire and gas

S. No.	EC Conditions	Compliance status
A.	Specific Conditions	
		<p>detection systems. In addition, fire tenders are available.</p> <p>Control Room and process locations have been provided with a fire and gas detection system along with the fire extinguishing system. OISD Standards have been complied with the design and installation of both passive and active Fire protection system.</p> <p>The vertical stack of 30 m height is provided at the Suvali terminal, and they are connected to the knockout drums for effective separation of vapor-liquid.</p>
vi	The Company shall take necessary measures to reduce noise levels such as proper casing at the drill site and meet DG set norms notified by the MOEF. Height of all the stacks/ vents shall be provided as per the CPCB guidelines.	DG sets are provided with acoustic enclosures in accordance with E(P) Rules and effective stack height.
vii	After well testing at each drilling site, all installations, equipment and debris shall be removed and site shall be restored to the near original condition by re-vegetation with appropriate plant species	<p>The entire drilling as per this EC permission was carried out in the offshore area only, thus restoration and re-vegetation after well testing are not applicable.</p> <p>No drilling activity was carried out during the reporting period.</p>
viii	The company shall ensure that natural drainage channels are avoided or drainage channels are rerouted to ensure unhindered flow of rain/flood water, wherever necessary adequate erosion control measures will be provided	<p>The Suvali terminal have separate paved drainage for storm water collection and this drainage is connected to the rainwater recharge pit within the terminal premises.</p> <p>Enough green cover has been developed to prevent soil erosion.</p>
ix	The design, material of construction, assembly, inspection, testing and safety aspects of operation and maintenance of oil and gas facilities and pipeline and transporting the natural gas shall be governed by ASME/ANSI B31.8/B31.4 and OISD 141 standard.	Relevant standards and codes such as ASME/ANSI/OISD/BIS are followed in all aspects of design, construction, commissioning, operation and maintenance of the oil and gas facilities.
x.	Annual safety audit shall be carried out for the initial three years by an independent agency and report submitted to this Ministry for ensuring the strict compliance of safety regulations on operation and maintenance of facilities	<p>HSE Management System in place (certified to the ISO 14001 & 45000 standards). Mock drills have been conducted regularly.</p> <p>OISD (Oil Industry safety Directorate) also carried out the compliance audit with respect to OISD safety standards periodically and the recommendations are implemented and communicated to OISD.</p>
xi.	The project authorities shall provide 3 layer polythene coating to prevent contamination of sub soil	The pipelines have been provided with 3 layers of polythene coating to prevent contamination of soil
xii	The project authorities shall patrol and inspect the pipeline regularly for detection of faults as per OISD guidelines and continuous monitoring of pipeline operation by adopting non-destructive method(s) of testing as envisaged in the EMP.	<p>Regular patrolling is being carried out.</p> <p>Corrosion inhibitor injection has also been injected in inter-field pipelines as required to minimize/prevent corrosion.</p>
xiii	The project authorities shall plant a minimum of 10 trees for every tree cut along the pipeline route in consultation with the local DFO(s). The company shall develop a social forestry program to benefit the project affected local people in consultation with the local DFO (s). The company shall develop a social forestry program to benefit the project affected local people in consultation	Noted for compliance.

S. No.	EC Conditions	Compliance status
A.	Specific Conditions	
	with the local DFO/ village panchayat/ NGO.	
xiv.	The fire water facilities at the terminals must be designed as per OISD-117 guidelines. However, for fighting prolonged fires, the company should firm up a plan for assured water supply from nearby ground water source/ surface water supply from nearby ground water source/surface water source. This must be Complied before commissioning the project.	Complied. The fire protection and fighting system have been implemented in compliance with the OISD requirements. There are two Fire water ponds in case of emergency water supply for firefighting.
xv.	All the conditions stipulated vide letter no. WLP/13/32/A/2315-17/2005-06 dated 10.02.2006 from the Addl. Principal Chief Conservator of Forest, Wildlife, Gujarat State, Gandhi Nagar shall be strictly implemented.	Being complied.
xvi.	The International 'Good Practices' adopted by the petroleum industry viz. international norms to safeguard the Coastal and Marine biodiversity would be implemented by M/s. CEIL.	Cairn has implemented and practiced the oil & gas sector specific international and national standards and guidelines and shall adhere to this in future.
xvii	The flare system shall be designed as per good oil field practices and Oil Industry Safety Directorate (OISD) guidelines. The stack height shall be provided as per the regulatory requirements and emissions from stacks will meet the MOEF/ CPCB guidelines	Complied. Elevated flare height of 30 m has been provided. The ground level concentrations (GLC) are monitored periodically through ambient air monitoring. Refer Annexure – 1 for environmental monitoring details.
xviii	The project proponent shall also comply with the environmental protection measures and safeguards recommended in the EIA/ EMP/ risk analysis report as well as the recommendations of the public hearing panel	The environmental protection measures and safeguards recommended in EIA-EMP & Quantity Risk assessment (QRA) are being implemented during construction and operation phase.

ANNEXURE NO. 01

Environmental Monitoring Report – CB/OS-2
(For the Period April 2024 – September 2024)

Environmental Monitoring for Ambient air, Gaseous emissions, Wastewater and Noise is carried out monthly and the same is submitted to GPCB every month.

All parameters are under the standards as prescribed by GPCB and no deviations were observed.

Ambient Air Quality Monitoring Results in Suvali- Onshore Terminal

Seven locations were selected around the Plant site for monthly Environmental monitoring. The locations are approved by GPCB. The graphical interpretation of the results is provided below.

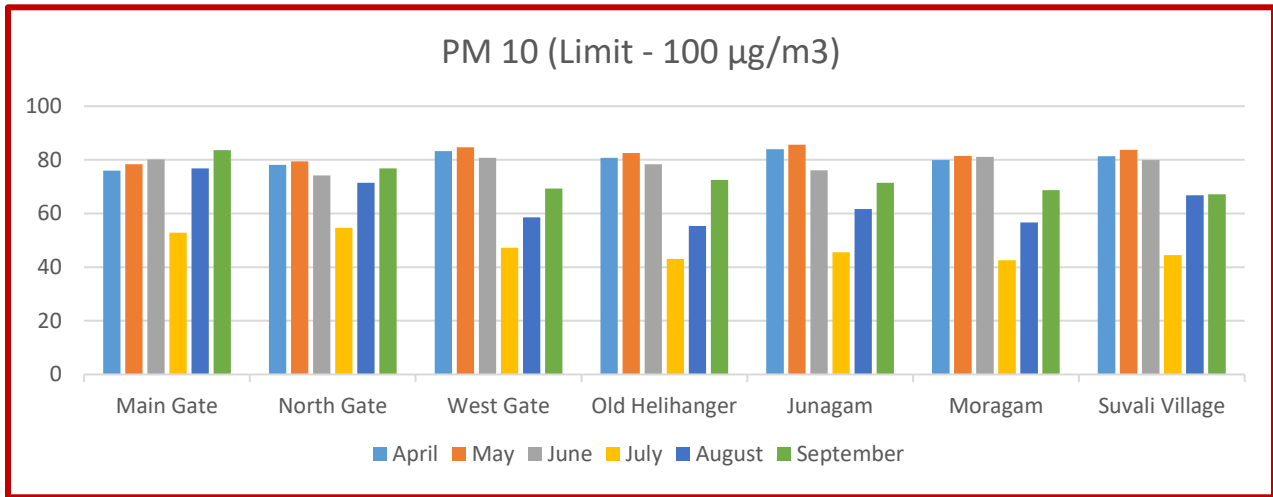


Figure 1: Graphical representation of average trend of PM₁₀ in block area

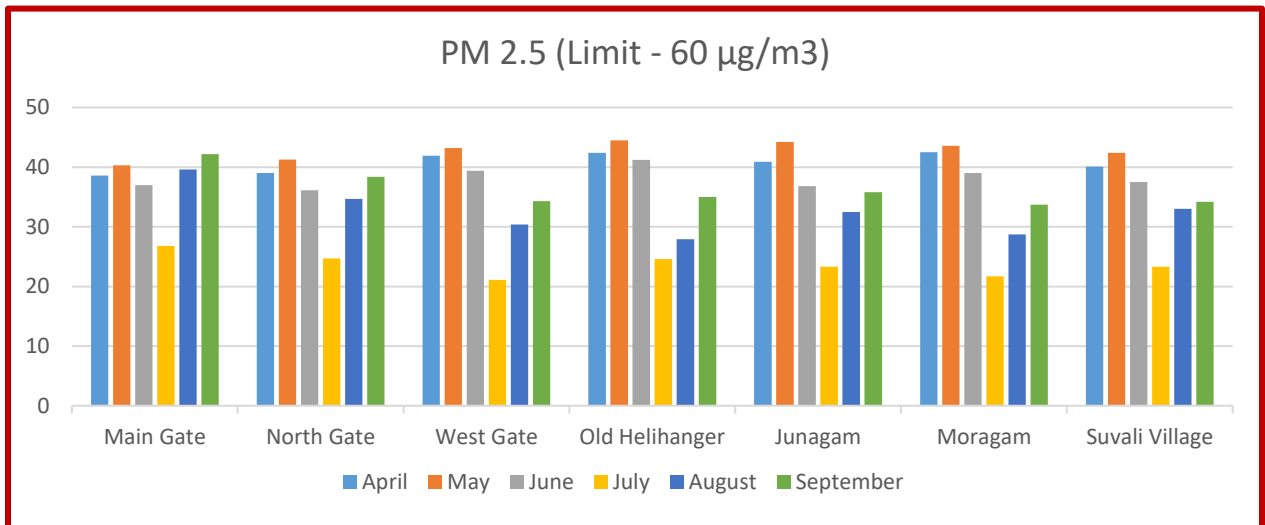


Figure 2: Graphical representation of average trend of PM_{2.5} in block area

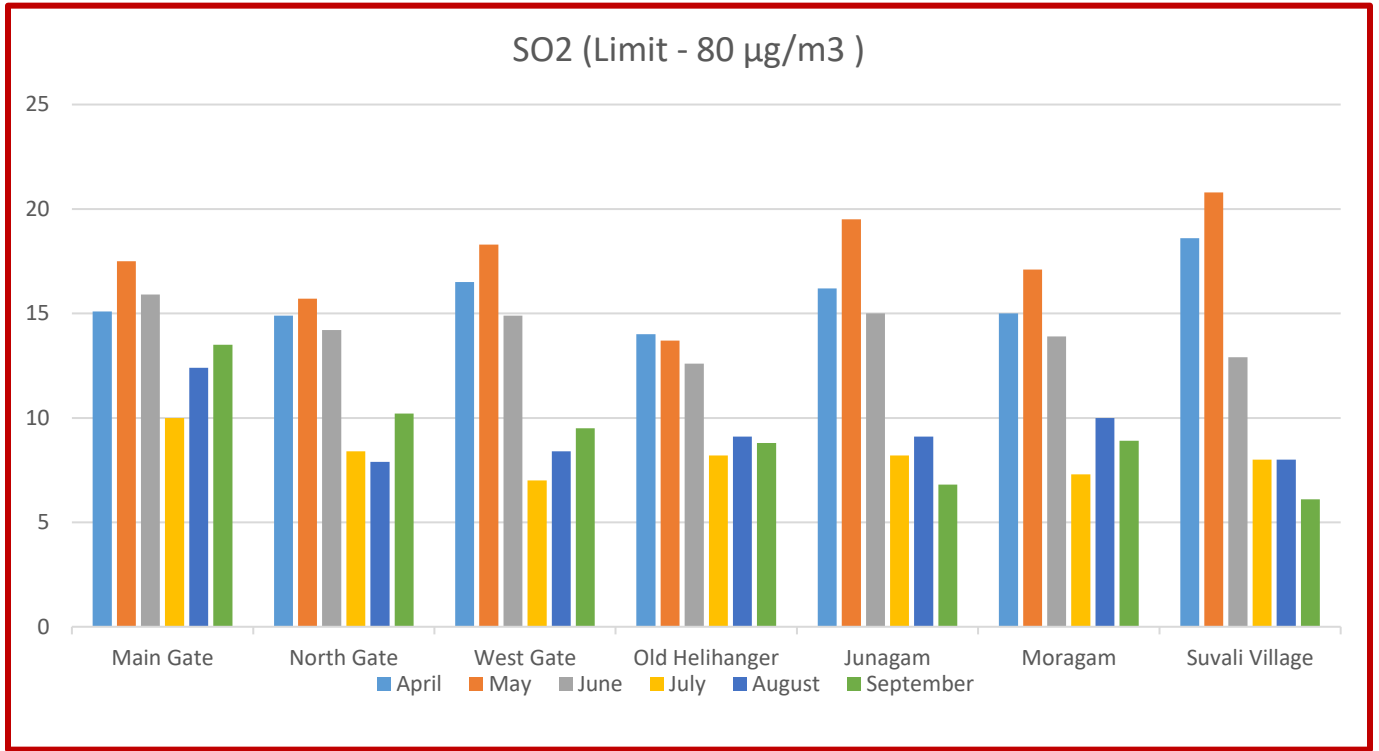


Figure 3: Graphical representation of average trend of SO₂ in block area

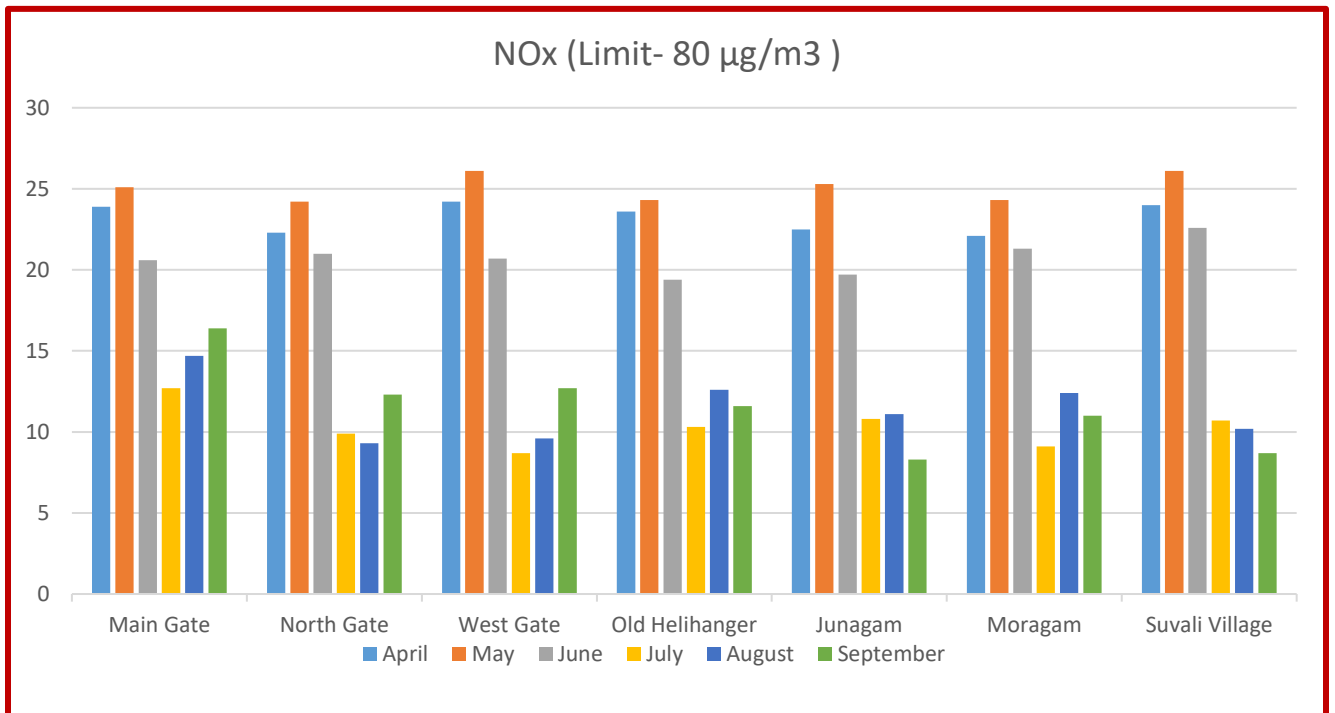


Figure 4: Graphical representation of average trend of NO_x in block area

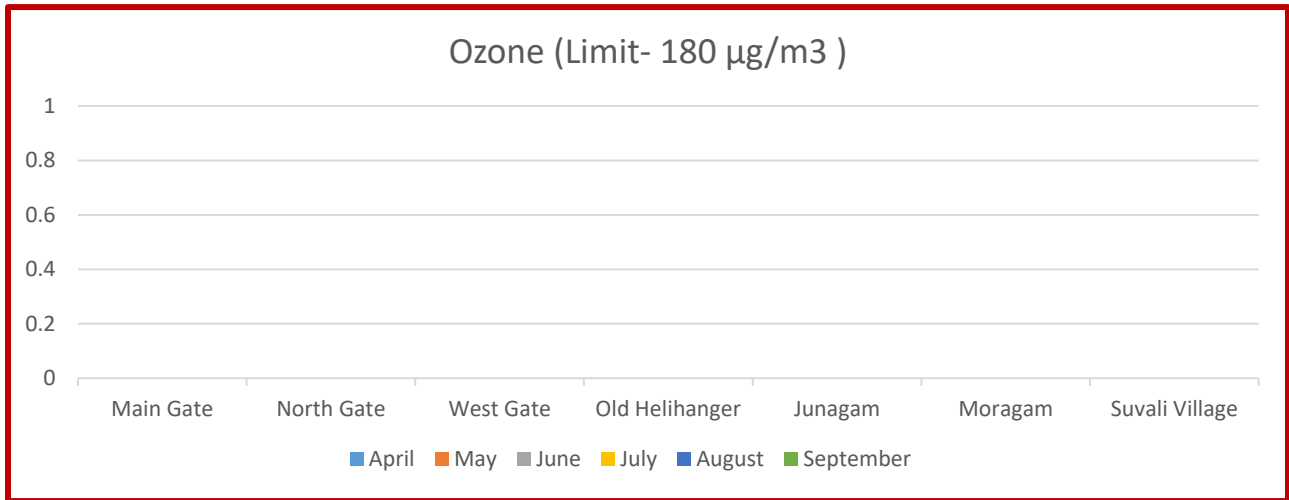


Figure 5: Graphical representation of average trend of O₃ in block area

Ambient Noise Quality Monitoring Results in Suvali Onshore Terminal

Four locations were selected around the Plant site for monthly noise monitoring. The locations are approved by GPCB. The graphical interpretation of the results is provided below.

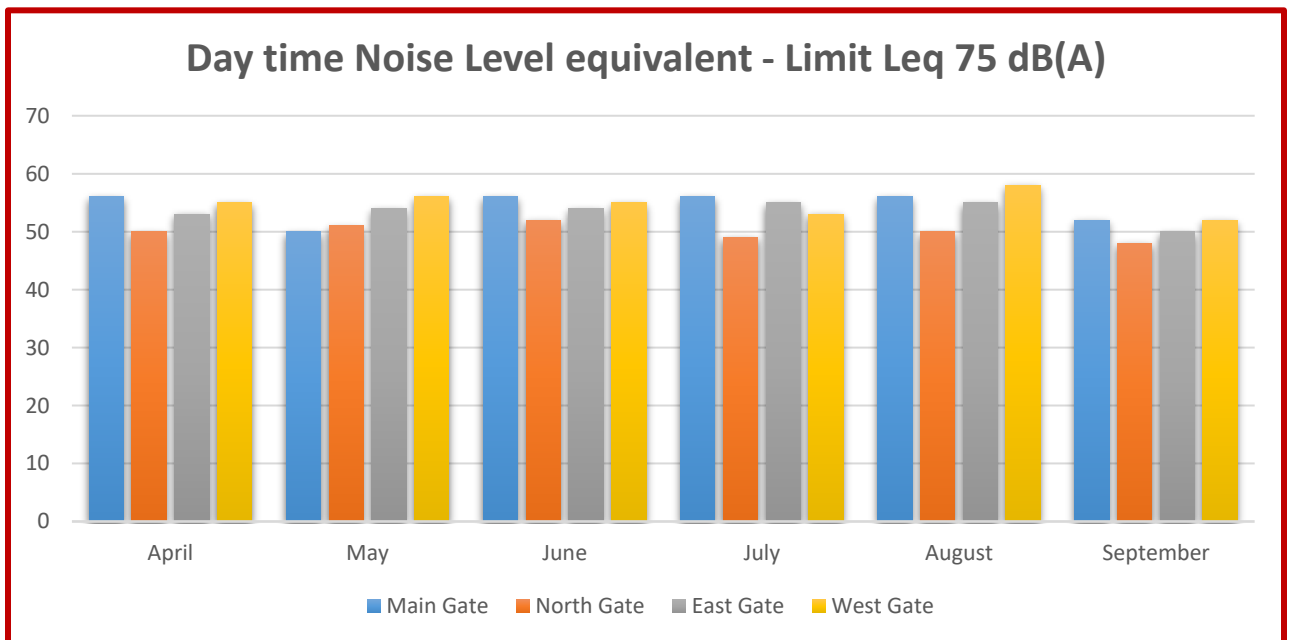


Figure 6: Graphical representation of trend of Noise Level in Leq dB(A) in the Day Time

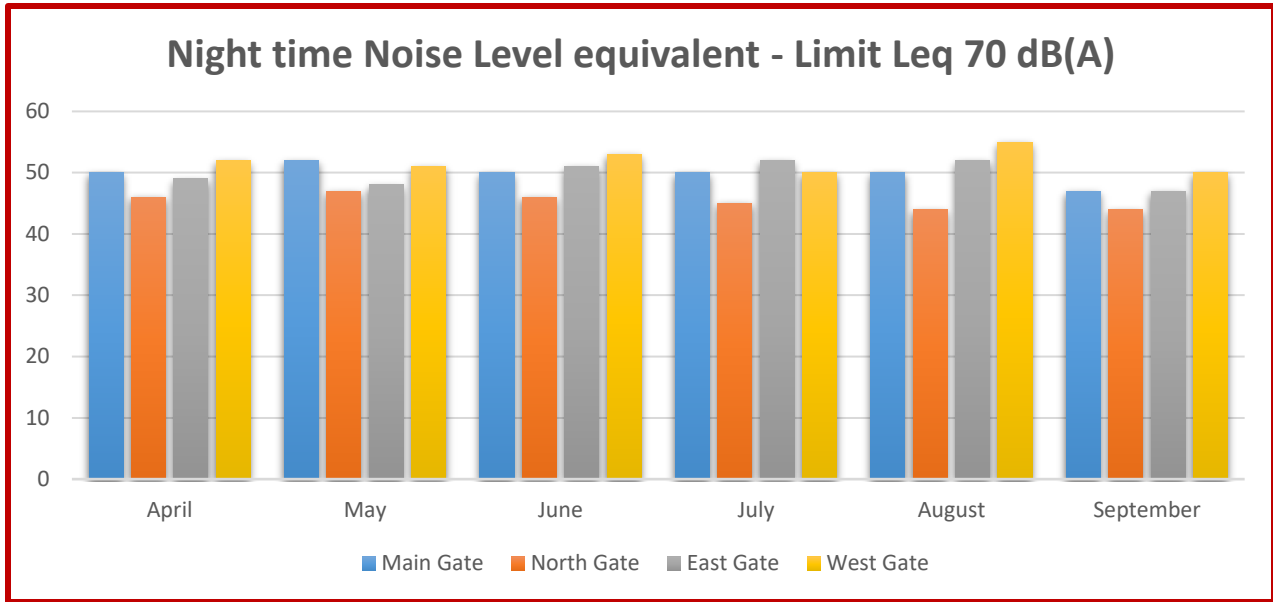


Figure 7: Graphical representation of trend of Noise Level in Leq dB(A) in the Night-time

Stack Monitoring Results in Suvali Onshore Terminal

Stack Monitoring was carried out for stacks attached to the exhaust of 12 equipment. This equipment are Hot Oil Heater (New and Old), Booster Compressor (BCP), Gas Turbine Compressor (GTC), Gas Turbine Generator (GTG), Tri ethylene Glycol absorbers (TEG) and Diesel Generators

(Graphical representation of average emission monitoring results during the reporting period (i.e. April'24 - Sep'24) is as follows:

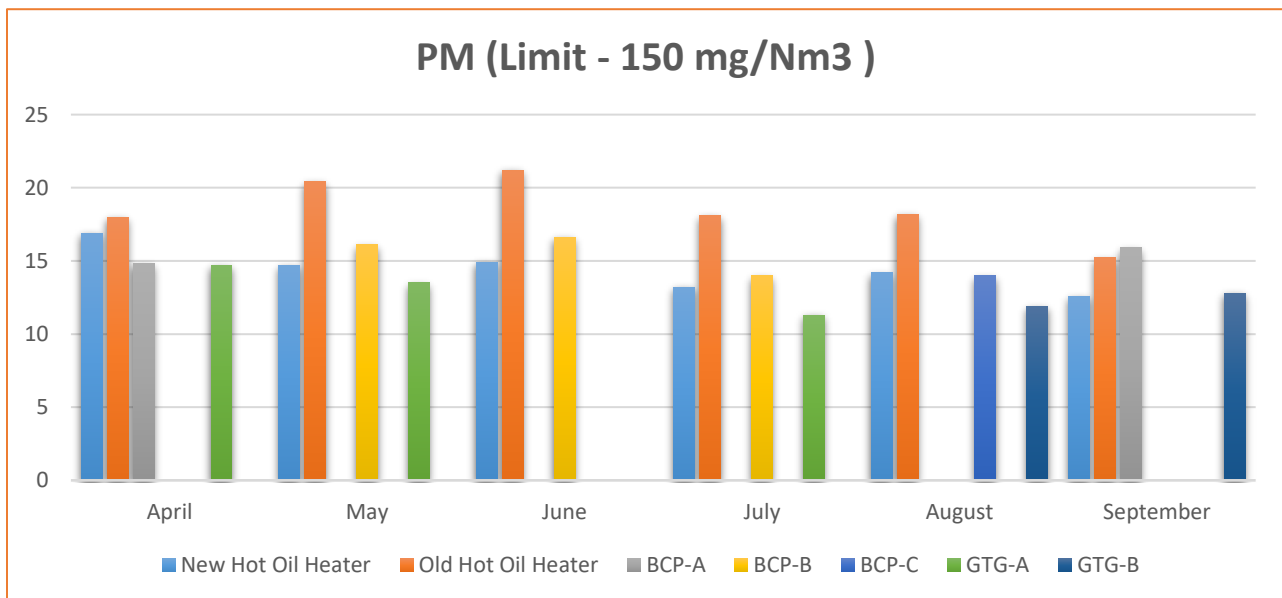


Figure 8: Graphical representation of average emission of Particulate Matter (PM 10) in mg/Nm³

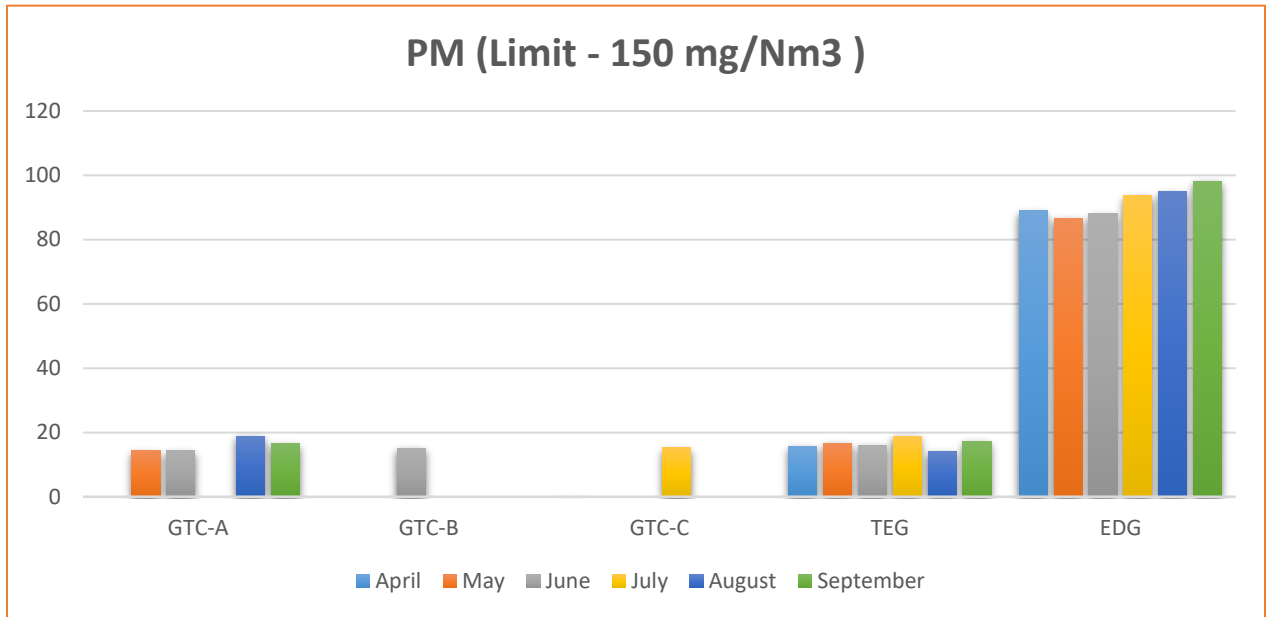


Figure 9: Graphical representation of average emission of Particulate Matter (PM10) in mg/Nm³

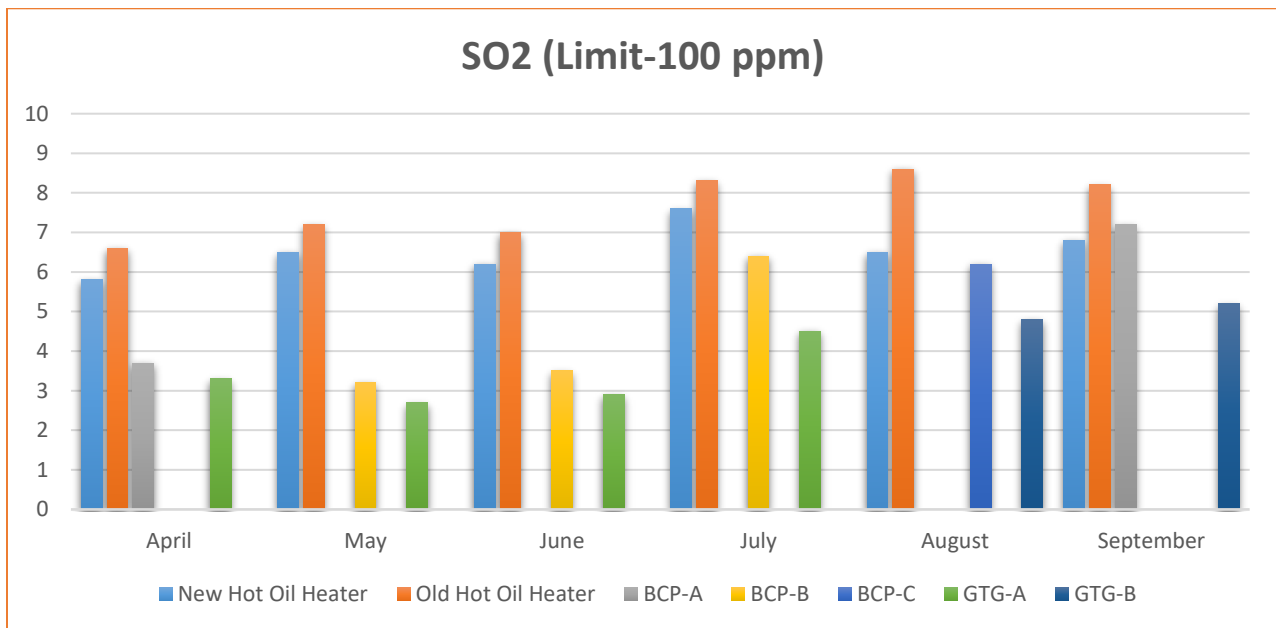


Figure 10: Graphical representation of average emission of Sulphur Di-oxides (SO₂) in mg/Nm³

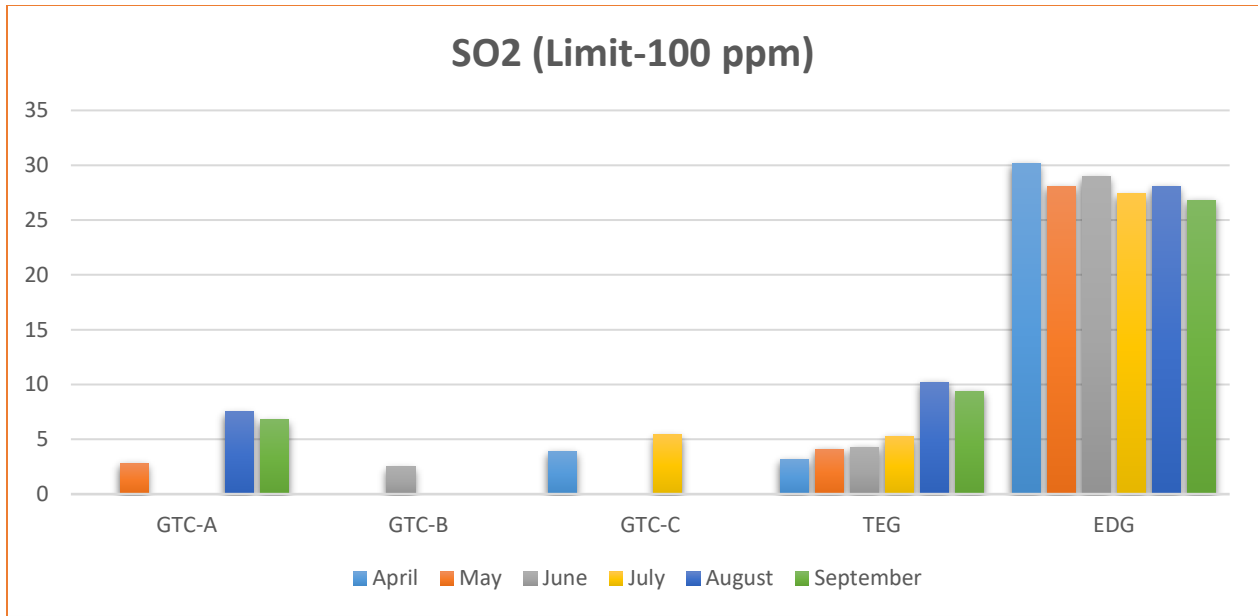


Figure 11: Graphical representation of average of Sulphur Di-oxides (SO₂) in mg/Nm³

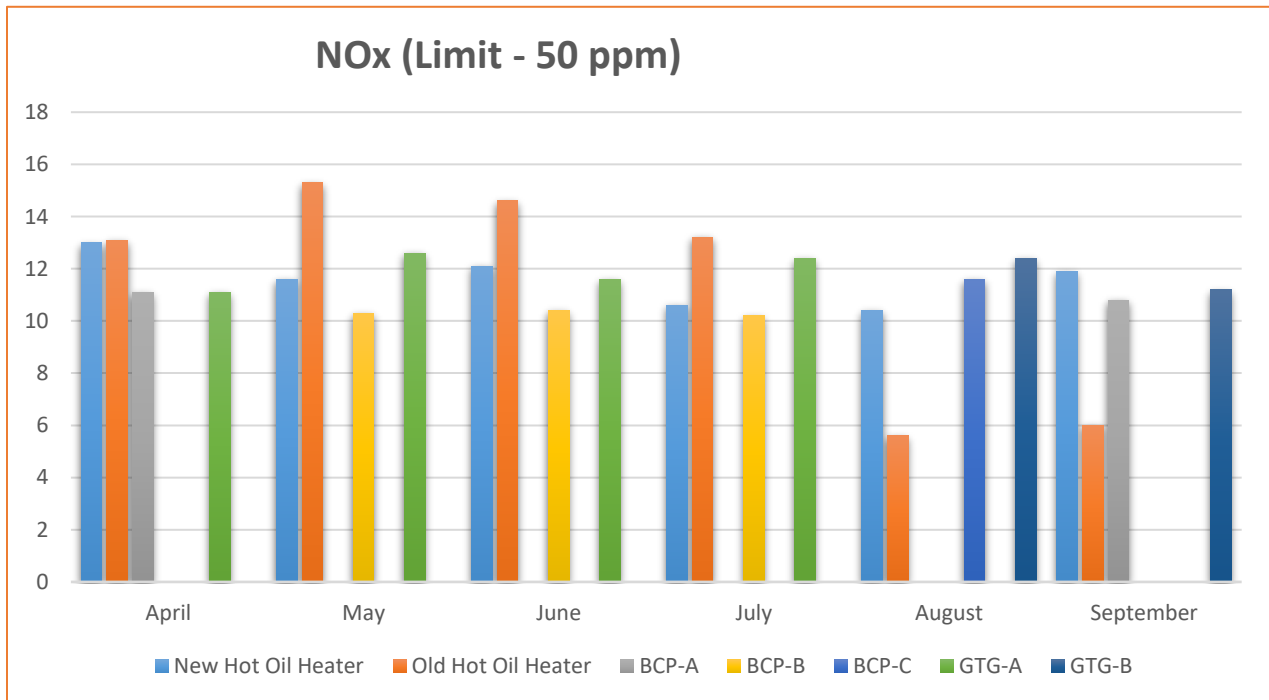


Figure 12: Graphical representation of average emission of Oxides of Nitrogen (NO_x) in mg/Nm³

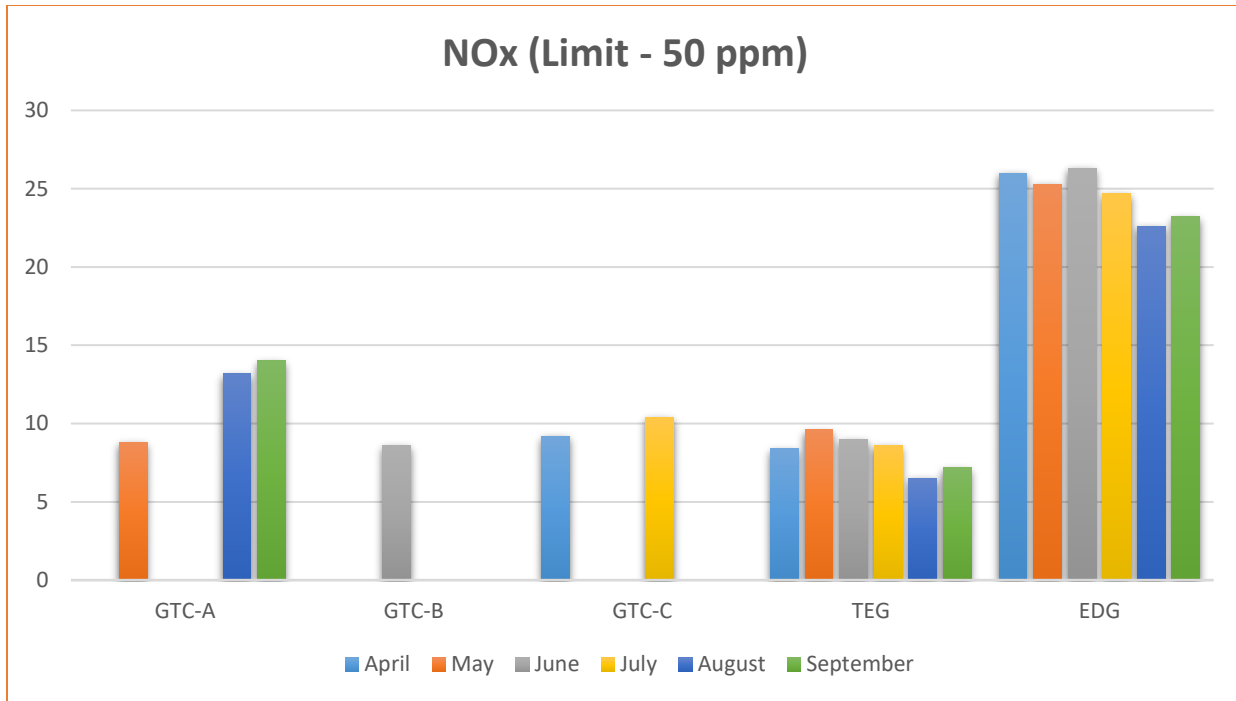


Figure 13: Graphical representation of average emission of Oxides of Nitrogen (NOx) in mg/Nm³

Effluent Quality Monitoring Results in Suvali Onshore Terminal

The ETP of 1920 KL per day capacity is installed to treat the produced water separated from the well fluids. The ETP has primary and secondary treatment system. Primary treatment removes the oil and suspended solids and the Secondary treatment has aeration process (Sequencing Batch Reactor) to remove the organic load from the effluent. The final treated wastewater meets the marine discharge standards specified by Gujarat Pollution Control Board and is discharged into sea through marine outfall located about 500 m from Low Tide Level (as recommended by NIO after carrying out the study).

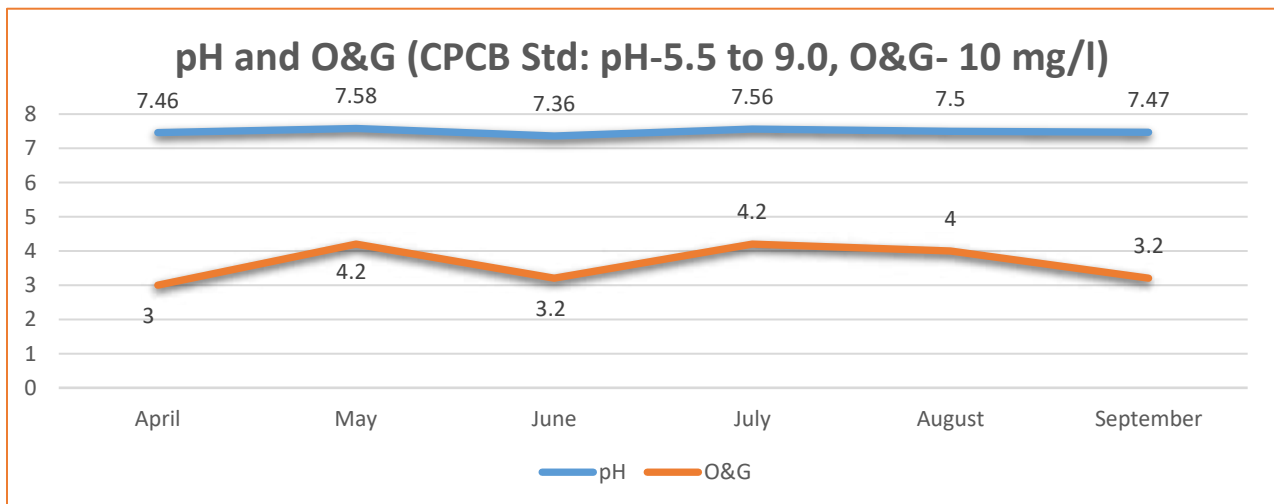


Figure 14: Graphical representation of pH and O&G of Treated Effluent

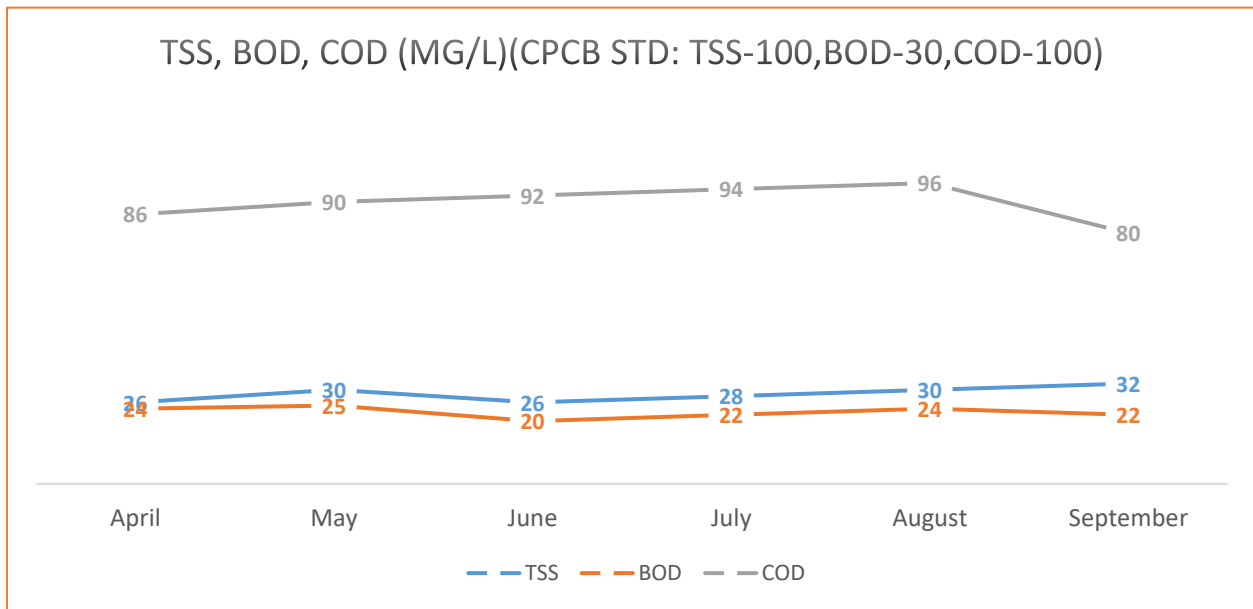


Figure 15: Graphical representation of TSS, BOD and COD of Treated Effluent

Sewage Quality Monitoring Results in Suvali Onshore Terminal

The STP of 30 KLD capacity is installed to treat the sewage generated from the Suvali Terminal. The STP has extended aeration treatment process. The treated sewage after disinfection is being discharged to the terminal for greenbelt development.

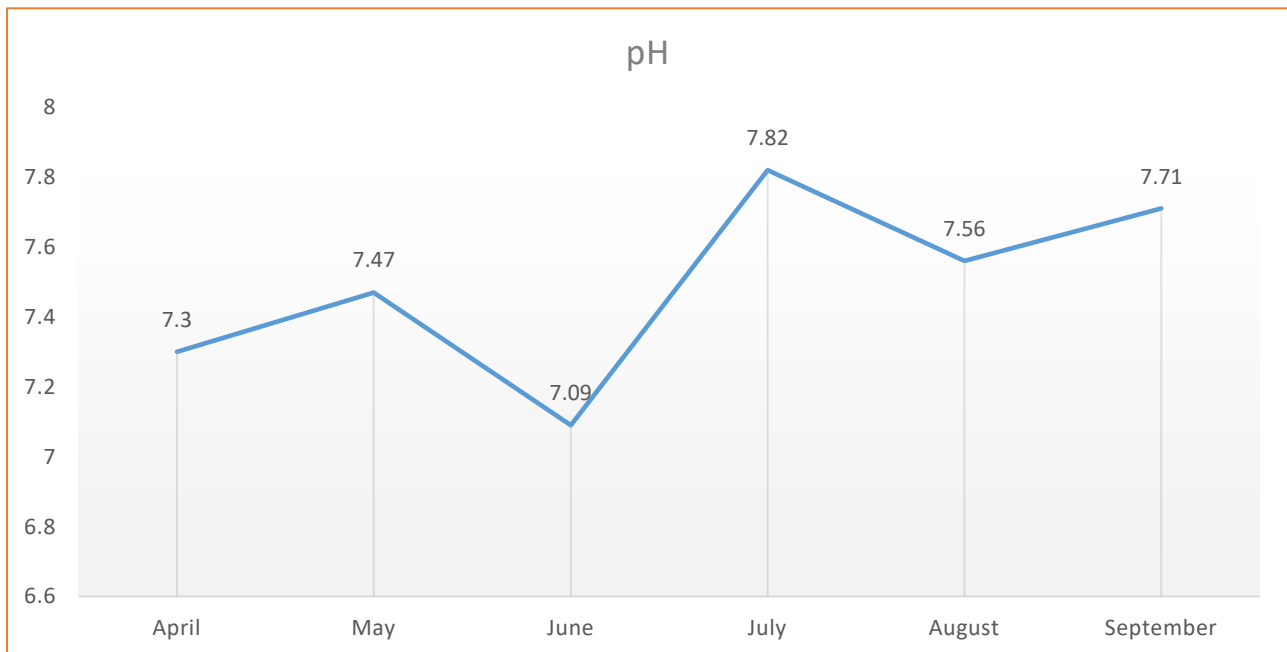


Figure 16: Graphical representation of pH of Treated Sewage

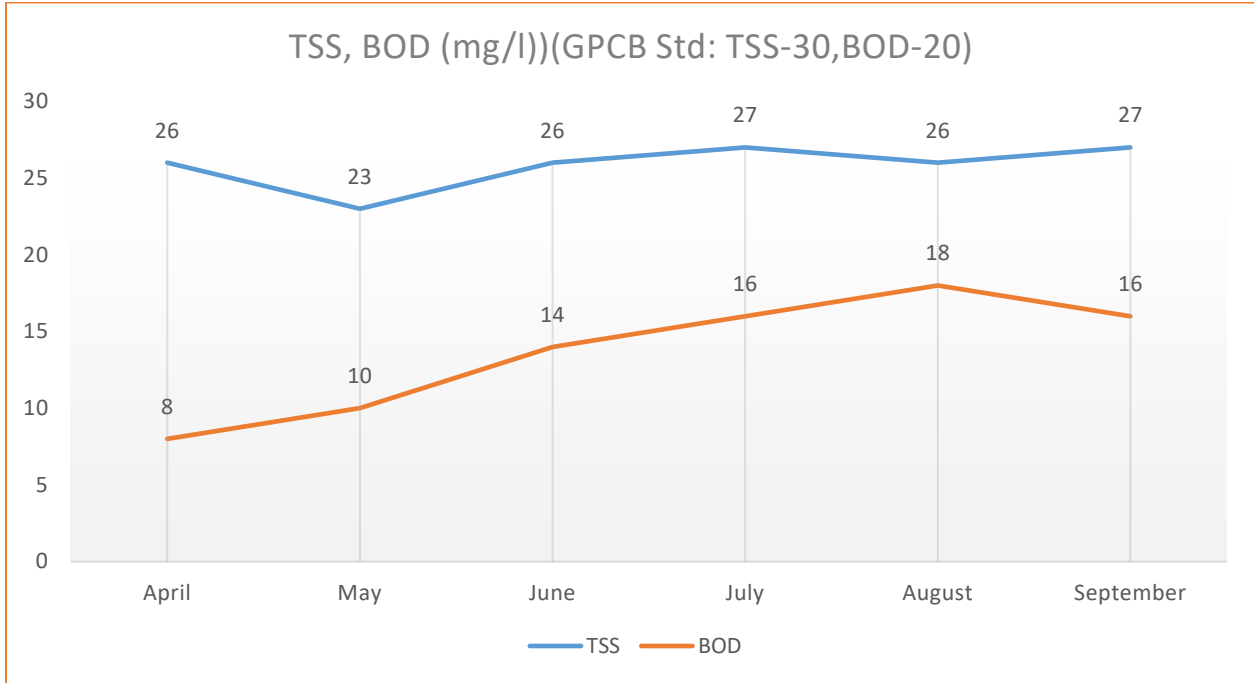
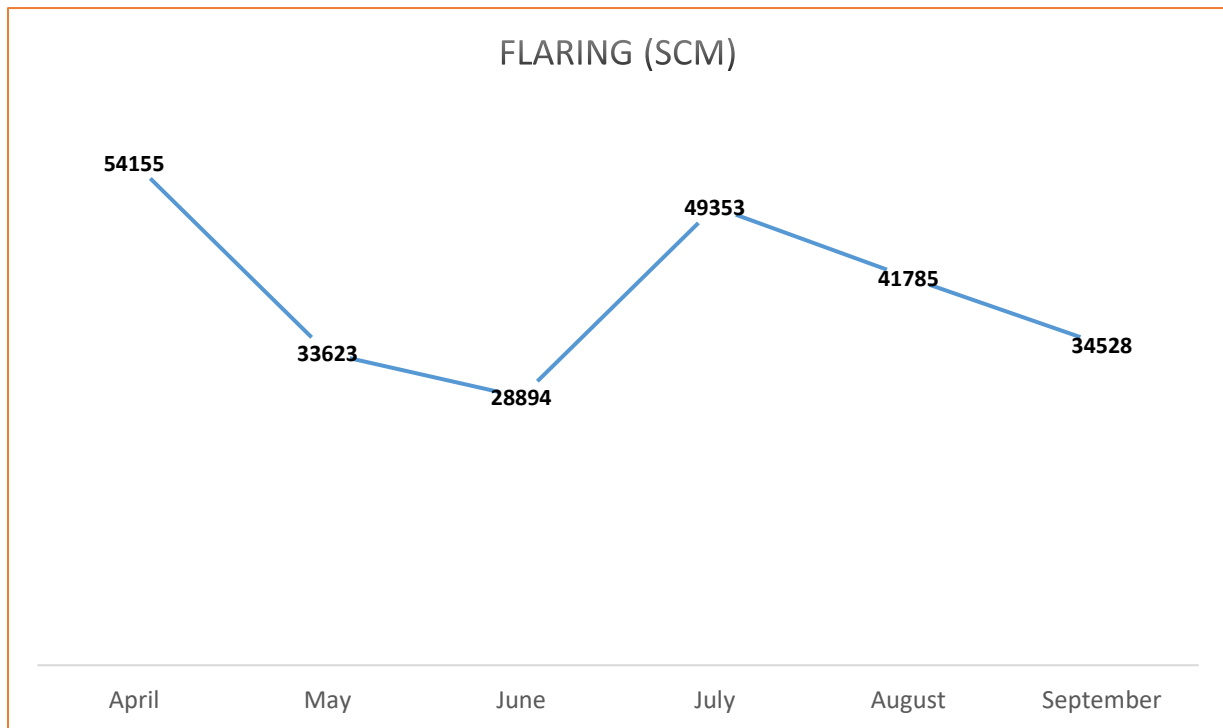


Figure 17: Graphical representation of TSS and BOD of Treated Sewage

Trend analysis of gaseous flaring carried out from April 2024 to September 2024



ANNEXURE NO. 02
CSR Report
(April 2024 – September 2024)

The major CSR activities conducted in Gujarat over the reporting period is described below:

April 2024:

- Installation of Water Pump at Vansva Village, with the support of village panchayat. Convergence amount of Rs.1,30,700 was collected for the same.
- Primary Health Care support extended to 870 patients, at PHC, Suvali



May 2024

- An 8-day summer camp was organized for 220 school students to engage them in a variety of fun and educational activities, including drawing, arts and crafts, dance, games, and storytelling. The camp aimed to help students build character, boost confidence, and develop new skills through enjoyable and interactive experiences.
- Primary Health Care support extended to 964 patients, at PHC, Suvali



June 2024

- Celebrated Shala Pravesh Utsav at all Government Schools of Gujarat during 26th to 28th June, 2023. Cairn employees participated actively in imparting fire safety training to local community. Cairn team handed over a total of 9 fire extinguishers at Junagam Primary school and other locations.
- Primary Health Care support extended to 1003 patients, at PHC, Suvali



July 2024

- Cairn Oil & Gas supported and installed Submersible water pump at Vansva village in partnership with Vansva Gram Panchayat to meet water requirements across village for daily usage.
- Primary Health Care support extended to 1125 patients, at PHC, Suvali



August 2024

- Held Independence Day Celebration at Suvali Primary school & Junagam Primary School on 15th August 2024. Around 550 students participated.
- During the celebration of Independence Day program, **Vedanta Limited distributed Education Kits to 149 students of Suvali Primary School & to 122 students of Junagam Primary School.**
- Primary Health Care support extended to 1124 patients, at PHC, Suvali.





September 2024

- As a meaningful Corporate Social Responsibility (CSR) initiative, 30 dedicated participants took part in the VDHM (Vedanta Delhi Half Marathon) walkathon, organized at Suvali beach where every kilometer they ran contributed directly to providing a meal for an underprivileged child. This initiative not only encouraged a healthy and active lifestyle among employees but also highlighted Vedanta’s commitment to making a positive impact in the community. A Fire Safety Training Program was conducted at Bhatlai Primary School during twinning program of the schools of Junagam Primary School and Bhatlai Primary School on 19th March 2024 to aware people about Fire & Safety. Total 90 participants attended the Program.
- Primary Health Care support extended to 1169 patients, at PHC, Suvali.



ANNEXURE NO. 03
Greenbelt Development in Suvali Onshore Terminal

Greenbelt Development in Suvali Onshore Terminal

Cairn Oil and Gas, a vertical of Vedanta Limited is one of the largest explorations and production companies in India, contributing to around 25 per cent of India's domestic crude oil production. The company is committed to conducting all its business activities in a socially responsible, ethical and environmentally friendly manner while continuously working towards improving the Human Development Index (HDI) in its operational areas in Rajasthan, Gujarat, and Andhra Pradesh.

The 33.3 ha. Onshore processing facility at Suvali Terminal processes the natural gas and crude oil from the Lakshmi and Gauri fields. The green belt in Suvali Terminal covers an area of 7.88 ha. Considering the area of Suvali Terminal is 33.3 ha., the green belt hence constitutes 23% of the total area of the terminal. However, an MoU with Gujarat Ecology Commission was established for Restoration, Plantation and Conservation of Mangroves in a 50 ha. area at Karanj Village, Olpad Taluka of Surat district in 2012.

Flora and Fauna

The Suvali processing terminal is known to be mostly dominated with exotic ornamental, plant species such as Scarlet cordia (*Cordia alliodora*) and African tulip (*Spathodea camponulata*). Some native plant species were also recorded from this area such as Neem (*Azadirachta indica*) and Scholar Tree (*Alstonia scholaris*) (BMP, 2017). During the biodiversity assessment conducted in the terminal, 32 tree species, 11 shrub species and 20 herb species were documented from within the terminal (BMP, 2017). The terminal has a well maintained garden area with well grown avenue plant species present. The plantation activity is carried out as a part of the greenbelt development. The area in the Phase II is left natural and has very few operations in place. Where the helipad is, there is very sparse vegetation present in this phase and is mainly grassland habitat. Seasonal waterbodies are formed in this area after monsoon due to water logging, which is then host to a number of avian fauna (BMP, 2017).

During the biodiversity assessment conducted in the Suvali terminal (BMP, 2017), 23 birds, 2 mammals, 1 reptile and 2 butterfly species were encountered. Winter migrant barn swallow and common snipe were seen in Suvali terminal. Greater spotted eagle was observed over the plant area.

Canopy Density

Canopy density was calculated for the plantations developed within the Suvali Terminal. Forest cover is broadly classified in 4 classes, namely very dense forest, moderately dense forest, open forest and scrub. The classification of the cover into dense and open forests is based on internationally adopted norms of classification (FSI, 2018). According to FSI, the classes are defined as below.

Table 1: Classification Scheme for Canopy Cover

Very dense Forest	All Lands with tree cover of canopy density of 70% and above
Moderately dense forest	All lands with tree cover of canopy density between 40% and 70% above
Open forest	All lands with tree cover of canopy density between 10% and 40%
Scrub	All forest lands with poor tree growth mainly of small or stunted trees having canopy density less than 10 percent

While collecting ecological data, data was collected using spherical densimeter from the Suvali Terminal and the canopy density calculated. The calculation of canopy density resulted in the canopy density of 40.6% of plantation within the Suvali terminal, which is considered to be of the moderate density class as per FSI (FSI, 2018).

Table 2: List of Recorded Tree Species in Suvali Terminal

S.No	Scientific Name	Common Name
1	<i>Acacia auriculiformis</i>	Earleaf Acacia
2	<i>Acacia nilotica</i>	Desi Babool
3	<i>Ailanthus excelsa</i>	Mahanimb
4	<i>Alstonia scholaris</i>	Devil's tree
5	<i>Annona squamosa</i>	Sitafal
6	<i>Azadirachta indica</i>	Neem
7	<i>Bauhinia variegata</i>	Kachnar
8	<i>Callistemon viminalis</i>	Weeping bottlebrush
9	<i>Cassia fistula</i>	Amaltas
10	<i>Casuarina equisetifolia</i>	Whistling Pine
11	<i>Citrus limon</i>	Lemon
12	<i>Cocos nucifera</i>	Coconut
13	<i>Conocarpus erectus</i>	Button Mangrove
14	<i>Cordia sebestena</i>	Scarlet cordia
15	<i>Cycas revoluta</i>	Sago palm
16	<i>Delonix regia</i>	Gulmohor
17	<i>Eucalyptus globulus</i>	Southern blue gum
18	<i>Eythrina variegata</i>	Indian coral tree
19	<i>Ficus benghalensis</i>	Banyan
20	<i>Ficus racemose</i>	Cluster fig
21	<i>Ficus religiosa</i>	Peepal
22	<i>Ficus virens</i>	White Fig
23	<i>Grevillea robusta</i>	Silver oak
24	<i>Mangifera indica</i>	Mango
25	<i>Manikara zapota</i>	Noseberry
26	<i>Mimusops elengi</i>	Spanish cherry
27	<i>Morus alba</i>	White Mulberry
28	<i>Murraya koenigii</i>	Kadipatta
29	<i>Neolamarckia cadamba</i>	Kadamba
30	<i>Nyctanthes arboritis</i>	Har singar

S.No	Scientific Name	Common Name
31	<i>Peltophorum dubium</i>	Copperpod
32	<i>Peltophorum pterocarpum</i>	Yellow flametree
33	<i>Pithecellobium dulce</i>	Jangal Jalebi
34	<i>Platyclusus orientalis</i>	Oriental thuja
35	<i>Plumeria pudica</i>	Frangipani
36	<i>Plumeria rubra</i>	Common White Frangipani
37	<i>Polyalthia longifolia</i>	False Ashok
38	<i>Psidium guajava</i>	Guava
39	<i>Roystonea regia</i>	Royal palm
40	<i>Samanea saman</i>	Rain Tree
41	<i>Senna siamea</i>	Siamese Senna
42	<i>Spathodea campanulata</i>	African tulip tree
43	<i>Syzygium cumini</i>	Jamun
44	<i>Tamarindus indica</i>	Imli
45	<i>Tectona grandis</i>	Teak
46	<i>Terminalia catappa</i>	Indian almond
47	<i>Ziziphus jujuba</i>	Ber

Table 3: List of Recorded Shrub Species inside Suvali Terminal

S.No	Scientific Name	Common Name
1	<i>Bougainvillea glabra</i>	Paper Flower
2	<i>Cadaba fruticosa</i>	Cadaba
3	<i>Caesalpinia bonducella</i>	Gray nicker
4	<i>Calotropis gigantea</i>	Crown flower
5	<i>Calotropis procera</i>	Rubber bush
6	<i>Cascabela thevetia</i>	Yellow oleander
7	<i>Catharanthus roseus</i>	Periwinkle
8	<i>Dracaena fragrans</i>	Corn plant
9	<i>Dracaena spp.</i>	Dragontree
10	<i>Euphorbia caducifolia</i>	Leafless milk hedge
11	<i>Hibiscus rosa-sinensis</i>	Chinese hibiscus
12	<i>Ixora coccinea</i>	Jungle geranium
13	<i>Justicia adhatoda</i>	Malabar Nut
14	<i>Murraya paniculata</i>	Orange jessamine
15	<i>Nerium oleander</i>	Oleander
16	<i>Plumeria pudica</i>	White frangipani
17	<i>Tecoma stans</i>	Narrow leaf yellow bells



ANNEXURE No. – 04

Mangrove Plantation Details – CB/OS-2

Mangrove Plantation Details

The CB/OS-2 offshore block is located in the Gulf of Khambhat, West Coast of India. The block extends from Ghogha to Mahuva on the western shore and Dandi to Delwara on the Eastern Shore of the Gulf. The block lies within Latitude 21°00'00" to 21°37'51" and Longitude 71°45'00" to 72°45'00". The retained area of the block is approximately 2642 km².

As per Environmental Clearance conditions, an MoU was signed on 9th August 2012 between Cairn Energy India Pvt. Ltd (herein after referred to as Vedanta Ltd (Cairn Oil & gas)) and Gujarat Ecology Commission to act as an implementing agency for and on behalf of Cairn to implement the project "Restoration, Plantation and Conservation of mangroves at Karanj Village of Olpad Taluka of Surat district". The Project period was 1st August 2012- 31st July 2013.

Another MoU was signed on 20th October 2022 with the Gujarat Forest Department for the development of 60Ha of mangroves at Surat coastal region. Another MoU was signed on 09th November 2023 with the Gujarat Forest Department for the development of 130Ha of mangroves at Surat coastal region.

Trees/Species were planted in the following manner:

Local Name	Botanical Name	Percentage
Cher	<i>Avicennia marina</i>	100%

The species were planted in Raised bed model and the number of them planted were 24000 seeds per hectare. Year wise/ Month wise Plantation Schedule of Activities were as follows:

Name of Model	Year	Financial Year	Month	Activities carried out
Raised Bed Model	Planting Year	2013-14	February to March	Preparation of bed, collection of seed, Alignment, seed sowing, Transportation of labour, etc.
	1 st Year	2014-15	March to August	Removal of algae & protection
			September to October	Protection of plantation & maintenance
			November to March	Casualty replacement

Cost of the project

Sl. No.	Budget Head	Total Amount (INR)
1	Mangrove Plantation (50Ha)	1000000
2	Baseline Survey	12500
3	Awareness Creation	25000
4	Administration (Salary, wage. Etc.)	125000
5	Documentation & Dissemination	10000
6	Travel & others	22500
	Total	1195000

Proposed Budget and Activity Schedule for the 60 Ha. Mangrove Plantation

Starting Year : November 2022

Mangrove Plantation Scheme- Surat Forest Department					
Sr. No.	Details	Unit	Rate	Quantity	Amount
Nursery – Starting					
1	Seed Collection	Per Hec	1600	60	96000
2	Soil filling in polythene bags	Per Hec	1884	60	113040
3	Preparation of beds	Per Hec	12400	60	744000
4	Seeding, Watering	Per Hec	5228	60	313680
5	Removal of Algae and weeds	Per Hec	6100	60	366000
					1632720
First Year					
1	Alignment Work	Per Hec	2480	60	148800
2	Sowing	Per Hec	5140	60	308400
3	Soil overturning	Per Hec	9315	60	558900
4	Protection	Per Month	10206	12	122472
5	Alae removal	Per Hec	6233	60	373980
6	Monitoring and boat rent	L.S.	Lumpsum	Lumpsum	100000
7	Public awareness program	Nos	50000	2	100000
					1712552
Second Year					
1	Casualty Nursery	Per Hec.	7975	60	478500
2	Sowing	Per Hec.	5654	60	339240
3	Soil overturning	Per Hec.	10246.5	60	614790
4	Seeding, Watering	Per Hec.	5750	60	345000
5	Protection	Per month	10206	12	122472
6	Algae removal	Per Hec	7167.95	60	430077
					2330079
Third Year					
1	Litter cleaning around the plant	Per Hec.	7884.7	60	473082
2	Protection	Per Month	10206	12	122472
					595554
Fourth Year					
1	Litter cleaning around the plant	Per Hec.	8673.17	60	520390.2
2	Protection	Per Month	10206	12	122472
					642862.2
Fifth Year					

1	Litter cleaning around the plant	Per Hec.	8673.17	60	520390.2
2	Protection	Per Month	10206	12	122472
					642862.2
Sixth Year					
1	Protection	Per Month	10206	12	122472
Seventh Year					
1	Protection	Per Month	10206	12	122472
Eighth Year					
1	Protection	Per Month	10206	12	122472
Ninth Year					
1	Protection	Per Month	10206	12	122472
Tenth Year					
1	Protection	Per Month	10206	12	122472
Fencing			35000	60	2100000
					Total – 10268989.4
					Cost/Hec- 171150



Glimpses from Mangrove Plantation Site

Proposed Budget and Activity Schedule for the 130 Ha. Mangrove Plantation

Starting Year: December 2023

Mangrove Plantation Scheme – Surat Forest Department					
S.No.	Details	Unit	Rate	Quantity	Amount
First Year					
1	Line Alignment	Per Ha	2,400	130	3,12,000
2	Seed Collection	Per Ha	1,600	130	2,08,000
3	Bed Preparation (1mX1mX30cm)	Per Ha	13,000	130	16,90,000
4	Seed Sowing	Per Ha	1,000	130	1,30,000
5	Plant Protection	Per Month	10,500	12	1,26,000
6	Algae Cleaning	Per Ha	3,000	130	3,90,000
7	Labour Expenses	Per Ha	3,000	130	3,90,000
					32,46,000
Second Year					
1	Casualty 20%	Per Tree	2.5	8,000	20,000
2	Plant Protection	Per Month	10,500	12	1,26,000
3	Algae Cleaning	Per Ha	3,000	130	3,90,000
					5,36,000
Third Year					
1	Casualty 20%	Per Tree	2.5	8,000	20,000
2	Sea Tide Litter Cleaning	Per Ha	3,000	130	3,90,000
3	Plant Protection	Per Month	11,500	12	1,38,000
					5,28,000
Fourth Year					
1	Sea Tide Litter Cleaning	Per Ha	3,000	130	3,90,000
2	Plant Protection	Per Month	11,500	12	1,38,000
					5,28,000
Fifth Year					
1	Sea Tide Litter Cleaning	Per Ha	3,000	130	3,90,000
2	Plant Protection	Per Month	13,000	12	1,56,000
					5,46,000
Sixth Year					
1	Plant Protection	Per Month	13,000	12	1,56,000
Seventh Year					
1	Plant Protection	Per Month	13,000	12	1,56,000
Eighth Year					
1	Plant Protection	Per Month	13,000	12	1,56,000
Ninth Year					
1	Plant Protection	Per Month	13,000	12	1,56,000
Tenth Year					
1	Plant Protection	Per Month	13,000	12	1,56,000
Demarcation of Plantation Area (Fencing)		Per Ha	35,000	130	45,50,000

	TOTAL	1,07,14,000
	Total Cost/Hectare	82,415



Glimpses from Mangrove Plantation Site

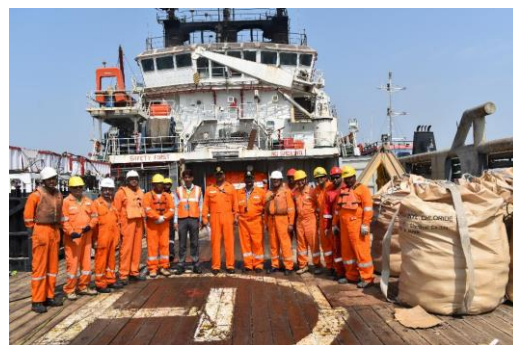
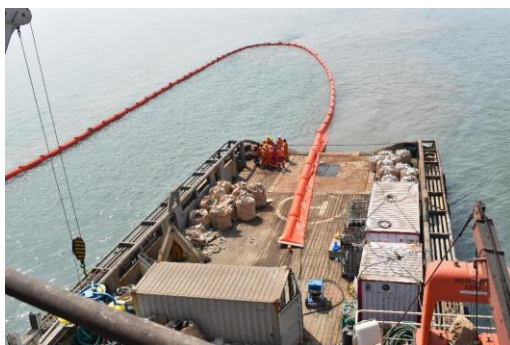
ANNEXURE NO 05

Oil Spill Contingency Plan – CB/OS-2 Operations

OIL SPILL CONTINGENCY PLAN FOR OFFSHORE OPERATIONS AT CB/OS-2, WEST COAST OF INDIA

Document Reference No: VL-SVL-QHSE-OSCP-01

This document is prepared as per the guidelines issued in National Oil Spill Disaster Contingency Plan, 2015 and latest Edition, issued by Indian Coast Guard, Ministry of Defense, GoI, Coast Guard Headquarters, New Delhi 110 001



OCTOBER 20, 2023

VEDANTA LIMITED (DIVISION: CAIRN OIL & GAS)


**CB-OS 2 Suvali Onshore Terminal, Survey No. 232, Village Suvali, Surat Hazira Road,
Surat 394510, Gujarat,**

Document Change History

Rev	Date	Editor	Section	Nature of Change
A	30.04.2009	HSE	Entire Document	For CB/OS-2 Onshore and Offshore Facility
1.0	30.11.2011	HSE	Entire Document	Change in Service Provider name, inclusion of Oil Spill Response Equipment List, Mutual Aid Agreement with M/s Niko
2.0	25.04.2012	HSE	Entire Document	Changes to the Document; ref Fax from Coast Guard dt. 20.04.2012
3.0	03.04.2014	HSE	Entire Document	Best Practices
4.0	11.11.2015	HSE	Entire Document	Revision of Emergency Communication List
5.0	07.08.2017	HSE	Entire Document	Revision as per NOSDCP 2015 guidelines.
6.0	01.11.2017	HSE	Entire Document	Revision to include comments / suggestions received from ICG (NW), Gandhinagar.
7.0	25.02.2021	Sagorika/ S. Karthik	Entire Document	Revised the entire document to align with the Annexure E1-1 of Appendices to NOS-DCP, 2015 Edition.
8.0	05.07.2021	S. Karthik	Section 2.6, 3.1, 4.1, 5.5, 7.1 etc and based on the discussion held with ICG, Vadinar, Gujarat	Revised the document to incorporate the comments issued by Coast Guard Pollution Response Team (NW), C/o ICG Station, Vadinar. Quoting: 718, dated 15 th June 2021 Appendix 3 revised to include the valid Mutual Aid contract, OSRL agreement and Mock Drill report
9.0	20.10.2023	Vijay K.	Entire Document	Revised the document to include comments/ suggestions from PRT ICG (NW), Gandhinagar. Annexure 4 revised to update the available quantity of OSD. Annexure 9 inserted to include authorized recyclers for disposal of expired OSD

Distribution List

Copy Identification	Recipient	Issue Date
Master Copy	Hard Copy to Installation Manager - Suvali Operations	
Four Copies	Hard Copies to HSE Team, IRT & Radio Officer at Suvali Operations	
Two Copies	Hard Copies to Radio Officer at Gurgaon and Radio Officer at Ravva	
Indian Coast Guard	Three set of hard Copies to Gandhinagar, Vadinar and New Delhi office	
Soft Copy	Field Manager Production -Suvali	
Soft Copy	Field Manager Maintenance -Suvali	
Soft Copy	Manager Logistics -Suvali	
Soft Copy	HSE Manager-Suvali	
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Hard copy	Gujarat Pollution Control Board, Gandhinagar and RO Office	

 vedanta transforming elements Internal (C3) 	Table of Contents	Rev. No: 09 Date: 20 th Oct 2023 Doc No: VL-SVL-QHSE-OSCP-01 Page No:1
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Certificate of Endorsement



E4

Appendix E4 to NOS-DCP 2015

(Para 4.5 refers)

Certificate of Endorsement

I hereby certify that:

1. The oil spill contingency plan for the facility under my charge has been prepared with due regard to the relevant international best practices, international conventions, and domestic legislation.
2. The nature and size of the possible threat including the worst-case scenario, and the resources consequently at risk have been realistically assessed bearing in mind the probable movement of any oil spill and clearly stated.
3. The priorities for protection have been agreed, taking into account the viability of the various protection and clean-up options and clearly spelt out.
4. The strategy for protecting and cleaning the various areas have been agreed and clearly explained.
5. The necessary organization has been outlined, the responsibilities of all those involved have been clearly stated, and all those who have a task to perform are aware of what is expected of them.
6. The levels of equipment, materials and manpower are sufficient to deal with the anticipated size of spill. If not, back-up resources been identified and, where necessary, mechanisms for obtaining their release and entry to the country have been established.
7. Temporary storage sites and final disposal routes for collected oil and debris have been identified.
8. The alerting and initial evaluation procedures are fully explained as well as arrangement for continual review of the progress and effectiveness of the clean-up operation.
9. The arrangements for ensuring effective communication between shore, sea and air have been described.
10. All aspects of plan have been tested and nothing significant found lacking.
11. The plan is compatible with plans for adjacent areas and other activities.
12. The above is true to the best of my knowledge and belief.
13. I undertake to keep the plan updated at all times and keep the Indian Coast Guard informed of any changes through submission of a fresh certificate of endorsement.

Seal:

Signature:

Name: Viresh Patel
Designation: Installation Manager, Suvali
Organization: Vedanta Limited (Cairn Oil & Gas Division)
Date: 25th February 2021

Place: Suvali



VEDANTA LIMITED

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CIN : L13209MH1965PLC291394

Sensitivity: Internal (C3)

 	Certificate of Endorsement	Rev. No: 09 Date: 20 th Oct 2023 Doc No: VL-SVL-QHSE-OSCP-01
		Page No:3

Contingency Planning Compliance Checklist

NAME OF PORT/ OIL HANDLING AGENCY	Vedanta Limited (Division: Cairn Oil & Gas), Suvali Onshore Terminal Hazira, Surat
-----------------------------------	---

DESCRIPTION		COMPLIED	REMARKS
S. No.		YES/NO	
RISK ASSESSMENT			
1	Whether the facility produces/ handles/ uses/ imports/ stores any type of petroleum product	Yes	Suvali offshore is designed to produce 25,000 Barrels of Oil per Day (BOPD) and gas up to 120 million standard cubic feet per day (MMSCFD). Refer Section 1.5; Page no. 27.
2	Whether risk assessment is done	Yes	Oil spill modelling and mapping of marine sensitive areas were prepared for key scenarios of oil spill. Refer Section 2.1; Page no. 37 onwards. Refer Annexure - 1 - Oil spill modelling; Refer Annexure - 2 - Environment Sensitivity Index Mapping & Atlas; and Refer Annexure - 6 - NEBA for details.
3	Who did the risk assessment	Yes	Expert agency was hired to carry out the oil spill risk assessment from Suvali Block area. The study was carried by M/s Environ Software (P) Ltd, #60/4, Environ Towers, Electronic City, Bangalore -560100. Refer Executive Summary; Page no. 18.
4	Whether maximum volume of oil spill that can occur in the worst-case scenario is considered	Yes	The prediction of fate and transport of crude oil spill was carried out for maximum estimated spill volume. Refer Section 2.1; Page no. 37.
5	Whether relative measure of the probability and consequences of various oil spills including worst case scenario are taken into account	Yes.	The probability of oil spill was considered from three vulnerable locations, which includes LA, LB, GA platform and pipeline. The worst-case scenario was considered for 100, 1000 and 5000 Tons of oil spill including the pipeline leakages - midway of LA, LB and GA pipeline locations connecting terminal. Refer Section 2.1; Page no. 37.
6	Whether all types of spills possible in the facility are considered including Grounding, Collision, Fire, Explosion, Rupture of hoses	Yes	The potential risks associated with operations and exploration of the well, that may result in accidental spill were considered for the study area are as follows <ul style="list-style-type: none"> • Operational spills during diesel transfer • Leakage at wellhead • Utility spills from platform/ships • Flow line rupture/leak. • Diesel spill from support vessel • Blowout and BOP failure • Major Accident in Block area Refer Section 2.1; Page no. 37.

DESCRIPTION		COMPLIED YES/NO	REMARKS
S. No.			
7	Please specify the list of oils considered for risk assessment	Yes.	The list of oils considered for the risk assessment are <ul style="list-style-type: none"> Suvali field crude oil (well fluid) and gas Diesel used as fuel in rig & vessels have API gravity (API 35 – 45) Synthetic oil base mud used while drilling Refer Table 2-1, 2-2, 2-3, 2-4, 2-5, and 2-6; Page no. 39 to 41.
8	Whether the vulnerable areas are estimated by considering maximum loss scenario and weather condition	Yes	The spill quantity, total losses due to weathering process, oil reaching the coast and landing location has been studied. Refer Section 2.4; Page no. 43.
9	Whether impacts on the vulnerable areas are made after considering the Marine protected areas, population, fishermen, saltpans, mangroves, corals and other resources within that area	Yes	The vulnerable areas were studied and accordingly the environmental sensitive index mapping was plotted. The specific maps considering the Block area prepared include Mangroves, Mudflat, fish landing, ports & jetties, salt pans & aquaculture and human settlements. Refer Section 2.4; Page no. 43.
10	Whether measures for reduction of identified high risks are included by reducing the consequences through spill mitigation measures	Yes	The offshore operations consisting of platforms, pipeline and drillings are carried out considering the highest level of safety and asset integrity standards, few key points to highlight are <ul style="list-style-type: none"> The oil and gas wells are fitted with subsurface safety valve. A safety device is installed in the upper and lower wellbore separately to provide emergency closure of the producing conduits in the event of an emergency. The drilling activity is carried out after installation of BOP. A blowout preventer is a specialized valve used to seal, control and monitor oil and gas wells to prevent blowouts. All the pipelines are continuously studied for their corrosion rate. Periodic pigging activities are carried out to enhance the life of the pipeline to prevent from any failures. In addition to the above considerations, spill contain equipment such as booms, skimmer, Oil spill dispersants etc., are always available in the platform & vessels in Block area. Refer Section 3.3 Oil Spill Response in Offshore Zones; Page no. 59.
11	Whether steps have been considered to reduce risks to the exposed population by increasing safe distances by acquiring property around the facility, if possible	Yes	All wells and offshore platforms are situated in sea at distance of >15.0 kms away from the nearest shore point. Refer Section 1.5; Page no. 27.
12	Whether risk levels are established for each month after considering the	Yes	The risk levels were studied for season wise, the months included are January, March, July, and November taking the year 2016 as study period.

DESCRIPTION		COMPLIED YES/NO	REMARKS
S. No.			
	probability with tide and current and consequences of each such spill		Refer Annexure – 1.
13	Whether prevention and mitigation measures are included in the plan	Yes	Prevention of the oil spill is considered as part of plant design and operational issues. The oil & gas facility design was carried out based on the Quantitative Risk Assessment study outcome. Refer section 3.3.1; Page no 61.
14	Whether the spill may affect the shoreline. (length of the shoreline with coordinates)	Yes	Oil spill analysis were carried out to identify the spill quantity, amount of oil reaching the land / domain boundaries and the coast for that particular period. Refer Annexure – 1; Table 1.1 (a) to Table 1.4 (d) Page no. 22 to 24.
15	Whether time taken the oil spill to reach ashore in each quantity of spill in various months are mentioned in the plan		
16	Whether sensitivity mapping has been carried out	Yes	Environ Software Pvt Ltd prepared marine sensitive area atlas in the East coast of India. Landsat-8 satellite data was used to map various coastal land, biological, environmental, fish landing, human settlement, geographical features and prepared the sensitivity index mapping with regards to oil spill risk assessment and management. Refer Figure A11.1 to A11.8 of Annexure – 2; Page no. 32 to 39.
17	Does the sensitivity mapping clearly identify the vulnerable areas along with MPAs, corals, fishermen community, saltpans, mangroves and other socioeconomic elements in the area	Yes	
18	Do the sensitivity maps indicate area to be protected on priority	Yes	
19	Does the map indicate boom deployment locations	Yes	
20	Whether any Marine Protected Area will be affected	No	No.
21	Whether total number of fishermen likely to be affected is mentioned in the plan	Yes	If spill occurs, fishermen livelihood will be affected, since no fishing activity can be carried out.
22	Whether any saltpan in the area is going to be affected	No	No saltpan is identified in the vicinity of the operating area. The salt pans are located at far away location. Refer Figure A11.5; Page no. 36 of Annexure – 2.
23	Whether any mangroves in the area will be affected by a spill	Yes	Mangroves location are likely to be affected. Mapping has been carried out mentioning the locations of Mangroves. Refer Figure A11.1; Page no. 32 of Annexure – 2.
Preparedness			
24	Whether any containment equipment is available	Yes	Refer Annexure – 4 for the list of oil spill pollution response equipment available at Suvali facility, such as containment equipment, recovery equipment and temporary storage facility to store the recovered spill oil.
25	Whether any recovery equipment is available	Yes	

DESCRIPTION		COMPLIED YES/NO	REMARKS
S. No.			
26	Whether the facility is having any temporary storage capacity	Yes	
27	Whether location of the oil spill response equipment is mentioned in the plan	Yes	The marine oil spill response equipment is stored at three different locations. The locations are one of the three operating platforms, one of the vessels engaged in the routine operations and in the port during drilling campaign otherwise in the Suvali terminal. Refer section 4.1; Page no. 69.
28	Whether suitable vessels available for deploying the boom, skimmer etc.	Yes	One Tugboat and one Vessel is available for deploying the oil spill pollution response equipment. Provision for hiring additional vessel as required is possible. During drilling and well workover activities, additional vessels are hired. Refer Section "Lists"; Page no. 133.
29	Whether OSD held with facility	Yes	In total 03 KL of OSD (Foamtech type II/III) is available. Date of Manufacturing: March 2022 having ten years period as shelf life. Refer Annexure – 4 for details.
30	Whether the OSD held with the facility is approved for use in Indian waters	Yes	Foamtech Oil spill dispersant make is Tested & Approved by National Institute of Oceanography – GOA.
31	Whether the facility has MoU with other operators for tier 1 preparedness	Yes	As per this MOU, each operator is obliged to provide necessary equipment and services to the requesting party during oil spill emergencies without any profit motive.
32	Whether the list of oil spill response equipment available with each agency in MoU is deliberated	Yes	The guiding principle is to extend all necessary help without sacrificing any inherent risks to their own facilities at the time of emergency. The MOU has details of list of OSR equipment available with each facilities. The same is being updated annually The need for mutual cooperation during oil spill response was realized between Vedanta Limited (Cairn Oil & Gas); Hazira Port Private Limited; Reliance Industries Limited; Adani Hazira Port Private Limited; Sun Petrochemicals Private Limited; and Essar Bulk Terminal Limited. Refer Annexure – 3 for the details of MOU signed between various parties. The MOU is valid till 31.10.2025.
33	Whether the facility has any MoU with private OSRO	Yes	Cairn has associate membership agreement with M/s. Oil Spill response Ltd. (OSRL), Singapore to mobilize technical experts/ advisors, OSR equipment and trained manpower in case of emergency situation notification. Refer Annexure – 3, Pg. No. 26-57 , for details. The contract is valid till 04.02.2023.
34	Whether the procedure for evoking the mutual aid is clearly described in the plan	Yes	Refer Annexure – 3; Page no. 05. MOU was entered for the period of five years wherein the Parties agreed to enter into mutual aid agreement for bringing together their individual capacities for spillage contingency plan in case of oil spillage
35	Whether additional manpower is available	Yes	Company has more than 80 work force as skilled, semi-skilled and unskilled manpower immediately available for any support. Refer Section 5.4; Page no. 80.

DESCRIPTION		COMPLIED YES/NO	REMARKS
S. No.			
36	Whether list of approved recyclers is mentioned in the plan	Yes	Link to the GPCB approved vendors is mentioned in the plan. Refer section 3.6; Page no.66.
37	Whether NEBA (Net Environmental Benefit Analysis) has been undertaken	Yes	M/s Environ Software (P) Ltd has prepared the NEBA study report. Refer Annexure – 6 for NEBA study report.
38	Whether the areas from priority protection have been identified in the plan	Yes	Also, the sensitivity maps in Annexure – 2 can be referred. Refer section 2.5; Page no. 47.
39	Whether relevant authorities and stakeholders were consulted for NEBA and during the areas for priority protection	Yes	NEBA study was conducted based on the reference to Landsat-8 satellite data, which helped to map various attributes such as coastal land, biological, environmental, fish landing, human settlement, geographical features. The same was also physically verified by local interaction with various stakeholders. Refer Annexure – 6 for NEBA study report.
40	Whether District administration has been appraised of the risk impact of oil spills?	No	The OSCP, after approval by CG will be submitted to the District Administration, Surat district and the possible risk impacts due to the oil spill will be appraised.
Action Plan			
41	Whether the plan outlines procedure for reporting of oil spills to Coast Guard	Yes	Refer Annexure – 7, which mentions all the relevant forms of oil spill reporting as suggested in NOS-DCP.
42	Whether the oil spill response action is clearly mentioned	Yes	Refer Figure 3.1; Page no.64 for spill response action plan flowchart.
43	Whether the action plan includes all duties to be attended in connection with an oil spill	Yes.	Suvali facility has continuous workforce covering all the shifts all the days. This means the concerned manpower will always be available round the clock including public holidays covering the key positions. The broad functions and responsibilities of IRT, EMT and CMT of Cairn is mentioned in Chapter - 5 Refer section 5.2; ; Page no. 77.
44	Whether the action plan includes key personnel by their names and designation viz. C/C, S/C	Yes.	Contact details provided as part of Table – B in Annexure – 8; Page no. 04.
45	Whether alternate coverage is planned to take care of the absence of a particular person (in cases where action plan is developed basis names)	Yes	The alternate details are considered as part of Table – B in Annexure – 8; Page no. 04
46	Whether the plan includes assignment of all key coordinators viz. the Communication Controller, Safety Coordinator, Emergency management	Yes.	All the key roles and responsibilities of the IRT/EMT/CMT are detailed in the Chapter – 5. Refer section 5.2; ; Page no. 77.

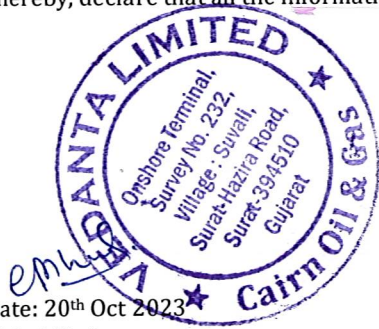
DESCRIPTION		COMPLIED YES/NO	REMARKS
S. No.			
	team, Administration and Communication Coordinator and Safety Coordinator		
47	Whether contact directory containing numbers of key response and management personnel is intimated in the plan	Yes	Contact details provided as part of Annexure – 8.
48	Whether approved recyclers are identified for processing recovered oil and oily debris	Yes	The recovered oil can be processed in Suvali Terminal, whereas other hazardous waste will be disposed to the authorized identified recyclers. Refer section 3.6; ; Page no. 66.
49	Whether the shoreline likely to be affected is Identified	Yes.	The spill quantity reaching the coast and landing location has been studied and identified. Refer Annexure – 1; Table 1.1 (a) to Table 1.4 (d) Page no. 21 to 36.
50	Whether final report on the incident is submitted to CGHQ as per NOS-DCP 2014	No	No such event occurred so far to report to CGHQ. However, the communication format details to CG is mentioned in Annexure – 7:Formats as per NOS-DCP.
51	Whether the spill incident and its consequences are informed to fishermen and other NGOs for environment protection through media	No	No such event occurred so far to report to fishermen and NGOs. However, the communication format details to various stakeholders is mentioned in Annexure – 7: Formats as per NOS-DCP. During mock drill exercise, the fishermen and other local communities are being appraised.
Training and Exercises			
52	Whether mock fire/emergency response drills are specified in the plan	Yes	The mock fire/emergency response drills are planned annually. Refer Table 5.3; Page no. 85.
53	Whether the mock drills cover all types of probable oil spills		
54	Whether the plan mentions list of trained manpower	Yes	The list of trained manpower is available with HSE team and Radio Officer. The training record is a dynamic record and is periodically updated. Refer Table 5.4; Page no. 86.
55	Whether records for periodic mock drills are maintained in a well-defined format	Yes	The mock drill records are maintained by HSE team in a prescribed format. Refer Annexure – 3, Page No. 22-25, for sample mock drill report.
56	Whether the plan to be updated according to the findings in mock-drills and exercises	Yes	The OSCP are/will be revised based on the mock drill recommendations and lessons learnt. This is a continuous process.
57	What is the frequency of updation/ review of contingency plan?	Yes	OSCP will also be revised based on the need arise. However, minimum once in three year, the OSCP will be considered for revision.

Oil Spill Contingency Plan for Offshore Oil & Gas Operation at CB/OS-2 Block, Surat District, Gujarat, West Coast of India

DESCRIPTION		COMPLIED YES/NO	REMARKS
S.No.			
58	Periodicity of joint exercise with mutual aid partners	Yes	The joint inspection is done between CG and OISD at least once a year.
59	Frequency of mock-drills for practice	Yes	The mock fire/emergency response drills are planned annually. Refer Table 5.3; Page no. 85.
60	Whether the records for periodic mock drills are maintained in a well-defined format	Yes	The records are maintained by HSE team in a prescribed format. Refer Annexure - 3, Page No. 22-25, for sample mock drill report.
61	Whether the plan is updated according to the findings of mock-drills and exercises	Yes	The OSCP are/will be revised based on the mock drill recommendations and lessons learnt. This is a continuous process.
62	Frequency of updation/ review of contingency plan	Yes	OSCP will also be revised based on the need arise. However, minimum once in three year, the OSCP will be considered for revision.

VERIFIED

I hereby, declare that all the information appended above are true and correct to my knowledge or belief.



Date: 20th Oct 2023
Vishal Shah
Installation Manager

Date: _____ (Regional Commander ICG)
or his representative

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Preface

This study report describes the scope of the oil spill contingency plan including geographical coverage, oil spill modeling studies, perceived risks, spill response and clean-up strategy, equipment availability, storage facilities, responsibilities, action plans, communication, etc.

The study report also presents the characteristics and weathering processes of oil, the impact of oil spills on the marine environment and agencies to be informed in case of emergency. This report elaborates on the strategy plan for the oil spill management as per NOS-DCP requirements including the responsibilities of regional, national, and international oil spill combating agencies.

The report also includes specific instructions for responders, once the spill occurs, response plan based on NEBA studies for combating operations for spilled oil. This is to ensure that emergency action by responders gets underway promptly and in an orderly manner. The statutory regulations, area operations, training and competence also included in the report.

Marine Atlas has been carried out for areas all along the coasts of Hazira. Environmental sensitivity mapping was prepared based on the available primary and secondary data related to of environment, biological and industrial information.

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Executive Summary

On the basis of the issued Terms of Reference (ToR) by Coast Guard, Delhi, who has decided that all the Ports and Oil Companies should have approved Oil Spill Contingency Plan as per NOSDCP-2015. M/s Environ Software (P) Ltd, Bangalore was contacted by Vedanta Limited, Cairn Oil and Gas to carry out the Oil Spill Modeling, Risk analysis studies and response plan, Marine Atlas all along the coasts of Surat, Gujarat of India.

This Oil Spill Contingency Plan (OSCP) is prepared based on the output of various studies consisting of Hydrodynamic modeling, Oil spill modelling, Environmental sensitive index mapping and Net Environmental Benefit Analysis

Hydrodynamic Modeling:


- Preparing the input data for model.
- Calibration and Validation of hydrodynamic model with the available tides.
- Numerical runs were carried for various hydrological conditions for predicting the tides and tidal currents in the West coast of India.
- Flow model studies were carried out using the Hydrodyn-FLOSOFT, with local refinement in the area of marine facilities incorporation of marine sensitive areas and existing marine structures and facilities in the area of influence. For all possible marine facilities, spring and neap tide conditions was simulated.
- Flow modeling was also carried for the entire year.

Oil Spill Modeling:

- Sensitivity mapping of the study area was prepared considering environmental, ecological, social, economic, and other factors.
- Risk assessment carried out to identify potential oil spill scenarios software.
- Crude oil weathering and dispersibility study was considered to provide necessary data dispersant efficacy and to optimize oil spill response plans.
- Generation of data such as: tidal current, ocean current, local winds and others was gathered.
- Oil spill modeling considering worst case scenarios was prepared.
- Oil spill response action plan & strategies as per NOSDCP-2015 and latest requirements; Tire-1 (most of the equipment), 2 & 3 arrangements were compiled.
- Discussion of OSCP with site team and Training was carried out.

Environmental Sensitivity Index mapping

- Sensitivity Index Mapping was prepared to develop action plan against oil pollution and protect the shorelines and its clean-up requirements.
- Identification of the most sensitive site and resources potentially exposed to oil spills due to operation and drilling activities.
- The sensitivity maps cover the entire coastline of the susceptible area including inlets and islands. Mapping the sensitivity of the terrestrial environment surrounding the installations and pipelines was also considered.
- Maps (including the mapping of coastal sub tidal habitats) was prepared to support the application of dispersant by providing information on the potential impact of dispersed oil in the water column.
- The Environment Sensitivity Index Mapping range from 1 (low sensitivity) to 10 (very high sensitivity), integrating the 1. shoreline type, its grain size and slope which determines the capacity of oil penetration and/or burial on the shore, and movement, 2. Exposure to wave and tidal energy which determines the natural persistence time of oil on the shoreline and 3. General biological productivity and sensitivity. The 10 levels of Environment Sensitive Index were color coded from cool color to warm color indicating increased sensitivity. Each color corresponds to a particular type of coast, allowing identification of the type and relative sensitivity at a glance.
- The mapping of biological resources considers the seasonality and life stages present, i.e. breeding, spawning, hatching, migration etc. Depending on the information available, the species concentration information is simple (presence/absence) or more detailed (1. no information, 2. Rare, 3. Common, 4. Abundant and 5. Highly abundant). The use of the four

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seasons, spring, summer, autumn and winter was avoided to prevent confusion between northern and southern hemispheres.

- Since some of the sub-tidal habitats (coral reefs, sea grass beds and kelp beds) are essential for the coastal marine biodiversity, they were also considered and localized while preparing the maps.
- Sensitive socio-economic features are mapped to include the non-living resources that may be directly injured during oil spill. These features are grouped into various categories like 1. subsistence, artisanal and commercial fishing, and fishing villages, 2. aquaculture, 3. water intakes like salt marsh plant, desalination plant, aquaculture and salt production and industrial use, 4. Tourism and recreation areas like hotels, restaurants, marinas, beaches, recreational fishing, diving, etc., 5. Port including the activities and infrastructures, 6. Industrial activities relying on maritime transport activities, and 7. Cultural sites like archaeological, historical, religious, etc.

NEBA Studies

NEBA studies is prepared to evaluate and compare the oil spill response options against oil spill response plan. In addition, the NEBA intend to support spill response efforts, in the unlikely event of a spill incident, and provide a basis for acquiring approval for the use of Oil Spill Dispersants with Indian Coast Guard on the matter.

The emphasis of the NEBA is on a structured qualitative analysis to identify response options, which offer a net environmental improvement over the natural attenuation as a baseline. It is not intended to be a quantitative analysis. The purpose of the analysis is to help to form informed decisions. In summary, NEBA is a holistic approach that:

- Consider potential impact to the resources of concern.
- Consider how well the resources (such as, marine sensitive areas, tidal flats, islands, and coastal areas) can be protected with the available response techniques at the time of a spill.

Refer **Annexure-6** for NEBA Report

The Report consists of four parts including Main Part

Main Part: Oil Spill Contingency Plan. The report consists of the following sections

1. **Strategy Section:** This section consists of oil spill risk assessment, objectives, strategies, and details of available response equipment's. This section discusses the possible oil spill scenarios, the ways and means to respond effectively to minimize pollution. This part is covered between Chapter 2 to Chapter 6.
2. **Action and Operation Section:** This section includes specific instructions for responders once the spill occurs, on what to do and how to do, for each oil spill incident. This is to ensure that emergency action initiated by the responders are addressed in a promptly and orderly manner. This part is covered between Chapter 7 to Chapter 10.
3. **Data Directory:** This section includes information on statutory regulations, area of operation, training and competence, weathering data on ADIOS, Mud flat shore cleanup techniques, OSD Specifications etc. This part is covered in Chapter 11.

In addition to the main part of the report, the following eight **Annexures** have to be referred.

Annexure -1: Oil Spill Modelling Studies and Results for CB/OS-2

Annexure -2: Environmental Sensitivity Index Mapping and Atlas

Annexure -3: Copies of Mutual Aid; Contract with OSRL, Singapore; and Sample Mock Drill report




Annexure - 4:Oil Spill Response Equipment at CB/OS-2

Annexure - 5:Oil Spill Response Equipment Maintenance Logbook for Vedanta Ltd (Division: Cairn Oil & Gas) at Suvali in Gulf of Khambhat, Gujarat

Annexure - 6:NEBA (Net Environment Benefit Analysis)

Annexure - 7:Formats as per NOS-DCP

Annexure - 8:Emergency Contact Directory

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Project Team

Environ Software (P) Ltd

Name of the Person Involved	Project Designation	Role and Responsibility
G S Reddy	Project Leader	<ul style="list-style-type: none"> Assessing the data required Managing the team and Supervision of data input to the model Analyzing the output data
Mr. Satyanarayana and Mr. Eswar	Team Members	<ul style="list-style-type: none"> Data interpretation & Simulation runs Prepare the tools for report preparation Preparing the input data for model Simulation runs Digitizing the satellite Maps
Ms. Smitha and Mr. Jubin Thomas	Team Members	<ul style="list-style-type: none"> Graphical outputs preparation Report preparation

Vedanta Limited (Division: Cairn Oil & Gas)

Name of the Person Involved	Project Designation	Role and Responsibility
Mr Vijay Kansagara Nr Vishu Sawhney Ms Sagorika Mallick Mr. Gurralla Sunad Kumar	HSE Team Members	<ul style="list-style-type: none"> Providing the field data to the Consultants for carrying out various model studies Preparing various chapters of the report as per NOSDCP guidelines Referring various international best practices
Mr. S. Karthik	DGM - Environment	<ul style="list-style-type: none"> Content writing
Mr Viresh Patel	Installation Managers – Suvali	<ul style="list-style-type: none"> Review the report

1.0 Introduction

Vedanta Limited (Cairn Oil & Gas division) is one of the largest independent oil and gas exploration and production companies in India. Vedanta Limited (Cairn Oil & Gas division) (erstwhile Cairn India Limited and now referred as Company) has been carrying out oil and gas operations in CB/OS-2 Block since the year 2002 onwards, located in the Gulf of Khambhat (Arabian Sea) in the west coast of India

The CB/OS-2 Block is held by a Joint Venture (JV) consortium of Vedanta Limited - Cairn Oil & Gas, Oil and Natural Gas Corporation Ltd. and Tata Petrodyne Ltd. for developing and producing Crude Oil & Gas. A production sharing Contract dated 30th June 1998 was executed by and between JV parties and Government of India. M/s Vedanta Limited, Cairn Oil & Gas is the operator of this Block on behalf of the CB/OS-2 Joint ventures partners.

This document establishes an organizational structure along with procedures and arrangements for response to oil spill incidents in CB/OS-2 oil and gas field. This document is prepared based on the guidelines issued in "Appendix E1 – 1 of National Oil Spill Disaster Contingency Plan", Year 2015 and latest edition by ICG, Ministry of Defense, GoI, New Delhi and also referring the industry best practices (IPIECA, IMO) to address various strategic and operational requisites necessary for activation of the plan.



Details given in this plan will be familiarized by all personnel responsible for implementation of oil spill response in Suvali facility. The details of the plan shall be trial tested periodically to check effectiveness and based on the requirements the necessary changes will be amended. This document will be a live document with continual update as and when required.

Purpose of the plan: All the measures are being taken to confirm that the safe operation is being carried out in CB/OS-2 to ensure that there is no spillage or leakage of oil to the marine or land. However, in case of any accidental occurrence of oil or well fluid outside the pipeline, then Company is committed to appropriately manage such spill incident/accident to minimize the impact on personnel, environment, ecology, socio-economy, property, company's financial position and its reputation.

As part of regulatory requirements Vedanta Limited is mandated to establish an Oil Spill Contingency Plan (OSCP), duly approved by the regulatory authorities, and which includes an effective response system with trained personnel and a pre-established organization structure as well as the capability to mobilize and respond to the spill occurrence in the least amount of time. The primary purpose of the plan is to facilitate the implementation of the necessary actions to stop or minimize the discharge of oil/ chemicals / well fluids and to mitigate its effects.

Objectives of the plan: The objectives of the OSCP are:

- To establish system for detection and reporting of spills, with adequate measures for preparedness for oil / well fluids and chemical pollution.

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- To facilitate rapid and effective response to spill events with adequate measures to protect the health and safety of personnel, community, and protection of the marine environment.
- To establish appropriate response techniques to prevent, control, and combat oil and chemical pollution during spills, and disposal of contained material in an environmentally sound manner.
- To establish the communication channels essential for the coordination of tasks needed to deal with a pollution incident, and
- To ensure that the plan provides an integrated response together with the National Oil Spill Disaster Contingency Plan (NOS-DCP).

1.1 Authorities and responsibilities

Prevention of accidental oil spillage is Cairn's first priority. Offshore production and drilling facilities are designed, installed, and operated in such a manner so as to minimize possibility of oil spills. Facilities, resources, and support provided by third parties are also required to meet international pollution prevention design and operation standards.



Risks of oil spills associated with these operations are planned for development by Cairn and as such several measures for oil spill contingency planning were taken by the company.

Cairn shall be responsible for any clean-up responses and all other incidental and consequential costs of whatsoever nature resulting from oil spills due to their operations at oil wells as well as in pipeline leakages at Suvali area.

Cairn Suvali Installation Manager is Incident Response Coordinator.

Cairn shares the community's concern for the protection of the natural environment from oil spill. The company is committed to integrate in its operations ways to identify oil spill risks, prevent oil spills, and to implement appropriate changes in its contingency plan for spill response and clean-up strategies. To achieve this, Cairn's policy will be to:

- Respond immediately to any oil spill incident with the objective of protecting Marine & Human life and to minimize environmental impacts.
- Work and consult with appropriate government bodies and the local community to address any issues relating to oil spills in a timely manner.
- Provide adequate training and information to enable employee and contractors to adopt environmentally responsible work practices and to be aware of their responsibilities in the prevention and clean-up of oil spill.
- Develop emergency plans and procedures so that incidents (accidental releases) can be responded to in a timely manner.
- Develop and maintain management system to identify, control and monitor risks and to comply with Statutory Regulations and Industry Guidelines.
- Assess the situation and take timely and appropriate action where third-party interests are involved, such as products or chartered vessels, drill rigs nearby ports etc.

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Ascertain that each identified employee is responsible for implementation of this policy in association with his/her specific duties. This also includes contractors and employees. Cairn Oil & Gas emergency management procedure uses a three-tiered emergency management organization. The broad functions and responsibilities of IRT, EMT and CMT of Cairn are depicted in detail in Chapter 5 of this OSCP. Refer the Figure 1.1 for overall view of the emergency tiers.

1.2 Coordinating committee

Vedanta Limited (Cairn Oil & Gas division) referred as Company shall coordinate and lead the response within its Block limits. This oil spill response plan identifies the Company's responsibilities, team responsibilities, communications and the procedures to respond with all possible oil spill emergencies that may occur within the block limits and in the surrounding areas of the block, where it may have influence or control.

For responding to any incidents at the initial stages of the incident and to mitigate smaller incidents which can be handled under the Tier-1 category, the Incident response Team (IRT) at Suvali Terminal is fully responsible and accountable. The IRT leader is the designated Installation Manager, who will act as Incident Controller of the Suvali operations team supported by the operational and technical teams operating from Suvali terminal and associated bases.


1.3 Statutory requirements

An oil spill contingency plan is based on the understanding of the regulatory framework in which the assets are located, and operations are being carried out. This section summarizes the relevant national and international legislations related to oil spill response.

Enforcement agencies and authorities

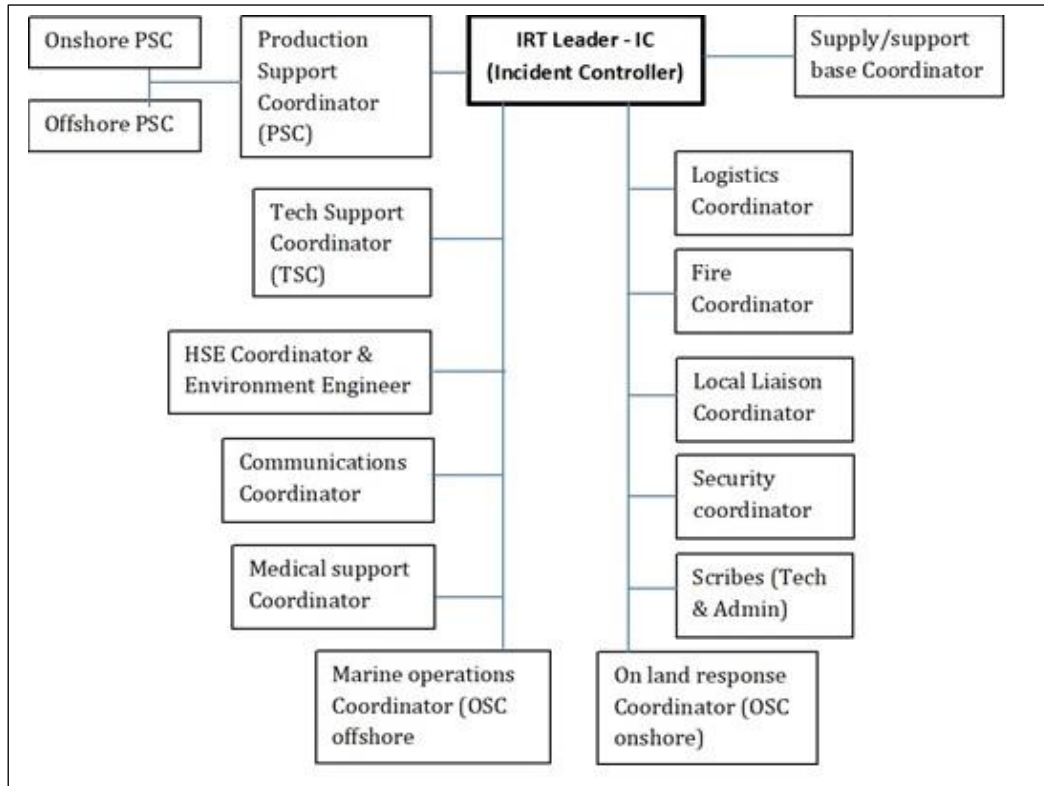
At national level, various regulations have been formulated to ensure that oil spills are adequately notified and handled with least impacts on the environment, public health, and safety.

- **Merchant Shipping Act 1958 and Amendment in 2003:** This Act requires oil companies to clean up any oil spill from offshore petroleum related activities whether at sea or ashore.
- **Environment Protection Act 1986 and EIA Notification, 2006:** The Ministry of Environment and Forests and Climate Change (MoEF&CC) while granting environmental clearance to oil and gas projects requires the company to establish oil spill control capabilities.
- **Coastal Regulation Zone (CRZ) Notification 2018:** This Notification, ensures that the activities carried out in the coastal zone comply with the requirements specified in CRZ clearances obtained by the Company.
- **Section 32 of the Water (Prevention and Control of Pollution) Act 1974:** The Gujarat State Pollution Control Board (GPCB) holds the power to prevent discharge of hazardous and polluting materials into the sea or tidal waters.

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- **Coast Guard Act, 1978:** The Act requires every owner, operator of a port facility, oil installation, and offshore installation to prepare and implement oil spill disaster contingency plan.

Figure 1-1: Vedanta Limited (Cairn Oil & Gas) Emergency Tiers



- **Petroleum and Natural Gas (Safety in Offshore Operations) Rules, 2008 (PNGSOOR), G.S.R. 469(E):** These Rules have been formulated through Sections 5, 6 and 7 of the Oilfields (Regulation and Development) Act, 1948 (53 of 1948). It requires operators to undertake risk assessment related to activities and prepare safety management systems and emergency response plans pursuant to the provisions of the Rules.

Indian Coast Guard: The Indian Coast Guard is the national coordinating authority for marine oil spills. Under the Coast Guard Act, 1978, the CG is responsible for control of pollution at sea and protection of marine environment. Indian Coast Guard has prepared and implemented a National Oil Spill Disaster Contingency Plan (NOS-DCP). As per the Act, all spills are required to be reported to the Coast Guard. In the event of a spill, the nearest Coast Guard station will be notified. When a spill is reported, the Coast Guard will monitor the movement of spill while Company takes the response measures. In case of any delays in response action, the Coast Guard will take necessary remedial measures at cost to the company.

Oil Industry Safety Directorate (OISD): OISD is a technical directorate under the Ministry of Petroleum and Natural Gas that formulates and coordinates the implementation of a series of self-regulatory measures aimed at enhancing the safety in the oil and gas industry in India. OISD maintains a database of accidents

taking place in the oil industry and investigates the major incidents, therefore has to be notified of incidents in offshore installations.

International Convention for the Prevention of Pollution from Ships (MARPOL 73/78): MARPOL 73/78 is the International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978. The Protocol desires to achieve the complete elimination of intentional pollution of the marine environment by oil and other harmful substances and the minimization of accidental discharge of such substances. The Convention includes regulations aimed at preventing and minimizing pollution from ships - both accidental pollution and that from routine operations - and currently includes six technical Annexes.



- Annex I: Regulations for the Prevention of Pollution by Oil.
- Annex II: Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk.
- Annex III: Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form.
- Annex IV: Prevention of Pollution by Sewage from Ships.
- Annex V: Prevention of Pollution by Garbage from Ships; and
- Annex VI: Prevention of Air Pollution from Ships.

Regulation 37 of MARPOL Annex-I require that oil tankers of 150 gross tonnage and above and all ships of 400 gross tonnage and above carry an approved Shipboard Oil Pollution Emergency Plan (SOPEP). Regulation 17 of MARPOL Annex-II makes similar stipulations that all ships of 150 gross tonnage and above carrying noxious liquid substances in bulk carry an approved shipboard marine pollution emergency plan for noxious liquid substances. The latter may be combined with a SOPEP and should be referred to as a Shipboard Marine Pollution Emergency Plan (SMPEP). The SOPEP/ SMPEP must include:

- Procedures for reporting oil pollution incidents.
- List of authorities and persons to be contacted in the event of an incident is mentioned in **Annexure - 8**.
- Detailed description of immediate action to be taken to reduce or control discharge of oil following an incident.
- Procedures and point of contact for coordinating spill response actions with national and local authorities.

The International Maritime Organization (IMO) has produced the following guidelines to facilitate the preparation of such plans:

- Guidelines for the Development of Shipboard Marine Pollution Emergency Plans, 2010 Edition which includes Guidelines for the development of Shipboard Oil Pollution Emergency Plans (SOPEP) (resolution MEPC.54 (32), as amended by resolution MEPC.86(44)
- Guidelines for the development of Shipboard Marine Pollution Emergency Plans of Oil and/or Noxious Liquid Substances (Resolution MEPC.85 (44), as amended by resolution MEPC.137 (53)).

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MARPOL also gives guidelines for reporting pollution incidents to the authorities and outlines standard report formats.

International Convention on Oil Pollution Preparedness, Response and Cooperation, 1990

The IMO's Marine Environment Protection Committee developed this Convention to provide a framework for international cooperation for combating major oil pollution incidents. The Convention has the following key elements:



- precautionary and preventative measures are important in the avoidance of oil pollution in the first instance.
- prompt and effective action is essential to minimize possible damages in the event of pollution.
- contingency planning needs to be emphasized and the role of the oil and shipping industries should be included within these plans.
- the need for mutual assistance, international cooperation and information exchange (on response capabilities and reporting incidents).
- the 'polluter pays' principle; and
- the importance of related international instruments on liability and compensation, including the 1992 Civil Liability Convention (1992 CLC) and the 1992 Fund Convention.

Article-3 of the International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990, also requires operators of offshore units under the jurisdiction of Parties to have oil pollution emergency plans or similar arrangements which must be coordinated with national systems for responding promptly and effectively to oil pollution incidents.

1.4 Mutual aid agreements

Regional agreement:

The need for mutual cooperation during oil spill response was realized by the operating oil companies in Hazira (viz Vedanta Limited, ONGC, Reliance India Limited, GSPC and Oil India Limited) and based on broader guidelines given by the OISD and MoPNG, a regional cooperation arrangement was worked out through a Memorandum of Understanding (MOU). As per this MOU, each operator is obliged to provide necessary equipment and services to the requesting party during oil spill emergencies without any profit motive. The guiding principle is to extend all necessary help without sacrificing any inherent risks to their own facilities at the time of emergency. This mandates each company to have minimum facilities available with them all the time. After completion of exposure to the emergency, the equipment shall be returned to assisting party in near original state or replaced/cost refunded by the requesting party in certain time frame. Such regional cooperation agreements are actively pursued by various operators in the areas like Gulf of Kutch, Port of Mumbai, and Gulf of Khambhat and in the west coast.

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Global agreement:

While the company’s own facilities and the response facilities with the nearby operators can help tackle small and medium oil spills, it is inevitable to depend on external agencies for larger spills and for longer period of spill. Apart from the facilities of Coast Guard available at the nearby region, additional facilities of external agencies are also planned to manage in case of major spillage. A few such Oil Spill Response Organizations (OSROs) are available globally among which the service of Oil Spill Response Ltd (OSRL), a nonprofit, industry supported OSRO in Singapore was considered based on their quick mobilization provision available and technically competent. The services of OSRL are also sought by several other operators in India. Company took associate membership with OSRL for support in case of spills of larger magnitude and inclusive of offering equipment for mobilization and help of experts for technical coordination and guidance. The membership fees are renewed annually.

1.5 Geographical limits of plan

This OSCP is limited to the Company operating location within its block area mentioned in the below section.


Block location:

Block Name	CB/OS-2 Block, Gulf of Khambhat
Location of Block	The block lies within Latitude 21°00’ 00” to 21°41’ 15” N and Longitude 71°45’ 00” E to 72°46’ 15” E. The area of the block is approximately 400 km ² , out of which about 33 km ² forms the onshore area.
State / Country	Surat District, Hazira Region, Gujarat State, India
Production Capacity of the Plant	25,000 Barrels of Oil per Day (BOPD) and gas up to 120 million standard cubic feet per day (MMSCFD)

The exploratory block is located offshore of Suvali and close to city of Surat. The offshore operation area is situated approximately 25 km south west of Surat city along the eastern shoreline of Gulf of Khambhat. The CB/OS-2 field consists of three unmanned well-head platforms Lakshmi-A (LA), Lakshmi-B (LB) and Gauri-A (GA). Onshore processing terminal is located at Suvali, in Surat District in Gujarat. A 600 mm submarine pipeline connects the LA platform to the onshore terminal, with a 300 mm nominal bore spur line from LB tying in subsea. A 300 mm pipe connects GA to LA and joints LA – Onshore Terminal pipe line at deck level. Untreated natural gas & oil (referred fluids) flows as well from the LA, LB and GA platform to onshore terminal during all phases of operation.

CB/OS-2 offshore block through Lakshmi (LA and LB platform) and Gauri platform has already been developed for production of oil up to 25,000 Barrels of Oil per Day (BOPD) and gas up to 120 million standard cubic feet per day (MMSCFD).

All wells and offshore platforms are situated in sea at varying distance of about 15.0 -23.0 kms from the nearest shore point. Cairn have developed the terminal Incident Response Plan and are responsible for emergency response within the operational area of Cairn.

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The limits of the block are given by following co-ordinates: The location of oil wells in the CB/OS-2 block is at approximately between the longitudes 71° 37'47" E and 72° 16' 29.9" E, Latitudes 21° 01' 53.47" N and 21° 10' 39.9" N in the Cambay oil field.

Cairn discovered the following fields in the block near the coast of Surat. Lakshmi field is approximately 15 to 16 kms. from coast offshore, and Gauri field is approximately 14 to 15 kms. from coast offshore. The Block area is in the depth range of 10-30 m with large fluctuations of tidal influence. The bottom is mostly sandy silt with occasional sand bars parallel to the coast, making the marine logistics difficult access across the project areas. The port of entry for vessels is Adani Hazira Port Pvt Ltd, which is approximately 5 to 11 Nautical Mile from the platform locations within the CB-OS/2 Block area.

The coastline of Gulf of Khambhat is highly undulating and interspersed by innumerable creeks and river mouths. Prominent among the river mouths include Narmada, Tapi, Tena etc. while smaller tidal induced creeks are many along the coastline. The high tidal variation makes the region highly complex with circulating pattern reversing every 6 hours and currents reaching to peak of 6-8 knots in the project region. Further north of the project area, the tidal currents exceed 8 knots near Narmada river mouth.

Table 1-1: Coordinates of Offshore Platforms at CB/OS-2 Block

S.N.	Surface Facility	Latitude, N	Longitude, E	Air distance From Suvali	Distance from Adani port to platforms- sea route)
1	LA platform	21° 03'56.30"	072° 31' 37.41"	9.25 NM / 17.131KM	8.2NM
2	LB platform	21° 06'12.39"	072° 31'01.54"	8.48NM / 15.66KM	10.7 NM
4	GA Platform	21° 01'55.18"	072° 33' 17.20"	9.74 NM / 18.038	4.8 NM

Existing offshore facilities: There are presently three unmanned offshore platforms and subsea pipelines within the offshore areas of the block. An onshore terminal is located around ~1.0 km from the seashore on landward side. The location coordinates of the offshore facilities are given in Table – 1.2. Other geographical areas of concern are:

1. Hazira Bird Sanctuary (21°5'53"N 72°38'3"E) at a distance of 11 Km from the block in South direction
2. Sarthana National Park (21.2303° N, 72.8988° E) at a distance of 30 Km from the block in East direction
3. Villages scattered along the coastline

Figure 1-2: Block Diagram of CB-OS 2 Block on Navigation Chart – Overview and Specific

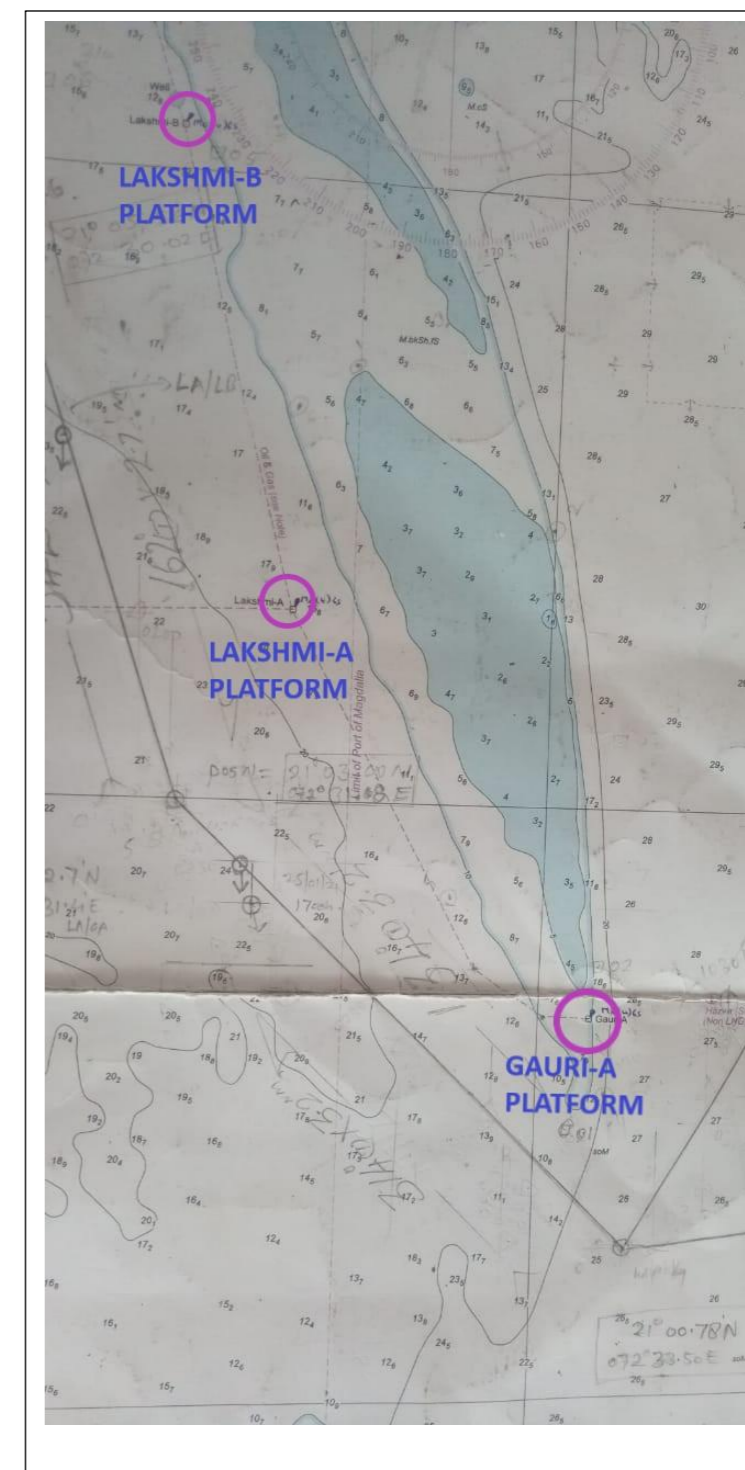


Figure 1-3: Drainage Pattern in and around the Suvali Block area



Figure 1-4: Layout of CB-OS/2 Block area (offshore and onshore)

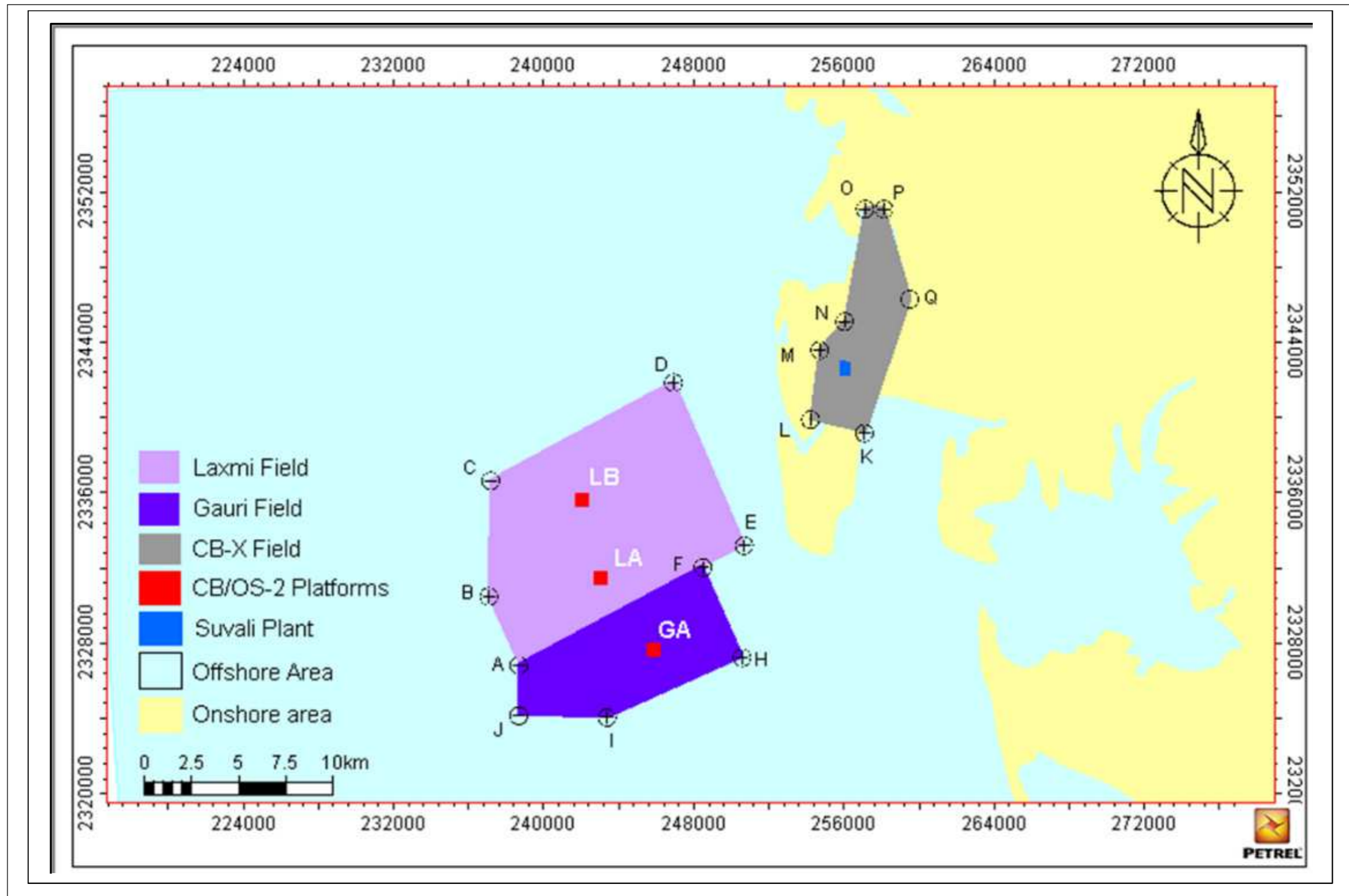


Table 1-2: Coordinates of Offshore Fields at CB/OS-2 Block

CB-OS/2 Offshore Field Coordinates					
Lakshmi Field			Gauri Field		
Coordinates	Latitude	Longitude	Coordinates	Latitude	Longitude
A	21°01'27.7"N	72°29'8.8"E	A	21°01'27.7"N	72°29'8.8"E
B	21°03'25.8"N	72°28'11.4"E	F	21°04'21.7"N	72°34'45.4"E
C	21°06'45.6"N	72°28'11.8"E	H	21°01'47.0"N	72°35'60.0"E
D	21°09'40.1"N	72°33'46.1"E	I	21°00'0.2"N	72°31'52.9"E
E	21°05'0.8"N	72°36'1.0"E	J	21°00'0.6"N	72°29'10.2"E
GA Platform	21°01'55.18"N	72°33'17.20"E	LA Platform	21°03'56.3"N	72°31'37.41"E
			LB Platform	21°06'12.39"N	72°31'01.54"E
Onshore Field Coordinates – CB X Field					
Coordinates	Latitude	Longitude	Coordinates	Latitude	Longitude
K	21°08'18.0"N	72°39'40.0"E	O	21°14'45.0"N	72°39'35.0"E
L	21°08'40.0"N	72°37'60.0"E	P	21°14'45.0"N	72°40'10.0"E
M	21°10'40.0"N	72°38'15.0"E	Q	21°12'10.0"N	72°40'60.0"E
N	21°11'30.0"N	72°39'0.0"E	K	21°08'18.0"N	72°39'40.0"E
Suvali Onshore Terminal – Control Room Coordinates					
Control Room	21°16'59.7"N	72°65'08.1"E			

Figure 1-5: Layout of CB/OS/2 Plant (without the well details)

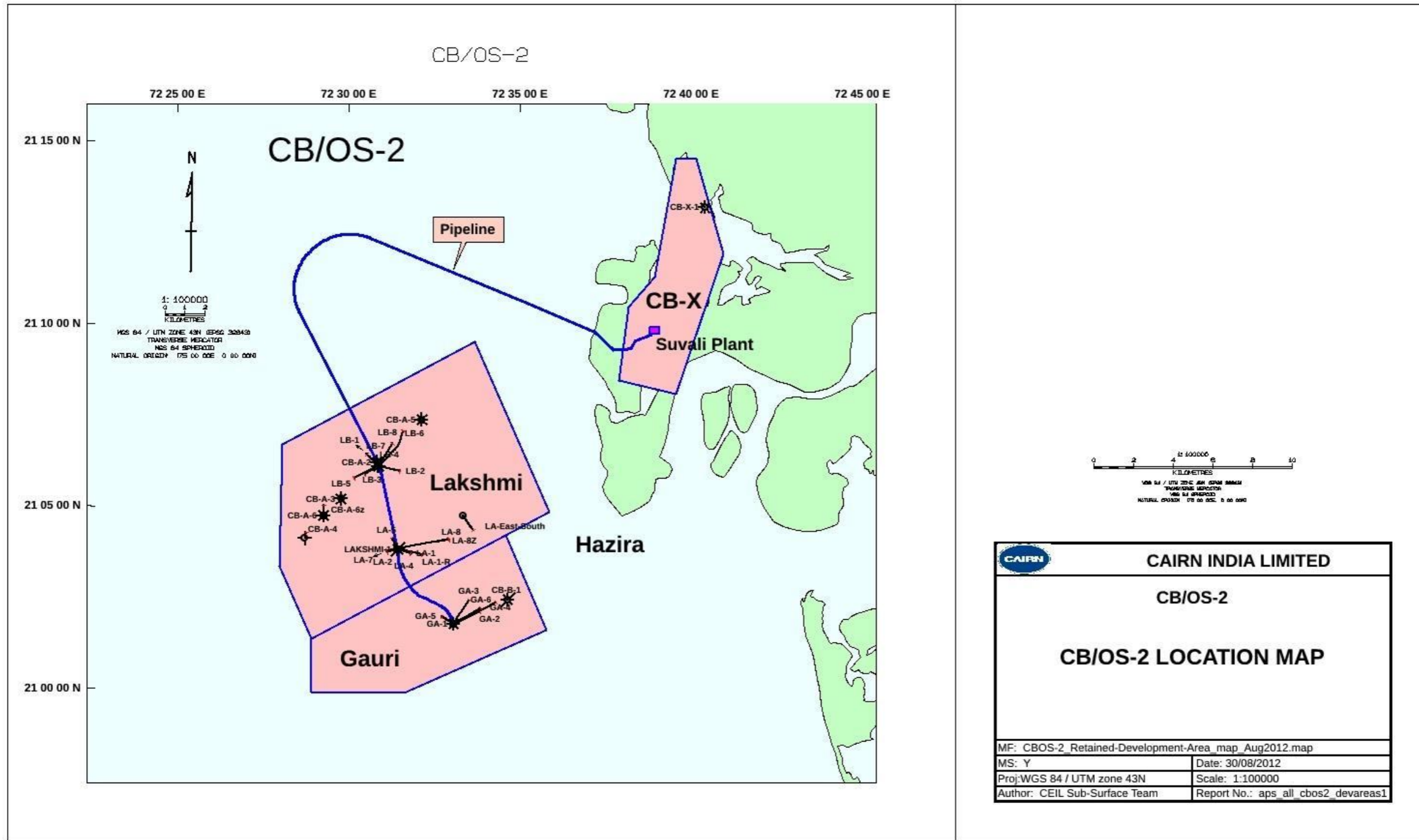


Figure 1-6: Layout of CB-OS/2 Plant (Pipeline and offshore oil & gas platform details)

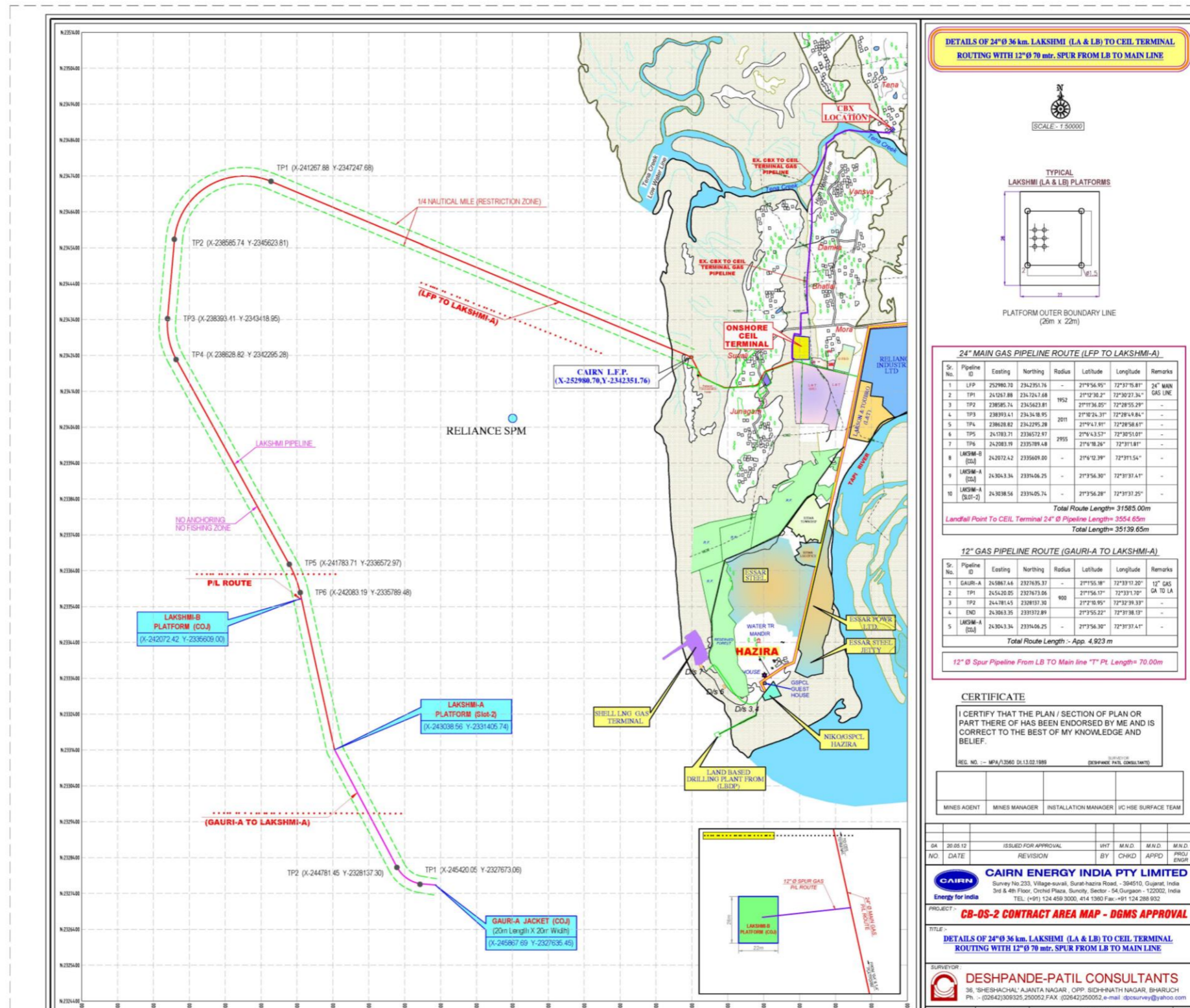
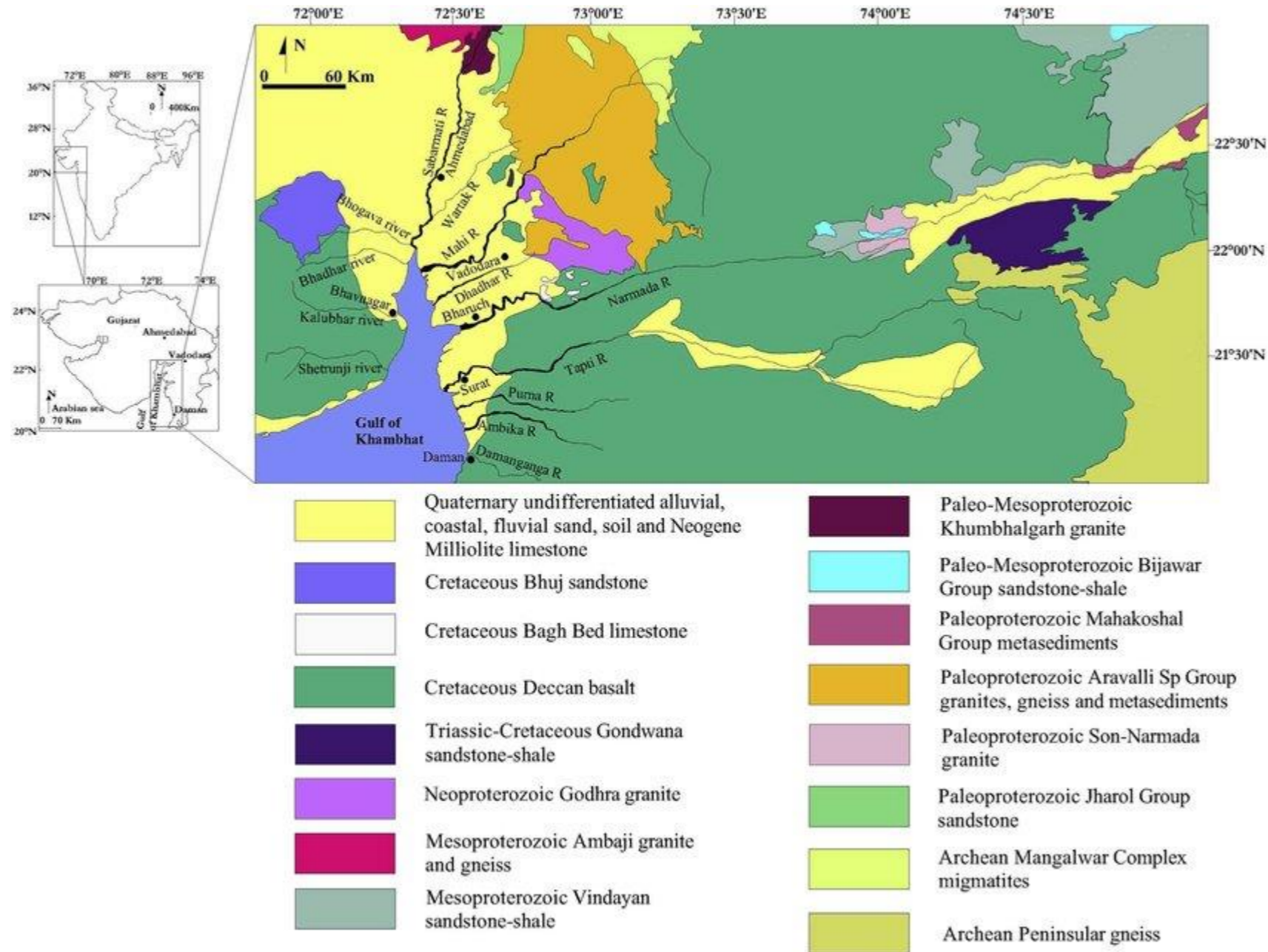


Figure 1-7: Geological map of the area surrounding the Gulf of Khambhat and the major rivers in this region



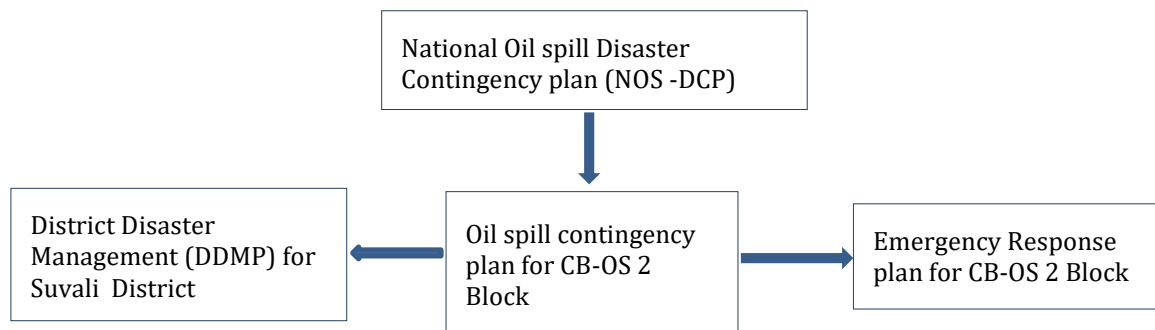
1.6 Interface with ROSDCP and NOS-DCP

The National Oil Spill Disaster Contingency Plan (NOS-DCP), 2015 and latest amendments was prepared by Indian Coast Guard, Ministry of Defense, Government of India. The Indian Coast Guard is the Central Coordinating Authority for combating oil spills in Indian waters and undertaking oil spill prevention and control. It sets out the arrangements for dealing with a spill of oil or other hazardous material in Indian waters. As per the NOS-DCP, responsibilities for responding to oil spills in Indian waters are shared between the Indian Coast Guard, State Governments, Port Authorities and Corporations, and the oil industry. Interface with these authorities will be primarily done by Vedanta Limited (Division: Cairn Oil & Gas).

Occupiers of offshore oil installations are to maintain an oil spill contingency plan meeting specified requirements and maintain appropriate manpower, equipment, and resources for oil spill response.

This OSCP for the present Block is to be applied in conjunction with Regional Oil Spill Disaster Contingency Plan (ROS-DCP) and National Oil Spill Disaster Contingency Plan (NOS-DCP). A spill situation could arise out of an incident or a number of incidents that could be either natural or man-made leading to emergencies. In the event of multiple emergencies, while the spill response will be undertaken as per this Plan, response to other emergencies will be as per Cairn Emergency Response Plan.

Figure 1-8: Oil spill contingency plan interface details



This Oil Spill Contingency Plan has the direct interface with the following plans, manual, guideline, and standards of Vedanta Limited (Division: Cairn Oil & Gas):

- Emergency Preparedness (Cairn/HSEQ/GDN/18/001).
- Vedanta Limited (Cairn Oil & Gas), Doc Ref: RFERP-000-001), Date of Issue: 01 Dec 2017.
- Suvali Incident Response Plan

2.0 Risk assessment

As part of the risk assessment review related to the oil spill, the following studies were carried out.

- Oil Spill Risk Analysis and Modelling studies for Cairn at Suvali in Gulf of Khambhat, Gujarat (refer **Annexure - 1** of the report).
- Mapping of Marine Sensitive areas in the Coastal areas of Hazira, Gujarat (refer **Annexure - 2** of the report).

The oil spill modelling study referred in **Annexure - 1** of this report deal extensively with oil spill risk analysis & trajectory. These studies were carried out in reference to the "IPIECA-A guide to contingency planning for oil spills on water and are aligned with the Indian coast guard "National Oil Spill Disaster Contingency plan" The study provide details of the local environment, risks of the oil spill Tier-I credible spill, fate of the spills, sensitivity mapping of the area and local, regional and country wide response capabilities. These documents shall be referred in conjunction with the oil spill response plan.

Risk of an oil spill within the Block: They may vary from a few liters of accidental spill of Crude oil from offshore operations to several thousands of tons of oil spill during unexpected blow out situations. In line with the standard industry practice, Cairn Oil & Gas has prepared itself to contain/response to any kind of the accidental oil spill from routine operations through Tier-1 preparedness. While oil spill situations of higher magnitude are dealt with industry co-operation and external intervention referred as Tier – 2 and Tire – 3 preparedness. However, Company has a fair understanding of the risks and probability of spills arising out of its operations and their consequences due to movement and landing of the oil spill along the coast.

Cairn Oil & Gas is the operator of the CB-OS 2 Block and will be responsible for cleanup and all other incidental and consequential costs resulting from oil wells and pipeline leakages due to various operations to onshore area.

2.1 Identification of activities and risks.

Risks of oil spills associated with these operations are identified as


- Flow pipeline leakage / Flow-line rupture
- Leakage at wellhead
- Oil wells blow out during the drilling activities
- Tanker Collapse

The risk and associated spillage details are mentioned in the below sections.

Sources of Oil Spill:

Oil Pollution may be caused by, but not limited to, any of the following causes:

- Offshore Drilling (deploying offshore mobile drilling units).
- Offshore Production (unmanned installations, submarine pipelines).
- Blow outs at Oil Wells
- Tanker collapses

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The following Risks are identified in Cairn operations:

- Well fluid leakage from
 - Pipeline including rupture.
 - At wellhead.
- Spillage from Production Support Vessel due to Hose failure, tanker grounding and collision; and
- Oil Wells Blow-Out
- **Rupture of Submerged Pipelines**

An Oil Spill from rupture of submerged pipelines from the production site to shore station will activate the auto shut off valves of the concerned platform through appropriate control system if the flow pressure drops down to 8 bar. Taking into consideration the rate of oil flow (10000 BOPD), length and diameter of the submerged discharge pipe [Flow of 55 TPH, Length of submerged pipe below the sea - 32 km, and Diameter 600 mm] and reaction time of 1 minute, it is estimated that approximately 150 tons of oil will flow out as the spillage. This is only a part of the total volume of oil that is expected to come out from the pipeline, as the pumping pressure would stop immediately, and the remaining available crude pressure will be neutralized by the sea water column pressure. Almost 95 % and above oil will remain inside the pipeline. The rupture of individual flow lines from the well will result in lesser quantity of spill due to smaller pipe diameter and length.

- **Tanker Grounding / Collision:**

The exact quantities from each incident is difficult to predict due to the variables of operating conditions and the length of risk exposure.

- **Well Blow- Out Incidents:**

An oil spill due to Well Blow out is possible during drilling activities. Well Blow out is also possible during any subsequent "Well Intervention" of existing wells for Work - Over activities. In the event of an unfortunate well blow out, the situation will call for the immediate services of Well Control specialists. But, adherence to established drilling procedures which includes proper use of Blow out Preventers (BOPs) of rated pressures will adequately control the oil spill risk due to well blow outs. The exact quantity is difficult to quantify in this case.

Oil Spill Modelling Quantity Consideration:


For the purpose of oil spill modelling simulation, three scenarios were taken into account considering the above spill risks and the guidelines for development of Oil Spill Contingency Plans.

- **Instantaneous spills**

Spill of 100T, 1000T and 5000T at three oil platforms (LA, LB and GA).

- **Continuous spills**

Pipe Line leakages (36.6 m³/hr for 15 Minutes) at LA, LB and GA locations.

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Maximum Pipe Line leakages possible is 366 m³/hr for 15 minutes duration at LA, LB and GA locations.

The spill scenarios range from extremely negligible quantities to enormous quantities in rare catastrophic events. The simulation of oil spills does not vary significantly in various scenarios except the magnitude of impact zone and the quantity involved in such impacts. The software is intended for use for specific scenarios, through a few hypothetical simulations are made in this report considering the worst possible case scenarios.

Table 2-1: List of risks associated with PKGM-1 Block operation

S. No.	Nature of the risk	Location	Quantity of likely spillage	Risk category
1.	Operational spills during diesel transfer	Platforms	<0.16m ³	LOW
2	Leakage at wellhead	Platforms	<2m ³	LOW
3	LSFO spills during transfer of fuel	Marine	<0.16-8 m ³	LOW
4	LSFO leakage from crude oil export oil tankers (single largest compartment storage)	Marine	<500 Tons	High
5	Flow line rupture/leak	Between terminal & Platform	< 652 Tons	High
6	Diesel or synthetic oil (used as drilling fluid) spill from support vessel	Marine	< 500 m ³	High
7	Blowout and BOP failure (Dependent on well flow and response times)	CB/OS-2 Field	<102-2040 Tons	High

Note:

- 1 m³ of crude oil is equivalent to 0.85 Tons weight.
- From the above table, the maximum possible spillage quantity is estimated to be 2040 Tons. However, the oil spill modelling was carried out for 5000 Tons as maximum quantity spill at given time.

2.2 Types of oil likely to be spilled

Physical and chemical composition of oil influences the impact on the marine environment upon spillage. Fluidity of the crude, rate of initial evaporation and chemical constituents of the crude significantly differ from one oil type to the other. Detailing of Various possible oil characteristics is necessary for understanding the fate, weathering, and environmental risks during a spill.

The possible type of oil to be spilled are mentioned in the above Table 2-1 such as Crude oil present in the well fluid (consisting of water, crude oil and natural gas), natural gas, HSD, LSFO and Synthetic based oil mud (drilling fluids). Most of these oil types will spread rapidly on water and will evaporate within a few days upon release onto the sea surface. Evaporation can be enhanced by higher wind speeds, warmer water, and air temperatures. A small percentage may also dissolve.

Lubrication oil types are medium to heavy oils and relatively persistent. They vary in viscosity but generally have a high capacity to take up water. Consequently, emulsification of these oils can be very rapid at sea and their resulting emulsions can be highly stable.

Table 2-2: Suvali crude oil characteristics

Properties of Crude Oil			
Density @ 15.6 °C gm/ml	0.8074	Asphaltene	<0.5 wt.%
Specific Gravity	0.8078	Wax	3.1 wt.%
API	43.7	RVP	5.5 Psi
Pour Point	-3°C	Ethane	<0.01 wt.%
Water Content	0.02 wt.%	Propane	0.05 wt.%
Salt Content	<1.0 ppm	Butane	0.10 wt.%
Sulphur	0.034 ppm	Isobutane	0.19 wt.%
Carbon Residue	Nil	Characterisation Factor	12.24
Metal Contents	<1.0 ppm	Ni/Fe/Cu	<1/3/1
Kinematic Viscosity	2.58 @ 40 °C		

Table 2-3: Suvali gas characteristics

Indicator name	Value	Unit
Sales gas density	0.7584	Kg/Sm ³
Sales gas lower heating value (LHV)	37027546.0	J/SCM
Sales gas Sulfur content	0.0	wt%
Sales gas composition - CH ₄	92.92	%
Sales gas composition - C ₂ H ₆	2.93	%
Sales gas composition - C ₃ H ₈	1.97	%
Sales gas composition - C ₄ H ₁₀	1.20	%
Sales gas composition - C ₅ H ₁₂	0.29s	%
Sales gas composition - C ₆ H ₁₄	0.06	%
Sales gas composition - CO ₂	0.41	%
Sales gas composition - N ₂	0.19	%

Table 2-4: HSD (High Speed Diesel) Characteristics

S. No	Parameter	HSD Properties
1	Acidity, total mg of KOH/G, Max	0.30
2	Ash, percent by mass, Max	0.01
3	Carbon residue (Ramsbottom) on 10 percent residue, % by mass, Max	0.35
4	Cetane number, Min	45
5	Pour point, Max	6°C for winter and 18°C for summer
6	Copper strip corrosion for 3 h at 100°C	Not worse than No. 1
7	Distillation 90 percent volume recovery at °C	366
8	Abel, °C, Min	32
9	Kinematic viscosity, cSt, at 40°C	1.8 to 5.0
10	Sediments, percent by mass, Max	0.05
11	Density at 15°C, kg/m ²	820-880
12	Total Sulphur, percent by mass, Max	1.0
13	Water content, percent by volume, Max	0.05
14	Cold Filter Plugging Point (CFPP) , Max	9°C for winter and 21°C for summer
15	Total sediments, mg per 100 ml, Max	1.6

Table 2-5: LSFO (Low Sulphur Fuel Oil) – Marine Fuel Characteristics

S. No	Parameter	LSFO Properties
1	Kinematic Viscosity at 50°C in cSt	180 – 380
2	Density at 15in Kg/m ³	991 max
3	Sulphur in % mass	0.5% max
4	Flash Point in °C	66 min
5	Hydrogen Sulfide in mg/kg	2.0 max
6	Acid Number in mg KOH/kg	2.5 max
7	Total Sediment in % mass	0.10 max
8	Carbon Residue in % mass	18.0 max
9	Pour Point in °C	30.0 max
10	Water in % vol	0.50 max
11	Ash in % mass	0.1 max
12	Vanadium in mg/kg	350 max
13	Sodium in mg/kg	100 min
14	Aluminum + Silicon in mg/kg	60 max

Table 2-6: Synthetic Drilling Base Fluid Characteristics

S. No	Parameter	LSFO Properties
1	Appearance	Colorless Liquid
2	Initial Boiling Point and Boiling Range	200 - 320 °C
3	Pour point	-21 °C / -6 °F
4	Flash point	85 °C
5	Upper / lower Flammability or Explosion limits	1 - 6 % (V)
6	Auto-ignition temperature	> 208 °C / 406 °F
7	Vapor pressure	0.001 kPa at 25 °C
8	Density	0.78 g/cm ³ at 20 °C
9	Kinematic viscosity	2.6 mm ² /s at 40 °C

2.3 Probable fate of spilled oil

The physical and chemical characteristics of spilled oil change almost immediately when spilled in the marine environment due to evaporation, dispersion, emulsification, dissolution, oxidation, sedimentation, and biodegradation. All of these processes that set in together are collectively referred to as oil weathering and decide the final fate of spilled oil and quantities that would need to be removed physically. If the oil is persistent and does not vaporizes immediately or disperses and comes ashore, then the costs in terms of clean up, damages and economic loses can be considerable. Some of the weathering processes that spilled oil goes through and the time duration of these processes which are important for emergency response and need to be considered by the responders, are provided in Table 2-7.

In this present study, the oil type considered is ‘non-weathering’ type which is typically used for all the oil spill trajectory prediction studies. Non weathering oil is an oil type that does not change chemically or physically over time in the marine environment. Weathering Processes like evaporation, emulsification

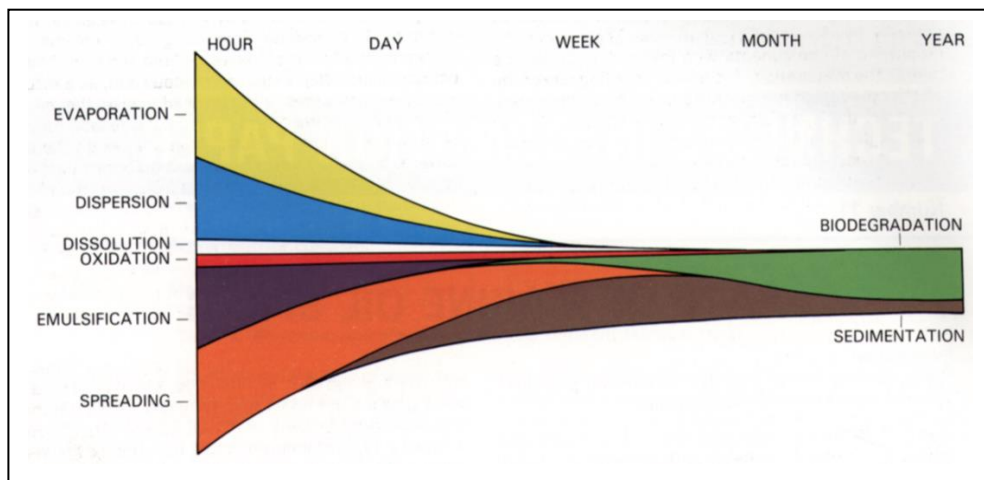
etc., affect spills and non-weathering oils doesn't considered these processes hence the trajectory oil spill analysis for non-weathering type represents worst case scenario.

The processes of spreading, evaporation, dispersion, emulsification, and dissolution are most important during the early stages of a spill whilst oxidation, sedimentation and biodegradation are long term processes which determine the ultimate fate of oil. Below Figure 2.1 shows schematic diagram of weathering processes with time.

Table 2-7: Oil weathering process

Process	Description	Importance	Time Frame
Evaporation	Conversion of liquid to gaseous state. Lighter fractions are lost first.	Major process accounting for loss of oil. At 15°C, gasoline will evaporate completely in 2-day period, 80% of diesel fuel and 40% of light crude, 20% of heavy crude and about 5- 10% of Bunker fuel.	< 5 days
Emulsification	Small water droplets get mixed into liquid oil. Water content will reach 50-80%.	Will increase the amount of pollutant to be recovered by a factor of 2 - 4.	Onset may be delayed but emulsification process will start rapidly.
Natural Dispersion	Breakup of an oil slick into small droplets	Removes oil from water surface	< 5 days
Dissolution	Mixing of soluble oil components into water	Water soluble components are most toxic	< 5 days
Biodegradation	Breaking of oil by microbes into smaller compounds and finally to water and carbon dioxide	Rate depends on oil type, temperature, nutrients, oxygen, and amount of oil	Weeks to months
Formation of tar balls	Breakup of heavy crudes and refined oils into small patches with long persistence	Hard to detect	Days to weeks

Figure 2-1: Schematic diagram with weathering process with time



Appearance and thickness of oil slick

Depending on the spilled oil property, the thickness of oil slick can range from 1/10th of a micron to 1/100th of microns. The color of oil film, post spreading is a good measure of quantity of oil that may be contained within the slick.

- When direct light from the sun contacts a very thin oil film (<0.1µm), much of the light is reflected back to the observer as grey or silver sheen.
- If the film is thicker (0.1 to 3 µm), the light passes through the film and is reflected off the oil-water interface and back to the viewer. The observer will then see a film that can range from rainbow to darker-colored sheens.
- For very thick films (> 3 µm), the light is absorbed, and the slick appears dark colored (i.e., black, or brown) to the observer. However, the viewer can no longer determine film thickness based on color. If the slick is dark-colored, the observer cannot tell whether the film is 3 µm or 100 µm thick. In order to quantify oil thickness, the following thumb rules are used:

Table 2-8: Appearance and thickness of slick

Appearance	Thickness
Silver Sheen	0.0001mm
Rainbow sheen	0.003 mm
Light brown/ Black slick	0.1 mm
Dark brown/ Black slick	> 1 mm

To determine an approximate quantity of spilled oil in the event of a spill, the following formula is used:

$$V = L \times W \times (T / 100)$$

Where, L = Length of slick (in meters), W = Width of slick (in meters),

T = Thickness of slick (in mm) and V = Volume of spilled oil (in cubic meters)

2.4 Development of oil spill scenarios including worst case discharge

The prediction of fate and transport of oil spill plays a major role in the analysis of risks due to oil spills. It is computed based on the surface resulting forces of surface water currents and wind speed.

In compliance with the Indian legislation the software Hydrodyn-OILSOFT has been considered to study the fate and trajectory of crude oil spills at the exploration block (near the oil wells) and at sub-sea pipelines. The computational domain of the model, is selected between the longitudes of 70'12" E and 72'54"E and the latitudes of 18'36" N and 22'12" N. The software has been validated successfully with available current and tide data. Crude Oil have been considered to have impact on the environment rather than other refined products, Several runs have been made for predicting the fate and trajectory of Crude Oil at oil wells LA, LB & GA and leakages at subsea pipelines for various seasons i.e. Pre-monsoon, Monsoon, Post Monsoon and N-W Monsoon seasons and for various tidal conditions i.e. spring and neap tides.

The spill quantity has been selected as per worst case extreme Oil Spill scenario and as recommended by Indian Coast Guard under NOSDCP (crude oil of 100 tons, 1000 tons and 5000 tons). Study has also been carried out for

leakage at sub-sea pipelines during pumping operations as well as for accidental Oil Spills for various seasons and tidal conditions. The details of spill volume, time taken for landing, extent of oiling on the port bunds/coast in meters, likely volumes areas, spill analysis, and losses during its movement have been, furnished in the report trajectories of crude oil for all seasons and tidal conditions have been showed graphically. Resources such as tidal flats, islands, and coastal areas, which are likely to threatened from oil spills, have been identified.

In the present study, an extreme scenario and logarithmic multiple to up to 5000 MT has been considered for the model study. It is assumed that oil leakages can occur in and around Cairn Oil well platforms due to sudden blow out (only during the drilling period of the wells), spills due to leakages at well heads and subsea pipeline leakages. Accordingly, the spill locations were considered at oil wells LA, LB & GA and leakages at subsea pipelines as shown in Fig. 2-2

An extreme accidental leakage of 100 tons, 1000 tons and 5000 tons of crude oil spill were carried out for modelling:

Results of scenario:

The detailed results of the simulations are available in the tabular form in the Oil Spill Risk Analysis in **Annexure - 1**.

Knowledge of probable movement of an oil slick gives a distinct advantage while planning response strategies. Thus, for instance, no major clean-up operation is necessary if the modelling results indicate that the spilled oil would remain at sea thereby sparing the shore ecology. On the contrary, if modelling results are suggestive of shoreward drift and predict that particular ecologically sensitive or important areas would be hit, effective counter measures such as deployment of deflection booms, containment and recovery of oil etc. can be effectively taken.

Hydrodyn-OILSOFT a dedicated software for Oil Spill Trajectory Modelling, which was used for prediction of oil spill scenarios at CB/OS-2 Block area for various meteorological and hydrological conditions. The results of various numerical runs are discussed in the following sections.

North-West Monsoon: During North-West Monsoon, Oil Spills at LA, LB, GA and at subsea pipeline would move towards open sea and Hazira coastal areas in south & south-west direction and depending on the spill residence time as showing in Fig A.6.1 to Fig.A.6.60 in **Annexure - 1** (Oil Spill Modeling (OSM) Report)

The behavior of slick movement is more or less similar in various scenarios irrespective of quantities of oil spilled. The area of oil spread differs depending on the source quantities. The details of spill losses during its movement and time taken to reach the coast boundaries from all locations have been furnished in **Annexure - 1**. From the Tables 1.1(a) to 1.4(d), it can be concluded that nearly 30%-40% of oil volume would be lost due to

evaporation and dissolution and remaining will be reaching to the either coast or on sea surface.

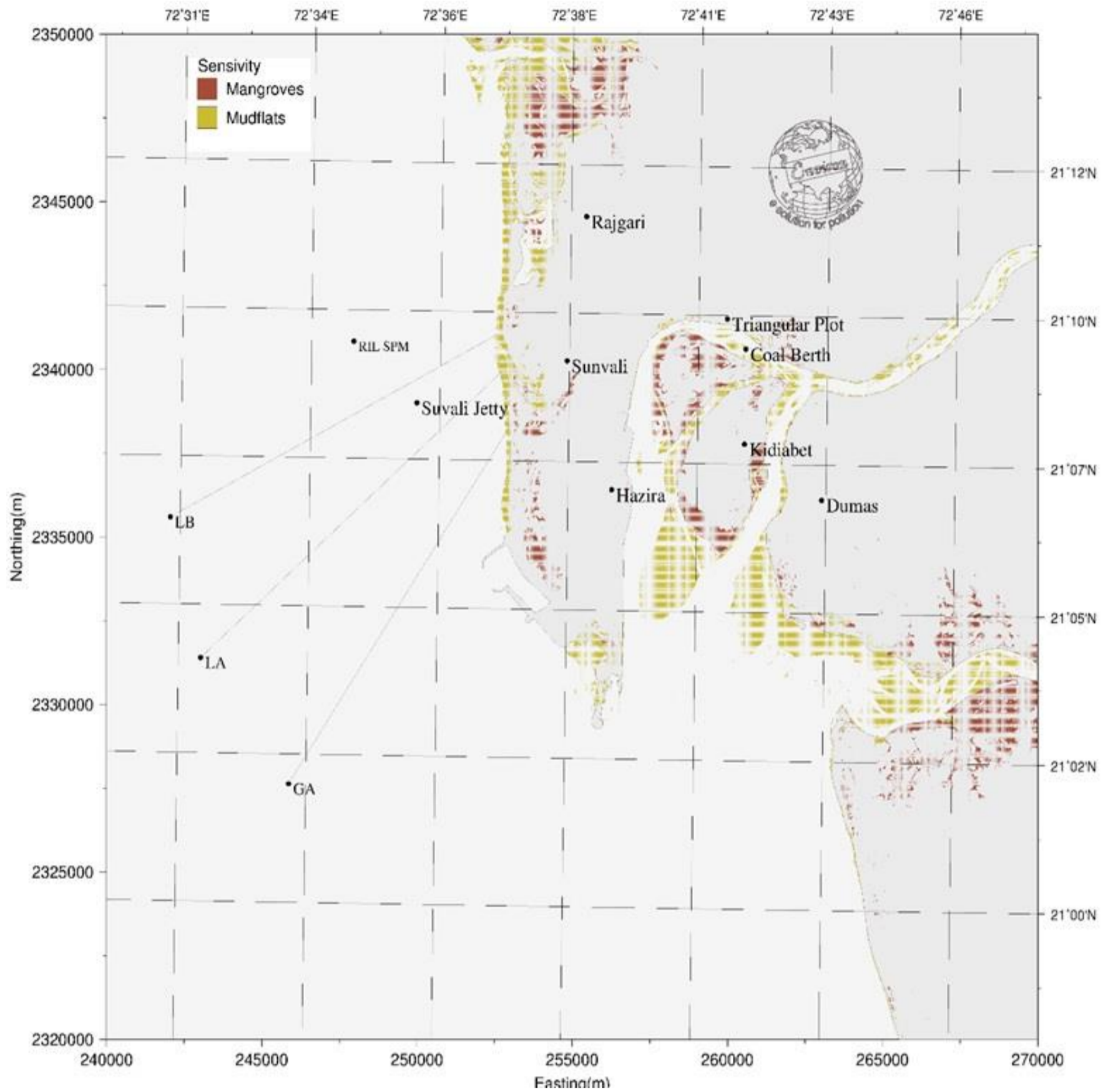
Pre-Monsoon: The simulation runs have been continued for 30 days and the output results i.e. the spill residence time and trajectory of spills have been shown graphically. The magnitude of the resultant current will be in the range of 0.0 -2.4 m/s, which varies with respect to tide phase and time as shown in Fig.A3.1 to Fig.A.3.16 of **Annexure - 1**. From the figures, it can be seen that the resultant of water and wind velocity is towards south-east direction, but due to tide predominant the spills at LA, LB, GA and pipeline locations would move towards north and south direction, ultimately moving towards coastal areas of Hazira direction and depending on the spill residence time as showing in Fig A.7.1 to Fig.A.7.60 **Annexure - 1**.

Monsoon: The simulation runs have been continued for 30 days and the output results i.e. the spill residence time and trajectory of spills have been shown graphically. The magnitude of the resultant current will be in the range of 0.0 -2.9 m/s, which varies with respect to tide phase and time as shown in Fig.A4.1 to Fig.A.4.16 **Annexure - 1**. From the figures it can be seen that the resultant of water and wind velocity is towards North-east direction. Hence, the spills at all spill locations would move towards south and north of spill location and reaching the Hazira coast as showing in Fig A.8.1 to Fig.A.8.60 **Annexure - 1**.

Post-Monsoon: The simulation runs have been continued for 30 days and the output results i.e. the spill residence time and trajectory of spills have been shown graphically. The magnitude of the resultant current will be in the range of 0.0 -2.5 m/s, which varies with respect to tide phase and time as shown in Fig.A5.1 to Fig.A.5.16 of **Annexure - 1**. From the figures, it can be seen that the resultant of water and wind velocity is transition state i.e. sometimes towards south-east and sometimes south-west direction. The spills at all locations during flooding moves towards the west coast of Khambhat and during ebbing the oil spills are on the open sea and moves towards the upstream and downstream of spill location. The spill trajectory plots are shown in Fig A.9.1 to Fig.A.9.60 **Annexure - 1**.

The details of spill landing location and residence time have been furnished in Table 1.1 – Table-1.4 **Annexure - 1**. The behavior of slick movement is more or less similar in various scenarios irrespective of quantities of oil spilled. The area of oil spread differs depending on the source quantities. The details of spill losses during its movement and time taken to reach the coast boundaries from all locations have been furnished in Table 1.1 – Table-1.4 **Annexure - 1**. From the tables, it can be concluded that nearly 40%-50% of oil volume would be lost due to evaporation and dissolution and remaining will be reaching to the either coast or on sea surface.

Figure 2-2: Oil Spill locations LA, LB & GA subsea pipeline locations



2.5 Shoreline sensitivity mapping

The preparation of the sensitivity map is an essential step in oil pollution preparedness, response, and coordination efforts. 'Sensitivity' relates to the efforts of accidental marine pollution involving hydrocarbons. Sensitivity mapping has been prepared, which provides a basis for the definition of priorities for protection and clean-up to the On-scene commander, on-site responders, and information to plan the best suited response strategy to the decision makers. Sensitivity mapping has been used to support the development of the response strategy for oil spill contingency plan. Elements which have been considered sensitive to oil spill are protected areas, important areas for biodiversity, sensitive ecosystems, critical habitats, endangered species, and key natural resources.

Sensitivity maps prepared has covered the areas of coast at risk of spillage originating from the facilities and provide information about the various types of environment that may be affected by a spill (sand beached, rocky coast, marshes, etc.) for which the clean-up equipment should be suited. Sensitivity maps prepared also included the mapping of coastal, sub-tidal habitats and information on the potential impact of dispersed oil in the water column so as to support the decision on the use of oil spill dispersant.

The shorelines are of the high priority areas for protection because they are difficult to clean once the spill washed to shore. According to the sensitivity and importance of the shoreline, the areas of priority protection is mentioned below in order towards shoreline cleaning activity:

- Marshes and mangroves.
- Coral reef flats which are exposed at low tide.
- Raised fossil reefs with undercuts which allow the floating oil to penetrate boulder and Cobble beaches.
- Pebble and cobble beaches.
- Beaches of mixtures of sand, pebbles, and cobbles.
- Exposed beach rock.
- Beach rock covered by thin layers of sand, pebbles, or cobbles.

The details of the environmental sensitivity map including ecologically sensitive areas and economic resources for the CB-OS 2 offshore block have been provided in **Annexure – 2** of this report.

2.6 Shoreline resources, priorities for protection

Amenity areas, economically important tourist and recreation facilities, beaches, ecologically sensitive areas, industrial or drinking water intakes, fisheries, Marine culture, sea birds, marine mammals, and other resources likely to be threatened are being identified.

In determining protection and cleanup priorities, problems and conflicts will frequently arise. Equipment, manpower, time, and other needed resources are usually limited, especially in the early phases of an oil spill making it impossible to devote equal effort to all areas simultaneously.

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Hopefully in a minor spill, the majority of the areas can be protected and cleaned up concurrently. However, the larger the spill, either in volume or area covered, the larger the potentially affected areas. This results in decreased ability of the oil spill control equipment to gather and allocate resources to address adequately all necessary control and counter measures.

It is the primary responsibility to decide which threatened areas should be protected and in what order they should receive attention. This is the first priority. Cleaning up already contaminated areas is a secondary consideration.

Decisions made to protect the locations affected due to the spill are based on information that is accurate, detailed, complete, updated, and unbiased. In addition, it must be gathered and assessed quickly and efficiently. This section provides a systematic approach to the establishment of priority actions. It includes:

- a preliminary, quick- screening mechanism to be used when time is extremely limited
- a numerical rating system to be used to determine the relative sensitivities (including the outside considerations) of all areas under investigation
- the establishment of protection priorities for threatened areas
- the establishment of cleanup priorities for affected areas.

The coastal areas of Hazira-Suvali, Gulf of Khambhat abounds in marine wealth and is considered as one of the richest in industrial activities along the west coast of India. It is endowed with a great diversity of natural ecosystems, of which the major systems are salt pans, intertidal zones, sand dunes, mangroves, creeks, and open ocean.

There is a pressing need of having marine sensitive area Atlas of coastal areas of Hazira, Gulf of Khambhat which can fulfill the requirement of various organizations including the state governments in taking policy decisions. Environ Software Pvt. Ltd prepared marine sensitive area Atlas of the Suvali region, Gulf of Khambhat with technical inputs from the available data sources. Satellite data has been used to map various coastal lands, biological, environmental, and geographical features and prepared the sensitivity index mapping with regards to oil spill risk assessment and management.

Attempts was made to overlay the marine sensitive areas based on the data available in the cadastral maps of the respective areas so that the status of sensitive areas cover may be known down to the coasts. The maps have been interpreted at 1:50,000 scale and the sensitive areas have been classified into mangroves, mudflats, rock coast, corals, industrial & biological sensitive areas Environmental Sensitivity Index mapping was prepared as a part of the NEBA study. Refer for details **Annexure - 2: Environmental Sensitivity Index Mapping and Atlas**. The environmental sensitivity with some of the key ecologically sensitive areas and economic infrastructures are highlighted below.


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Figure 2-3: Environmental sensitivity details in the Block area

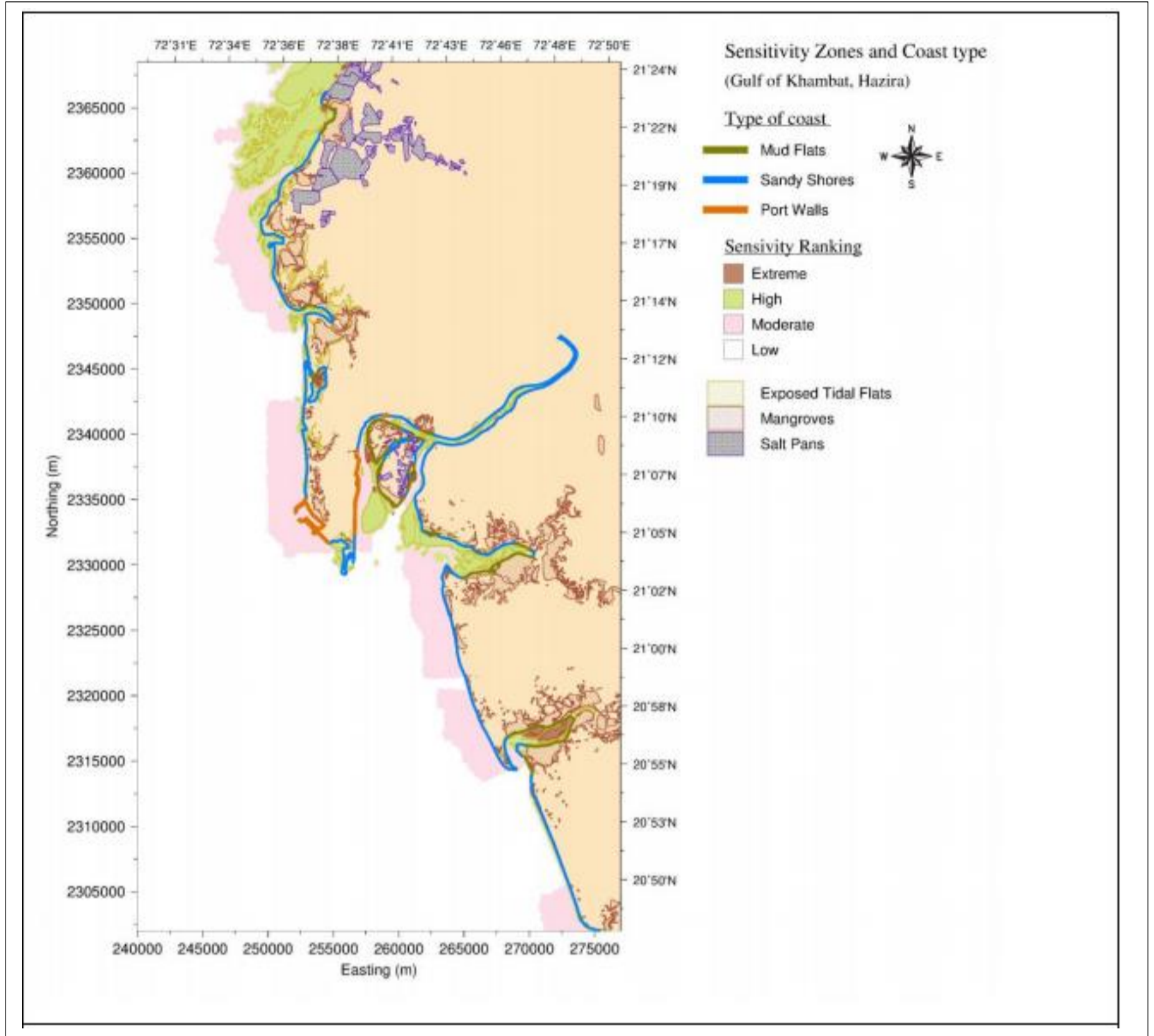


Figure 2-4: Flora Habitants in the coastal area within the Block area and surrounding 10 km radius



Prosopis Juliflora



Zizyphus



Acacia Miotica



Lantana Camara



Aribus Precatorious



Typha



Salvadora



Aloe Vera



Eucalyptus

Figure 2-5: Avifauna Observed around the Block area



Black Drongo



Green Bee Eater



Red Vented Bulbul



Common Sand Piper (Acitis Hypoleucos)



White Breast



Habitat of the birds

Figure 2-6: Mudflats and Mangroves in the bank of the River Creek



Avicennia Marina



Avicennia Marina



Mudflats

2.6.1 Phytoplankton

Phytoplankton's 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. Phytoplankton long has 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. Some species develop noxious blooms, sometimes creating offensive tastes and odors or anoxic or toxic conditions resulting in animal death or human illness. 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. Generally, phytoplankton standing crop is studied in terms of biomass by estimating chlorophyll a and primary productivity, while in terms of population by counting total number of cells and their generic composition. When under stress or at the end of their life cycle, chlorophyll in phytoplankton decomposes to phaeophytin as one of the major products.

2.6.2 Mangroves and Mudflats



Annexure - 2 shows the location of Mangroves and Mudflats in the coast of Hazira, Gulf of Khambhat.

Mangroves are the dominant coastal vegetation growing in the clayey, silty intertidal coastal zones, deltaic and estuarine coasts, backwaters, and sheltered regions. The coast around the Gulf is indented by estuaries and consists of extensive mudflats and sporadic presence of sandy beaches favorable for mangrove vegetation. However, mangroves in the coastline of the Gulf are stunted and sparse in distribution. Mangroves are dominant near Bhavnagar, Devla in Bharuch, Mangrol, Pardijankri, Dashariphalia and Dandi in Surat. PIRAM Island, Ghogha and Mahuva showed high density of *Avicennia marina*. Mangroves in the intertidal mudflats are stunted and sparse particularly near Mahi, Dhadhar, Kim and Sena estuaries. A patch of *Avicennia* is observed in Aliya Bet at the mouth of the Narmada estuary. At most of the places, the growth is stunted and horizontal. Some tall trees were observed at PIRAM Island. District wise details of Mangroves of the Gulf are as follows:

The total mangrove area estimated is around 52.46 km² for the period November 1999 (Singh, 2000). Mangroves of Ghogha Jetty, Bhavnagar creek and coastal Ahmedabad district are scrubby, expanding gradually to the surrounding areas due to plantation carried out by the Forest Dept. *Avicennia marina* dominated as a single species in most of the mangrove patches. *Sonneratia apetala* is found either scattered or in dense patches in a few places.

2.6.3 Zooplankton

The occurrence of zooplankton revealed the dominance of copepods and eggs in most of the stations in both seasons studied. However, their percentage contribution varied seasonally and station wise. Density of larvae occupied

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third position after copepods and eggs. Hydrozoans, pyrosomids, and chaetognaths had good shares in most of the stations. Chaetognaths, cladocerans and foraminiferans occurred in moderate numbers.

2.6.4 Macro benthos

The organisms inhabiting the sediment are referred as benthos. Depending upon their size, benthic animals are divided into three categories, macrofauna, microfauna and meiofauna and macrofauna. Benthic community responses to environmental perturbations are useful in assessing the impact of anthropogenic perturbations on environmental quality. Macrobenthic organisms which are considered for the present study are animals with body size larger than 0.5 mm. The presence of benthic species in a given assemblage and its population density depend on numerous factors, both biotic and abiotic.

The subtidal benthos along the shallow regions of the Gulf during March 1999 consisted of 7 groups, the major group being bivalves. *Tellina* sp. dominated this group occurring at 2 stations. Polychaetes also occurred in some locations with lesser numbers. Gastropods, scaphopods, copepods and amphipods were also observed at a few stations, their occurrence being very less. Plant debris and broken shells (coarse and fine) were observed in most of the sampling stations. Mahuva recorded maximum density. Overall, the Gulf was observed to be poor in faunal diversity and total count. This might be due to the suspension and re-suspension of sediments by strong semi-diurnal currents at the bottom.

2.6.5 Marine Algae

As a whole, 13 species of algae were recorded during post-monsoon followed by 12 species during pre-monsoon and 8 species during monsoon. Mahuva and Gopnath, having rocky intertidal shoreline, have recorded high diversity during October 1998 and March 1999. *Ulva lactuca*, *U. fasciata* and *Enteromorpha tubulosa* were the most common species in these areas. At Piram Bet, only blue green algal filaments were recorded from the mid-littoral zone and a green alga and one red alga (*Enteromorpha*, *Ulva* and *Gracilaria*) were observed during pre-monsoon.

As far as the seasonal variation is concerned, it is negligible during the monsoon season whereas, optimum growth of algae had been observed during the pre-monsoon season. Mahuva displayed maximum species in pre - monsoon and post - monsoon seasons, whereas Ghogha did not show much variation in all the seasons. The poor diversity of marine algae at Gulf of Khambhat may be due to high siltation rate and strong currents which are not conducive for marine algal growth.

2.6.6 Fishery

Fishing activity is well established in Bhavnagar, Bharuch, and Surat districts. A total of 6115 fishermen from 3017 families are involved in fishing in the region and about 16,280 tons of fish was landed (1999-2000) at 41 landing centers in the Gulf of Khambhat. With a smaller number of active fishermen (28.83% of total population) and minimum number of mechanized boats (only 10), Surat district got the maximum share which may be due to high productivity in the region and easy accessibility for exploitation. Details of marine fish landing in the Gulf of Khambhat region are presented in **Annexure - 2**. Major commercial fishery is constituted by Bombay duck with 24.91% of the total fish catch followed by shrimp with 22.39%. Groupwise marine fish production in the Gulf is depicted in **Annexure - 2**.

2.6.7 Reptiles and Mammals

The reptiles are mainly represented by marine turtles *Chelonia mydas* and *Lepidochelys olivacea* which breed and spawn on the sandy beach along Gulf of Khambhat coast as well as on the islands.

Dolphin (*Dolphinus delphis*) and whale (*Balanoptera sp*) are common in the Gulf. Though occurrence of Dugong (*Dugong dugon*) in the Gulf particularly along the Jamnagar coast has been reported, there are no recent sightings.


2.6.8 Saltpans

Annexure - 2 shows the location of Saltpans in the Suvali-Hazira region, Gulf of Khambhat. Saltpans are unique tide water impounded enclosed system adjacent to creek environment. They are characteristically exposed to a wide range of environmental stress and perturbation which manifest mainly through salinity changes. The distinct feature of the brine ecosystem is its biotic simplicity and stability. However, saltpans are immature ecosystem as compared with a typical marine system and harbor a high proportion of opportunistic and fugitive species. The ecosystem is simplified, as the number of species in each trophic level is low. Species diversity is directly linked with salinity. Hence the higher the salinity, the lower the species diversity and simpler the structure of the ecosystem. Energy influx to the saltpan ecosystem is usually large and algal production may, therefore, be high, but food chain nevertheless is usually simple and often restricted to a few producers and low number of consumers.

In the Gulf there are many salt work units. These saltpans serve as feeding grounds for a variety of resident as well as migrant birds.

2.6.9 Intertidal zone

The intertidal area is the transitional region between land and sea. In general, it is covered and exposed by the tidal waters each day. The intertidal zone can be either rocky or particulate shore. Rocky shores are solid substrates and particulate shores consist of sediment particles ranging in size from clay through cobbles. Particulate shores may be either well or poorly sorted. The

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rocky shore provides a firm substratum while the others are unstable. The rocky intertidal area consists mostly of epibenthic organisms attached to the rock surface. The communities of the intertidal fauna can be divided into epifauna, which live at the surface of the rocks, shore and sediment, and infauna consisting of all animals that burrow and live in the sediment. The intertidal expanse of the Gulf increases towards upstream. The increase is from 0.5 to 2 km from Hazira to Dahej.

The intertidal habitat of Gulf covers a wide range of ecosystems, sandy beaches, mud and sand flats, rocky foreshore and rock pools, sea grass beds, salt marshes and mangroves. The continuous wave action and associated littoral sediment transport make intertidal stretch a unique environment for biogenic activities of organisms. The physio-chemical, geomorphological, and biological features play an important role in determining the distribution and abundance of benthic fauna of the intertidal habitats. Gulf sustains a rich and highly bio diversified intertidal flora and fauna.

2.6.10 Open Ocean

The open sea has very specific characters. Most evident are its uniformity and stability in environmental conditions, its three – dimensional space and its vastness. In the pelagic realm there are no boundaries or barriers to distribution of organisms and all environmental changes are gradient. This part of the sea harbors two types of communities namely the nekton or good swimmers and the plankton, with feeble powers of movement. The bottom fauna or benthos is constituted by epifauna and infauna. Typical sea fauna, in general, exhibits a rather high diversity and this is clearly seen in the zonation of organisms.

2.6.11 Priorities Outcome

All the elements selected for the sensitivity index are listed in Table 2.9. They are selected based on their sensitivity to oil spills, their ecological importance and their importance to biodiversity and the local human population. For details refer **Annexure - 2: Environmental Sensitivity Index Mapping and Atlas.**

The relative sensitivity (RS) for the species rely on available information regarding the vulnerability, recovery potential and the potential for lethal and sublethal effects which are summarized in Table 2.9 and Figure 2.3. The relative sensitivity the ranges from 1 to 10.

Table 2-9: The relative sensitivity and characteristics of the selected groups in relation to oil spills based on NEBA study

S. No.	Group	Relative Sensitivity (on a scale of 1 to 10)
Natural Resources		
1	Mangroves	10
2	Mudflats	9
3	Reeflats	10
4	Sandy Area	5
5	Sea Birds/Birds Nesting Area	9
6	Marine Mammals (Dolphins, Dugongs, Whales)	8
7	Turtle Nesting Areas	7
8	Marine National Park	10
9	Marine Sanctuary	10
10	Forest Area	9
Human Activities Related		
11	Fishing Zones	6
12	Industrial Sea Water Intakes	6
13	Ports	4
14	Jetties	4

2.7 Special local considerations

Adani Hazira port Private Limited is situated in a high tidal range area resulting into strong tidal currents, which effects the movement of oil spill drastically in the area. Strong tidal currents also severely affect response capability and methodology, any response to the spill must be very swift and prompt without ambiguity.

3.0 Response Strategy

The overall oil spill response strategy in the event of an oil spill contingency consists of three principal elements, namely:

Spill prevention: This is the most important element and most effective way of protecting the natural environment. It consists of planning, risk identification and assessment and application of a variety of design and procedural controls, some of which are standard practice.

Spills control: This is the second line of defense, which involves a number of options to restore control of the spill from the source such as well, pipeline etc.

Spill response: This strategy consists of a tiered approach for oil spill response appropriate to the spill size and severity. This OSCP is based on internationally accepted standards of Tier classification and response concept to describe different categories of oil spill events based on their severity and availability of response resources.

This section defines the response strategy and actions, which will be in place to deal in event of an accidental oil spill through a multi-tier response procedure depending on the type of spill involved. These strategies will guide the response team during spill related emergencies.

3.1 Philosophy and Objectives



Overall objective is to minimize the impact and efforts will be made to effectively mitigate the different oil spill scenarios keeping in view the following factors:

- Most probable discharge scenarios.
- Oil spill trajectory and possible fate of oil spilled.
- Time window available for the spill and likely time of hitting the coastline.
- Nature of shoreline and priority for protection.

Oil Spill Tier Classification

The below section details the potential spill scenarios associated with the operation. Spill incidents can be classified into three types based on the volume of spill, sensitivity of threatened resources and level of response required to achieve appropriate containment and clean up. A description of the three tiers of spills, primarily depending on the quantity of spilled oil is provided below.

Tier 1: A spill incident up to 700 MT, which can be responded to and controlled with the existing resources, equipment (spill response kits) and resources on the rig without any further escalation falls under this tier. Most of the potential drill stage spill risks are Tier 1. In a Tier 1 spill incident, the volumes involved are limited due to the extent of hydrocarbons or chemicals spill and spread at site. Incidents which can be included in Tier 1 are:

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- Diesel spills from refueling i.e., drill rig - hose leaks, overfilling or connection/disconnection incidents.
- Chemical spill from the storage containers used, drums etc.
 - Hydraulic oil spill resulting from a split hydraulic hose or failed connector (moderate pressure, low volume lines).
 - Fluid leaks from separator vessel, tanks, pumps etc.
 - Spill from support/ supply vessels carrying fuel to the offshore.

Cairn has formulated following response plan:


- Mobilization of oil spill response equipment onboard Production Support Vessel (PSV) and IRT personnel from Suvali will take roughly 2 hours, i.e., time required to place OSR equipment in place and personnel required onboard for commencing spill response operations.
- Response equipment at Suvali terminal will take ~ 2 hours for mobilization and deployment off the coastline, where the spill might hit land.
- Dispersant Spraying by Production Support Vessel will take less than 30 minutes to commence, as the vessel is already operating in the area

Tier 2: A spill incidents > 701 MT will require additional onsite support to contain the spill. In these scenarios, the additional external resources to assist with the response to the spill incident are initiated. Tier 2 spill incidents may require initiation of Emergency Operations. There may be danger to people on board the rig and/or assets from such spills. Such possible incidents are likely to include:

- Transportation incidents associated with the delivery of hydrocarbon fluids i.e., vessel collision en-route.
- Complete failure of an on-board drilling fluid (base oil) storage tank(s).
- Complete failure of on-board fuel storage tank.
- Pipeline rupture or leakage
- In order to contain such potential spill incidents, the resources of the local administration such as Indian Coast Guard may be required.

Cairn has formulated following response plan:

- Mobilization of equipment from mutual aid partners will take one hour, as their equipment are already loaded on their vessels/available in Port. Cairn has a mutual Aid Program with ONGC, Reliance India Limited, GSPC and Oil India Limited.
- Mobilization of equipment from other operators will take 2 hours. Cairn has a MoU with nearby operators in case of such emergencies. Details of MoU is in **Annexure – 3**.
- Intimation to the Coast Guard will be done within 1 hour of the incident, (Fixed wing aircraft for aerial application of Oil Spill Dispersant (OSD) and monitoring of Oil Spill movement).
 - Mobilization of oil spill response equipment onboard Coast Guard vessel from Porbandar or Mumbai will require about 18-20 Hrs.

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Support to the oil spill response would be sought towards mutual aid cooperation from the regional operators. As per this MOU already signed, each operator is obliged to provide necessary equipment and services to the requesting party during oil spill emergencies without any profit motive. The guiding principle is to extend all necessary help without sacrificing any inherent risks to their own facilities at the time of emergency. This mandates each company to have certain facilities available with them all the time. After completion of exposure to the emergency, the equipment will be returned to assisting party in near original state or replaced/cost refunded by the requesting party in certain time frame. Details of MoU is in **Annexure – 3**.

Tier 3: Tier 3 spill incidents (> 700 MT) are significant spill incidents that escalate from a Tier 1 or 2 and exceed the capabilities of the on board and local administrative resources to respond, requiring a State/National response. An uncontrollable well blow out scenario and fire on the offshore rigs or platforms would fall into this category. Cairn Oil & Gas has associate membership with M/s OSRL, Singapore and is being renewed every year for advisory support and with provision of manpower, equipment, etc., during the emergency situations. Both Indian Coast Guard and OSRL will be notified of the spill incident and will take their support accordingly. The OSRL will be mobilized under Coast Guard Control to contain the spill.


3.2 Limiting and Adverse Conditions

Weather, sea conditions and time factor play an important role in oil spill response operations. The response operations will be largely restricted during nighttime and adverse sea conditions. Safety factors including vessel limits, night movements, risk of fire and explosion and toxicity (oil contact/inhalation/ingestion) might need consideration while planning response operations.

3.3 Oil spill Response in Offshore Zones

While deciding upon the response strategies that would be adopted for an oil spill incident, several important factors need to be considered. All these factors will help in determining the level of response based on the type of spill incident.

- Type and characteristics of oil that is spilled (weathering properties of the oil determine the time required to initiate a response)
- Size of the oil spill (tier classification of the spill incident and response type can be determined)
- Geographic location of the spill (level of response – internal or external, can be determined)
- Sea conditions at the time of spill (fate of spill and hazards to response team can be established)

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- Estimated time in which the spill might reach the coastline (will determine the response window)
 - Resources available
 - Available response options
- Net Environment Benefit Analysis (NEBA): Based on the above factors, following tasks have been identified that would form an integral part of oil spill response and control strategies for combating oil spill incidents:
 - Initial Assessment to prevent or reduce further spillage.
 - Monitoring and evaluation (no active intervention but the spill is under observation).
 - Containment and recovery (for protection of environmentally sensitive areas).
 - Spill Clean-up.
 - Waste disposal.
 - Post spill evaluation.

The Table 3.1 presents the flow of response and control operations in case of an oil spill. A brief explanation of these various response and control strategies is provided in the following sub-sections. The spill response action flow chart for spill control has been presented as Fig.3.1.

Table 3-1: Spill response and control measures

Flow of oil spill response	Operational control measures in case of oil spill
Initial assessment	<ul style="list-style-type: none"> • Spill observer to report the spill to Incident Controller / Radio officer • Ensure safety of personnel on board • Take actions to prevent or reduce further spillage • Notify the EMT Leader and Crisis Management Team
Monitor, evaluate and communicate	<ul style="list-style-type: none"> • Assess the size, nature, and direction of flow of spill • Assess whether the spill will affect environmentally sensitive areas • Establish the type of spill to determine level of response • Decide on spill response strategy • Communicate to the relevant authorities in case of Tier 2/3 spills
Containment and recovery	<ul style="list-style-type: none"> • Restrict the movement of oil spill to nearby coastal areas • Application of spill dispersants • Contain spill on board if possible • Recover off board spilled material if conditions allow
Spill Clean up	<ul style="list-style-type: none"> • Clean up of shore area if the spill reaches the shore • Clean up contaminated surfaces on board • Medical screening of response team personnel • Clean spill response equipment
Waste Disposal	<ul style="list-style-type: none"> • Separate, liquid, and solid wastes • Dispose as per waste disposal procedures for oily wastes
Post Spill Evaluation	<ul style="list-style-type: none"> • Spill incident reporting • Evaluate cause of spill and implement corrective action • Conduct post spill environmental monitoring

3.3.1 Prevent or Reduce the Spill

The first response action to be undertaken, where feasible is the isolation or prevention of the source of the spill in an attempt to limit any further discharge. Such first response actions may include an emergency shutdown of the particular equipment, isolation of a valve or line causing the spill or providing some immediate containment to prevent the further spread of a spill. Such measures are only a first immediate response prior to a more coordinated effort being planned and undertaken.

When oil is spilled in a confined area, there may be a risk of fire. In such circumstances, prevention of fire shall be top priority. In unventilated areas, fuel fumes can also affect breathing and cause nausea. No clean-up shall be attempted until the spill area is safe. All the on-board personnel would be evacuated, and all operation/ drilling activities will be terminated.



3.3.2 Monitor and Evaluate

This task would not involve any active intervention, but the spill will remain under observation. It is essential to know the position of spilled oil/chemicals and a forecast of its movement or direction (whether it is moving towards coast) to develop a spill response. Aerial surveillance of the spill will enable collection of some of following information that will be required to monitor and evaluate the spill response:

- the location and movement of the spill (if any).
- appearance of the spill.
- the size and quantity of the spill.
- changes in the appearance and distribution of the spill over time.
- the potential threat to the environment and nearest coastal areas; and
- possible resources required to combat the spill (more effective and coordinated response).

3.3.3 Communicate

Once the station response team has been mobilized, a radio room shall be set up and logbook of actions and communications shall be opened. The logbook is to be kept up to date by the radio operator. The satellite communications/ radio room will be used as the on-site communications center. It will be manned by the radio operator, as well as the during situation reports. All rescue and clean-up team members shall carry hand-held radios.

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3.4 Oil Spill Response in Coastal Zones

In event of a large spill or depending on sea conditions and direction of flow, the oil is likely to reach the shore. Such cases will require a shore clean up. Shoreline clean up by mechanical removal involves a wide range of different tools and techniques. Techniques may range from manual removal of oil using sorbents to advanced beach cleaning machinery:



- Manual sorbent application
- Manual removal of oiled materials (hand, shovel, rakes)
- Manual cutting of vegetation
- Low pressure flushing at ambient temperature
- Vacuum trucks
- Warm water / low pressure washing
- High pressure flushing
- Manual scraping
- Beach cleaners

Bioremediation: Bioremediation is another option for shoreline clean up. It involves the application of nutrients (fertilizers containing nitrogen and phosphorous) to the shoreline to accelerate the natural biodegradation of the oil. Oil biodegradation is the natural process by which microorganism oxidizes hydrocarbons, ultimately converting them to carbon dioxide and water. The process is limited by the availability of oxygen, moisture and nutrients needed by microbes. The use of non-native bacteria is not recommended as most areas have indigenous bacteria that are capable of degrading oil. Bioremediation is typically used as a final treatment step after completing conventional shoreline treatment or in areas where other methods are not possible or recommended.

The priority for protection of shoreline zone areas is to protect those areas which have great economic, environmental, and social importance such as Aqua Culture Farms (on experimental basis by fisheries dept.), Hazira Port entrance, Mangroves, Tapi River Estuary etc.

Aqua Culture Farms - There are lot of aqua culture farms established by Fisheries department (on experimental basis) in and around Suvali village which are fed by sea water. Oil contamination of inlet points would ruin the whole aqua culture experiment program, resulting in loss of hard work put in by Scientists and Research personnel as well as mass unrest among local population directly / indirectly dependent on these farms for their livelihood. As the damage caused may be of permanent /semi-permanent nature, the public outcry may raise a political storm among the villagers.

Hazira Port entrance - The Hazira Port Private Ltd. is a deep-water port. Its entrance is very next to Suvali and it is handling LNG Cargo. Since the port is handling LNG as cargo, the oil spill entering inside the break water of the port may create a dangerous situation for the vessels berthed as well as to other assets of the port.

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Mangroves - Mangroves are the one of the most sensitive areas prone to destructions by accidental oil spill. The potential impact areas extend from Dandi (Lat. 20° 54' N) and Machhiwada (Lat. 20° 48'N) in March to Bhimpur and Dumas (Lon. 20° 55'N) and Suvali (Lon 21°10'N) in July. These areas, though predominantly mud flats, have some areas with mangroves also. Once affected by the oil spill, it is very difficult for the mangroves to regenerate.

Tapi River Estuary - Tapi River is one of the important rivers for the people of Gujarat and Surat, in particular. This river is also considered as backbone of the economical hub of Surat in particular and South Gujarat in general, as number of industries are either having their jetties on the banks of river Tapi or are dependent on the water of Tapi river for their industrial requirement. Further down towards sea, the estuary is full of mud flats and a variety of marine creatures, including fishes are available. Being a fishing ground, dependence for livelihood of local fishing community on this area is a natural phenomenon. The Tapi river opening is very huge and hence actual action can only be decided after the oil spill, noting the exact state at that period of time

3.5 Shoreline Oil Spill Response

Shoreline oil spill response include protecting and cleaning up wetland, coastal waters, shoreline, and marinas etc. Refer **Annexure - 2** in detail to understand the various environmental sensitive living and nonliving things available nearer to CB/OS-2 Block area. Some of the key details are mentioned below.

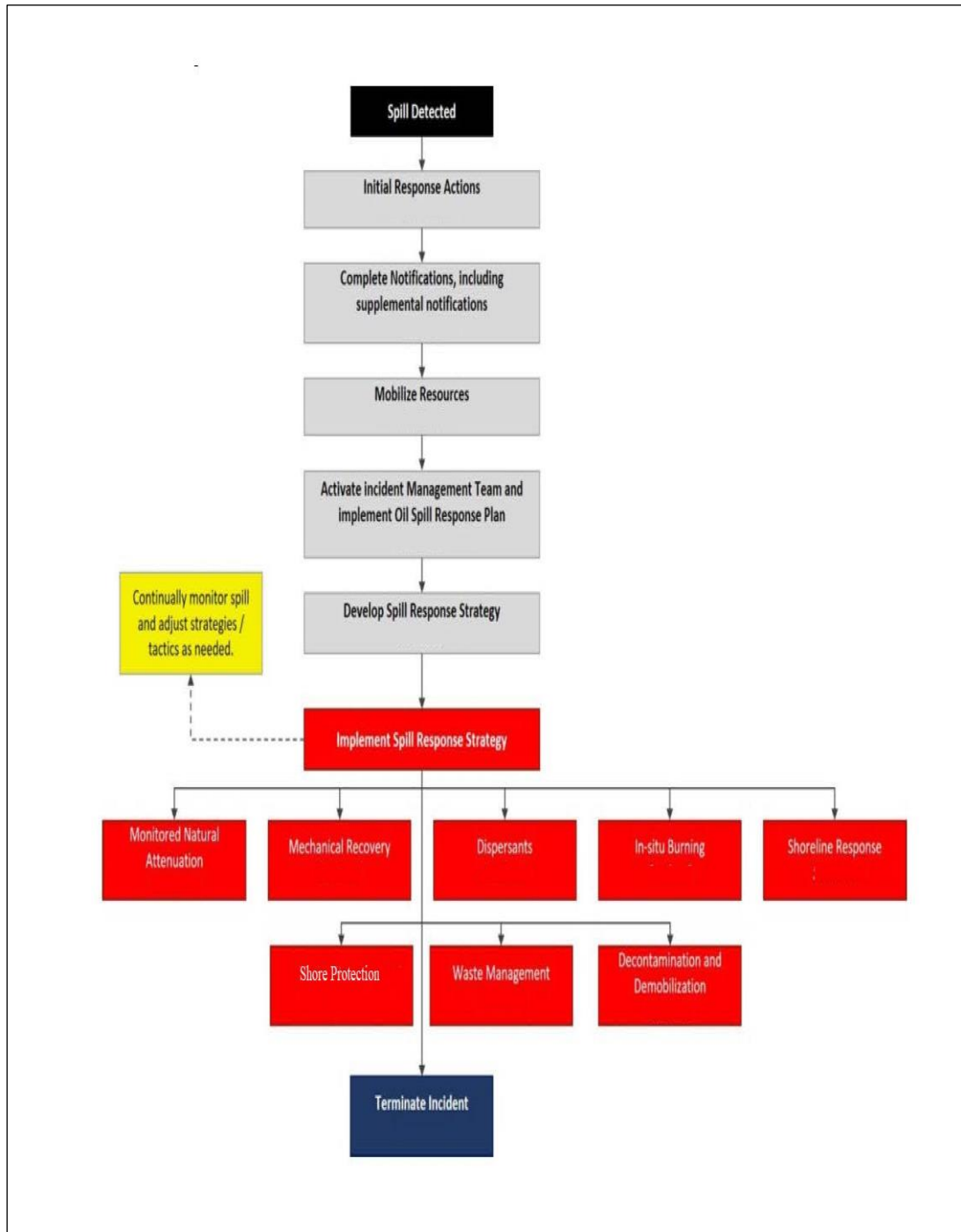
The beach sand and at Suvali is moving constantly in northerly direction pushed by the strong flood currents. This in combination with wave action will generate a self-cleaning effect of the lower beach and only weathered oil washed up or above the high tide line will be removal.

To facilitate beach clean-up, access to the beach should be prepared. To clean up the earth moving equipment, tractors, trailers, and numerous personnel with shovels will be required. It has to be mentioned that the approach in the beaches at the Suvali consists of a low tiding area of very fine and soft sand with is extremely difficult to cross the vehicles unless fitted with tracks any beach clean-up operation will take days to prepare.

There are no beach access roads. In order not to do excessive damage to beach by removal of excess sand techniques are to be developed. For land spills, the selection of appropriate control and equipment techniques will be depended on factors that will include:

- The nature substrate
- The slope of terrain
- The amount and type of product released
- The time available to implement response activities

Figure 3-1: Spill response action plan flowchart



The objectives of the response measure to contain the oil spill response action plan on land are:

- To confine spill as much as possible to restrict in one area
- To recover and remediate as much as the spilled material as feasible
- To reduce additional impacts to the area while promoting the speediest recovery.

The following recovery and removal strategies are amongst those that should be considered:

- Using earth moving machinery and trucks to excavate materials.
- Recovering damaged, posted, and contained products with vacuum trucks and mini vacuum system pumps, and skimming equipment.
- Manual recovery, placing, materials into containers for subsequent disposal.
- Collecting with artificial and natural absorbents

The following treatment techniques after the character of oil and promote weathering and natural degradation:



- In-situ burning may be considered where combustible, as logs, debris, vegetation have been heavily soiled.
- Bioremediation involves application of nitrogen and phosphorous fertilizers to stimulate the growth of existing natural community's microbes.
- Land tilting involves the tilting of oiled area to maximize the exposure to physical, microbial, and photochemical degradation.

Shoreline Booming Guidelines

- Determine priorities
 - Protection
 - Deflection
 - containment
 - To assist shoreline cleanup
- Obtain local knowledge concerning
 - Tide times
 - Springs/neaps
 - Tide range
 - Sensitivities
 - Access
- Shoreline type - load bearing capacity (equipment/moorings)
 - Gradient HW/LW marks
- Locate convenient slipways for launching boats/booms.

Containment

- Find a natural collection point
- Look for where debris to collect (remove if possible)
- Utilize natural or manmade features e.g. sand bar or groyne.

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Deflection

- Extend from a land promontory e.g. peninsula or sand spit
- Assess current and wind strength to establish boom angle and length.
- Use shore sealing boom in the intertidal zones
- stockpile equipment above HW mark
- Establish how to fill shore-sealing boom water tubes e.g. use incoming tide
- If flooding or water tank supply above HW mark it ebbing.
- Deployment vessels should
 - be shallow draft
 - have sufficient power
 - have good deck space
- Before Deployment - inshore moorings should be established (above HW mark)
 - Booms pre-connected
 - Floating moorings should be prepared at approx.25m intervals.
 - Ensure good communication between shore and boats

3.6 Storage and Disposal of oil and oily waste

Spilled oil and water mixture recovered from sea with the help of recovery devices will be recovered in the Extra Fuel tank on-board support vessel. Recovered oil mixture will be pumped to onshore for separating oil and water with the help of effluent treatment plants already available. Additional floating tanks will also be used for collection of recovered oil, if necessary. Spill response operations have the potential to generate liquid and solid wastes, if there are clean up operations. The types and quantities of waste material largely depend on the amount of liquid material spilt and the specific clean-up methods employed. Collected oil and oily wastes will be stored in suitable containers. Refer the below details for GPCB authorized TSDF and incinerator operating facilities at Gujarat.

Hazardous Waste TSDF in Gujarat

- Bharuch Enviro Infrastructure Ltd, Ankleshwar
- Vapi Green Enviro Ltd. Vapi
- Nandesari Environment Control Ltd. Nandesari, Vadodara.
- Saurashtra Enviro projects Pvt. Ltd, Bhachau, Kutch, which is owned by Detox India Private Limited.
- Bharuch Enviro Infrastructure Ltd. Dahej, Bharuch.
- Eco care Infrastructures Pvt. Ltd. Dasada, Surendranagar.

HWF (Common Hazardous Wastes Incineration Facility) in Gujarat

- Bharuch Enviro Infrastructure Ltd, Ankleshwar
- Nandesari Environment Control Ltd. Nandesari, Vadodara,
- Saurashtra Enviro projects Pvt. Ltd, Bhachau, Kutch, which is owned by Detox India Private Limited.
- Saurashtra Enviro projects Pvt. Ltd, Dahej, Bharuch, which is owned by Detox India Private Limited.
- Geohybrid Industrial Solutions Private Limited. Plasana, Surat

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Disposal options for oily wastewater may include high temperature incineration, bioremediation, or disposal at secured onshore landfill sites approved by Gujarat Pollution Control Board (GPCB). The recovered / skimmed oil will be disposed to the authorized recyclers as per the GPCB. Any disposal option selected will be complied with the requirements specified in Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 and amendment.

Vedanta Limited has valid contract for disposal of the Oily waste with M/s Detox India Private Limited, who is approved by Gujarat Pollution Control Board. The Contract Number is 4600011122 and it is valid till 14th December 2023. The address and contact details are mentioned below.

Detox India Private Limited
5, Hira Modi ni sheri, Udhana Ring Road,
Surat Gujarat - 395002
Attention: Mr. Amit Renos
Email: tenders@detoxgroup.in,
Mobile:+91 98241 46420

Please refer the below link to access GPCB authorized waste oil and used oil recyclers.

<https://gpcb.gujarat.gov.in/uploads/Actual User for Used Oil - Waste Oil.pdf>

A range of options for shoreline clean-up and waste disposal methods as per IMO guidelines given below will be followed:

Table 3-2: Option for separation and disposal of oil & debris

Type of Material	Separation Methods	Disposal Methods
Liquids (Non-emulsified oils)	Gravity separation of free water	Use of recovered oil can be further processed within Suvali Terminal as it is oil separation facility.
Emulsified	Emulsion broken to release water by Heat treatment emulsion-breaking chemicals mixing with sand.	Use of recovered oil within Suvali Terminal
Solids (Oil mixed with sand)	Collection of liquid oil leaching from sand during temporary storage Extraction of oil from sand by washing with water or solvent. Removals of solid oils by sieving	Use of recovered oil within Suvali Terminal and return of separated solids/sand to secured landfill.
Oil mixed with cobbles, pebbles, or shingle	Collection of liquid from debris during temporary storage. Extraction of oil from beach material by washing with water or solvent.	Separated and washed cobbles, pebbles or shingle will be sent back for appropriate restoration. The waste oil will be further treated and reused in Suvali terminal. The contaminated solids including seaweed and sorbents, tar balls left out after oil separation and sand will be disposed to the cement industry for co-processing / secured landfill.
Oil mixed with wood plastics, seaweed, and sorbents	Collection of liquid from debris during temporary storage. Flushing of oil from debris with water.	
Tar balls	Separation from sand	

Note: Suvali terminal has 2000 m³/day capacity of Effluent Treatment Plant (ETP) for handling treatment of the produced water. Thus, this ETP can be used for treating the recovered oily waste for further treatment (separation of solid, liquid, waste etc).

Post Spill Evaluation: Post spill evaluation will involve recording of the spill incident in logbook or register with appropriate response and control measures that were taken. The cause of the spills will be evaluated, and a corrective action plan will be developed in order to prevent similar future incidents.

As part of the post-spill evaluation, a program of environmental monitoring may be necessary. The objectives of monitoring will be to determine:

- Movement and fate of spills
- Short-term and long-term environmental effects

The environmental monitoring will involve following activities:

- Visual examination supported by photographic and video records.
- Oil sampling to determine chemical characterization and deterioration level.
- Sampling of water and sediment for assessing impacts of the spill on marine and benthic flora and fauna.

4.0 Equipment

There are a number of techniques to remove the oil floating on the sea. The oil spill combating equipment should be selected in relation to the assessment of the risk of spills and to the defense of agreed priorities for protection. The equipment must be chosen for the anticipated range of weather conditions and oil types. Various equipment and methodologies used are booms, skimmers, pumps, absorbents, chemical dispersants, burning etc. The oil spill response equipment is distributed and stored in Adani port, Platforms and Suvali terminal based on the offshore activities.


4.1 Marine oil spill response equipment

Once suitable marine pollution control and response strategies are assessed for any particular kind of spill, then need to agree on the planning scenarios, focus to identify the appropriate equipment, personnel and logistics resources needed to implement the strategies and ensuring their availability within the necessary time frame.

Using the tiered response approach, the provision of resources is kept flexible and adaptable enough to handle not only the smaller, low-impact spill scenarios but also the integration of additional regional and global resources to address more complex spills, such as worst credible case discharge scenarios or an escalating response. Ultimately, the goal of planners is to determine an adequate capability to mount and sustain an effective response to a spill of any magnitude as applies to an organization's unique risk profile.

The marine oil spill pollution response equipment that are procured and available for CB/OS-2 Block with their specifications is mentioned in **Annexure - 4** along with their actual images (photographs). However, for quick reference, please find below the key marine oil spill equipment's details.

- **Booms:** Booms are used for oil collection, deflection, containment / concentration, and protection. Boom selection for a given situation must take into account the following considerations:
 - The circumstances under which the boom will operate, i.e. weather conditions, wave heights, open or enclosed water, current speeds etc. The availability of manpower and equipment to deploy the boom.
 - The necessity of making different types of booms, compatible to each other. Booms can be deployed either:
 - In the event of an oil spill.
 - During the transfer operations.
 - Permanent deployment
 - Booms should be suitable for the operation in open sea conditions, where high currents and choppy waves can be expected
 - Booms should have adequate reserve buoyancy to operate under the above conditions.
 - Booms should have easy handling facilities and compact storage system.
 - Floating barriers should have good stability, buoyancy, and corrosion resistance for the oil spill containment solution.

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- **Skimmers:** A skimmer is a mechanical device designed to recover the oil or oily water mixtures from the surface of the water, particularly where it has concentrated in thicker layers against a boom or other obstacles. The efficiency of a skimmer will depend on several parameters such as:
 - Operator’s skill
 - Oil thickness
 - Oil viscosity or degree of emulsification
 - Debris handling capability
 - Drag in action
 - Sea state
 - Storage capabilities

People deploying skimmers should be aware of three important points: They must be selective in their choice of skimmer type. No skimmer will be 100% effective. Skimmer will generally recover a mixture of oil and water. Skimmers can be used in open seas, but it is generally considered that when waves are higher than 2 meters (6 feet), the efficiency is very low. Skimmers should be used in conjunction with containment booms to maximize recovery efficiency, because they increase slick thickness.

- **Absorbents:** Absorbents are defined as any material that recovers oil through either absorption, in which the oil penetrates into the pores of the sorbent material, or adsorption, in which the oil is attracted to the sorbent surface and then adheres to it. Absorbents are generally marketed as sheets, rolls, pillows, and booms, or in particulate form. The absorbents material can consist of natural or perlite, and most commonly, synthetic products such as polyethylene, polypropylene, or polyurethane foam. Absorbents are not used as the primary method of clean up in a large spill; rather they are usually used in the final cleanup stages to remove small amounts of remaining oil, especially along the shoreline. In addition, they are used to remove oil from areas inaccessible to skimmers and other recovery equipment. Perhaps the greatest use of Absorbents is the clean-up of small operational spills in facilities, such as refineries and plants.

The capacity of an absorbent material depends on the amount of surface area to which the oil can adhere. Some of the absorbents are treated with oleophilic or hydrophobic agents to increase their recovery capacity. Oleophilic agents attract oil, whereas hydrophobic agents repel water.

- **Dispersants:** Chemical dispersants are used to combat oil pollution by breaking up oil slicks into very small droplets. These become suspended in the water and are rapidly diluted by the turbulent motion of the sea. Dispersion of oil into the water prevents the formation of persistent water-in-oil emulsions and residues are difficult to clean up. In dispersed form, the oil is available for degradation by microorganisms, which occur naturally in the sea. Dispersants consist of two components: a blend of surfactants, which consists of emulsifiers and wetting agents and a solvent system, which acts as a carrier for the surfactants. Dispersants are designed to emulsify the oil into the water

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column in the form of oil droplets, small enough for them to remain below the surface and reform as a slick. Natural water movement then ensures that the oil is diluted in the sea, to levels, which cause no environmental problem.

“Use of Chemical/Dispersant is strictly prohibited unless authorized/permitted by ICG.”

Cairn – Suvali is equipped with limited spill combating & containment equipment as all products being handled fall outside the classification of persistent oil and probability & quantity of spillage is very low.

A Bird's Eye View: Looking for Oil Spills from the Sky

During an oil spill, responders (Tier 1 here is Cairn own oil spill response team) need to answer a number of questions in order to protect coastal resources: What happened? Where is the oil going? What will it hit? How will it cause harm? Not all of these questions can be answered adequately from the ground or even from a boat. Often, it is required to take a bird's view through aerial survey to understand the consequence of oil spill.


Aerial surveys are carried out from helicopters, which will help Cairn to find oil slicks as they move and break up across a potentially wide expanse of water. Cairn has a dedicated helicopter stationed with pilots in its Suvali onshore terminal location. Helicopter takes minimum twenty minutes to reach the platforms and maximum forty minutes flying time to take complete round about visit of CB/OS-2 Block area. Cairn has hired M/S GVHL on contract basis, who can fly in the helicopter to take an aerial survey. This survey will help to make predictions about where a spill might go, but each spill presents a unique combination of weather conditions, ocean currents, and even oil chemistry adds uncertainty due to natural variability. Aerial survey gives snapshots of where the oil is located and how it is behaving at a specific date and time, which can be compared with the oil spill model outputs. By visually confirming an oil slick's location, Cairn will be able to provide more accurate forecasts of where the oil is expected to go, which is a key component of response operations.

The oil spill responders, both at sea and sky will report critical information like location, size, shape, color, and orientation of an oil slick. They can also make wildlife observations, monitor cleanup operations, and spot oceanographic features like convergence zones and eddies etc. All of these details will help to take decisions for appropriate cleanup strategies.

4.1.1 Guidelines on use of Oil Spill Dispersant in Indian Waters

Referring to “Policy and Guidelines for Use of Oil Spill Dispersants (OSD) in Indian Waters” issued by ICG, the following measures/details mentioned below will be followed while the usage of OSD need arise.

- OSD to be used for application for operations at CB/OS-2 already comply with the requirements meeting the specification for Type II / Type III OSD application.
- Type II/III combination dispersant can be used on high spreading rate light crude oil spill, which is relevant for Cambay basin type of crude oil.

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- OSD will not be used in case of light distillate fuels spilled in sea such as synthetic oil-based mud (SOBM) used for drilling, diesel, Maritime fuel oil etc.
- OSD shall be used on weathered viscous emulsions (chocolate mousse) at sea.
- Type II OSD is water dilutable concentrate dispersant, which shall be used either by spraying from ships or boats in the diluted form (1 part of dispersant to 10 parts of sea water) in the ratio of 1 part of dispersant to 2 - 3 parts of oil (equivalent to 1 part of concentrate dispersant to 20-30 parts of oil for mainly combating offshore spills, coastline and beaches, etc).
- Type II/III (combination) concentrate type dispersant shall be used from aircraft (fixed or rotary wing) in the ratio of 1 part to 20 - 30 parts of oil.
- Type II/III (Combination) Concentrate dispersant shall be used from ships or boats using appropriate spray gear in the diluted form for combating mainly offshore, coastline and beaches spill.
- Type II/III OSD combination can be used for final shoreline cleanup after physical removal on persistent leftover hydrocarbon products.
- Before applying oil spill dispersant on spilt oil, application rate shall be calculated for effective results. For calculation refer below section.
- Before procuring the OSD, toxicity limits shall be tested for 96 hours, LC₅₀ test. It shall be ensured that the LC₅₀ test results are > 10,000 ppm. Since the OSD will be used between the distance from the coastline up to 12 NM, this requirement as per "Chairman NOS-DCP Circular No. 01/2019 dated 29 April 2019 is being complied. The OSD available is of Foamtech make, and it meets the above-mentioned NOS-DCP circular requirements.


APPLICATION OF OIL SPILL DISPERSANTS (OSD)

1. Important Factors.

- a. To achieve best results, dispersant application should be started as soon as possible and shall be planned as the first stage of a response strategy.
- b. Many oils form stable water-oil in emulsions (chocolate mousse) the viscosity of which is higher than that of the original oil. Since, chocolate mousse is very difficult to disperse; treatment with dispersants should start before the mousse formation.
- c. Dispersant application is a specialized operation that requires trained manpower.
- d. All the vessels engaged by Cairn has/shall have OSD spray arm fixed to both the sides (periphery of the vessel), these spray arms shall be connected to the OSD storage tank with pump. And also, Cairn has portable spray guns available in the vessel and nearby platforms. As soon as spill occurs, spraying operation will be initiated to maximum available time during day light hours. Vessels shall have enough OSD stocked for immediate usage.
- e. The window of opportunity can be calculated using either "Automated Data Inquiry for Oil Spills by ADIOS package and or referring to the oil spill modeling studies (trajectory details). The package requires certain data inputs including the life of oil and various other factors associated with weathering such as wind current, tidal range, and wave height.

2. Application Methods.

- a. Dispersants can be applied to spilled oil on open waters by boats or aircrafts. Whichever method of application is used, the key to a successful response is the

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ability to target the thickest part of the oil slick within a short time and before weathering.

- b. **Vessel Spraying.** Dispersants are usually applied from boats equipped with spray arms. Spray units available at Cairn are both portable and permanently installed on a vessel. Vessels offer certain advantages for dispersant spraying because they are usually readily available, easy to load and deploy, have cost advantages over aircraft and can apply dispersant fairly accurately to specific areas of a slick. Nevertheless, they also have serious limitations, particularly for larger spills, because of the low treatment rate which they offer and the added difficulty of locating the heaviest concentrations of oil from the bridge of a vessel. These problems can be partially overcome by controlling the operations from a spotter aircraft.
- c. **Aerial Spraying.** Aerial spraying of dispersant offers the advantage of rapid response, high treatment rates and optimum dispersant use. The aircraft should be capable of operating safely at a low altitude (typically 50 to 100 feet for larger aircraft) and at relatively low speeds (50 to 150 knots). Only concentrate dispersants are suitable for aerial spraying as they require no mixing.

3. Application Rate.

- a. One of the main challenges of dispersants lies in the estimation of the volume of oil to be treated and, hence, the calculation of the appropriate application rate. To achieve this, assumptions must be made concerning the average thickness and volume of an oil slick. The ratio of dispersant to oil required for effective dispersion varies between 1:3 to 1:50 depending on the type of dispersant, the type of oil and prevailing conditions. For planning purpose, the application rate can be calculated as per the below Tables and details mentioned below.
 - i) Estimation of the volume of oil (in liters/hectare)
 - ii) Calculation of the quantity of dispersant needed to achieve the dose required (liters) and the application rate (liters/hectare)
- b. As a general rule, most fresh oil on the sea surface will spread within a few hours to reach an average thickness of 0.1mm. As the thickness and the volume of oil in one hectare (10,000m²) would be:

$$10 \cdot 4m \times 104m^2 = 1m^3 \text{ or } 1,000 \text{ liters.}$$
- c. For a dosage of 1:20, the quantity of dispersant required would be: 1000 liters / 20 = 50 liters, and the application rate would be 50 liters/hectare . The discharge rate can then be calculated by multiplying the application rate (liters/ m²) by the swath width of the spraying arm (m) and the speed of the vessel/aircraft (m/s). An illustration for 8-meter spray arms is shown in the below Table 4.1.

**Table 4-1: Neat (concentrated) (Type II/III) Dispersant Application
8 mm spray arms**

Vessel Speed (knots)	Neat Application Rate (Black Nozzles) Liters/ Hectare	Neat Application Rate (Yellow Nozzles) Liters/ Hectare	Area Treatment Rate Km ² /hr.
4	430	287	0.13
6	287	191	0.20
8	215	143	0.27
10	172	115	0.33
12	143	96	0.40

Table 4-2: Diluted (Type II/III) Dispersant Application

8 mm spray arms

Vessel Speed (knots)	Application Rate Liters/Hectare (10 LPM)	Application Rate Liters/Hectare (15 LPM)	Application Rate Liters/Hectare (20 LPM)	Application Rate Liters/Hectare (25 LPM)	Application Rate Liters/Hectare (30 LPM)	Area Treatment Rate Km ² /hr.
4	43	65	86	108	129	0.13
6	29	44	58	73	86	0.20
8	22	33	44	55	65	0.27
10	17	26	34	43	52	0.33
12	14	21	28	35	43	0.40

4.2 Inspection, Maintenance and Testing

The oil spill response (OSR) equipment is maintained in highest state of operational readiness. This is achieved through a planned maintenance, inspection and testing program carried out periodically by Cairn maintenance team and also the services hired by J.V.M. Marketing Private Limited.



The maintenance schedule checklist was prepared based on the OEM (Original equipment manufacturer) recommendations. Refer **Annexure – 5**.

A record of inspection, maintenance and test will be maintained. The readiness of OSR equipment, production support vessels, spill response and dispersant capacity will be verified through regular testing and conduct of the mock drills. All personnel assigned with the task of operation are adequately trained and their level of competency is monitored during exercises. Hands on training to personnel are provided by actually deploying the equipment and checking their coordination effectiveness. Similarly, crew of support vessels are also continuously trained, and their skill is verified through participating in the exercises. Refer **Annexure - 5** for OSR maintenance log sheet formats.

4.3 Shoreline equipment, supplies and services

Shoreline response and cleanup equipment is required to be deployed to protect environmental sensitivities, if an oil spill is predicted to impact a shoreline. Cairn has stocked all the shoreline oil spill prevention and response equipment inside two nos of 40 feet and 20 feet containers stored at Suvali onshore terminal at Surat village. Thus, when need arises, these containers can be loaded to the trailer and transported to the required shore location. Following equipment and supplies are maintained at Suvali onshore terminal. Adequate number of boats and manpower including equipment can be made available at Suvali within about 2 hrs.

- Dispersant chemicals
- Bioremediation
- Flex barges
- Integrated contaminant cum recovery system with powerpack
- Sorbent boom reel and pads
- Shoreline sealing boom
- Mini vacuum pumps and liquid handling pumps

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- VOC monitors,
- Spades, shovels, scrapers, buckets, rakes, ropes, lines, and Zodiacs
- Key PPEs such as SCBA, gloves, disposable suits, chemical protective suits, helmets/hats, safety shoes, coveralls, goggles etc.
- Cleaning material, rags, soap, detergents, brushes, hot water generator with high pressure jets.
- Plastic bags (heavy duty) for collecting oily debris.
- Heavy duty plastic sheets for storage areas as temporary storage pits.
- JCBs for making access/approach
- Tents and temporary sheds/huts
- Food and provisions for the people
- Medicines and first aid boxes
- Communications (radios/VHF, mobiles) to the site crews
- Cameras for photography
- Anchors, buoys
- Lamps and portable generators
- First aid material
- IMO level trained manpower


Adequate Pollution Response equipment during drilling campaign, would be placed in the Adani port.

Equipment handlers are local contractual manpower, who are employed in Cairn Suvali Terminal and staying in the nearby villages and Surat city. The workforce consists of skilled, semi-skilled and unskilled manpower. Since this workforce belongs to the local coastal villages/residents, they are aware of local road route, sea behavior, beach details etc., which are crucial to take up cleanup activities.

The quantity and nature of equipment/tools are adequate to handle the spill scenarios. People, who can be mobilized for shoreline cleanup are identified and their contact details are maintained in the data directory.

Mobilization time for oil spill equipment

- As soon as intimated, it will take at least 02 hours for the vessel/tugboat, truck trailers to be available.
- Loading of the OSR equipment's by arranging manpower and hydra / crane requirement in Terminal will take 03 hours.
- Distance from Terminal to Adani Port will take 01 hour of time.
- It will take 02 hours in the Port to complete the loading of OSR equipment's considering the customs clearance, berth availability etc.
- It will take 02 hours to reach the offshore spill location from Adani Port considering the Tide plan of the day.
- Thus, in total it will take minimum 8 hours for the Vessel to reach the oil spill location along with the OSR capable equipment's.

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Local Vendor details for shore cleanup: The detail list of local vendor/suppliers for shore clean up equipment and provisioning of additional manpower is mentioned below and refer Appendix – G for the complete contact details.

Table 4-3: Local vendor/suppliers for shore clean-up equipment

Name of the local vendors/suppliers with full contact details	Description of the activity	Equipment available details	Remarks
M/s CTPL Industrial Services Pvt. Ltd., 417, Orange Mall, Near Sharda Petrol Pump, IOC Circle, Chandkheda, Ahmedabad, Gujarat – 382424 Attn: Mr. Khetmal Bothra Email: info@ctplservices.com Mobile – 99099 53367	Supply of material handling equipment and earth moving equipment	Poclain, Tractors, Tippers, Forklift, Boom Lift, Crane, Trailers, Dumpers, JCB, Tractors etc	Current contract is valid till 21 st January 2023. New contract will be tendered and awarded after its validity expire.
Mr Mittan Parmar M/s Ranjit Petroleum 312, GIDC Rd, Beside Om Pippadiya Hanumanji Mandir, Ghanshyam Nagar Society 2, Manjalpur, Vadodara, Gujarat 390011. Mobile – 9898615166	Supply of earth moving equipment	Fighter Vehicle available to combat oil spill	Current Contract valid till 30 th April 2022.

Table 4-4: Local vendor/suppliers for shore clean-up equipment

Name and Address of the Contractor/Agency	Maximum no of Contractor Workers Employed	Email Address	Contact Number of the Agency/ Contractor
M/s ANI Integrated Services Limited 624, A Wing, Lodha Supremus, 2, Wagle Estate Rd, Thane, Maharashtra 400604	16	hirenpanchal@gmail.com ;	022-6156-0404
M/s SACH E&I C - 2, Maheshwari Apartment, B/s T & T.V. School, Timaliyawad, Nanpura, Surat - 395001. Gujarat, India. +91 99099 81191	17	karriram2007@gmail.com ;	9849679566
M/s Aarvi Encon 79, Productivity Rd, Anand Nagar, Haripura, Vadodara, Gujarat 390007	35	info@aarviencon.com	7007927698

Note: All these manpower stays within 10 km radius of the Suvali Terminal and the contract validity is up to 30th April 2022.

5.0 Management

Management of the oil spill response operations will be undertaken by a Spill Management Team. The Spill Management Team comprise of three different tiers of personnel based at different locations:

- Spill Location Incident Response Team (IRT)
- Gurgaon Emergency Management Team (EMT)
- Gurgaon Crisis Management Team (CMT)

5.1 Crisis Manager and Financial Authorities

Leadership for managing the response is very essential in emergency management. For each level of response, the team leads are identified who are authorized with delegated powers of response. Cairn's approach to an oil spill is based on the following:

- Tactical response to a spill will be carried out by the operating unit where the emergency is located.
- The incident controller here referred as Crisis Manger, will be responsible for coordinating the on-site tactical response to an oil spill Emergency.
- The emergency Management Team is responsible for mobilization of equipment, materials, services, and technical support as required in support of onsite spill response team and will manage follow-up actions.
- Communications will be timely and accurate in the event of an oil spill.
- All the necessary support will be provided as per the stablished procedure and there is no necessary for await of any financial approval during the emergency situations. The Crisis manager will have necessary financial authority in executing the action plan. He will take the necessary support from the relevant authorities, if required any financial approval.

5.2 Incident Organization Chart

Cairn Oil & Gas emergency management procedure follows a three-tiered emergency management system. The broad functions and responsibilities of three tier system consist of IRT, EMT and CMT are depicted in the Figure 5.1.

Incident Response Teams (IRT) – Operational Response

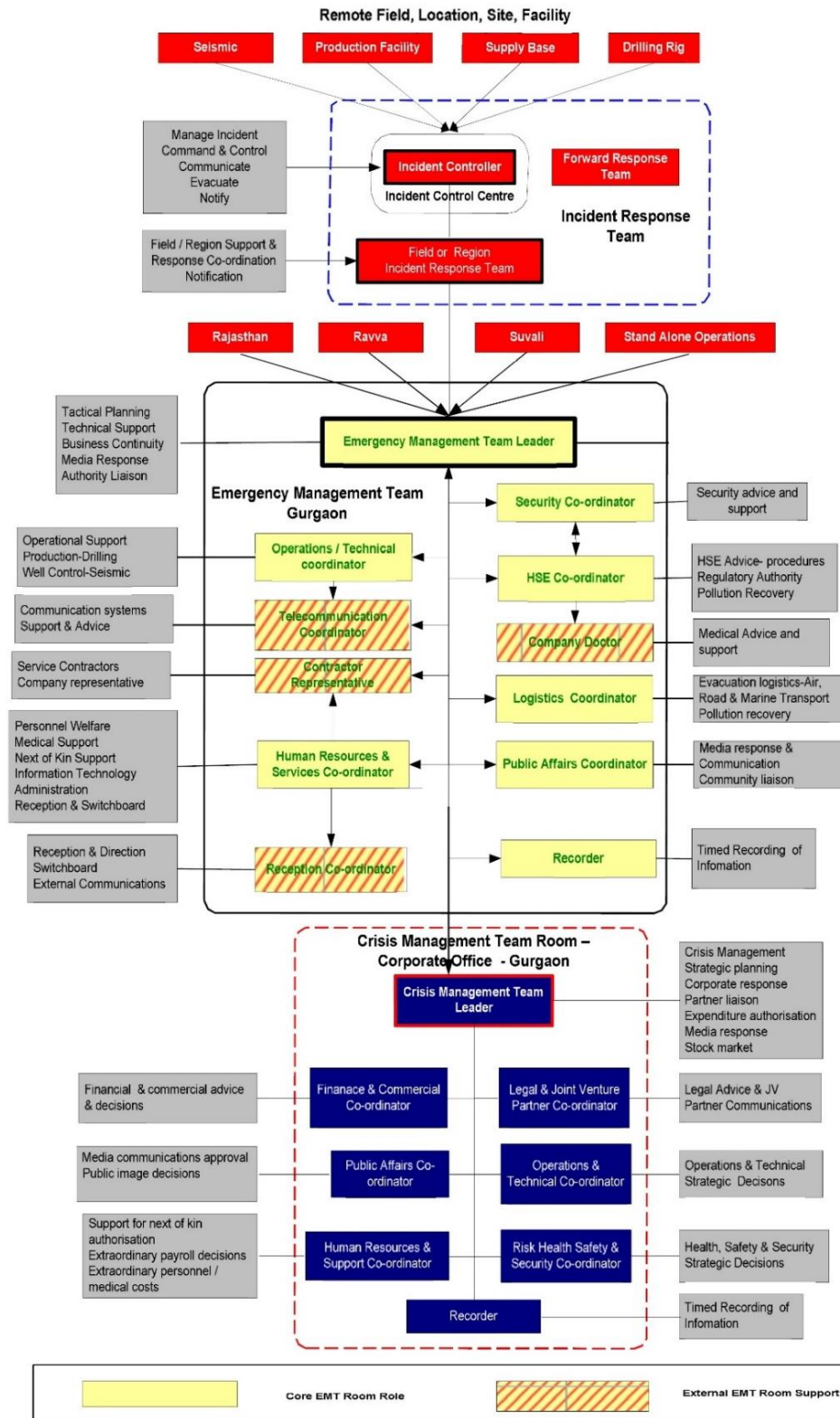
Each Incident Response Team will comprise a:

- Incident Control Team, (ICT) responsible for management and control of the incident and.
- Forward Response Team (FRT) responsible for at the scene response.

The IRT has responsibility for dealing with all incidents and emergency situations which may occur at or within their area of operation. Where additional support in the way of resources and advice is required by the IRT, this will be requested through and provided by the Emergency Response Team (ERT). Technical support will be provided from the Gurgaon office through the Emergency Management Team (EMT).

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Figure 5-1: Vedanta Limited (Cairn Oil & Gas) Emergency Tiers



Suvali Incident Response Team will be responsible for responding to and managing incidents or emergencies at their location. The leader of the Incident Control Team will be the appropriate Site Manager, depending on the situation such as Operations Manager / Marine Manger / Logistic Manger etc. Other members of the Incident Control Team will be: Site Manager, HSE Coordinator, Environmental Engineer, Radio Officer, Medical Officer, Muster Controller, Scribe. The Forward Response Team comprise of Forward Controller and Fire/Rescue Team

Emergency Management Team (EMT) – Tactical Response

The EMT is located in the Company’s head office in Gurgaon and in Suvali Terminal, Surat. EMT is responsible for providing support and the tactical response to any incident or emergency situation to all the sites, locations and for managing any incident or emergency. At any time, the EMT duty manager may decide to mobilize the EMT and take overall command of any incident or emergency situation.

Each EMT members have defined emergency roles and responsibilities with the appropriate experience within that role. In most cases the emergency response role is in line with their personal job role. In the event of an incident or emergency, the EMT duty manager will decide whether or not to mobilize the EMT. If the decision is taken to mobilize the EMT then all EMT duty personnel are required to proceed promptly to the Emergency Command Centre (ECC) and to implement actions in accordance with their role, responsibility and as directed by the duty EMT Leader. The EMT is comprised of the following roles and responsibilities:

1. **EMT Leader** – Overall in-charge including financial authorization. Responsible for Cairn tactical response to all emergency situations.
2. **Human Resources & Services Coordinator** – Responsible for providing human resources (HR) and Services advice and support.
3. **Business/ Financial Coordinator** – Responsible to ensure the funds available for any oil spill crisis
4. **Logistics Coordinator** – Responsible for providing transport and logistics support as required.
5. **Operation and Technical Coordinator** – Responsible for providing operational and technical support and advice.
6. **Public Affairs Coordinator** – Responsible for providing public affairs and M/s Vedanta Limited (Division: Cairn Oil & Gas) media response.
7. **HSE Coordinator** – Responsible for providing health, safety, environmental and security support, and response.
8. **Environmental Manager** – Responsible for providing information related to environmental aspect of the region and possible impacts that may cause due to the oil spill.
9. **Recorder** – Responsible to the ERT manager for maintaining a timed log of key events and actions.
10. **Reception Coordinator** – Responsible to the HR and Services Coordinator for managing the switchboard and reception.

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11. **Security Coordinator** – Responsible to the HSE Coordinator for providing office security and assisting Reception Coordinator.
12. **Telecommunication Coordinator** – Responsible to the HR and Services Coordinator for receiving and directing external communications to appropriate recipients.

Crisis Management Team (CMT) – Strategic Response

The Crisis Management Team (CMT) will also be based in M/s Vedanta Limited (Division: Cairn Oil & Gas) head office in Gurgaon and SBU Offshore office at Surat, Gujarat, and will be responsible for:

- Providing strategic response assistance, support, and advice to the EMT
- Notifying international authorities, shareholders, JV partners, and financial institutions
- Co-ordinating and approving all media releases, issuing international media releases
- Authorizing extraordinary expenditure
- Deciding on the course of action in the event of an emergency such as oil spill
- Providing legal advice and response

Incident Control and Emergency Response Centers

Suvali Terminal site emergency organization is headed by the Incident Controller (or appointed deputy), who has overall responsibility for the safety of all personnel on the site (in most of the cases it will be the Field general manger or Installation Manger or Mines Manger). The Incident Controller will also be responsible for co-ordination of response covering incidents affecting the site accommodation and administration.

Emergency Response Centre (ERC)

The Emergency Response Centre (ERC) will be based in Suvali Terminal and will have a designated Control Centre. The ERC will be manned by the Emergency Response Team Leader and his/her team during any incident.

5.3 Manpower availability (on site, on call)

Cairn will ensure the required manpower for all the OSR activities are available. The Cairn operates round the clock with people working, thus, the necessary manpower is always available. Maintenance of oil spill equipment is carried out by Cairn maintenance team and also specialized support by third party contractor on quarterly basis. The HSE Department will look after the training and exercises part as well. However, departments/ agencies aiding of watercraft/ vehicles, mobile cranes, forklifts etc., for movement of men and material would provide necessary crew and their replacements as required in order to continue the OSR operations uninterrupted.

5.4 Availability of Additional Manpower

Any requirement of additional manpower will be ensured by Cairn. HR Department, who will be maintaining a list of trained manpower available with various departments and also casual workers who can be utilized for shore

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clean-up operations or as deemed fit. It is pertinent to mention here, that while utilizing such people for this type of job it would be better to scrutinize/ screen such people of their suitability for skilled and unskilled work well before hand. Preferably this work is undertaken during Mock Drills so as to ensure availability of a dependable additional work force apart from the designated workforce.

As desired, Cairn will also source additional trained manpower from its other offshore operational facilities in Ravva, Andhra Pradesh and Bhogat, Gujarat. If required, Cairn will also take help of the other oil and gas operators as per MOU with Reliance Industries, Adani Hazira Port, Essar Terminal etc.

5.5 Advisors and experts – oil spill response, wildlife, and maritime environment

Cairn has access to the national/ international advisors/ experts in the areas of oil spill response, oil spill response equipment manufacturers, OSD manufacturers, wildlife, maritime and pollution control, oil spill response service providers. Cairn has associate membership agreement with M/s. Oil Spill response Ltd. (OSRL), Singapore to mobilize technical experts/ advisors, OSR equipment and trained manpower in case of Tier-3 emergency.

In addition, Cairn has dedicated environmental and Marine operation team located in Surat, Gujarat, for immediate assistance. Cairn also has established relationship with external stakeholders such as Gujarat Forest department, Wildlife institute, Dehradun, TERI, NIO - Goa etc., for their technical expertise.


Table 5-1: Advisors and Experts contact details

S. No.	Area/Field of Expertise	Contact Details	Remarks
1	Physical Oceanography Study / Oil Spill Dispersant Study; and Marine Ecology Expert	Mr. Sudheesh. K / Dr. Sanil Kumar National /Institute of Oceanography Dona Paula, Goa – 403004 Tele: +91- 8322450350 Email: sanil@nio.org ; sudheesh@nio.org	Cairn have carried out various studies in past through NIO, Goa. As need arise, expert study/view can be obtained.
2	Wildlife Conservation	Dr. Bilal Habib Head, Department of Animal Ecology & Conservation Biology, Wildlife Institute of India, Chandrabani, Dehradun, Uttarakhand – 248 001 Tel: 0135 – 2646283; Mobile: 09410992233, E- mail: bh@wii.gov.in	Cairn has already engaged with Wildlife Institute for conservation program.
3	District Forest Department	Chief Conservator of Forest – Surat, Chief Conservator of Forests, Van Bhavan, Shivaji Chowk, Gangeshwar Mahadev Road, Adajan, Surat-395009 Tel: 0261-2733821 Email: cfsurat@gmail.com	Surat district Forest department
4	Bioremediation Study/ Enzyme supply expert	Dr Banwari Lal Senior Director, Environmental & The Energy and Resources Institute Darbari Seth Block, I H C Complex Lodhi Road, New Delhi- 110003 Mobile : +91 9999797238/8860019555 Email: banwaril@teri.res.in	Product: Oilzapper and Oilivoros-S is used for bioremediation and is readily available for usage.

S. No.	Area/Field of Expertise	Contact Details	Remarks
5	Tier-3 Oil Spill Response	Mr. Darren Waterman, Regional Director, Oil Spill Response Limited, Loyang Offshore Supply Base, 25C Loyang Crescent, Mailbox No. 5105, Block 503 TOPS Avenue 3, Singapore 506818. Tel: +65 6266 1566 Email: darrenwaterman@oilspillresponse.com	Valid Contract in place till Feb 2023.
6	Oil Spill Modelling / Trajectory spill modeling study	Dr. G.S.Reddy, Managing Director, Environ Software (P) Ltd #60/4, Environ Towers, Electronic City, Bangalore -560100 Tel:+91-9845294052 Email: environ@environsoftware.com	Cairn have engaged Environ Software to carry out the numerical oil spill modelling study for Ravva Terminal activities.
7	Coastal and Marine Ecology including Mangroves Expertise	Dr. Logesh A. RAJA Scientist, Coastal and Marine Ecology Division Gujarat Institute of Desert Ecology PB#83, Mundra Road, Bhuj- 370 001 (Kachchh), Gujarat Ph – (O) – 02832-239027, Ext: 25 Email: desert_ecology@yahoo.com	Gujarat Government institute working in the areas of Terrestrial ecology; Coastal and Marine Ecology; Environmental Impact assessment; and Natural Resource Management
8	Working with mandate for enriching the environment for the Gujarat State.	Envis Coordinator, Gujarat Ecology Commission Block No: 18, 1st Floor, Udhyog Bhavan, Sector: 11, Gandhinagar – 382011 Phone: 079-23257656/58/59 Email: guj-env@nic.in ; mail@gecgujarat.org	Gujarat Ecology Commission works in the area of pollution control, environmental upgradation and improved ecological management of the State.
9	Pollution Prevention equipment manufacturer	Mr. Jan Hove Elastec 1309 West Main, Carmi, IL 62821 USA Phone: +1 (618) 382-2525 E-mail contact@elastec.com	Absorbents; aerial surveillance; Booms, barrier & accessories; fire boom; dispersant application; oil skimmer, power units etc.
10	OIL & HNS Spill Response Team - 1	Viraj Clean Sea Enterprises Pvt. Ltd Unit No.348, 3rd Floor, Building No.1, Edison, Plot-GEN-2/1/C, Raheja Universal Dist-II, Jui Nagar, Navi Mumbai-400705. Tel.:(22)20870348 Mobile 8451046877 Eail: info@virajcse.com	Provide services and experts for oil spill response.
11	OIL & HNS Spill Response Team - 2	Mr. Digvijay Velapure Head – Oil Spill Response Business Unit, JVM MARKETING PVT. LTD., 6/205, Jogani Industrial Complex, Sion-Chembur Road, Chunabhatti East, Mumbai - 400 022 India. Tel.:+91-22- 2405 4883 / 2405 1572 / 2405 4503 Mobile: +91-9323812109 Email: digvijay@jvm.co.in	OEM and service provider for maintenance of oil pollution response equipment. Contract is available to carry out periodic maintenance of the oil spill response equipment.

5.6 Training/ Safety Schedules and drill/ exercise program

A list of trained personnel would be made available and will be maintained by HSE team. Training need assessment will be carried out to map the competency levels of the OSR team members and based on the gap assessment, the training need assessment will be identified and conducted through internal and external agencies. Cairn will ensure that it has sufficient trained resources

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on oil spill as per IMO L1/ L2/ L3 for the potential oil spill. OSR mock drill will be conducted as prescribed by NOSDCP 2015.

Table 5-2: Training requirements for personnel involved in OSR

Team members	Role in oil spill emergency response	Functional training requirement	Frequency of training	Training imparting institutes
All personnel involved in the IRT, EMT and CMT organizational charts	Direct and supportive roles in contingencies	Basic awareness training on the oil spill impacts and response	One time	In-house, IMO approved training course or with the help of ICG
IRT and EMT Leaders and their alternates	Direct responsibility for coordinating the spill response	IMO Level 2 and 3 training courses	Induction followed by once in 3 years	M/S OSRL, Singapore
IRT and EMT team members	Involvement and support in strategies and tactical management of response	IMO level 2 training	Induction followed by once in 3 years	M/S OSRL, Singapore AMET University, Chennai with ICG
HSE coordinators	Guidance on spill movement and consequences	Oil spill trajectory modelling and simulation (with software)	Induction with the software and refresher every year	Envirosoft, Bangalore / Oil map, UK
Public affairs coordinators	Media management	Media management during major emergencies	Induction followed by once in 2 years refresher	M/S OSRL, Singapore
Marine crew of vessels	Deployment of equipment – First responder	Hands on training on deployment of booms, skimmers, and dispersant sets. IMO level 1 course	During every mock drill	AMET university with Coast Guard M/S OSRL Singapore
Coastal clean-up crew and fire teams of Suvali terminal	Sensitivity area protection, cleanup of coastline and disposal of wastes	Techniques of clean up, environmental sensitivities and practices of wastes handling from spill sites	During every mock drill	AMET University with Coast Guard. Environmental consultants

Effective oil spill preparedness and response are based on the systematic assessment of oil spill risks, considered within the appropriate operational setting, and referencing the ecological and socio-economic resources which may be threatened. This assessment will lead to the establishment of capability commensurate with these risks in the form of emergency organization, procedures, trained personnel, oil spill combatting equipment and logistical support. Oil spill contingency plans are the primary tools to ensure that the established capability is managed and coordinated, within a framework for integrated response between all relevant organizations. Oil spill exercises encompass those activities through which personnel can practice and check oil spill contingency plans and their incorporated procedures. This can

encompass incident assessment and decision making, working together with external organizations, mobilization or deployment of equipment and the development of personnel competence through continual improvement. A program of exercises for either an organization or facility is a fundamental tool to both verify and improve the effectiveness of oil spill preparedness and response capabilities

The drill exercise program will also provide an opportunity to deploy the OSR equipment's in sea. Exercise activities will be undertaken using a variety of methods, as listed below. Examples of the durations of delivery for each method are indicated in brackets (these times exclude the planning and preparation, which may be significant): Discussion-based activities; Seminar (1–2 hours); Workshop (2–8 hours); Tabletop (2–4 hours); Operations-based activities; Drill (4–8 hours); Functional exercise (4–8 hours); and Full-scale exercise (8–16 hours). Refer Table 5.2 for details pertaining to Annual mock drill tentative plan

The methods described are based on ISO 22398:2013; An exercise program is likely to encompass a mix of these methods, commensurate with the program objectives and requirements of the oil spill contingency plan. The approach is likely to be progressive, with discussion-based exercise activities preceding operation-based activities within the program.

Safety Schedule: As part of the training and periodic tool box talk with all the manpower to be involved in the oil spill response need to be made aware regarding the safety aspects such as possible health impacts that may be caused while handling the marine oil spill clean-up activities, coastal clean-up practices etc., to be made aware of the MSDS of the chemicals or enzymes they would be handling as part of bioremediation, washing etc. Safety awareness training will be arranged with reference to National Institute of Environmental Health Sciences for "Oil Spill Cleanup Initiative - Safety and Health Awareness for Oil Spill Cleanup Workers" as per OSHA requirements published June 2010.

Drills: A drill is a coordinated, supervised activity usually employed to validate a specific function or capability in a single organization or agency. Drills are commonly used to provide training on new equipment, validate procedures, or practice and maintain current skills. For example, a drill may be used to test the notification and alert procedures within an oil spill contingency plan. A drill is useful as a stand-alone tool, such as to test or verify a tactical booming plan to protect a sensitive shoreline resource. The drills will be carried out as mentioned in the annual HSE plan for mock drills. It will be ensured that drill will be carried out before starting up of any new drilling campaign, offshore construction activities etc.

Exercise Planning: The four phases of the exercise planning process are defined as follows:

1. **Design:** the design phase sets the specific exercise objectives and scope and sets out the timetable necessary for completion of the event.

2. **Develop:** this describes those steps that are taken to create the exercise, and to fully prepare for, and organize, the related activities. This phase must consider any public affairs/media aspects of the exercise.
3. **Conduct:** the exercise consists of the initiation of play and its maintenance by simulating, monitoring, controlling, and facilitating activities to ensure that the exercise remains within the design parameters. It also involves documentation of the participants' activities and conclusion of the exercise.
4. **Evaluation/review:** the review phase consists of collecting and analyzing data, documenting findings, and recommendations for improvement, and ensuring feedback to management. As the oil spill contingency plan is revised and updated, the exercise program is similarly adjusted to consider the lessons learned from prior exercises.

Table 5-3: Annual mock drill tentative plan

Quarter	Mock Drill	Process Emergency Drills
April to June	Terrorist Activity - Offshore	Total Plant Black Out
	Gas Leak at inside the terminal(Multiple Scenario Drill)	
	Storm threat / Torrential Rains	
July to September	Helicopter Crash or missing- Tabletop exercise	Helicopter Incident
	Fire / explosion + Personnel by Medevac - offshore	Well Control Incident
	Work at height / confined space rescue	Rescue plan
	Fire in the plant area	Fire in LQ
October to December	Mob attack at Onshore Plant	Liquid Carry over to flare and resulting in Fire
	Man overboard - Injury and Medevac from Offshore / Man-overboard from Offshore Platform	
	Pipeline Leakage at Village Pipeline corridor - Offsite Mock Drill	
January to March	Vessel Collision to Offshore Platform leading to Fire / Explosion at Offshore Platform	Loss of flare ignition
	Oil Spill equipment deployment/desk top exercise	
	Road transport accident - chemical transport trucks	
During drilling	Oil leakage / explosion during drilling - various oil spill scenarios shall be considered.	Marine oil/ SOBM/ Diesel spillage
Mutual aid drill	One to two drills in association with the mutual aid partners based on various scenarios (either Cairn will participate in other partners drill or scenario will be in Cairn and other will participate)	In coordination with or without OISD / ICG Requirement for Oil Spill Response at Offshore / OSRL / Cairn Internal

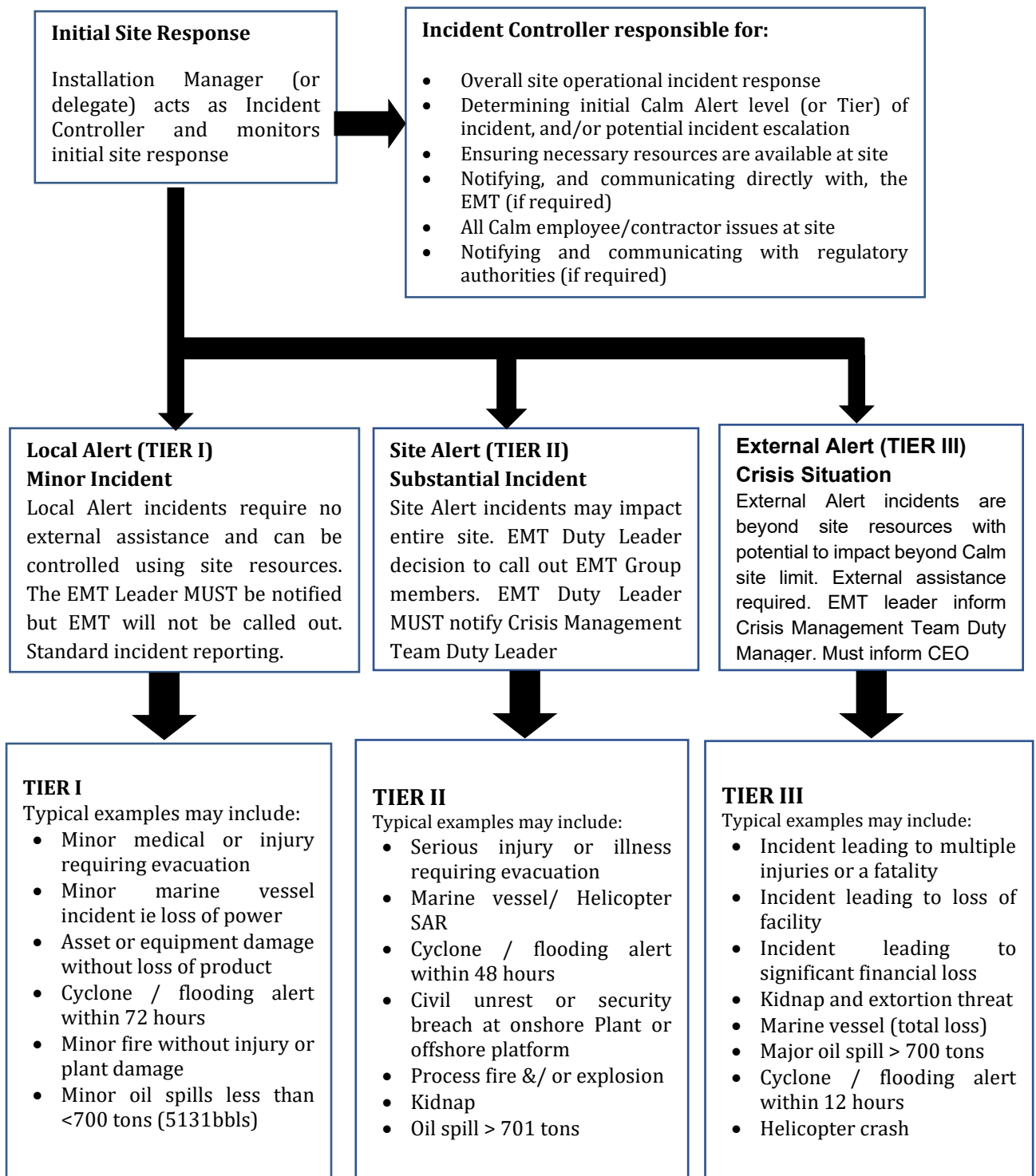
Note: The above is the tentative incident categories considered as part of the mock drill plan for every year. The actual incident to be considered for the mock drill will change and will be decided during the annual HSE plan preparation. Some of the incidents mentioned above may be dropped or new incidents can be added depending on the need/requirement of the time.

Table 5-4: OSR - IMO Level Trained Manpower Details at Vedanta

IMO Level Training	Name	Designation	Training held on	Training valid till	Training conducted by
IMO Level - 1	Senthil Murugan	Manager - Prod.	2018	2023	ICG, VADINAR
	Vijayanand S	Sr. Er. Mechanical	2018	2023	ICG, VADINAR
	Ram Niwas Yadav	Diving Supervisor	2019	2024	ICG, Chennai
	Jagvir Singh	Diving Supervisor	2019	2024	ICG, Chennai
	Vijay Kumar	Mooring Supervisor	2019	2024	ICG, Chennai
	M. Venkatesh	Manager – Vessel	2019	2024	ICG, Chennai
	Navin Kumar	Oil Spill Responder	Oct 2019	04 Oct 2022	Viraj Clean Sea
	Radhey Shyam	Oil Spill Responder	Jan 2021	20 Jan 2024	Viraj Clean Sea
	Shyam Gariya	Oil Spill Responder	Jul 2018	27 Jul 2021	Viraj Clean Sea
	Rahul Parmar	Air Diver	Jan-2020	Jan-2023	Viraj Clean Sea
	Praveen Kumar	Air Diver	Jan-2020	Jan-2023	Viraj Clean Sea
	Harwinder Singh	Air Diver	Jan-2020	Jan-2023	Viraj Clean Sea
	Shailender Singh	Air Diver	Jan-2020	Jan-2023	Viraj Clean Sea
	Anuj Rana	Air Diver	Jan-2020	Jan-2023	Viraj Clean Sea
	Pawan Kumar	Air Diver	Jan-2020	Jan-2023	Viraj Clean Sea
	Anil yadav	Rigger	Jan-2020	Jan-2023	Viraj Clean Sea
	Virendar Singh Rathore	Air Diver	Jan-2020	Jan-2023	Viraj Clean Sea
	Sawar Mal	Bosun	Jan-2020	Jan-2023	Viraj Clean Sea
	Manoj Kumar	Diving Seaman	Jan-2020	Jan-2023	Viraj Clean Sea
	Alok Singh	Diving Seaman	Jan-2020	Jan-2023	Viraj Clean Sea
IMO Level - 2	Rohith K V	Deputy Manager HSE	Aug-2018	Aug-2023	AMET & ICG
	G S Lavanya	Sr. Engineer HSE	Aug-2019	Aug-2024	AMET & ICG
	SV SINGH	Diving Supervisor	Jan-2020	Jan-2023	Viraj Clean Sea
	Shashi Kumar	OSR Supervisor	Jul-2020	Jul-2023	Viraj Clean Sea
	Sunil Kumar	OSR Supervisor	Mar-2020	Mar-2023	Viraj Clean Sea
	Pankaj Kumar	Sr. Responder	Jan-2019	Jan-2022	Viraj Clean Sea
	M.Yuvaraj	Deputy Manager HSE	Aug-2016	Aug - 2021	AMET & ICG
	Sanjay Lipane	Sr, Engineer Marine	Aug - 2017	Aug - 2022	AMET & ICG
	Agnelo Thompson	GM Operations Vessel	Jan-2019	Jan-2022	Viraj Clean Sea
	A. Kumaresan	Manager Operations Vessel	Jan-2019	Jan-2022	Viraj Clean Sea
IMO Level - 3	Srihariprasad Reddy	Installation Manager	Aug-2015	-	OSRL
	Jacob Mathew	President Offshore	Jun-2011	-	LAMOR
	Manish Joshi	DGM Maintenance	Aug-2015	-	OSRL
	M Gopala Rao	Sr. Mgr. Marine	Aug-2015	-	OSRL

Note: The list was updated on June 2021. Training is ongoing activity.

Figure 5-2: Emergency Response action plan flowchart (Tier based)



Note: Oil spills- Tier-1: Though 100 tons)of oil spill is classified as Tier I as per National / Coast Guard definitions, 100 tons oil spill or even spills of lesser volume may involve calling out the EMT, seeking external support to handle the oil spills, handling media etc.

6.0 Communications

6.1 Incident Control Room and Facilities

Cairn Oil & Gas has emergency response communications system to connect with Suvali terminal, offshore platforms, and also Vedanta corporate office at Gurgaon. This system includes mobile telephones and VHF radio. Tactical communications will be the responsibility of the Emergency Response Team (ERT) Leader and the Radio Officer. A dedicated communication center (referred as incident response Centre) is already set up at Suvali Terminal. The communications network includes the following systems:

Radio Room: A radio room with experience Radio Officer working round the clock is already available. He maintains the logbook of actions and communications as per the protocol. The location and telephone number(s) of the Radio Room and other key members are made available to all the persons on the weekly update.

Incident Control Room: The room for the Emergency Management Team (EMT) and Crisis Management Team (CMT) at Gurgaon Office of Cairn is equipped with state-of-the-art communication systems.


Mobile Telephones: Cairn personnel's and contractors assigned to media/public relations duties during an incident will be issued through mobile telephones

Press Room with Telephones: If the incident is of sufficient magnitude /sensitivity, a pressroom will be established. The pressroom will have access to temporary telephone lines.

VHF/UHF: Every vehicle operating onshore will be equipped with a handheld VHF radio with dedicated channel.

Aircraft (ground to air): The crew members are provided with VHF radio, which have appropriate air-band frequencies enabled for communication with helicopters, radio officers etc. The same will be extended during any aerial survey or other purpose towards oil spill event.

Other details availability: The other facilities available with the incident control room includes maps (shore and navigation), daily weather update, weather forecast, bathymetric details (Refer Figure 11.4 for bathymetry details) of the Suvali block area, oil spill contingency plan copy, video conferencing facilities – provision to connect any facilities, OSRL Singapore contact details, contact details of all Cairn staff including contractors, IMO trained personnel details on oil spill response Level -1,2 and 3, subsea diver agency contact details, Cairn other offshore asset contact details such as Bhogat terminal key personnel, other expert agency details such as well control, ICG contact details, Tier – 2 Memorandum of Agreement copy and the organization contact details etc.

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6.2 Field Communications Equipment

Reliable communications equipment and support are available for use during an emergency situation and enable communications to be made throughout the onshore and offshore operations, the regional emergency Centre and Gurgaon. The dedicated radio room is located in Suvali terminal. Communication facilities include the following:


- VHF / UHF radios
- HF Single Side band (SSB) facility
- Voice Over Internet Protocol (VOIP) phones
- Analog phones at all platforms and terminals
- Mobile phones (designated places in the operations sites)
- Public Address and General Alarm (PAGA) System at terminal.
- General Alarm System (as part of PAGA) with 3 different tones for emergency alerting / evacuation of personnel.
- Emergency siren.
- Helicopter communication established using VHF frequency, VHF MMB etc.

Communication is already established round the clock through Radio Officer connecting base and marine locations such as support vessels, helicopter, offshore platforms, port, warehouse etc. Details of emergency numbers and contact details are available at key locations of the operational area and the same is circulated to all the emergency Rota members. Suvali communications Centre be manned by a competent radio operator, who is responsible for maintaining communications with all sections of the IRT and the ERT and for passing on information as required to the Incident Controller.

All personnel who are issued with communications equipment such as VHF Radios, mobile telephones are competent in its use and familiar with emergency communications procedures such as usable channels, telephone and alternative systems and procedures if primary system fails to raise help.

6.3 Reports, Manuals, maps, charts, and Incident Logs

From Oil Spill Report Form it is to be ensured that the basic information required to formulate a response strategy to combat offshore emergency is obtained. Refer **Annexure - 7** for forms to be notified related to oil spill. The Installation Manager will complete the Emergency Report Form and forward it to ERT coordinator. The Personal Log Forms (and Continuation Sheets) allow all personnel involved in the emergency response to maintain a personal log of events. The personal Log forms and the Continuation Sheets are to be used during the emergency response to record the contacts and actions carried out during the emergency. After "stand-down" the Personal Log Form and the Continuation Sheets, are numbered, signed, and handed over to the Head Operations. All incident logs and records will be maintained.

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7.0 Initial Procedures

Oil spill is being identified as one of the emergencies in the potential list of emergencies as part of the Suvali operations. The initial activation of emergency plan commences from the site level irrespective of the magnitude of the event. Since not all the emergencies lead to oil spills, the activation of emergency response is oriented towards the required technical and operational mitigation. Cairn's Emergency Response Plans at the site will take the precedence to the oil spill response plans in the initial events.

7.1 Notification of oil spill to Concerned Authorities

A trigger to activate emergency response can be done by any individual either working in company roles or in contractual arrangements based on his initial observations or inferred potential threats in the process or hazards involved in operations. The escalation of emergency from the observer to the ERT leader/ Incident Controller must be fast and unhindered.


Notification of the oil spill event: Apart from the media, communications with the other internal and external stakeholders are to be managed effectively during emergency management. Such communications include notifications of incidents, updating of status of response, damage and damage control measures adopted etc. Notification of the oil spill event shall be carried out as per the Spill Notification Proforma for Oil and HNS Formats mentioned in the **Annexure - 7**. The notification shall be issued to the authorities as mentioned in Section 7.3 of this OSCP. It is essential that specific information relevant to the authority/stakeholder needs to be screened and forwarded by the respective functional coordinators (HSE, Legal, Corporate communications, etc.) through their defined channels after approvals from EMT/CMT leaders.

Communication of the oil spill event: Following communication channels will be used by the individuals at the work site to communicate emergency:



- Shout about the event – viz., leak, spill, fire, gas release, collapse, fall, etc. depending on the event so as to catch the attention of others in the vicinity.
- Hand signals: When the working personnel are at a distance viz. between the decks of a platform or near process equipment, the audible signs may not be effective. When there is no other means of communication, hand signals shall be used to convey the above events.
- Walkie-talkies and other marine communications: when the individuals have communication facilities viz. walkie talkie, mobile etc, the details of the incident shall be communicated to next higher position.

Once the nature, source & quantity of oil spill is assessed then the following procedure will be followed for notifying the oil spill

1. In the event of an oil spill, the spill observer will alert and notify the concerned authorities of the spill. The spill will be reported to the On-Scene Commander/ Incident Controller (IC). Preliminary information on the location of the spill, spill size, oil type, release rates and any injuries will be

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- provided to the IC (**Annexure - 7** Prescribed Formats). The IC will thereafter notify the EMT Leader. In case the EMT is activated, the Crisis Management Team Leader will be notified.
2. A preliminary estimate of the response will be undertaken by the IC. The IC will allocate appropriate Tier level using guidelines. Onsite Incident Response Team (IRT) will be activated for Tier 1 spills while EMT (Gurgaon/Suvali) will be activated for Tier 2/3 spills.
 3. The spill event will also be reported to the Adani Port Authority, Indian Coast Guard, and other relevant authorities by the EMT Leader, in the prescribed formats (refer **Annexure - 7**). The EMT Leader and IC will also have the responsibility to manage and mobilize external resources. If required, the EMT Leader will liaise with EMT (Gurgaon) for information and support requests.
 4. The IC will collect information on the oil type and sea/ wind forecasts of the region, which will assist in handling the spill. Aerial surveillance will be initiated if required to assess the extent of the spill and record the size and location of the slick. The response team deployed onshore in the case of spill reaches the shore will also be instrumental in generating reports.
 5. The fate and movement of the slick will be estimated as part of the initial response actions. Assessment of oil slick trajectory will be undertaken as following:
 - a. Obtain information on tides, direction / speed of current and wind. These information is collected periodically by Radio Officer.
 - b. Using the information on current and wind, predict the trajectory and speed of the spill movement. This shall be referred to the OSCP, where the trajectory is predicted month wise.
 - c. Draw the slick on a chart (map) with co-ordinates, showing position and predict/understand the movement of the oil
 - d. Aerial surveillance will provide/ allow to observe and record the size and location of the slick. Frequent aerial survey can be carried out in a day to re-confirm the slick movements. Two shall be carried out in a day, the first at dawn and the last before dusk.
 - e. Record observations provided in **Annexure - 5** logbook Format.
 6. The color of the oil on water will indicate its thickness. The volume of oil will be calculated based on the area and color of oil visible from the aerial observation. Photos and videos can be verified to confirm.
 7. Once the size and movement of the spill are known, it is possible for the Incident Controller to assess the potential danger to people, surrounding environment, and nearby installations, and if necessary, to set safety exclusion zones. The predicted movement of the slick is also important for guiding responders to the right locations for clean-up. The Incident Controller will also gather additional key information about the incident from the On-Scene Commander.

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Reporting of oil spill incident: In case of reporting of oil spill incidents, the following information will be provided by the incident observer.

- Location of the spill
- Likely source of the spill
- Area impacted at the time of observation
- General observation of movement of slicks (based on winds and currents)

Upon receipt of such first information report, the same will be forwarded to the IRT leader through the fastest means of communication through the channels defined above. The person intimating about the incident (including near miss) will not be made responsible for any actions relevant to spill response unless they are member of response team. Prompt intimation of such incidents and near misses are encouraged by Cairn as a part of incident reporting and management system. Concerned authorities will be intimated according to the statutory requirements as mentioned in **Annexure - 7**.


7.2 Preliminary Estimate of Response Tier

The IC along with the necessary manpower will make a preliminary assessment of the incident by contacting the person reporting the spill. If needed, the IC may take assistance/ guidance from ICG Coordinator and other Government Agency. The following will be the broad objectives:

- Evaluating the magnitude and impact of the discharge or threat of discharge on the public health, welfare, environment, and the properties.
- Determining in which jurisdiction the incident occurred
- Determining or confirming the responsible party
- Determining or confirming the source of the spill
- Assessing the need for state assistance; and
- Assessing the feasibility of removal and determining the equipment needed to remove the oil.

Spill containment and clean-up actions will begin as soon as possible to minimize the effect on natural and other resources. These actions will include locating the source of the discharge and preventing any further spillage, placement of containment boom to control the spread of oil and to protect sensitive areas, measuring and sampling, physical removal of the oil from water and land, the use of chemicals to disperse the oil, and in-situ burning (if applicable). The response to the spill must address many questions, including:

- How large an area will the spill cover?
- Estimating fate of Oil Slick for first few hours, 24, 48 and 72 hours.
- How thick will the slick be?
- How fast and in what direction will the slick drift?
- When and where will the oil hit the shoreline?
- What will happen to the oil if it is not removed?
- What is the value and sensitivity of the resources at risk?
- Answers to the above questions will determine type of response actions to be taken.

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7.3 Notifying Key Team Members and Authorities

Depending on the magnitude of the spill and potential impacts to other stakeholders, the key team members will be intimated to activate the incident such as IRT / ERT / CMT. Installation Manager will lead and coordinate with members of the IRT / EMT / CMT leader of Cairn (Gurgaon - Head Quarters). The following stakeholders shall be intimated with a POLREP report (format placed at **Annexure - 7**) for all reportable spills (>100 tons). The Key Team members would be set up comprising of

1. Installation Manager
2. Duty PIC
3. Production Manager
4. Logistics Manager / Radio Officer
5. Maintenance Representative
6. HSE Coordinator
7. Sr. Manager Operations
8. Media coordinator
9. Medical officer

The IM will lead and coordinate with members of the ECT

- EMT Leader at Gurgaon
- District Collector, Surat
- Surat Pollution Control Board Regional office, Surat
- Commander Coast Guard, Surat base
- Upon confirmation of the incident with the IRT Leader, the EMT Leader shall inform CMT leader and initiate notifications to the DGH, OISD and MoPNG for all larger spills of more than 700 tons and intimation to OSRL for response readiness.

The Duty PIC is to inform IM of the incident who in turn is to inform all the concerned members and the authorities as per the existing Information System prevailing. The duties, roles, and responsibilities against each team for oil spill control during any eventuality is defined in the below Table 7.1. The contact details of the key members are mentioned in the **Annexure - 8** of this Plan.



Table 7-1: Duties and Responsibilities of the key members to be followed during Oil Spill control

Role	Designation	Duties and Responsibilities during Oil Spill
Incident Controller	Installation Manger	Overall, in-charge including financial authorization. Responsible for Cairn tactical response to all emergency situations.
HSE Support	HSE In Charge	Responsible for providing health safety, environmental and security support, and response
Environmental Manager	Environmental Engineer	Responsible for providing information related to environmental aspect of the region and possible impacts that may cause due to the oil spill.

Role	Designation	Duties and Responsibilities during Oil Spill
Technical Support	Field Manger Production / Field Manager Maintenance	Responsible for providing operational and technical support and advice.
Offshore Support	Offshore Superintendent	Responsible for providing offshore related operational and maintenance support.
Community Liaison	Administration Manager	Responsible for communicating with various stakeholders including residents, fishermen etc.
Warehouse	Warehouse Incharge	Responsible for supporting in providing the necessary vessel and pollution response equipment from Adani Hazira Port, Surat.
Forward Controller	Shift Production Superintendent	Responsible for providing necessary onshore support including the control room operations.
Fire Chief	Fire Controller	Responsible for providing any support related to fire and related emergency situation handling.
HR Manger	HR In Charge	Responsible for providing human resources support for the affected staff members to interact with their families.
Scribe	Instrumentation Superintendent	Take overall stock of the situation and make note of the communications and support with the required information to Incident Controller.
Radio Officer	Radio Officer In charge	Responsible for managing the Helicopter and vessel related support including the coordination with Adani port and Surat Airport.
Security Manager	Security In charge	Responsible for providing office and operation related security support.
Muster point controller - Main Gate	Access Control	Taking the account of overall muster both in onshore and offshore. Coordination with the offshore team to understand the manpower deployment details.
Medical Support	Duty Doctor	Duty doctor in charge should be ready to provide any medical related support that may arise.
First Aiders	Trained Staff on Duty	Medic on duty should be ready with the Material safety Data Sheet (MSDS) and be ready to provide necessary support that may arise.
Logistics Coordinator	Logistic Superintendent	Responsible for providing transport and logistics support as required including marine services.
Public Affairs Coordinator	Head of Operations	Responsible for providing public affairs and media response
Reception Coordinator	Receptionist	Responsible to the HR and Services Coordinator for managing the desk phone and reception

7.4 Manning Control Room

An emergency control room in Suvali Terminal will be managed by the IRT comprising of all relevant functions including Installation Manager, Duty PIC, Production Manager, Logistics Manager Radio Officer, HSE Coordinator, Senior Manager Operations, Media Coordinator, Medical Officer, Maintenance Representative.

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7.5 Collecting Information (Oil Type, Sea/ Wind Forecasts, Aerial Surveillance, Beach Reports)

The collection of the information includes oil type, sea/wind forecast, aerial surveillance, and beach reports. The Incident Controller (IC) is responsible for obtaining samples of oil, in brown bottle of one-liter capacity and samples in the triplicate of oil in water. Radio Office will be collecting meteorological, ocean data and forecasts and then pass on to IRT. Surveillance, reports will be collected and processed by IC. Beach reports shall be made by beach cleaning team to IC at a frequency desired (or at least once daily). Surveillance and tracking of oil at sea immediately after the spill, carry out the surveillance for assessing the quantity of spilled oil. The IC is to collect the following information immediately in case of oil spill, with the help of Master of the vessel/helicopter and or both.

- Time of the spill occurred
- Position in Latitude/ Longitude and also with reference to any prominent landmark (such as platform number)
- Visual appearance, apparent thickness of oil and extent of area covered
- Percentage cover of various thickness of oil
- Existing weather condition and weather forecast
- Current, tide and wind conditions;
- Immediate availability of support vessels, equipment and manpower specifying time factor as well
- Estimate oil spill trajectory, likely area, and time of its landfall (if relevant);
- Volume of each oil type.
- General comments on oil appearance (shape, direction of movement).
- General comments on weather.
- Appearance of oil at sea.

Table 7-2: Oil spill estimation based on colour & oil type


Code	Colour	Oil Type	Thickness	Volume/ km ²
1	Silvery	Sheen	0.0001 mm	0.1 m ³
2	Iridescent	Sheen	0.0003 mm	0.3 m ³
3	Black/ dark brown	Crude/ Fuel Oil	0.1 mm	100 m ³
4	Brown/ Orange	Emulsion	1 mm	1000 m ³

Note: Movement of oil on the sea surface: Oil will move at 100% of the current speed and approximately 3% of the wind speed.

7.6 Estimating fate of Oil Slick (24, 48 and 72 hours)

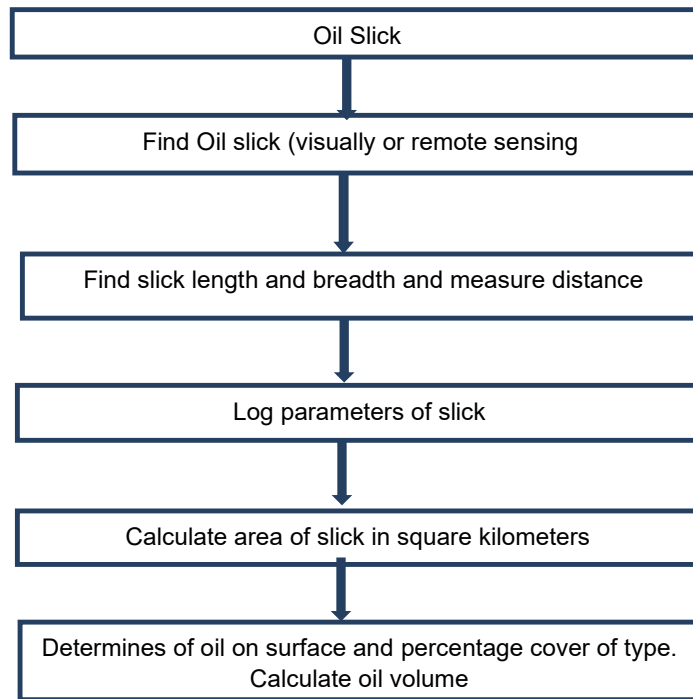
Oil spill response is more or less similar to fire fighting. If not controlled in the very initial stages, the quantum spillage and the treatment would require mobilization of extensive facilities and manpower with prohibitive costs and consequences.

The estimation of oil slick is important in the first few hours of the spill and then formulated for every hour, 24 hours, 48 hours and till 72 hours. While

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predicting the movement of the oil spill, state of tide and currents along with prevailing wind will be considered. As per the modelling output mentioned in the **Annexure - 1**, it is possible to estimate the losses of oil including the evaporation, weathering process with time etc.

Figure 7-1: Oil spill estimation





Broad approach for timeline plans is shown below:

Thus, the spill situation shall be continuously monitored both at sea and on land for giving updates/changes in decisions for an escalated tiered response during the entire episode of spill response. These include:

- Sea state and wind conditions (every 6 hours)
- Oil spill simulations update (every 6 hours)
- Status and progress of cleanup at sea and on land (every 12 hours)
- Manpower and vessels engaged and their safety
- Status of communications arrangements between various work sites
- Status of collected waste oil and its containment with no secondary effects
- Status of permissions from GPCB and Indian Coast Guard for various issues (dispersant application and waste disposal)
- Expert assistance for assessing the strategies of response and corrections
- Communications with the Government and press

7.7 Identifying Resources Immediately at Risk, Informing Parties

Based on initial observations & assessment of oil spill and inputs from oil spill modelling studies, the resources at risk will be identified by IC. Relevant stakeholders/ parties will be informed to take appropriate action.

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7.8 Response to Hazardous and Noxious Substances (HNS) Incidents

Marine incidents involving hazardous and noxious substances (HNS) occur at a much lower frequency than oil spills. There are various kinds of hazardous chemicals and substances being used in the offshore operations. During drilling various chemicals and muds are used such as water-based mud, synthetic oil-based mud, chemicals used in mud fluid such as barite, polymers stabilizers etc. Also, during operation and maintenance of the offshore wells, various chemicals are used such as biocides, oxygen scavengers, scale inhibitors, corrosion inhibitors, acids, diesel etc.

All these chemicals are kept in barrels/ tote tanks, transported from port through vessels and then lifted through various platform fixed cranes from vessels and stored in the platform deck for continuous operation and maintenance usage. During the transportation, lifting and storage, there may be possibility of these chemicals and substances being accidentally spilled over to sea. The quantity of spillage may be between low to moderate.

In these chemical spillage situations, the below mentioned response measures shall be adopted.

7.8.1 Response Options


In most of the cases, the quantity of chemicals stored for usage is limited to that period of operation or drilling of that particular well or maintenance for that particular campaign. In these scenario, the chemicals stored are in the range of few liters to few KL (say maximum few number of totes stored in the offshore platform/vessel say 10 KL)

In many cases, particularly if the release involves a chemical that evaporates or dissolves rapidly, it will not be possible to physically contain or recover the spilled product from the sea. In these cases, the response options may be limited to monitoring and measures designed to mitigate the potential hazards, for example communication to advise local people staying nearer to the beach or shore, so they can remain indoors or prohibition of fishing.

Following the identification of the hazards posed by the release, including consideration of the effects of fire and potential reactivity, the response techniques are finalized. The technique finalized shall ensure the reduction or possible elimination of the impacts related to the hazardous substance on humans and the environment.

In most chemical incidents the rapid communication of relevant information, both internal and external stakeholders are to be carried out. It is also necessary to maintain continuous liaison with the chemical/ HNS manufacturer and repositories of data.

Cairn always ensure that all the chemicals used have appropriate MSDS (Material Safety Data Sheet) including approved Standard Operating Procedures (SOPs). The SOPs capture all the possible measures to be taken in case of any spillage.

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7.8.2 Monitoring

Many chemical spills will be difficult or impossible to observe with the naked eye and it is essential that an appropriate monitoring strategy is put in place to confirm predictions of the spread and dispersion of the slick. The type of monitoring implemented will depend on the specific chemical properties and hazards posed by the substance involved.

Monitoring Gases in Air

It is essential to systematically monitor the concentrations of chemicals in air throughout any incident involving gases or vapors. Key aspects of monitoring include:

- **Oxygen concentrations** any atmosphere having <19.5% oxygen i.e., an oxygen-deficient atmosphere, should be entered only by personnel wearing self-contained breathing apparatus, monitoring will be carried out using onsite gas analyzers. The gas analyzers are always available at the platform and vessels engaged with chemicals.
- **Combustible or explosive gas levels** to identify areas where flammable air/fuel mixtures exist; a value below 10% of the Lower Explosive Limit may be considered safe. Typical instruments such as calibrated gas detectors are available at the operating platforms/ site for monitoring the concentration of gas change rapidly over 10% LEL.
- Toxic substances monitoring such as H₂S gas onsite pocket-based instruments are used where toxic substances are present, to establish safe outer limits. Before start of any operation, as per the job safety assessment the possible toxic gases are monitored using portable gas meters and also kept for periodic monitoring .

Monitoring the Water Column


Monitoring the concentration of chemicals in the water column typically involves two main techniques:

- **Collecting water samples** - these are then transferred for analysis at Suvali terminal laboratory;
- **Use of online probes** - Onsite portable monitoring devices are available at Suvali Terminal, the same can be mobilized to the site/offshore location based on the need arise. Some of the parameters, which can be analyzed at the site itself are pH, Temperature Conductivity, select ions, etc.

Monitoring Surface Slicks

Thin films on the sea surface can damp capillary *waves*. A number of techniques have been developed that make use of the altered properties of the sea surface:

- **Side-Looking Airborne Radar (SLAR)** makes use of the reduced intensity of the backscatter and the surface slick appears as a darker area on the SLAR image;
- **UV scanners** can identify changes in the UV reflectivity of the sea surface;

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- **IR scanners** and **Forward-Looking Infrared Imagers (FLIR)** identify changes in the radiation temperature of the sea surface. The effectiveness of these techniques differs depending on the properties of the chemical involved and the environmental conditions.

MONITORING SUNKEN SPILLS

When a pool of liquid chemical collects on the seabed, there will be a phase boundary between the chemical and the sea water. It may be possible to use echo sounders to locate this phase boundary and hence to identify the area affected by the spill. Monitoring of the concentration of the spilt substance at different depths may also be useful to delineate the area affected.

7.8.3 Response Techniques

Response to Gases and Evaporators

Plume modeling, air monitoring and defensive strategies such as water sprays are commonly used to respond to gas leaks. When applied as a fine droplet, i.e., as a mist and in calm conditions, they can:



- knock down water soluble gases;
- stop, steer, or disperse sparingly soluble or insoluble gas clouds;
- reduce the risk of fire and explosion in flammable clouds of gases, by cooling hot surfaces, putting out sparks and suppressing flame formation.

When applying water sprays, it is also important to be aware of consequences such as high-volume waste streams and, in extreme cases, contributing to the instability of the vessel.

Response to Floating Chemicals

A chemical that floats on the water surface will spread and form a large contact surface with the air. Depending on its vapor pressure, it may evaporate and give rise to a vapor cloud *above* the slick. Monitoring of air concentrations is important in these situations to assess fire and explosion risks and health risks. The selection of response technique must also take account of these hazards and the overall objective of the response. It is possible to attempt to contain and recover spills of floaters, but only of those substances that evaporate or dissolve slowly i.e., category F substances. Typical techniques involve:

- **Covering the slick with foam-** for flammable substances, this reduces evaporation and hence reduces possible fire and explosion risks (taking care to use the type of foam appropriate to the chemical involved). It also restricts spread over the water surface and hence can increase the effectiveness of containment and recovery operations. In this case, consideration must be given to the toxicity of the foam to marine life.
- **Application of sorbents** either loose, as mats or in "sausages". As many low viscosity chemical spills rapidly spread to cover a large surface area, these techniques are most applicable if the spread of the chemical can be confined.

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- **Bubble curtains** created by releasing compressed air through a perforated hose may be used to contain floating slicks in shallow, slow-flowing waters.
- **Conventional oil spill response booms and skimmers** may be used to contain and recover spills of floating chemicals. The effectiveness of these techniques depends on the physical properties of the substance involved, as the equipment may not be able to deal with the thin films and low viscosity of some floating chemicals. Compatibility of the equipment with the chemical must also be considered.

Response to Dissolved Chemicals

The potential to contain and recover spills of chemicals that dissolve is extremely limited. Response techniques are generally restricted to forecasting their spread, monitoring and mitigation of their effects. In the case of spills in shallow or confined waters, treating agents can include:

- Neutralizing agents;
- Flocculation agents;
- Oxidizing agents;
- Reducing agents;
- Gelling agents;
- Activated carbon; and
- Ion exchangers.



In practice though, the use of these treating agents is often ineffective as the dosage is difficult to estimate and recovery of the substance may be difficult. Curtain barriers may also be used to contain dissolved chemical spills in shallow and almost stagnant waters. Response to sunken chemicals must consider not only the recovery of the chemical itself, but the removal and treatment of contaminated sediments. The principal technique is that of dredging.

7.8.4 HNS Response Equipment Inventory

The broad inventory of equipment for HNS response is mentioned in Annexure – 4 of this plan.

7.8.5 Disposal

The collected hazardous waste material/wastewater shall be kept in a proper barrel and tote tank. The same shall be brought to Suvali Terminal for further treatment and disposal. Based on the laboratory analysis, the treatment methodology shall be established. Either the collected sample can be treated in the batch process or shall be treated in the already established Effluent Treatment Plant (ETP). If to be treated in the ETP, then it shall be ensured that the ongoing treatment process is not disturbed. The final treated wastewater shall be analyzed and after ensuring the final discharge standards as specified by GPCB/EP Rules, then shall be discharged for marine disposal. However, these activities need to be notified to GPCB and necessary approval shall be sought. Any hazardous waste generated from the process shall be collected,

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stored, and disposed to the authorized TSDF (Treatment Storage and Disposal Facility), M/s Detox India Private Limited for which the contract already been established.

Table 7-3: List of HNS Equipment

Equipment	Description
PPE	Sufficient numbers of chemical protection suits of various types together with properly fitting associated breathing apparatus is made available in the platforms.
Monitoring equipment	Oxygen monitors; photo-ionization devices; flame-ionization detectors; electrochemical cells; color tubes; portable mass spectrometers; Side-looking Airborne Radar; Ultra-violet scanners, Infrared scanners; and Forward looking Infrared Imagers as applicable will be available before taking up the major chemical related activities.
Pumps and hoses	Chemically resistant pumps and hoses for cargo transfer; perforated hose with air compressor will be available with the operation and maintenance crew at offshore.
Treating agents	Neutralizing agents; flocculation agents; oxidizing agents; reducing agents; gelling agents; activated carbon; and ion exchangers suitable for that particular chemical handling activity shall be identified and be made available as part of job execution plan.
Decontamination	Washing and decontamination equipment together with capacity to store contaminated water such as empty barrels, tote tanks shall be made available.
Booms and skimmers	Booms and skimmers for oil spill response may be suitable; however, understanding compatibility with chemicals is essential shall also be identified and kept ready for immediate usage.
Caution:	
<ol style="list-style-type: none"> 1. <i>No single type of equipment will be suitable for all types of chemical spills and care must be taken to understand the compatibility of materials and chemicals.</i> 2. Before starting the major chemical activities, prior job safety assessment plan and HAZOP as applicable shall be carried out to identify the possible hazards and risks. Therefore, suitable mitigation measures can be planned and kept in place. 	

Table 7-4: Types of Personal Protective Equipment

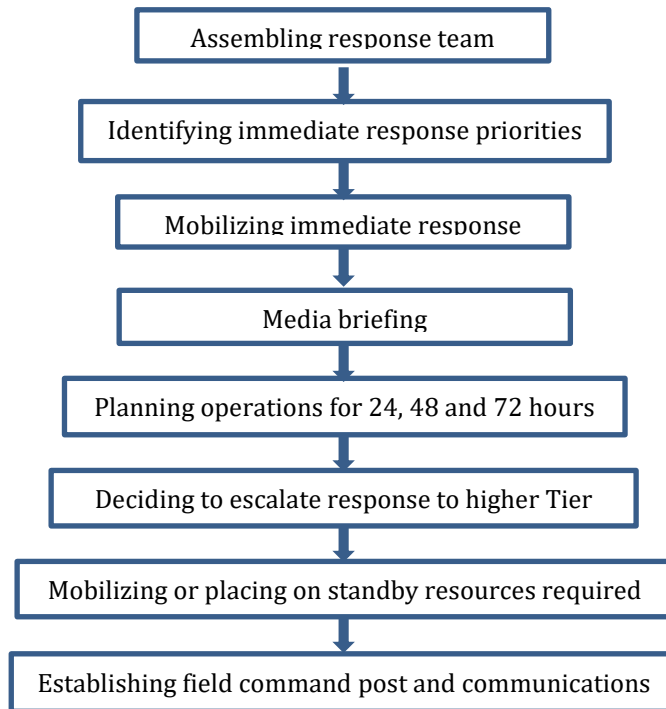
Level	Description
Level A	Highest level of protection for respiratory, skin, eye and mucous membranes consisting of fully encapsulating chemical protective suit with self-contained breathing apparatus (SCBA) is made available at the offshore platforms and shall be put in usage before carrying out the activity; restricts movement and has potential for heat exhaustion in response personnel needs to be understood.
Level B	Protection consisting of a chemically resistant suit with a SCBA worn outside the suit; provides maximum respiratory protection and lower level splash protection.
Level C	Used in situations with sufficiently low concentration of a known substance, which permits the use of a full-face mask air-purifying respirator; protects the body with chemical resistant clothing, such as a normal single piece coverall, and gloves and boots, which is mandatory PPE for the working crew.

Level D	Lowest level of protection consisting of basic work clothing such as coveralls, gloves, and safety shoes/boots; should not be used in any situations where respiratory or skin hazards exist.
Caution: <ol style="list-style-type: none">1. <i>Personal protective equipment (PPE) is designed to prevent exposure to the chemical through inhalation or ingestion and through skin/ eye contact.</i>2. <i>No protective clothing can provide total protection. it is important to be aware of the limitations of equipment in terms of breakthrough (penetration/ permeability of the chemical) and physical degradation. Information on the degree of protection provided by PPE to types of chemicals should be taken directly from the manufacturer's guidance.</i>3. <i>The type of PPE used must depend on the nature and severity of the hazard posed by the chemical. Different levels of PPE offer different degrees of protection.</i>4. <i>If the hazards of a particular situation are uncertain, a higher level of PPE should be used.</i>	

8.0 Operation Planning

The response to the operations planning will follow after the initial procedure is initiated. The operation planning to be adopted is discussed below:

Figure 8-1: Operation response planning flowchart



1. After assessing the Tier of response based on the size, type and fate of spill, the IC will initiate the response operations by assembling the onsite IRT. The immediate response priorities will be identified and mobilized. The response priorities for Cairn will be in the following order:
 - a. People residing in coastal villages and other establishments along the coastline and personnel on board the rig/ supply vessels
 - b. Environmentally sensitive areas
 - c. Assets i.e. platform/ supply vessels
 - d. Minimum reputational damages
2. The EMT will release a media briefing for ensuring that the information pertaining to the spill event is well communicated to the relevant authorities and coastal communities. The onshore response base at the Suvali Terminal will also notify the coastal communities/stakeholders.
3. Once the spill has been assessed thoroughly, the decision on which response strategy to use is crucial in the first few hours of the spill. The preferred strategy for an offshore spill has been presented below:
 - a. **RESPONSE OPS 1:** Monitor, Evaluate and Sample: when spill is drifting away from coast and if the oil is headed towards the shore
 - b. **RESPONSE OPS 2:** Offshore Containment and Recovery
 - c. **RESPONSE OPS 3:** Dispersant Application

- d. **RESPONSE OPS 4:** Shoreline Protection and Deflection Booming
 - e. **RESPONSE OPS 5:** Shoreline Clean-up: in case the spill reaches the shore
 - f. **RESPONSE OPS 6:** Waste Management
4. The response operations will be monitored by the IC on continuous basis through records and hourly reports from the response team. Based on the ongoing response operations, it will be the responsibility of the EMT Leader, in consultation with IC, to decide whether the response Tier has to be escalated to the next level and intervention of relevant authorities such as Indian Coast Guard and OSRL will be required to handle the spill event.

8.1 Assembling full Response Team

Once response priorities are established, IC shall brief the personnel to be deployed for the oil spill contain, control, and clean up team members about their role and responsibilities. The equipment shall be kept ready to embark onboard support vessel and available for deployment. In the event of need for extra resources, it will be immediately informed to EMT for sanction. Depending on the severity of the oil spill, there may be a need to escalate response to a higher tier. IC will advise for mobilizing resources required.

8.2 Identifying Immediate Response Priorities

IRT with the help of oil slick movement simulation data and prevailing weather condition, would prioritize, which are to be protected first from oil spill reaching. By selecting the appropriate strategy, the IRT can derive an indicative strategy path to mitigate the effects of an oil spill, consistent with safe practice and net environmental benefit analysis.

8.3 Mobilizing Immediate Response

The OSR equipment is usually stocked in platform, vessel, Adani Hazira Port and Suvali onshore terminal that have been sourced keeping in mind a Tier-1 response of crude that can be responded at the earliest response time. This equipment will be operated keeping existing weather conditions in mind. For adverse conditions, no response will be effective. During normal weather conditions, advancing skimming system will be operated from the vessel that will keep on operating at 3 knots speed. Once the advancing system is in place and the recovery started, the oily water mixture will be pumped into the vessel tanks or the floating towable tank as per the availability. Drilling support vessels/ Tugboats along with the staff and all deployable resources will be available for emergency response and will be under the direct control of IC. Radio Officers will exchange internal communication and keep incident appraised.

Clean-up actions must begin as soon as possible to minimize the effect on natural and other resources. These actions shall include locating the source of the discharge and preventing any further spillage, placement of containment boom to control the spread of oil and to protect sensitive areas, measuring and

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sampling, physical removal of the oil from water and land, the use of chemicals to disperse the oil. The official coordinating response to the spill will address many questions, including:

- How large an area will the spill cover?
- How thick will the slick be?
- How fast and in what direction will the slick drift?
- When and where will the oil hit the shoreline?
- What will happen to the oil if it is not removed?
- What is the value and sensitivity of the resources at risk?

The answers to these questions will determine what response actions are to be taken. Dispersants shall be used as per the Indian Coast Guard policy and Guidelines for use of Oil Spill Dispersants (OSD) in Indian waters. The IC will obtain clearance from the Indian Coast Guard before start applying chemical dispersants and or will inform the ICG as soon as the dispersants are used in marine. In case ICG advise to stop the dispersant application, the same will be implemented and further course of action will have to be finalized.

Table 8-1: Response plan to contain oil spill

Type and quantity of spill	Short term plans	Medium term plans	Long term plans
Very small spill on board the vessels and platforms/ tankers	Hands on activity for immediate clean-up as per SOP on-board	Arrangements for offloading the cleaned oily materials for shore disposal	Disposal of the oil soaked collected material as specified in the Suvali Terminal Hazardous Waste Authorization.
Small spills from pipelines etc., less than 10 tons spilled into sea	Immediate deployment procedures from the available PSV, tugboats, and other chase boats	As above	As above
Moderate spills of less than 100 tons.	As above. Remedial actions for stopping spill.	Readiness for escalated spill, communications for readiness of equipment with other operators and take permits from ICG etc.	Alert M/S OSRL if the spill has the potential to escalate or sensitive areas are threatened.
Medium spills of 100-1000 tons.	As above, supported by mobilization of equipment and services of other operators in the region, notify M/S OSRL for readiness.	Start procedures for mobilization of equipment of M/S OSRL with due permits/clearances from Customs etc.	Readiness for coastal clean-up, compensations, and public consultations
Very large spills of >1000 tons.	Deployment of all the internal resources, facilities of other operators, and M/S OSRL, lined up organization for spill cleanup at sea and coast and disposal facilities streamlined.	Handing over command and control to Indian Coast Guard and the operations are guided by NOSDCP, readiness for intervention by the Government agencies (for mitigation, expert assistance, and controls)	Readiness for compensation to affected people, Government, cleanup of extensive stretches with large mobilizations and preparations for legal suits and litigations

Immediate reporting and mobilization response flow chart for Oil spills is shown in the Figure 8.1.

Table 8-2: Techniques for oil sampling

S. No.	Technique for Oil Spill Sampling	
1	Equipment	Sampling from an oil slick itself and submission of the samples require use of correct and necessary equipment (oil sample boxes). Oil sample instructions are prepared considering the description of sampling, referencing, labelling storage, and forwarding procedure.
2	Frequency	For offshore spills a minimum of 1 sample per slick per day where possible.
3	Sample Size	<ul style="list-style-type: none"> • Un weathered oils that are liquid and subsequently free of water – 1 liter. • Oil exposed to sea surface and forming water-in-oil emulsion ‘chocolate mousse’-1 liter. • Over size water discharge of 100 ppm from a moving tanker or 15 ppm from a fixed source is suspected- 1litre of discharge. • If such quantities cannot be collected, sampling of any quantity should still be attempted;
4	Collection method	<ul style="list-style-type: none"> • Skim the oil off the surface of the water with great care, ensuring maximum oil content and minimum water. A bucket will be used to collect the sample. • Any collection of lumpy tar/waxy pollutant should be placed directly into sample containers, with no attempt to hear or melt these samples. • Oil collected attached to floating debris, or seaweeds etc., will be placed along with the debris/seaweeds directly into the sampling container. • The sample containers will be sealed and labelled as soon as possible to minimize the evaporation of the oil’s higher fractions.
5	Container Sealing, packing, and Transporting	<ul style="list-style-type: none"> • Where possible, all samples will be securely packed, and sealed using screw topped containers and fireboard boxes to ensure safe carriage of the samples. • Sample containers will be glass with a large neck and a screw cover and a seal, which would not be affected by oil, e.g. no waxed caped seals. • All sample containers will be sealed with a tamper proof seal. • Any bags will be sealed with a label which is signed with overlap on bag and label. • Samples will be stored in a refrigerator/ cold room at less than 5°C in the dark. • When transporting the materials, dangerous good instructions will be followed. • Each sample will be clearly labelled with an identification number, date, time, location, and signature of the sampler, these details will also be recorded on a log form.

Table 8-3: Techniques for Waste Disposal

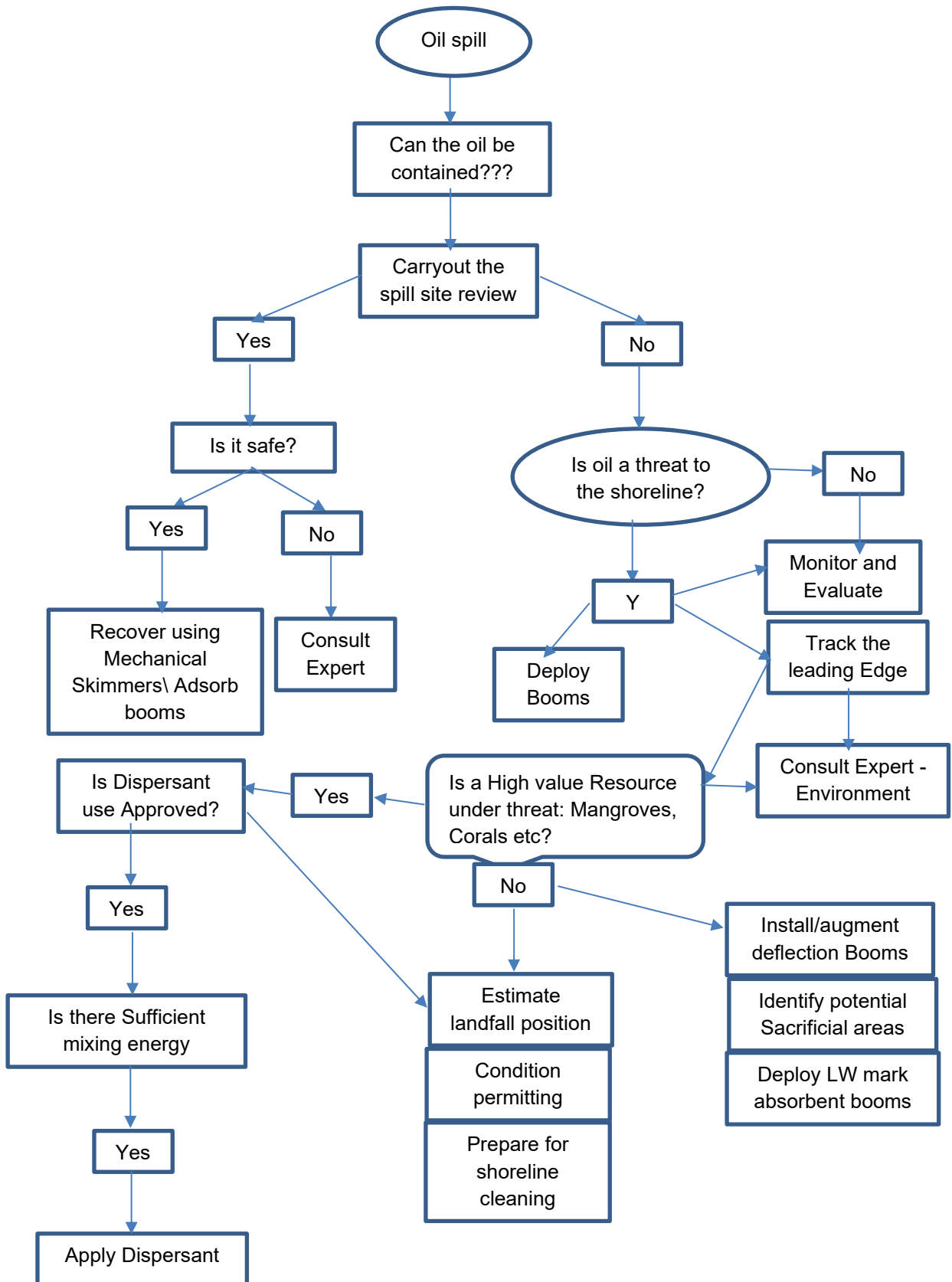
Technique	Effect on waste stream	Type of Waste
At-sea response options	Recovery operations will give potentially rise to a large quantity of waste oil and water for treatment. The type of oil spilled will influence resultant waste; viscous and waxy oils will entrain debris and can create large volumes of waste. They will also cause handling difficulties.	<ul style="list-style-type: none"> • Oiled equipment/ vessels/ used PPEs • Recovered oil/ oily water • Oiled vegetation • Oiled sorbent materials • Oiled flotsam and jetsam/ debris • Animal carcasses

Technique	Effect on waste stream	Type of Waste
Dispersant Application	Waste concentrations are minimal as the oil is dispersed in the water column and allowed to biodegrade naturally.	<ul style="list-style-type: none"> No hydrocarbon waste is generated Used PPEs Empty dispersant drums/ used HDPE liners in the pits
Shoreline Clean up	The type of oil spilled will often influence the amount of oily waste generated. Waste segregation and minimization techniques are critical to ensure an efficient operation. These will be established at the initial recovery site and maintained right through to the final disposal site. Waste sites will be managed in such a way as to prevent secondary pollution.	<ul style="list-style-type: none"> Oiled equipment/ vessels/ Used PPEs Animal carcasses Recovered oil/ oily water Oiled vegetation Oiled sorbent materials Oiled beach material Oiled flotsam and jetsam/ debris

8.3.1 Response OPS 1: Monitor, Evaluate, Sample and Analysis

- This is the preliminary action that must be taken once a spill has been confirmed. Following a hydrocarbon release on water, Cairn recognize that sometimes the safest and most efficient response will be to let the product naturally dissipate, whilst at the same time employing safety measures.
- Aerial surveillance will be carried out to provide the best option for monitoring a spill; however visual observation from sea level may be the only option initially. This will not give a reliable overall picture especially for larger oil spill events. As practically possible, aerial surveillance will commence to monitor and assess the oil spill. Aerial surveillance shall be carried out using the helicopter available at Suvali facility, this will enable:
 - Determine the of size, quantity, and location of the slick
 - Determine the movement of the slick
 - Noting of any changes in appearance and distribution of the slick
 - Forecasting of areas at risk
 - Reporting of effectiveness of response measures
- Aerial surveillance will be used to direct containment, recovery operations and call on usage of the offshore dispersant. It can also be used to assess and monitor the successfulness of these strategies.
Prior to flying, obtain information last known position of slick(s) and plot on a map. Manual plotting or oil spill modelling can provide an estimation of the slick position. On water oil moves at approximately 100% of current speed and direction, and 3% of wind speed and direction. Computer modelling of oil fate and trajectory will have to be referred.

Figure 8-2: Oil spill assessment



4. If there is an uncertainty as to the exact location or extent of spill, a spiral pattern can be used to investigate the area of interest. The shape and thickness distribution of fairly fresh oil spills depend on the oil properties, wind, and currents. The wind spreads and elongates the spill, eventually cutting it into windrows and finally fragmenting. The thickest patches move furthest downwind to what is termed the "leading edge" of the slick. Where practical, long search legs should be aligned at 90 deg. to the direction of the prevailing wind to increase the chances of oil detection as wind rows will lie parallel to the wind direction.
5. Fly the length and width of the slick and record the time taken and the aircraft speed. Once the speed and times to fly the length and width are recorded, the area can then be calculated.
6. The next step is to conduct an oil spill sampling. The sample collectors of required quantities are always available with Cairn laboratory at Suvali terminal. The technique for oil spill sampling is described below:
7. The sample analysis will be carried out immediately at Cairn laboratory as Chemists are available round the clock and the lab is equipped with all required analysis equipment including sample storage facilities. In addition, samples can also be provided to other laboratories for cross verification of the analysis details.
8. The weather conditions will be continuously monitored. Factors that should be considered when assessing oil spill movement and weathering include:
 - a. Currents
 - b. Tides
 - c. Weather (including wind direction and speed)
 - d. Wave height (sea state)
 - e. Sea temperature, salinity
 - f. Spill size / volume (m³)
 - g. Spill thickness (estimated by color e.g. sheen, rainbow)
 - h. Type of oil spilt (viscosity, pour point, specific gravity, dispersion, evaporation)

8.3.2 Response OPS 2: Offshore Containment and Recovery

1. Effective offshore recovery requires trained operators, suitable equipment, well maintained equipment, vessel logistics, aerial support, temporary storage, transportation, and waste disposal.
2. Even in the most ideal conditions recovery rates will never be and are actually more likely to be around 10 — 20%. The faster the response, the better the recovery rate as the spill will have had less time to spread and fragment.
3. Operations are unlikely to be possible in wave heights exceeding 2m (failure of boom with oil being washed over) or in winds of more than 35 km/hr.
4. Vessels are always made available for emergency usage during deployment of the offshore boom. This vessel has sufficient deck space to house boom

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- reels and power packs, with sufficient vessel power rating (bollard pull) to tow the boom and is provided with a low smooth stern without a rail. The vessels also have sufficient deck space to allow safe crew movement.
5. Steps to carry out offshore containment and containment techniques are listed below:
 - a. Identify the thickest concentrations of oil. Aerial surveillance is the best method of directing vessels to the most concentrated area of the spill to conduct containment and recovery operations.
 - b. Sites for containment and recovery operations should be selected where the collection will reduce the likelihood of the oil impacting sensitive sites.
 - c. Ensure communication are established between the aircraft and the vessel either or via the IRC team.
 - d. Deploying containment boom will limit further of the oil movement and concentrate the oil for recovery. Eddies behind the booms are an indication that they are towed too fast. Maximum speed is dependent on the amount of oil contained in the boom, boom characteristics and wave conditions. Typically, a speed of 0.5 – 1.0 knots is required for effective operations.
 - e. Oil lost under the boom will appear as or droplets rising 2-10m behind the boom. Sheens will often be present even when the boom is functioning well.
 - f. When towing a sectioned boom that has been joined in a 'U' configuration, an odd number of sections of boom should be used to prevent having a join in the Centre of the boom from which oil can more easily escape.
 - g. To avoid sharp stress or snatching on a towed boom, lines between boom ends and the vessel should be of sufficient length. 50 m or more would be appropriate for towing a 400 m length of boom.
 6. Steps to carry out recovery of spilled oil and recovery techniques are listed below:
 - a. Skimmers that are used to recover oil from the water shall have:
 - i) an oil recovery element
 - ii) notation or support
 - iii) pump or vacuum device to transfer recovered oil and water to a temporary storage device
 - b. Skimmers will need continuous maintenance by specially trained staff with a supply of spare parts
 - c. The effectiveness of a skimmer is determined by how quickly it can collect the oil, and how well it minimizes the water to oil ratio collected.
 - d. Recovered oil could be pumped into an inflatable storage barge or the recovery oil tank of a standby vessel.
 - e. Wave motion reduces the effectiveness of most skimmers. In calm waters better performance is achieved, as the selected skimmer is suitable for Cairn type light oil.

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- f. Floating debris, both natural (e.g. sea weeds, sea grasses, trees, and branches) and manmade (e.g. plastic, glass, timber) can affect a skimmer's performance. Skimmers may need trash screens and regular unblocking where debris is common.

8.3.3 Response OPS 3 Dispersant Application

1. The use of dispersant and its application will be the primary response strategy to prevent the oil from coming onshore due to the limitations of
 - booming operations in the offshore,
 - time taken to deploy the booms,
 - encounter rate due to the spreading of the oil and also sea conditions.

However, dispersants will be applied only on crude oils which do not disperse naturally and after obtaining the approval from the Indian Coast Guard.

2. The effectiveness of the dispersant on the oil slick will be monitored, and this is best done by observing the sprayed area from the air. The helicopter will fly around 30 minutes to observe the area after the dispersant was applied. If coffee-colored plume in the water is noticed, then it indicates the effective dispersion of the oil. In case, if the oil has resurfaced, then the color will be of black patches.
3. Dangers to consider during dispersant operations are - fire or explosion risk, exposure of personnel to dispersant, weather conditions allow safe operation of vessels and aircraft and ability to control aircraft in the aerial spraying zone (if considered as part of OSRL).
4. For effective use of dispersants, following considerations to be noted:
 - a. Dispersant will only be applied to crude and not light oils such as diesel
 - b. Dispersant effectiveness will decrease as the viscosity of oil increases.
 - c. It is unlikely that dispersant will be effective on emulsified crudes.
5. Steps to be followed when the dispersant application is carried out from the vessel:
 - a. Aerial surveillance will be utilized for all dispersant application operations to direct operations and monitor the effectiveness. The dispersant operation must be at the thickest portion of the slick (leading edge) and not the thinner iridescent silvery sheen areas. Dispersant application will be considered in offshore and near shore to prevent oil entering environmentally sensitive areas onshore.
 - b. The following techniques will be utilized during dispersant application:
 - i) Vessels hired are already fitted with the dispersant storage tanks of 2 KL capacity, high pressure pump to feed the dispersant to spray arm pipes and dispersant spray flexible arms on vessel both sides.
 - ii) Vessel speed will be maintained between 5 - 10 knots.
 - iii) The spray arms are mounted at the bow to avoid the effect of the bow wave, which can push the oil beyond the spray width. The bow

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- wave will also provide the required mixing energy. Dispersant will be applied considering the upwind direction.
- iv) Agitation will be required to produce the required mixing energy. In calm sea state, the bow wave of the vessel should be sufficient. Applying dispersant in conditions above a Force 5 is not recommended as the turbulence will cover the oil and spray droplets will be blown away.
 - v) Typically, the most efficient dispersant to oil ratio (DOR) is 1:20, but on fresh oils, this can be a lot less (1:100). The correct application is determined by the pump rate and the vessel speed (knots). For most modern chemical dispersants an application rate of approximately 1:30-1:50 (DOR) will be applied. The OSD manufacturer's information are verified and made available in the vessel.
 - vi) A visual check of the Spray area will indicate dispersant effectiveness. A grey / coffee color plume indicates successful dispersion. Spraying too much dispersant will result in a cloudy white plume, too little and there will be no effect.
 - vii) OSD will not be sprayed while the slick gets close to fishing boats
 - viii) Dispersant will be applied by trained operators, with wearing PPES.
 - ix) OSD will not be applied in the water depths < 20m unless otherwise discussed or recommended by the experts and ICG. The reason being that the insufficient depth for adequate dilution and possible impacts on seabed (benthic) marine life will be limited with 20m.
 - x) Dispersants will be clearly labelled and stored with the MSDS. The OSD shelf life is normally for the five years period and after five years complete, every year OSD will be analyzed in the laboratory suggested by the manufacturer (NABL accredited) to confirm its effectiveness.

8.3.4 Response OPS 4: Shoreline Protection and Deflection Booming

1. Areas to be protected include environmental and socio-economic sensitivities, with consideration of the time of the year. Protection booming is generally feasible across small bays, inlets, and river mouths with currents (< 1 knot) and breaking waves < 0.5 m and on straight coastline areas to protect specific sites having breaking waves < 0.5 m.
2. Deployment of shoreline protection will be supervised by trained Response Teams deployed to location that can assist in training and local personnel such as the Fire Service. A local workforce at Suvali Terminal would be deployed for manpower support.
3. Cairn has contract with J.V.M Marketing Private Limited, an authorized vendor of ELASTEC. Thus, J.V.M will also be involved in these kind of situations, who has trained manpower.
4. Due to the long inter-tidal zone of the coastline, it will not be practical to use booms from the shoreline for protection. If any deflection booming is to be done, it will be deployed beyond the surf zone from the coastline. This can be done by deploying the offshore booms in a deflection configuration,

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- which will require two boats - however the limitation will be the area covered by a single length of the boom.
5. For deflection booming the length of the boom has to be towed in a straight line between two vessels and angled in such a manner to deflect the oil away from the coastline concerned. Deflection booming operations will be done as far away from the shoreline as possible. Knowledge of the depth of the water is important to allow for sufficient under keel clearance for the vessels and also from the boom draft.
 6. Where possible, protective booms will be deployed at an angle to the approaching slick to divert oil away from any sensitive area. When wave amplitude exceeds 0.5m or currents exceed 3 knots, protective booms will be moved to calmer waters (if possible) as the boom are likely to fail. Booming will be ineffective if the current speed at right angles to the face of the boom (due to water current or speed of towing vessels) exceeds 0.75 knots.
 7. The use of oil snares (traps) strung on ropes is also a practical strategy to prevent or minimize oil from stranding on the shoreline. In order to implement this strategy, the following need to be considered.
 - a. The snares will be deployed beyond the low water mark of the inter-tidal zone and surf zone.
 - b. Suitable shallow draft boats will be required - Using the fishermen and their boats will be the most practical approach.
 - c. The snares attached to ropes will be tied to stakes at intervals of about 50 meters, parallel to the coastline.

8.3.5 Response OPS 5: Shoreline Clean-up

1. The purpose of shoreline clean-up is to produce a net environmental benefit. Clean-up techniques can be damaging, and, in some circumstances, oiled shorelines are best left to recovery naturally.
2. In many areas, bays and other inshore locations may also be somewhat protected from the extensive contamination by the flushing action of tidal currents and the natural outflow of streams and rivers. As a result, much of the shoreline may not require a widespread active cleaning effort unless it is found contaminated.
3. Where active shoreline clean-up is required, priorities for restoration can be established based on both the environmental sensitivity and oil persistence factors. Preference will be given to in-situ cleaning techniques such as in-place washing of rocky shores, use of shoreline cleaning agents, in-situ burning (if applicable) and bioremediation. Use of these techniques will minimize the amount of oily material collected and subsequent hauling requirements.
4. In general, heavily contaminated areas will be cleaned first, so that bulk oil is not remobilized impacting other areas:
 - a. Stage 1: Removal of heavy contamination and floating oil
 - b. Stage 2: Clean-up of moderate contamination, stranded oil, and oiled beached materials.

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- c. Stage 3: Clean-up of lightly contaminated shorelines and removal of oily stains.
5. Appropriate techniques to be used will depend on the characteristics of both the area oiled and moderately oiled, but include:
 - a. Natural recovery
 - b. Low or high pressure ambient or warm water flushing
 - c. Manual clean-up
 - d. Mechanical removal, e.g. graders, scrapers, vacuum systems
 - e. Sediment relocation
 - f. Absorbents
 - g. Washing
6. Following options for shoreline oil recovery and temporary storage will be considered:
 - a. **Vacuum trucks**
 - i) Vacuum trucks are a highly effective and rapid means of recovering and transporting liquid oil.
 - ii) They are most effective, when there are large volumes of oil contained in a particular location, can be used to recover oil from land or water, but may be limited by difficult access to the spill areas.
 - iii) Vacuum skimmers will not to be used with volatile oil. Ideally a submersible floating skimmer fitted to the suction nozzle available in Suvali terminal may be used as per the applicability to provide the most efficient means of recovering a thin layer of oil.
 - b. **Portable skimmers and pumps**
 - i) Portable skimmers and pumps are used to collect small to moderate concentrations of oil, or to pump larger volumes from areas where trucks are unable to go.
 - ii) Handheld vacuum units are ideal for recovering oil that is floating on a very shallow layer of water.
 - iii) Weir Skimmers will be used in the calm and still water, as they are good for low viscosity oils.
 - iv) The skimmed oil will be pumped to a temporary storage location which is safe, above flood levels, protected from rain, and sited to allow ease of access for future collection and transfer of the oil to the Suvali terminal.
 - c. **Manual recovery and sorbents**
 - i) Sorbents are available as pads and booms for use in specific locations and for specific types of oil spill clean-up.
 - ii) Sorbents are generally best used for absorbing minor spills of oil on hard surfaces, and for final clean-up of spills (e.g. helping to remove sheen or to wipe oily residue off solid objects).

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d. Temporary storage

- i) Fast tanks will be used for collecting recovered oil/water mixtures. Containers used for temporary storage will be tough and resistant to puncturing. Free-standing containers will be adequately strong to contain the weight of oil.
 - ii) Excavated pits will be HDPE lined and used for storage of recovered oil.
7. In the stage of final clean-up, the endpoint will be determined for each oiled site. Endpoints will be realistic and obtainable for the spill conditions.

8.3.6 Response OPS 6: Waste Management

- 1. Oil spill response operations have the potential to generate liquid and solid wastes. The types and quantities of waste materials largely depends on the amount of oil that reaches the shoreline and on the specific clean-up methods employed.
- 2. Waste from an oil operation includes:
 - a. recovered oily wastes
 - b. non-oily materials generated from the operation and supporting activities
 - c. materials contaminated with dispersants and other marine materials.
- 3. The types and volumes of waste generated by response activities are determined by the response objectives set during the spill management.

8.4 Media Briefing

Company has designated staff to interact with press, public, government and media briefing during emergency. The most important aspect of retaining the credibility of a company is to release the first press statement immediately after a major incident. As the news channels and print media are expected to react quickly to an incident for the purpose of "first reporting" and "breaking news", it is important to get prepared to issue the first press statement at the earliest possible moment. The EMT and CMT leaders along with Cairn Head Communication shall coordinate with the site team to get information to draft a press statement with the help of Public Affairs Coordinator. The information will cover:

- Specific and accurate to the extent of the event at the time of reporting
- Activities currently handled to minimize and control
- Immediate projected plans for mitigation will be highlighted. However, information shall not reflect any projections or perceptions of consequences or damage details (as they require assessment)
- No contradictory points in the statement
- Not attributing to a particular cause, as it would require investigations later
- The key facts and messages to be included in further statements will be agreed between Group media, Business, and country crisis Team leaders during conference calls.

- Group media will then distribute final statements to all crisis’s teams and other internal audiences as appropriate. Note – the only final drafts should be used to minimize confusion.
- Additional useful facts on the specific crisis as well as relevant background information and generic Question and Answer will also be prepared and shared with the group media by Business and country communications colleagues as quickly as possible.

The draft statement prepared by the Public Affairs coordinator must be vetted by the EMT/ CMT Leader (as the case may be) and seen by the Head Communications from a Cairn perspective before release. As the time is the essence of the effectiveness to deal with the media, all these actions will be parallel worked out with consultations among the leaders irrespective of their locations and timelines. The authorized personnel of Corporate Communication department will release the statement through the applicable outlets such as print media, digital media, TV etc.

8.5 Planning Medium-Term Operations (24, 48 and 72 hours)

Medium term operations would depend upon the size of oil spill occurred considering 24 hours, 48 hours, and 72 hours. Since, recovery of some oil would have started right in the beginning itself, the fate of balance of spilled oil will depend on prevailing weather conditions and can be either towards or away from the shore. In case oil slick hits, the shore, the shore cleanup is the only alternative and in case of slick remains away from the coast, recovery has to be continued with the help of advancing skimming system. However, the use of dispersants may also be resorted to as per the demand of the situation like.

- If adverse weather conditions prevent deployment of spill response equipment.
- Oil Spill Response equipment could not be deployed due to scarcity of time and Oil slick too close to shallow waters and thereby likely to damage ecosystem of the sensitive area nearby.

The dispersant is to be sprayed over the oil slick by the vessels spray system. Considering the oil spill trajectory modeling, when the oil spill will be moving away from the cost, the application of oil spill dispersant & mechanical recovery will continue, however, when the oil spill moves towards shoreline the mechanical recovery & shoreline protection needs to be undertaken. These operations will continue beyond 24hours or more, it will necessitate calling upon additional manpower and physical resource. The CMT/EMT will be approached for provision of additional resources.

8.6 Deciding to Escalate to Response to Higher Tier

When the oil spill response action has been initiated by EMT and IRT, which has started the recovery action, spill incident reporting has been made to concerned authorities, and then if IC understand that the quantum of oil spilled appears to be much more than what was reported earlier and the oil spill needs to be re assessed and deserves a higher response, he or she will inform the

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same to EMT. At this juncture, the IC, and members of EMT will re-inspect the spill site and assess the oil slick thickness, its size, status of spilled oil and decide accordingly. If EMT is convinced that spill report deserves upwards revision and the level of Tier Response needs to be raised, it should take necessary steps to raise the oil spill reporting level. This decision will help to initiate higher oil spill response activities as well as alert other helping agencies, for example Coast Guard Authorities, Port authorities, Pollution Control Board, Hospitals, Forest & Wildlife Department etc. or other organizations. The procedure for informing all concerned agencies / organizations of higher spilled oil threat perception remains the same.

8.7 Mobilizing or Placing on Standby Resources Required

When the decision to raise the Tier level of oil spill has been/ is being taken, a review of Cairn own spill response capability will also to be done simultaneously. Once it is felt that additional resources are required, the concerned agencies will be alerted immediately, and mobilization action for those equipment will be initiated without losing any time. It will be borne in mind that mobilization of resources from out stations such as Tier-2 (nearby operators), OSRL (from Singapore or other countries) is a time consuming process, therefore it should be calculated well before the anticipated arrival time of the Pollution Response Equipment on account of:

- i) Transportation time by rail/ road/ sea/ air.
- ii) Time taken by Government formalities such as Custom, Port etc.
- iii) Time taken in loading/ unloading.
- iv) Availability of specialized loading / unloading machineries and accessories.
- v) Availability of suitable berthing facility for the craft intended to be used.

It is also very important to keep in mind as who is going to operate the pollution response equipment that are being mobilized. In case the equipment is coming with one set of manpower, then from where their reliever team would come and in case only equipment is provided then, do we possess required trained manpower for operating these equipment? All such matters are to be deliberated upon in detail by the IC and EMT together during operation/ exercise planning stage itself. Otherwise it would be very difficult to mobilize desired manpower later.

For obtaining additional equipment, the local Oil Companies, and nearby ports, with which Vedanta Limited already have a memorandum of agreement as part of Tier-2 requirement will be contacted. Requirement of additional manpower to operate and deploy these equipment will also be thought. As Cairn already have two more additional offshore operations in Ravva facility, East Godavari District of Andhra Pradesh and Bhogat facility, Devbhoomi Dwarka district of Gujarat, it will be easy to deploy both the assets additional equipment including manpower. In these two locations, Cairn have OSR equipment in compliance to Tier-1 requirements as per NOS-DCP.

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Vedanta Limited has associate Membership to Oil Spill Response Limited, Singapore. OSRL is the oil industries international response organization, having oil spill equipment, which can be mobilized at short notice to the affected location. Indian Coast guard is also equipped and trained to deal with TIER II and TIER III spills.

8.8 Establishing field Common Post and Communications

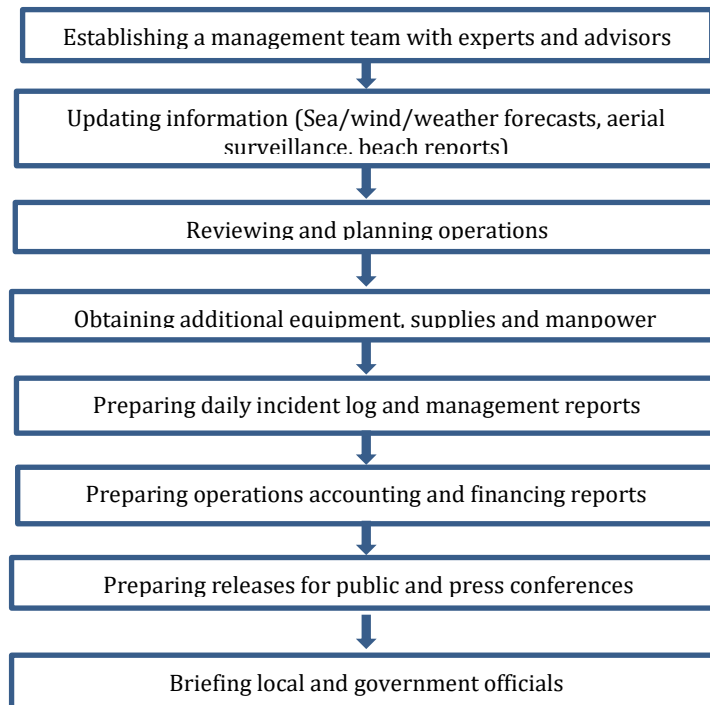
Incident Response Control Room set up in Suvali Terminal is equipped with phone lines, video conferencing, mobile phone etc.

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9.0 Control of Operations

Local control of operation will rest with Expert selected within Cairn IC (incident controller) and work in the coordination with Indian Coast Guard and internal company expert groups. Security aspect of the pollution area should be considered and unauthorized persons gaining access to the area will be restricted. A safety zone (Exclusion Zone) of 500mtrs surrounding oil slick will be established to avoid hindrance in the oil spill cleaning process.

Figure 9-1: Operation control process



1. Once the response action mechanism is decided, IC will establish a response management team consisting experts and advisors to support Cairn in response operations. The team will consist of wildlife and marine experts to provide inputs with respect to ecologically sensitive areas.
2. The IC will maintain updated information on sea, wind and weather forecasts, aerial surveillance, beach reports, etc. to ensure smooth response operations. The response operations will be reviewed on ongoing basis by the IC and EMT Leader and any changes in planning will be communicated to the response team.
3. In case additional equipment, supplies and manpower will be required for the response operations, the IC will notify the EMT. The Logistics Controller will be responsible for ensuring that the resources reach the contaminated site at the earliest from the resource base.
4. Daily incident log and management reports will be prepared and maintained by the IC till the spill is completely under control. Subsequent accounting and financing reports will also be developed and shared with the corporate EMT.

5. The EMT will be responsible for preparing releases for public and press conferences on the response operations. All local and government officials will be briefed on periodic basis until the spill is controlled and the shoreline clean up works are completed.

9.1 Establishing Management Team with Experts and Advisors

Incident management team comprises of well-trained high-level professionals, experts in the various field working in Cairn such as safety, environment, marine, onshore, and offshore operations, maintenance, telecom, communication, industrial relation, human resources, finance, supply chain management, logistics etc. In addition, as required, Cairn will engage support from nearby operators including ports and OSRL.

OSRL has a stock of equipment available at their Singapore as base, which is ready round the clock basis for mobilization on an authorized call from Cairn. A list of authorized persons for mobilization is maintained at EMT Room.


9.2 Updating information (Sea/ Wind Weather forecasts, Aerial Surveillance, Beach Reports)

The information which needs to be periodically updated are sea/wind/weather forecasts, aerial surveillance, and beach reports. Cairn has subscription with Skymet weather wise, India for weather intelligence details. The daily/weekly weather forecast related to Gulf of Khambhat is reported. The forecast report covers information related to Wind speed, visibility, temperature, pressure etc.

The Radio Officer is responsible for providing the weather information along with the position of oil spill, high water & low water timings, sea condition, swell and wave heights, navigational warnings, any Coast Guard/ Naval aircraft/ helicopter sighted in contact, any other relevant information available. Aerial surveillance shall be coordinated with the helicopter available with the Suvali base location in concurrence with IC. Any shore or beach cleanup update will be received to IC periodically as per the system already set in place. All this information is to be provided to IRT. All this information is to be automatically updated as and when they are received. In addition, regular inputs on the state of coastal areas are to be obtained from local sources.

9.3 Reviewing and Planning Operations

The ongoing operations will be assessed and reviewed as and when the IRT considers it is necessary or suggested by IC. This is required to upgrade the level of operations or scale down the operations due to various factors. Review of operations is an ongoing process and accordingly the planning is to be reoriented to maximize the utilization of men and machinery without compromising on safety of both. Periodic rest to men and machinery should also be kept in mind, because response teams can be rotated at regular intervals, but continuous running machinery also needs rest after certain

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stipulated continuous running hours as specified by the equipment manufacturers.

9.4 Obtaining additional Equipment, Supplies and Manpower

Logistic support is one of the key functions of IRT, which work under Logistic Department of Cairn. They provide and maintains personnel, materials, facilities, and services as and when required by EMT. The assignment of any member of the IRT to a function will be made by Incident Controller (IC), or substitute, taking in consideration the sponsor competencies available at any time at site and the type of incident. These assignments will be likely to change during the action as and when additional staff becomes available. The IRT may contact any other staff and in case they are reachable, request their involvement in incident Management activities at site or elsewhere.

9.5 Preparing Daily Incident Log and Management Reports

IC is overall in-charge of operations; he will delegate suitable and available persons to carry out the above function.


Log sheets are be filled for running of all operations and equipment as early as possible, since filling it later increases the chances of vital information getting missed. However at the end of the day, preferably time ending at 20:00 hours starting from 20:01 hours of the previous day, (or it may be from 0801 hours to 0800 hours of the previous day) a daily Summery of events is to be prepared and submitted to the leader of IRT, who in turn would prepare the report consulting all the members of the IRT and forward it to management at Gurgaon. This report should cover following details

- a) Manpower deployed
- b) Equipment deployed
- c) Weather conditions encountered
- d) Amount of oil recovered from sea
- e) Amount of oil transferred for storage / disposal
- f) Progress on shore cleaning efforts (as the case may be)
- g) Difficulties encountered
- h) Lessons learnt

9.6 Preparing Operations Accounting and Financing Reports

IRT Leader is overall in charge of operation. It will be financial responsibility to prepare accounting and financing report. Claims will be based on expenses actually incurred that these are made as a direct expense of an incident and that the expense incurred are reasonable. The following aspects will be considered while assessing cost of an oil spill combating, operating and preparation of claims:

- a. Delineation of the area affected describing the extent of pollution and identifying the most heavily contaminated. This may be best presented as a map or chart accompanied with photographs.

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- b. Summary of events including a description of work carried out in different areas and the working methods chosen in relation to the circumstantial evidence linking as pollution with the ship involved in the incident (e.g. based on the analysis report).
- c. Labor costs (numbers and categories of workers, rates of pay days, hours worked, total Costs etc.).
- d. Data on which work was carried out (daily or weekly costs).
- e. Material costs (consumable materials, utilized fuel, food shelter facilities, etc.).
- f. Finance statement need to assist IRT Leader in (preparing /scrutinizing) settling claims under the Guidance of Cairn Finance department.


9.7 Preparing Releases for Public and Press Conferences

When dealing with the Media, IRT will have to comply with the Vedanta Group Standard and Guidelines. In principle, no communication to the media and or press releases shall be done without receiving clearance from the Group Media Relations/ Head Communication from Cairn. No employee or contractor would interact directly with external agencies, without permission of IC.

9.8 Briefing Local and Government Officials

Cairn has designated staff (mostly Installation Manger or any designee), who will interact with press, public, Government. and media briefing the details of emergency after clearance from IRT. For managing the Media, few guidelines are mentioned below:

- Ensure that in all communication, care for human life and welfare is demonstrated above everything else;
- Provide as much information as possible based upon facts and refrain from assigning any cause or speculation towards the incident;
- In case a suitable reply cannot be framed, take a number, and offer to call back later or transfer to an individual, who would be able to answer;
- Avoid comments or statement that could be constructed as anger / distaste;
- Treat the media with respect, they need to understand the ground situation.
- Be precise and to the point.
- Ensure that the Media is aware, that accurate information is provided by Cairn.
- Anticipate in advance what queries may come and be prepared.
- The Crisis Coordinator, IC, or any other authorized personnel, must issue press releases and statements only.
- Ensure relatives are advised prior to the names of any personnel being made public.
- Prior to the Next of Kin being informed by the police DO NOT release the names of any casualties to next of kin, the press, or the public.

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10.0 Termination of Operations

After obtaining the mutually agreed & desired outcome of the oil spill operations from all the key stakeholders such as ICG, local bodies, GPCB etc., the response operations will be terminated. A post spill evaluation will be conducted. The final and optimal levels of beach clean-up will be decided and recorded.

All the equipment used for the oil spill response operations will be cleaned and maintained accordingly. An inventory of items that has been consumed shall be prepared and list of supplies that need to be replaced will also be prepared.

The cleanup may be verified through aerial survey and possible satellite images of past and current to verify the overall level of scaled down of the contamination.

The Incident Controller (IC) in consultation with the EMT Leader and onsite response team will prepare a formal detailed report including the details of the spill, actions taken, levels of clean up, etc. The report will be used for internal reference purpose within the organization. The current OSCP and related procedures need be reviewed and updated based on lessons learnt.

10.1 Deciding Final and Optimal Level of Beach Clean-up

The cleaning up of shoreline beaches are the most important in view of public/tourist interventions. Since, the clean-up of shoreline is very tedious, time consuming, complex in execution. Thus, Cairn will coordinate with the local administration, to involve local authorities in decision making process.


It would always be borne in mind that while in effort to clean up, it should not end up doing more harm than good. It will be also be prudent to seek the advice of ecology experts and regulatory agencies.

Beaches can be categorized as Sheltered Beach and Un sheltered Beach

Sheltered Beach: These types of beaches are found in the sheltered waters, like behind Islands, Coral reefs, beach surrounded by hills or beach surrounded or sheltered by group of islands. These types of beaches are well protected from vagaries of the Sea and have good connectivity with approach roads. They possess good habitable conditions and are safe for swimming, water sports and all sorts of amenities. Being of good tourist importance value, they may require nothing less than 100% clean-up. No such sheltered beaches are immediately available around the PKGM-1 block area.

Unsheltered Beach - In this category, beaches which are open directly to sea and prone to the vagaries of the Sea. Poor road connectivity, unsafe for swimming and water sports make them very less of recreational value. Such category of beaches may require a lesser degree of clean-up. However, in the present scenario no Beach front suitable for recreational purpose have been identified.

NEBA (Net Environmental Benefit Analysis) need be considered deciding on selecting the best response option or optimal clean-up of beaches, Mangroves,

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and other environmentally sensitive locations. Inspect segments/ section of shoreline that Clean-up Operations team declare ready for sign-off before final approval.

Responsibility: Shoreline Assessment Team

- Operations notify the Shoreline Assessment Team Coordinator that a segment is ready for inspection.
- Inspect the segment against agreed-upon clean-up endpoints (preferably using the same team that did the original survey). The original field sketch can be very helpful for evaluating effectiveness of the clean-up.
- Identify additional clean-up needed using standard shoreline assessment terminology forms and sketches or develop special forms for this purpose.
- Recommend segment for final inspection.
- Recommend any longer-term monitoring or iterative procedures needed.

10.2 Standing-Down Equipment, Cleaning, Maintaining, Replacing

It is important to remember that emergencies can be immediately followed by another one, hence it is of utmost importance to maintain the inventory of equipment. Hence, used equipment need to be cleaned and maintained, if required to be replaced at the earliest. It will be the direct responsibility of the operators of the equipment to restore after the operations. All the spill equipment and machines are to be cleaned as per the OEM's guidelines, necessary maintenance to be carried out and then equipment secured.


If required, the equipment need to be sterilized or cleaned using the appropriate chemicals, acids to remove the contamination from the equipment. It is also necessary to effectively segregate the removed contaminants (solid and liquid) and then send them appropriately for final treatment and disposal. All the necessary manifest and quantity of those material removed during the cleanup shall be maintained and record kept up to date.

10.3 Preparing formal Detailed Report

After the operations are complete, the IC need to prepare the detailed report as per the prescribed format. The report contains all detailed elements of incidents, including daily actions, response and communication, parties involved, equipment used, financial expense statement, total time taken, review of the spill against the model output, total waste recovered, manpower or manhours deployed in the cleaning up activities, estimate of environmental degradation or damage caused etc.

10.4 Reviewing Plans and Procedures from Lessons Learnt

A detailed and comprehensive review of plans need to be carried out with respect to the type of incident. This will immensely help in improving standards of safety, quality of response and quickness of the response. A through debriefing, brainstorming and lesson learning session have to be held internally and externally separately and together. This stakeholder

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consultation will bring together the various concern faced, sorted out, dispute etc. This lessons learnt have to be managed by EMT Leader. The report received from IC need to be submitted for the management review, shared among the peer industries locally and globally. Also, based on the lesson learnt, the policy, procedure, system as required shall be appropriately modified.

Investigation

Every oil spill/pollution incidence is followed by investigation both by the Company as well as Nodal agencies, in order to assist such investigations complete and accurate records as specified below will be maintained



1. Certificates and records of equipment issued by regulatory authorities.
2. Logbook showing weather and details of the incidents.
3. Chronological record of loading / discharging bunkering including agreed plans of such loading/ discharging/ bunkering.
4. Brief report on spill including: i) Time, ii) Location, iii) Cause and, iv) Type of oil and the incident.
5. Samples of spilled oil shall be taken as per procedures described.
6. Estimate of amount spilled and the process of such estimation
7. Copies of notification & update reports
8. Record relating to direction and rate of spread
9. Weather reports and recorded weather in logbook and
10. Where possible photographic and video evidence need to be collected. Such photograph and video records shall be identified with date, time, and location.

Where any original evidence is demanded by Nodal Authorities, photocopies of such evidence to be retained, and the concerned authority shall request to certify the same as true copy of the original.

10.5 Record Keeping and Preparation of Claims


In order to process the claims at later stage, it is essential that accurate records are maintained to support those claims. The claims will be settled based on expenses actually incurred, that these are made as a direct result of an incident, and that the expenses incurred are reasonable. In the case of economic loss, documentation supporting the claims will be prepared and referred to demonstrate the claim amount calculation. The following aspects will be considered during response operations, and preparation of claims:

- Delineation of the area affected describing the extent of pollution and identifying areas most heavily contaminated. This will be best presented as a map or chart accompanied by photographs;
- Summary of events including a description of the work carried out in different areas and of the working methods chosen in relation to the circumstantial evidence linking an oil spill involved in the incident (e.g. chemical analysis);
- Labor costs (numbers and categories of laborer's, rates of pay, hours worked, total costs etc);

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- Dates on which work was carried out (weekly or daily costs); and
- Material costs (consumable materials, fuel utilized, food, shelter, etc.).
- Preparation of claims shall be guided by the manuals, guidelines etc. published from time to time by the International Oil Pollution Compensation Funds (IOPC Funds) such as the claims manual and guidelines for claims in the fisheries and tourism sector.

An expert panel will be engaged to assess the extent of pollution and the amount of recovery/extent of cleaning that took place (before, during and after) will be considered. The expert panel will consist of technical advisors, regulators, scientific NGOs, local bodies representatives, fishermen, affected stakeholders etc.

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E1 - Data Directory

Maps/Charts

Data directory is an inventory of data that specifies the source, ownership, location, usage, and destination of data elements that are stored in a database.

1 Coastal facilities, Access roads, Telephones, Hotels, etc.

Surat city in Gujarat is a large seaport and is now the commercial and economic center on Southern part of the Gujarat. Surat city is famous for its diamonds and textile industries and has large shopping centers. The city is located in Tapti river, close to Arabian sea. The city is well connected with airport, railway station, port, highways connecting the surrounding states, communication facilities, hotels, hospitals, education institutions, various state, and central government offices etc.

Hazira is 22 km from Surat and takes 35 minutes from Surat to Hazira. Regular bus services are operated by Gujarat State Transport Corporation (GSTC) from Adajan GSRTC Depot to reach Hazira. Also, there are private taxis available to reach the Surat Terminal facility from Surat city.

Hazira is one of the major ports of India and the most important element of Surat. Surat is known as the industrial hub of India and is located on the bank of Tapti river. It is a major industrial and area like Essar, Kribhco, Shell, Larsen & Toubro, NTPC, GAIL, GSEG Power, GSPC, Vedanta Limited, Ultratech cement, Reliance Industries etc are located. Refer Figure 0-1 for Google map showing coastal facilities including Port in and around Surat. The list of hotels and hospitals, which Cairn has contract has been mentioned in the below Tables.

Table 0-1: List of Hotels and contact details

S. No	Hotel Name and Contact Details
1	Suvali Terminal -Living Quarters has 40 persons accommodation within its Terminal facilities .
2	Hotel Surat Marriott. Ambika Niketan, Athwalines, Surat, Gujarat 395007. Phone - 0261 711 7000
3	Hotel Courtyard by Marriott Surat, Earth space, Hazira Rd, Surat, Gujarat 394510. Phone - 0261 414 5555
4	Hotel Ginger Surat, 7, Gymkhana Road, Off, Dumas Rd, near Iskon Mal, Piplod, Surat, Gujarat. Phone - 0261 666 6333

Table 0-2: List of Hospitals and contact details

S. No	Hospital Name and Contact Details
1	BAPS - Pramukh Swami Hospital Shri Pramukh Swami Maharaj Marg, Adajan Char Rasta, Adajan, Surat 395 009. Phone: 0261-2781000 Mob: 98796 44144, 44244
2	Smt. R. B. Shah Mahavir Super-Specialty Hospital, Opposite Jivan Bharti School, Nanpura, Surat-395001,Gujarat, Phone: No: 0261- 2292022 / 23
3	Kiran Multi Super specialty Hospital Vasta Devdi Road, near Sumul Dairy Road, Katargam, Surat, Gujarat 395004 Phone: 0261 716 1111
4	Smt. Rasilaben Sevantilal Shah Venus Hospital Ashakataashram Campus, Venus Hospital Rd, near Lal Darwaja Flyover, Surat, Gujarat 395003 Phone: 0261 270 0300

2 Coastal charts, currents, tidal information (ranges and streams), prevailing winds

Tides: This shelf region being more than 100 km wide and less than 40 m deep, the circulation here is expected to be dominated by shallow water processes, the winds, and possibly influence of runoff from adjoining rivers. Tides along the west coast of India are mixed with the semi-diurnal constituents. The average tidal range during spring and neaps are 5.5 m and 2.3 m respectively. The tidal ranges predicted through tidal constituents are 5.3 m and 2.1 m for the respective tidal phases. The maximum tidal range at Cambay Oil field is 5.0 m during spring and 3.5 m during neap. The duration from ebb to flood tide is slightly longer (6.25 hrs.) when compared to flood to ebb tide (6.0 hrs.). The maximum tidal range at Cambay is 6.5 m during spring and 4.0 m during neap.

Current: Due to the large tidal ranges, appreciable tidal currents occur in the Suvali region. The current in this region is directed NNW during flood and South during ebb. The maximum currents, which are expected, are as below:

	Max. Flood	Max. Ebb
Spring tide	1.47 m/s	0.83 m/s
Neap Tide	0.8 m/s	0.42 m/s

Tidal current however are very variable in strength, apposite currents can occur at the same time in the approach channel and there is hardly any slack-tide period. Currents have been analyzed and predicted and accurate half – hourly information available.

Waves: Predominant waves entering the coast of Suvali have periods within a range of 6 – 10 s. These arise mainly just before and during the monsoons and their direction of approach is mainly south-west.

Cyclones: These may occur in the period May/ June or October/November. The last severe cyclonic storm was experienced in 1982. Occasionally, sudden high winds also occur during the fine weather period from N. E.

Weather Forecast: Cairn has subscription with Skymet weather wise, India for weather intelligence details. The daily/weekly weather forecast related to Gulf of Khambhat is reported. The forecast report covers information related to Wind speed, visibility, temperature, pressure etc.

Refer the following Figures related to coastal charts, currents, tidal information, winds etc.

- Figure 1-2: Block Diagram of CB-OS 2 Block on Navigation Chart – Overview and Specific
- Figure 0-2: Average wind rose diagram
- Figure 0-3: Average and Maximum Wind Speed and Gust at Gulf of Khambhat
- Figure 0-4: Bathymetry details of Gulf of Khambhat (GOK) Region
- Figure 0-6:Tidal values in the study domain area

3 Risk locations and probable fate of oil


Refer Table 1.1 and 1.2 for the coordinates of offshore block and platforms, where the possible risk of oil spill is detailed. Hydrodyn-OILSOFT a dedicated software for Oil Spill Trajectory Modelling, which was used for prediction of oil spill scenarios at CB/OS-2 Block area for various meteorological and hydrological conditions. The results of various numerical runs are discussed in Annexure-1.

North-West Monsoon: During North-West Monsoon, Oil Spills at LA, LB, GA and at subsea pipeline would move towards open sea and Hazira coastal areas in south & south-west direction and depending on the spill residence time as showing in Fig A.6.1 to Fig.A.6.60 in **Annexure - 1** (Oil Spill Modeling (OSM) Report)

The details of spill losses during its movement and time taken to reach the coast boundaries from all locations have been furnished in **Annexure - 1**. From the Tables 1.1(a) to 1.4(d), it can be concluded that nearly 30%-40% of oil volume would be lost due to evaporation and dissolution and remaining will be reaching to the either coast or on sea surface.

Pre-Monsoon: The spill residence time and trajectory of spills have been shown graphically. The magnitude of the resultant current will be in the range of 0.0 -2.4 m/s, as shown in Fig.A3.1 to Fig.A.3.16 of **Annexure - 1**. From the figures, the resultant of water and wind velocity is towards S-E direction, but due to tide predominant the spills at LA, LB, GA and pipeline locations would move towards NS direction, ultimately moving towards coastal areas of Hazira direction as shown in Fig A.7.1 to Fig.A.7.60 **Annexure - 1**.

Monsoon: The spill residence time and trajectory of spills have been shown graphically. The magnitude of the resultant current will be in the range of 0.0 -2.9 m/s, which varies with respect to tide phase and time as shown in Fig.A4.1

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to Fig.A.4.16 **Annexure - 1**. From the figures it can be seen that the resultant of water and wind velocity is towards North-east direction. Hence, the spills at all spill locations would move towards south and north of spill location and reaching the Hazira coast as showing in Fig A.8.1 to Fig.A.8.60 **Annexure - 1**.

Post-Monsoon: The spill residence time and trajectory of spills have been shown graphically. The magnitude of the resultant current will be in the range of 0.0 -2.5 m/s, which varies with respect to tide phase and time as shown in Fig.A5.1 to Fig.A.5.16 of **Annexure - 1**. From the figures, it can be seen that the resultant of water and wind velocity is transition state i.e. sometimes towards south-east and sometimes south-west direction. The spills at all locations during flooding moves towards the west coast of Khambhat and during ebbing the oil spills are on the open sea and moves towards the upstream and downstream of spill location. The spill trajectory plots are shown in Fig A.9.1 to Fig.A.9.60 **Annexure - 1**.

The details of spill landing location and residence time have been furnished in Table 1.1 – Table-1.4 **Annexure - 1**. The behavior of slick movement is more or less similar in various scenarios irrespective of quantities of oil spilled. The area of oil spread differs depending on the source quantities. The details of spill losses during its movement and time taken to reach the coast boundaries from all locations have been furnished in Table 1.1 – Table-1.4 **Annexure - 1**. From the tables, it can be concluded that nearly 40%-50% of oil volume would be lost due to evaporation and dissolution and remaining will be reaching to the either coast or on sea surface.

4 **Shoreline resources for priority protection**


Amenity areas, economically important tourist and recreation facilities, beaches, ecologically sensitive areas, industrial or drinking water intakes, fisheries, marine culture, sea birds, marine mammals and other resources likely to be threatened due to oil spill are being identified as part of environmental sensitive mapping and atlas. Refer Annexure -2: Environmental Sensitivity Index Mapping and Atlas for details.

The priority of the shoreline and other affected areas protection are prioritized based on the application of NEBA. Refer Annexure - 6:NEBA for details. For shore cleanup equipment availability and other resources such as manpower, contractor and service provider details may be referred from Annexure - 4:Oil Spill Response Equipment and Annexure – 8:Emergency Contact Directory.

5 **Shoreline types**

The exploratory block is located offshore of Suvali and close to city of Surat. The offshore operation area is situated approximately 25 km south west of Surat city along the eastern shoreline of Gulf of Khambhat.

Sensitivity maps prepared, refer Annexure -2: Environmental Sensitivity Index Mapping and Atlas, has covered the areas of coast at risk of spillage originating from the facilities and provide information about the various types

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of environment that may be affected by a spill (sand beached, rocky coast, marshes, etc.) for which the clean-up equipment should be suited.

Sensitivity maps prepared also included the mapping of coastal, sub-tidal habitats and information on the potential impact of dispersed oil in the water column so as to support the decision on the use of dispersant. The shorelines are of the high priority areas for protection because they are difficult to clean once the spill washed to shore. According to the sensitivity and importance of the shoreline, the following order of priority is set in shoreline cleaning:

- Marshes and mangroves.
- Coral reef flats which are exposed at low tide.
- Raised fossil reefs with undercuts which allow the floating oil to penetrate boulder and Cobble beaches.
- Pebble and cobble beaches.
- Beaches of mixtures of sand, pebbles, and cobbles.
- Exposed beach rock.
- Beach rock covered by thin layers of sand, pebbles, or cobbles.

6 Sea zones and response strategies



Sea zones can be classified based on depth of water i.e. deep water and shallow water zones. The response strategy will be different for different sea zones. The response options i.e. dispersant and burning can be done for deep water zones where there are not much marine life and the same response options cannot be used for shallow water since the marine activities will be exist along the coasts. Response strategy for sea zones has been discussed in section 3.3.

7 Coastal zones and response strategies

In event of a large spill or depending on sea conditions and direction of flow, the oil is likely to reach the shore. Such cases will require a shore clean up. Shoreline clean up by mechanical removal involves a wide range of different tools and techniques. Techniques may range from manual removal of oil using sorbents to advanced beach cleaning machinery:

- Manual sorbent application
- Manual removal of oiled materials (hand, shovel, rakes)
- Manual cutting of vegetation
- Low pressure flushing at ambient temperature
- Vacuum trucks
- Warm water / low pressure washing
- High pressure flushing
- Manual scraping
- Beach cleaners

Refer Section 3.4 of this Plan for details.

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8 Shoreline zones and clean-up strategies

Cairn shares the community's concern for the protection of the natural environment from oil spill. The company is committed to integrate in its operations ways to identify oil spill risks, prevent oil spills, and to implement appropriate changes in its contingency plan for spill response and clean-up strategies. To achieve this, Cairn will intend to:


- Respond immediately to any oil spill incident with the objective of protecting Marine & Human life and to minimize environmental impacts;
- Work and consult with appropriate government bodies and the local community to address any issues relating to oils spills in a timely manner;
- Provide adequate training and information to enable employee and contractors to adopt environmentally responsible work practices and to be aware of their responsibilities in the prevention and clean-up of oil spill;
- Develop emergency plans and procedures so that incidents (accidental releases) can be responded to in a timely manner;
- Develop and maintain management system to identify, control and monitor risks and to comply with Statutory Regulations and Industry Guidelines.
- Assess the situation and take timely and appropriate action where third-party interests are involved, such as products or chartered vessels, drill rigs nearby ports etc.

Ascertain that each identified employee is responsible for implementation of the OSCP in association with his/her specific duties. This also includes contractors and employees. Cairn Oil & Gas emergency management procedure uses a three-tiered emergency management organization. The broad functions and responsibilities of IRT, EMT and CMT of Cairn are depicted in detail in Chapter 5 of this OSCP. Refer the Figure 1.1 for overall view of the emergency tiers. Oil spill response in coastal zones and shoreline is discussed in Chapter 3 of this Plan.

9 Oil and waste storage/disposal sites

Recovered oil mixture will be pumped to onshore for separating oil and water with the help of effluent treatment plants already available. Spill response operations have the potential to generate liquid and solid wastes, if there are clean up operations. The types and quantities of waste material largely depend on the amount of liquid material spilt and the specific clean-up methods employed. Collected oil and oily wastes will be stored in suitable containers.

Disposal options for oily wastewater may include high temperature incineration, bioremediation, or disposal at secured onshore landfill sites approved by Gujarat Pollution Control Board (GPCB). The recovered / skimmed oil will be disposed to the authorized recyclers as per the GPCB. Any disposal option selected will be complied with the requirements specified in Hazardous and Other Wastes (Management and Trans-boundary Movement) Rules, 2016 and amendment. Table 3-2: Option for separation and disposal of oil & debris.

	E1 Data Directory including Maps/Charts, Lists and Data	Rev. No: 09 Date: 20 th Oct 2023
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Vedanta Limited has valid contract for disposal of the Oily waste with M/s Detox India Private Limited, 5, Hira Modi ni sheri, Udhana Ring Road, Surat Gujarat - 395002. Attention: Mr. Amit Renos, Email: tenders@detoxgroup.in, Mobile:+91 98241 46420

10 Sensitivity maps/atlas

The coastal areas of Hazira-Suvali, Gulf of Khambhat abounds in marine wealth and is considered as one of the richest in industrial activities along the west coast of India. It is endowed with a great diversity of natural ecosystems, of which the major systems are salt pans, intertidal zones, sand dunes, mangroves, creeks, and open ocean.

Attempts have been made to overlay the marine sensitive areas in the respective cadastral maps, so that the status of sensitive areas cover may be known down to the coasts. The maps have been interpreted at 1:50,000 scale and the sensitive areas have been classified into mangroves, mudflats, rock coast, corals, and industrial and biological sensitive areas. Refer Annexure -2: Environmental Sensitivity Index Mapping and Atlas for details.

The risk analysis study was carried out to assess the impact of major accidental hazards from the facilities on the marine population and property within and outside the battery limit of the facilities and on coastal environmental. Refer Annexure - 6:NEBA (Net Environment Benefit Analysis) for details.

Lists

Lists No.	E1 - Data Directory - List Requirements as per NOSDCP	Compliance to the Requirements
1	Primary oil spill equipment booms, skimmers, spray equipment, dispersant, absorbents, oil storage, radio communications, etc (manufacturer, type, size, location, transport, contact, delivery time, cost, and conditions)	All the oil spill response equipment is maintained in health conditions. There is also third-party maintenance contract with OEM or their nominees, who visit the facility once in three months and carryout the periodic maintenance. The marine oil spill response equipment is stored at three different locations. The locations are one of the three operating platforms, one of the vessels engaged in the routine operations and in the port during drilling campaign otherwise in the Suvali terminal. Refer Annexure - 4: Oil Spill Response Equipment at CB/OS-2 for details.
2	Auxiliary equipment tugs and work boats, aircraft, vacuum trucks, tanks and barges, loaders and graders, plastic bags, tools, protective clothing, communications equipment, etc (manufacturer, type, size, location, transport, contact, delivery time, cost, and conditions)	Refer Annexure - 4: Oil Spill Response Equipment at CB/OS-2 for details.; and Annexure - 8:Emergency Contact Directory. The required auxiliary equipment is in place. Tugboat name KB XV is available with contract validity till Feb 2023; and Vessel name COASTAL COMMANDER is available with contract validity till Jan 2024 is in place. Helicopter: Bell 412 EP from Global Vectra Helicorp Ltd with contract validity till Oct - 22 with pilot's standby is in place.
3	Support equipment aircraft, communications, catering, housing, transport, field sanitation and shelter etc (availability, contact, cost, and conditions).	Suvali Terminal has living quarters with 40 persons accommodation provision; and also have accommodation contract with various hotels at Surat. The Terminal has catering, security, manpower supply and transportation contract in place. The Terminals have standby vehicles

Lists No.	E1 - Data Directory - List Requirements as per NOSDCP	Compliance to the Requirements
4	Sources of manpower. contractors, local authorities, caterers, security firms (availability, numbers, skills, contact, cost, and conditions)	always in place in addition to Ambulance and air medivac. Refer Annexure - 8:Emergency Contact Directory for details.
5	Experts and advisors: environment, safety, auditing, (availability, contact, cost, and conditions)	Refer Table5-1: Advisors and Experts contact details. Cairn has in house professionals from Health, Safety and Environment background. Valid contract is available with various HSE auditing organizations and periodic audit is being conducted and audit findings are closed in a timely manner.
6	Local and national government contacts: (name, rank and responsibility, address, telephone, fax, telex)	Refer Table 5-1: Advisors and Experts contact details. This Table has reference to local and various Government agencies/stakeholder along with their designation and contact details.

Data

1 Specifications of oils commonly traded

The specifications (composition) of crude oil produced from CB/OS-2 Block is detailed in the Table 2-2; Refer Table 2-3 for Suvali gas characteristics.

2 Wind and weather

Refer Figure 0-2 for Average Windrose diagram; Figure 0-3 for Average and Maximum Wind Speed and Gust at Gulf of Khambhat.

3 Information sources

The information which needs periodical updated are sea/wind/weather forecasts, aerial surveillance, and beach reports. Cairn has subscription with Skymet weather wise, India for weather intelligence details. The daily/weekly weather forecast related to Gulf of Khambhat is reported. The forecast report covers information related to Wind speed, visibility, temperature, pressure etc. NEBA Study has been carried for selecting best response options based on coastal information and spill scenarios – Refer Annexure – 6 for details.

Sensitivity maps were prepared covering the areas of coast at risk of spillage originating from the facilities and provide information about the various types of environment that may be affected by a spill (sand beached, rocky coast, marshes, etc.) for which the clean-up equipment are identified. Sensitivity maps prepared also included the mapping of coastal, sub-tidal habitats and information on the potential impact of dispersed oil in the water column so as to support the decision on the use of oil spill dispersant. Marine Atlas has been carried out for areas all along the coasts of Hazira. Environmental sensitivity mapping was prepared based on the available primary and secondary data related to of environment, biological and industrial information. Refer Annexure – 2 for details.


	E1 Data Directory including Maps/Charts, Lists and Data	Rev. No: 09 Date: 20 th Oct 2023 Doc No: VL-SVL-QHSE-OSCP-01
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Figure 0-1: Map showing coastal facilities including Port in and around Surat

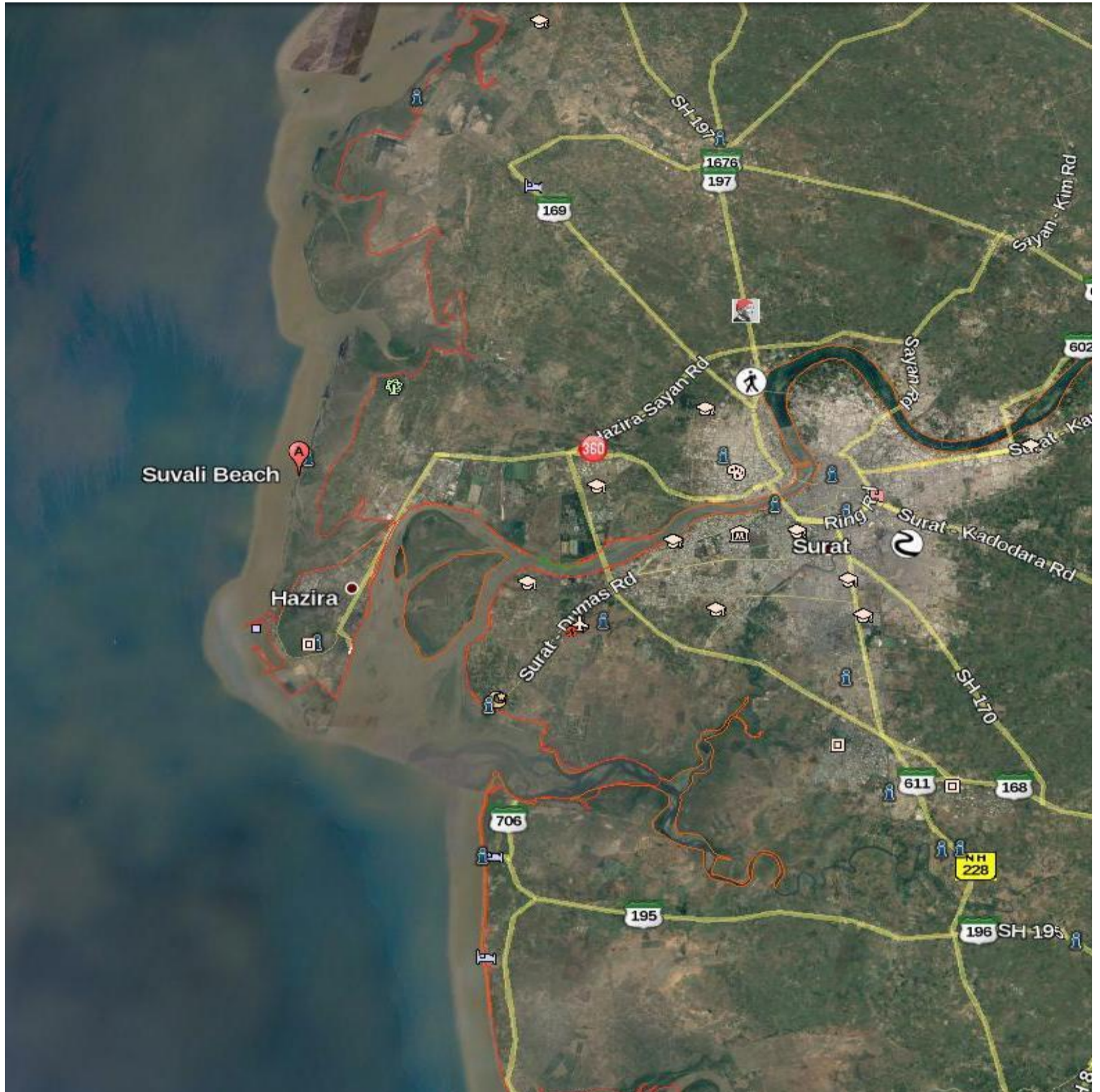
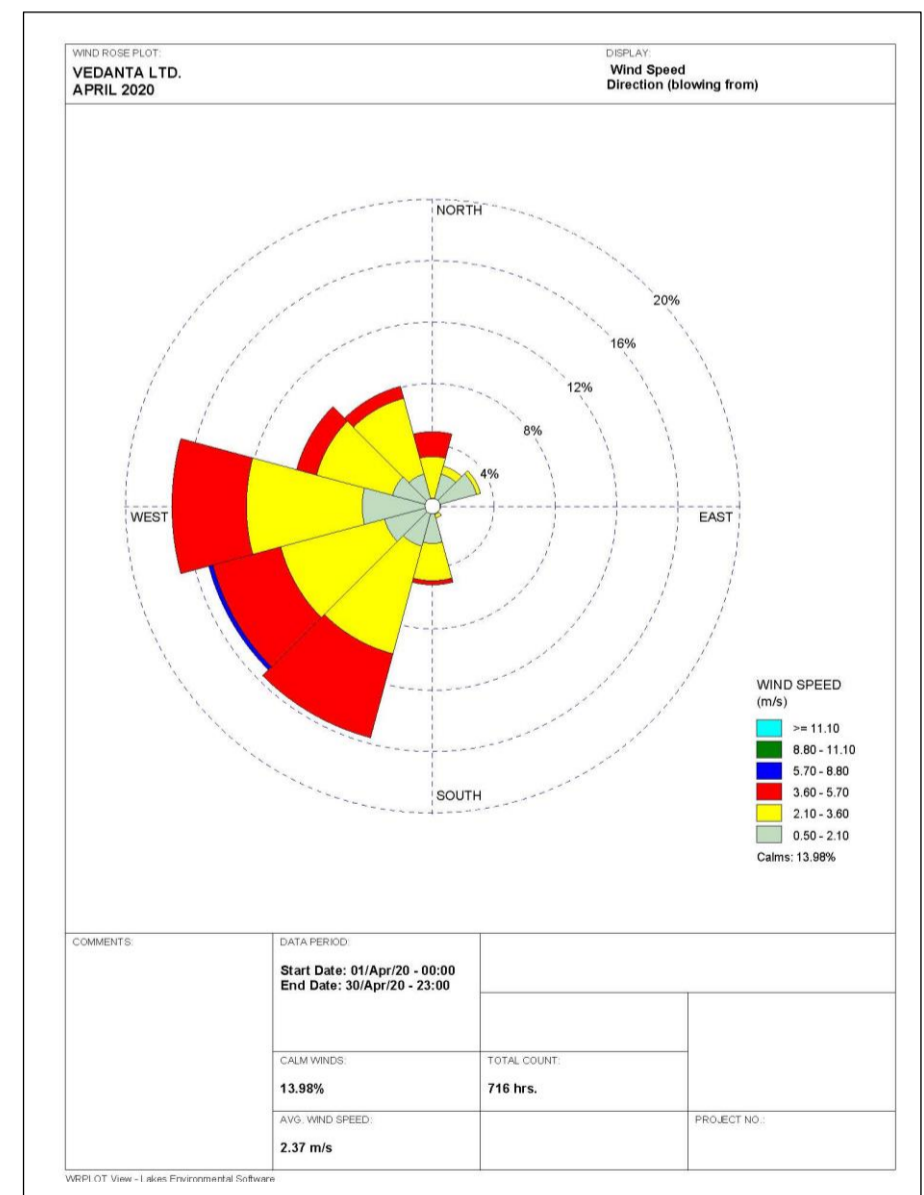
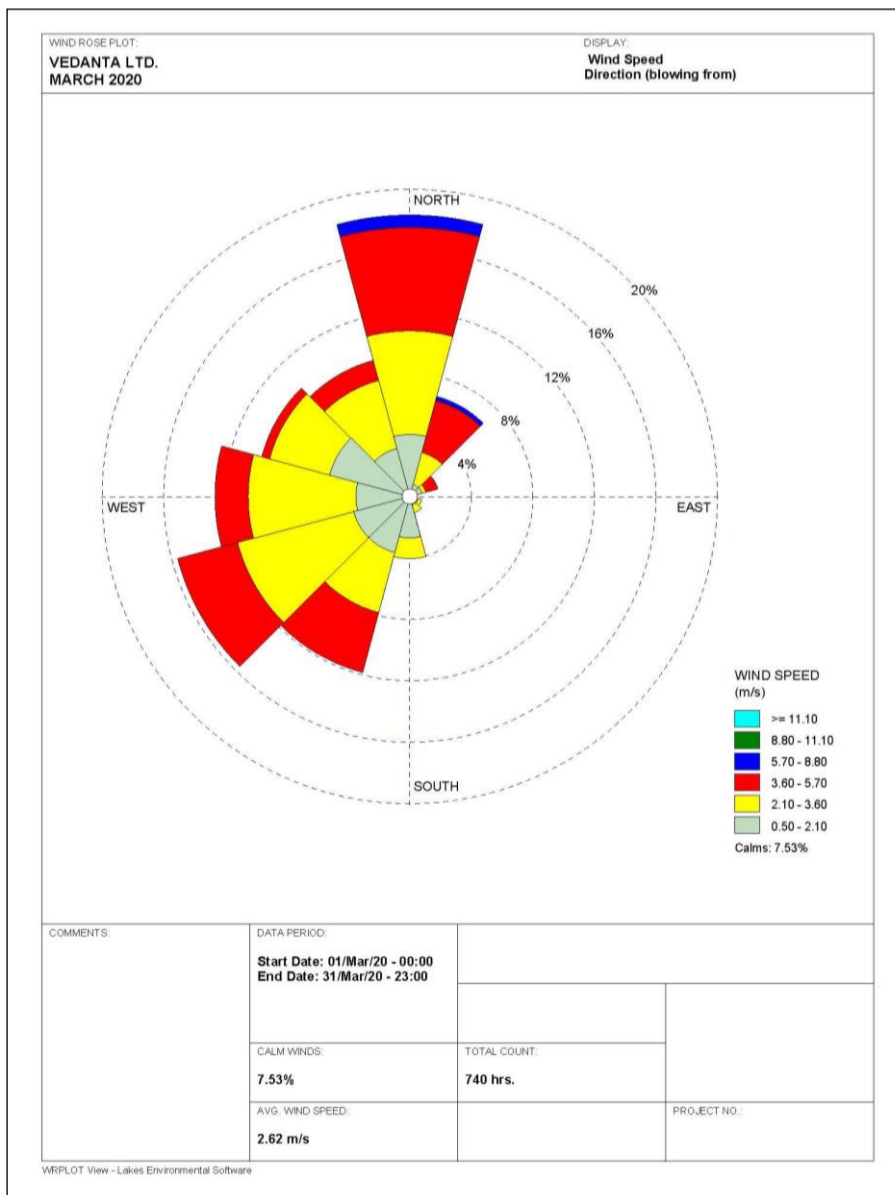
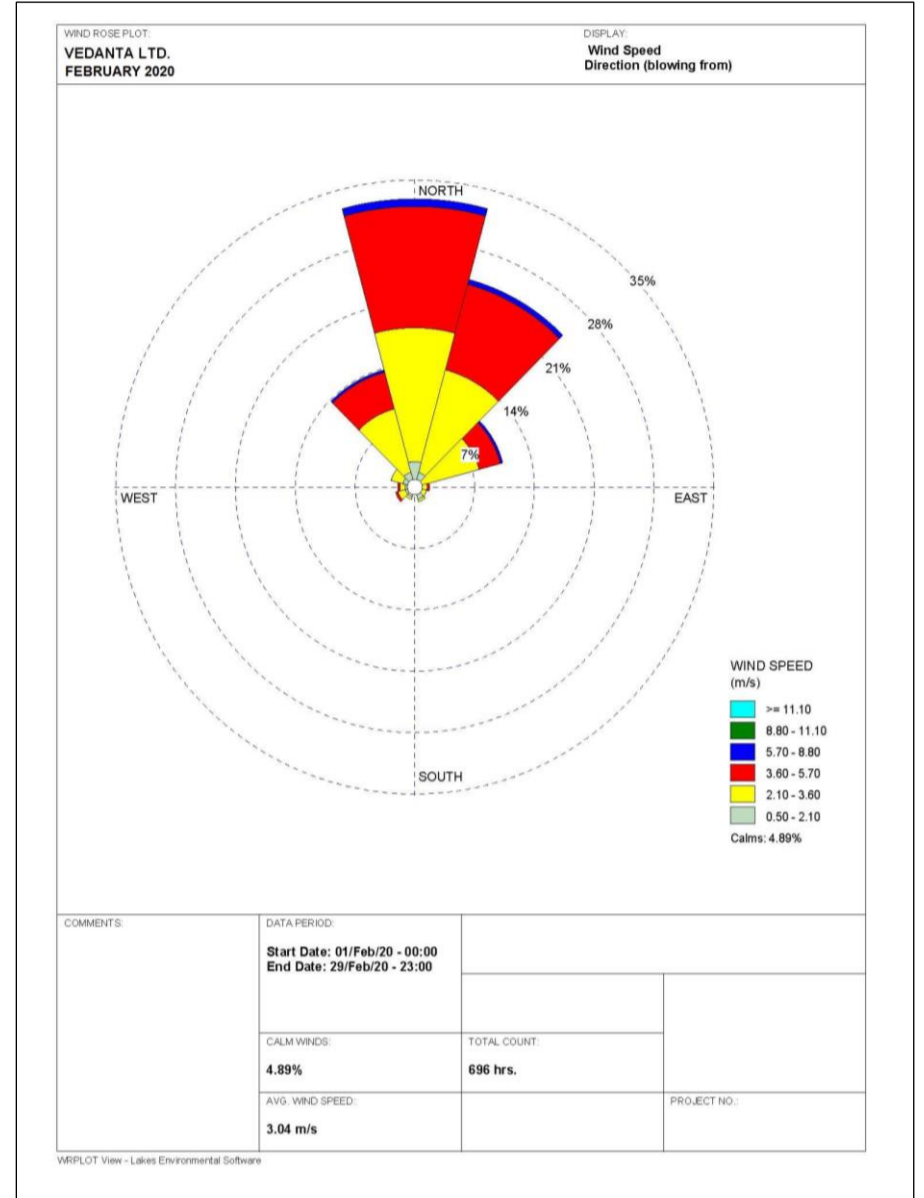
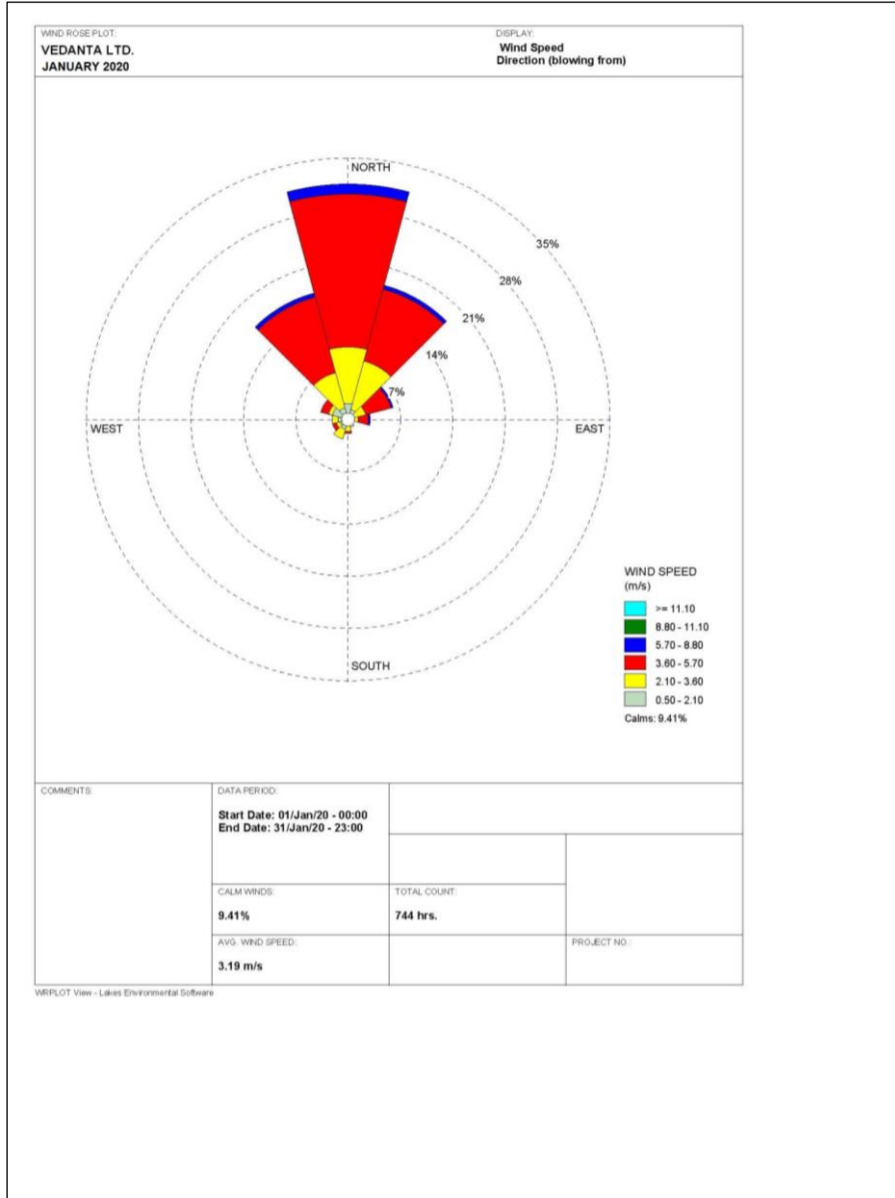
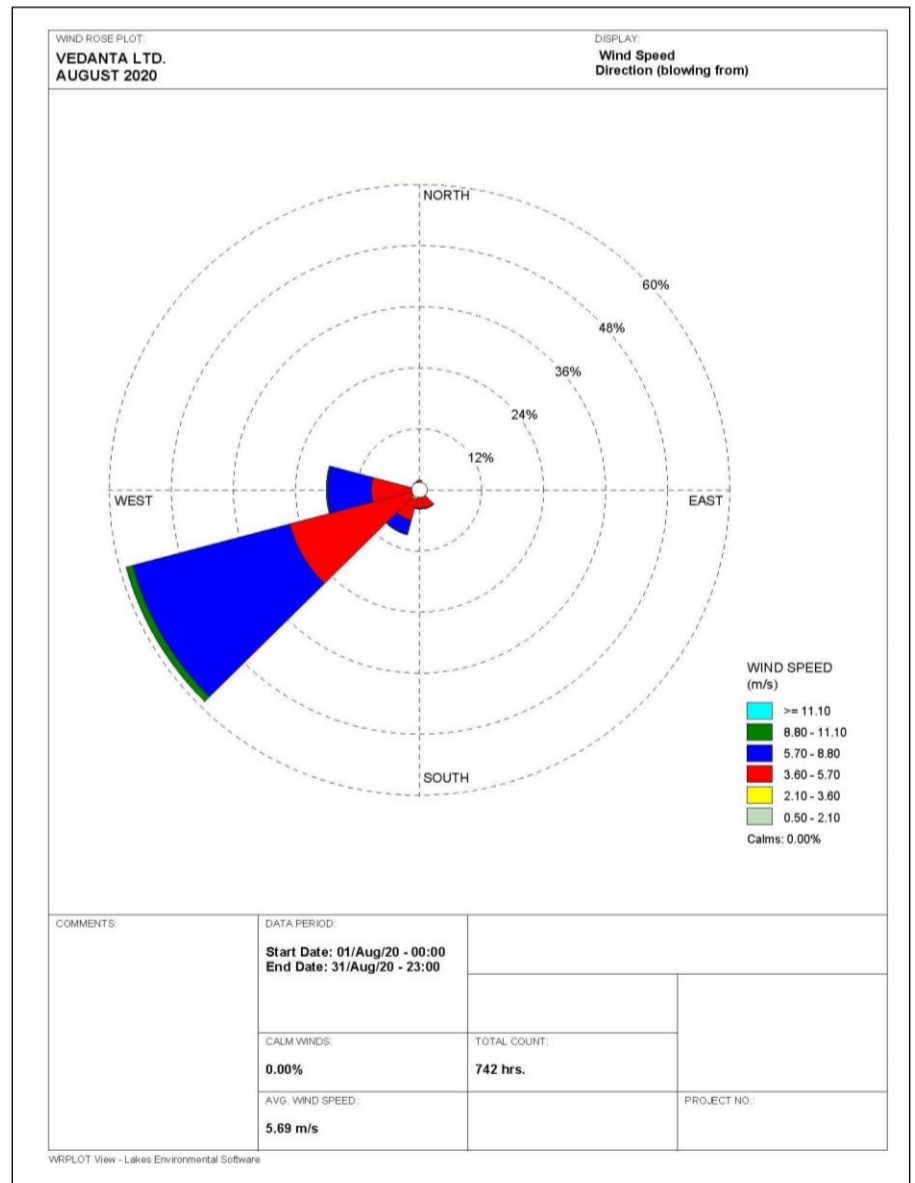
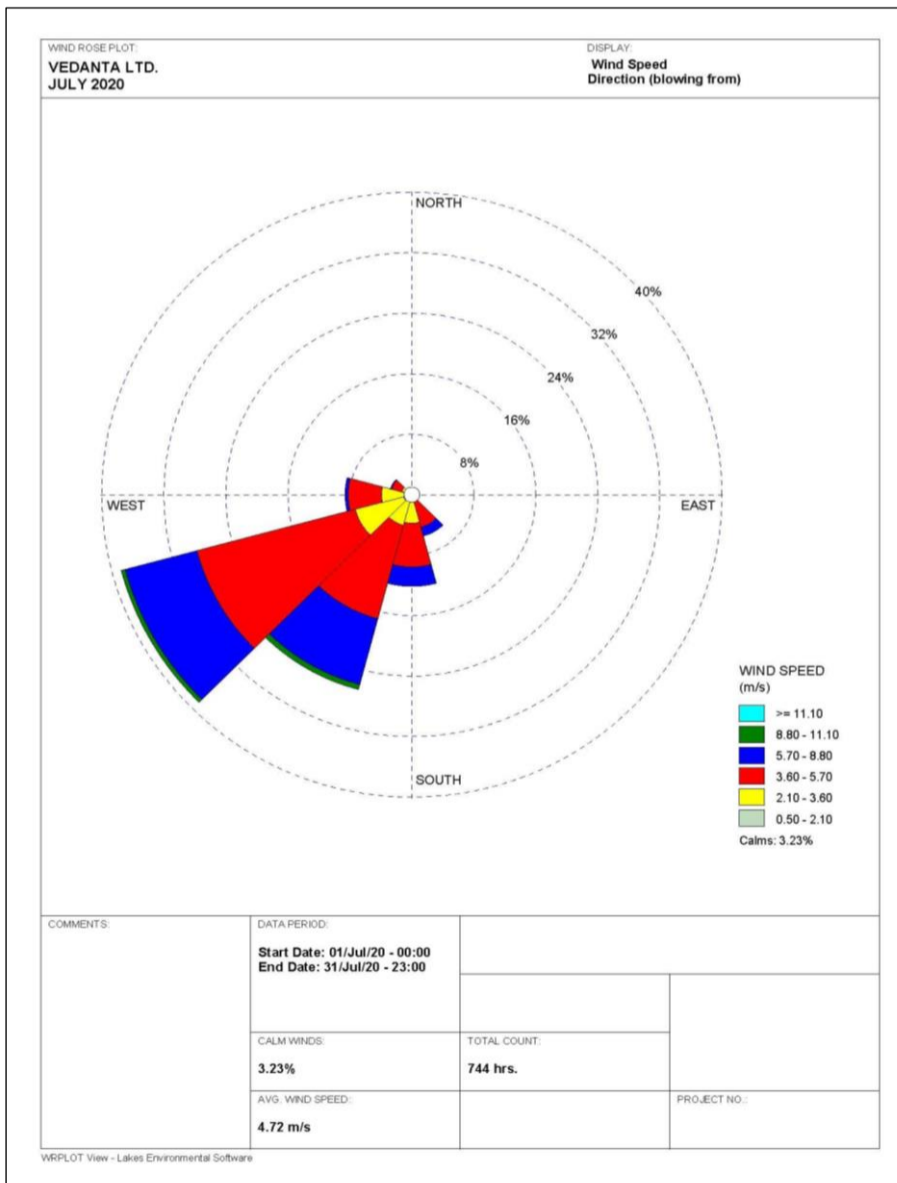
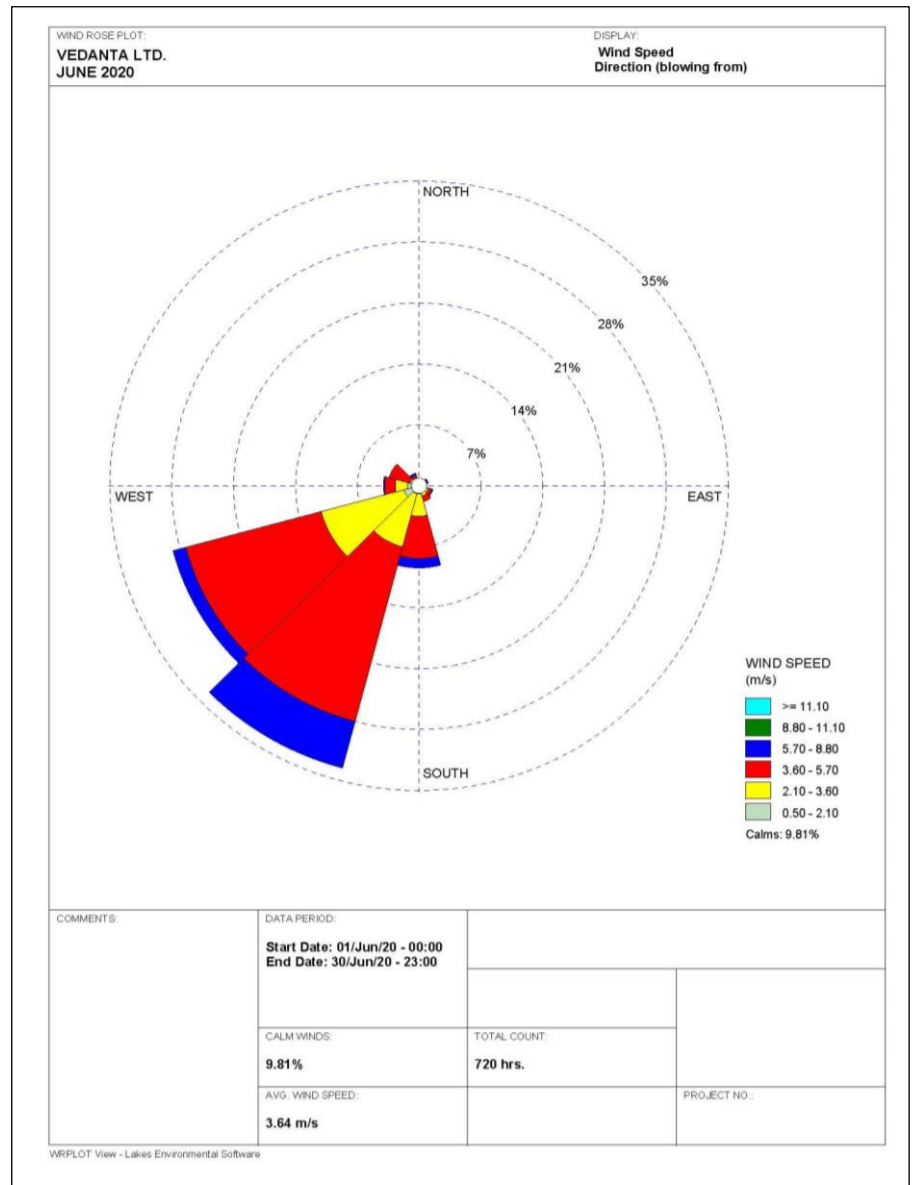
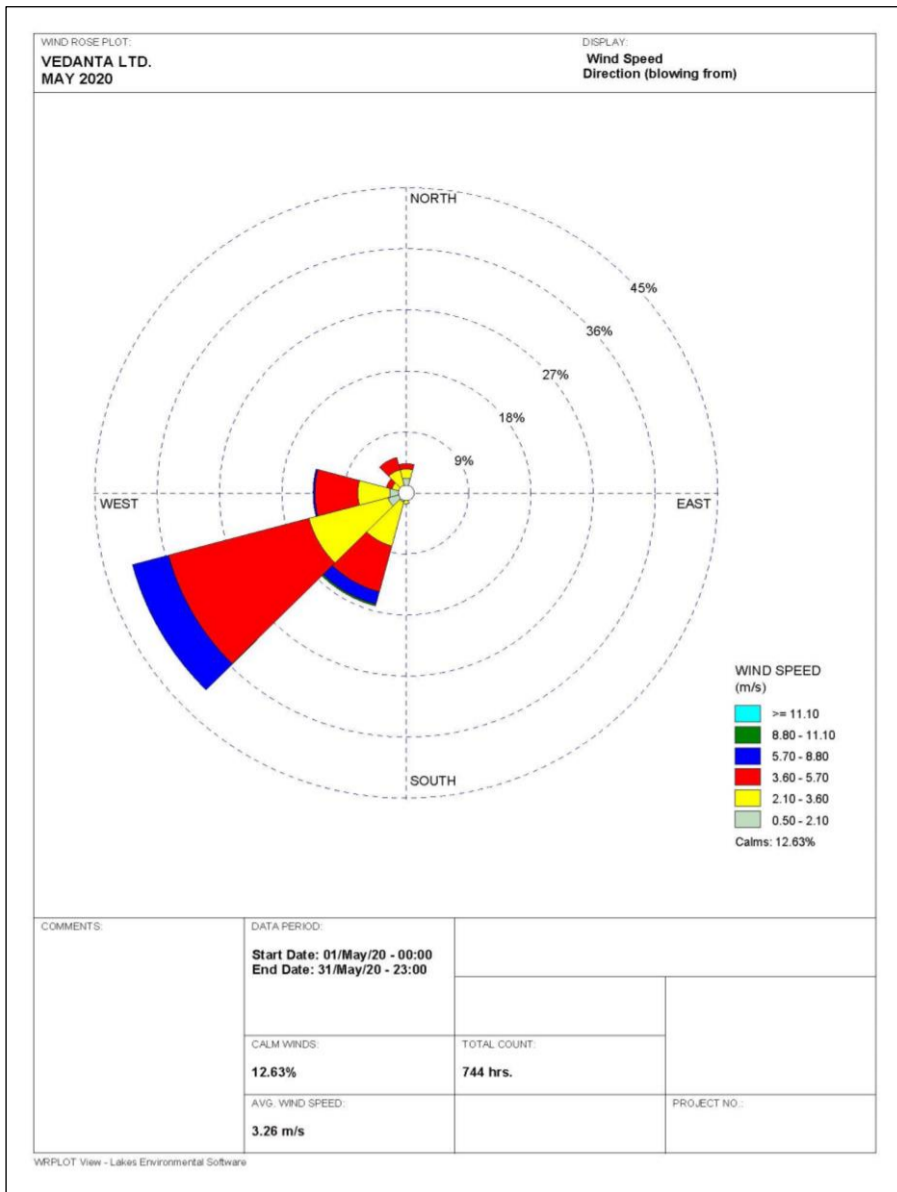


Figure 0-2: Average wind rose diagram





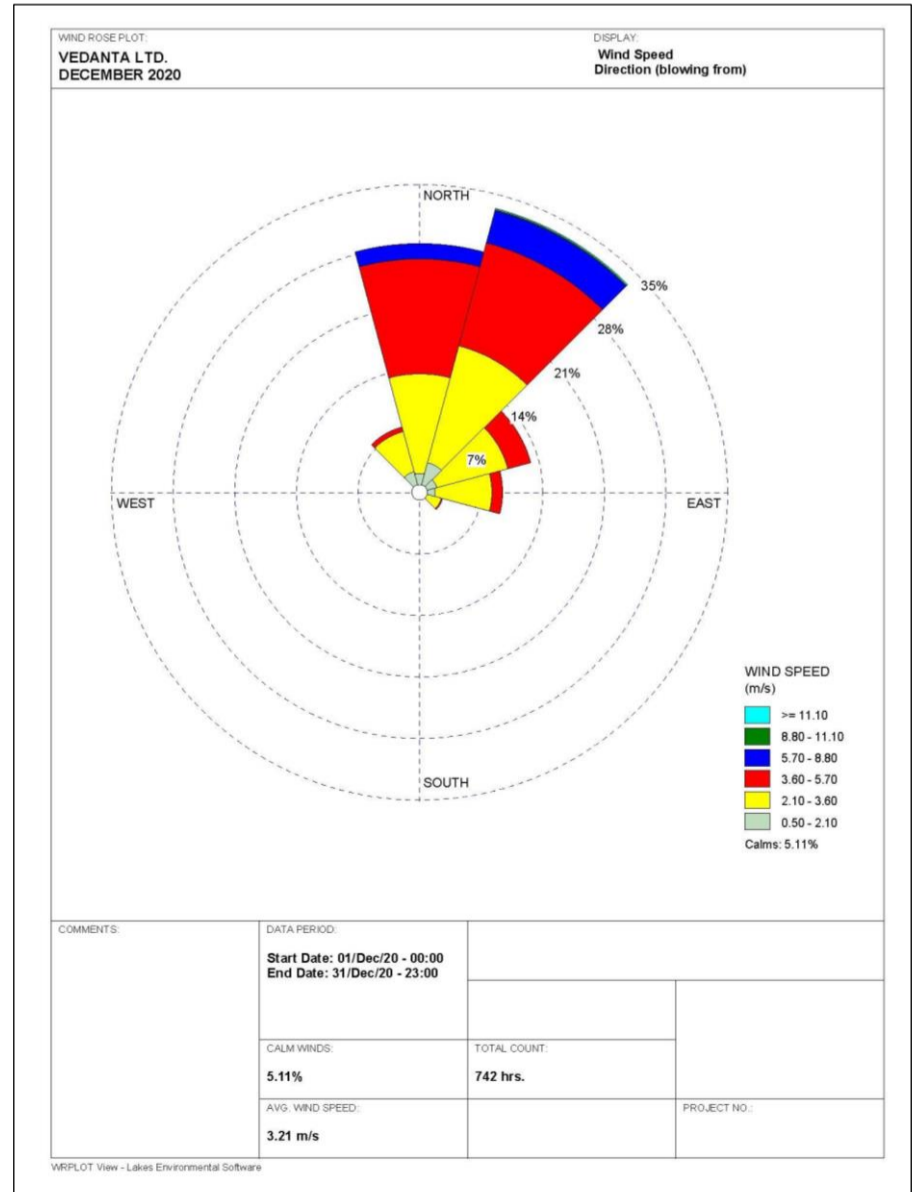
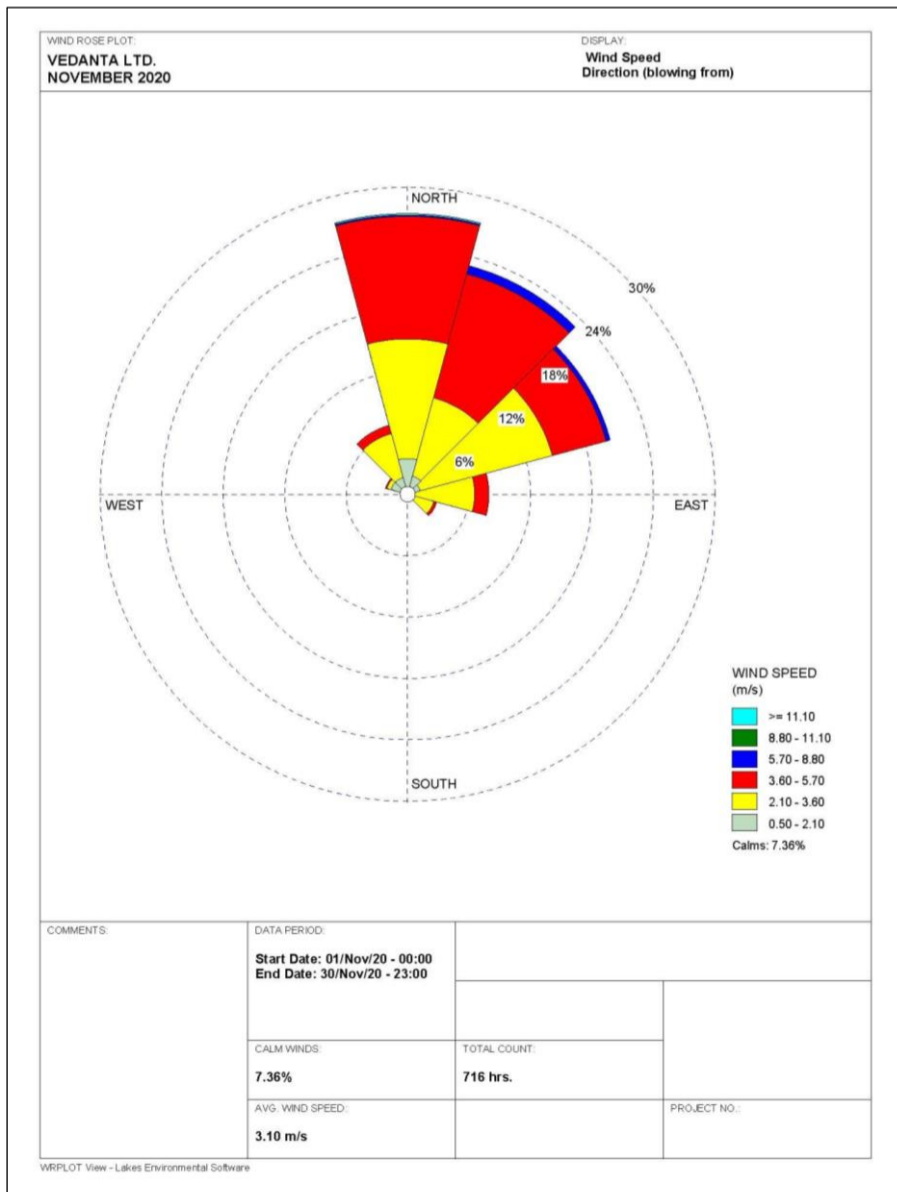
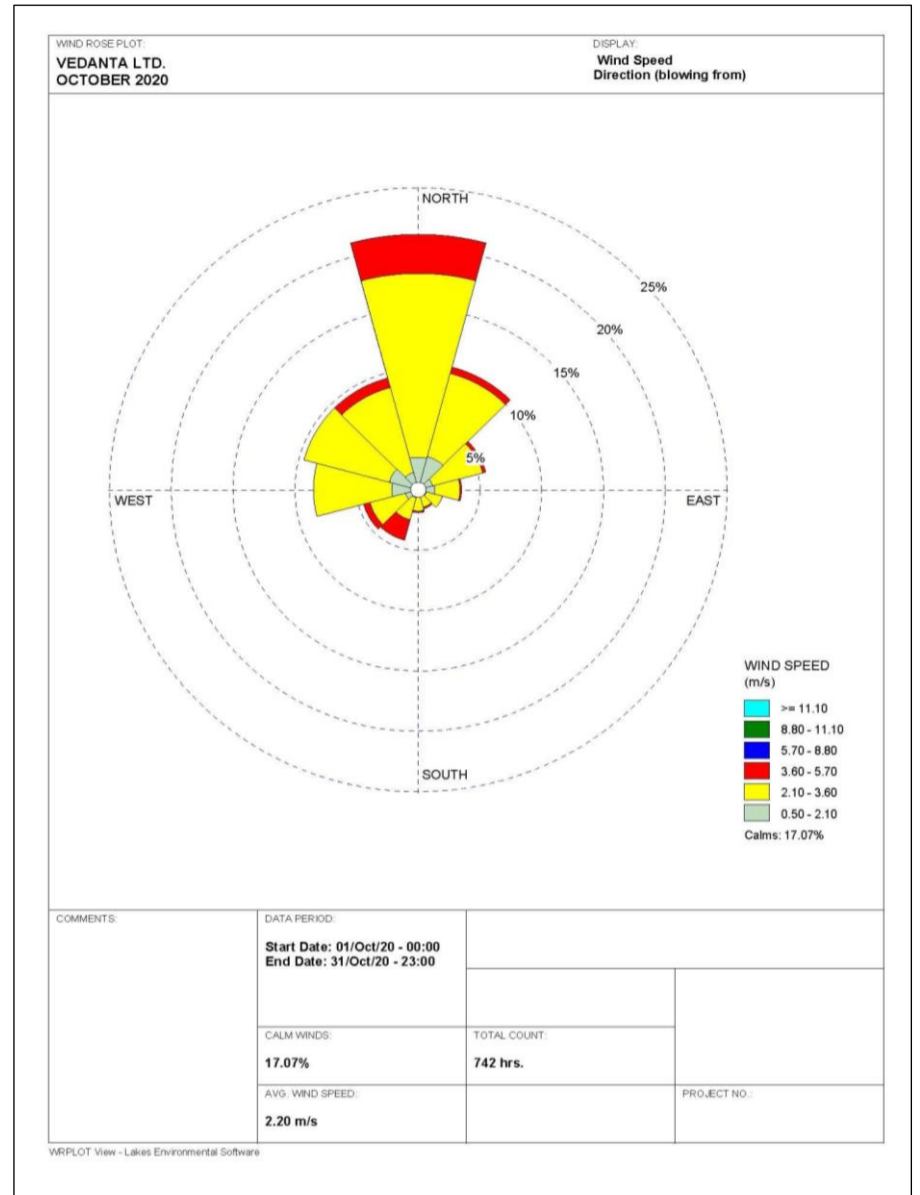
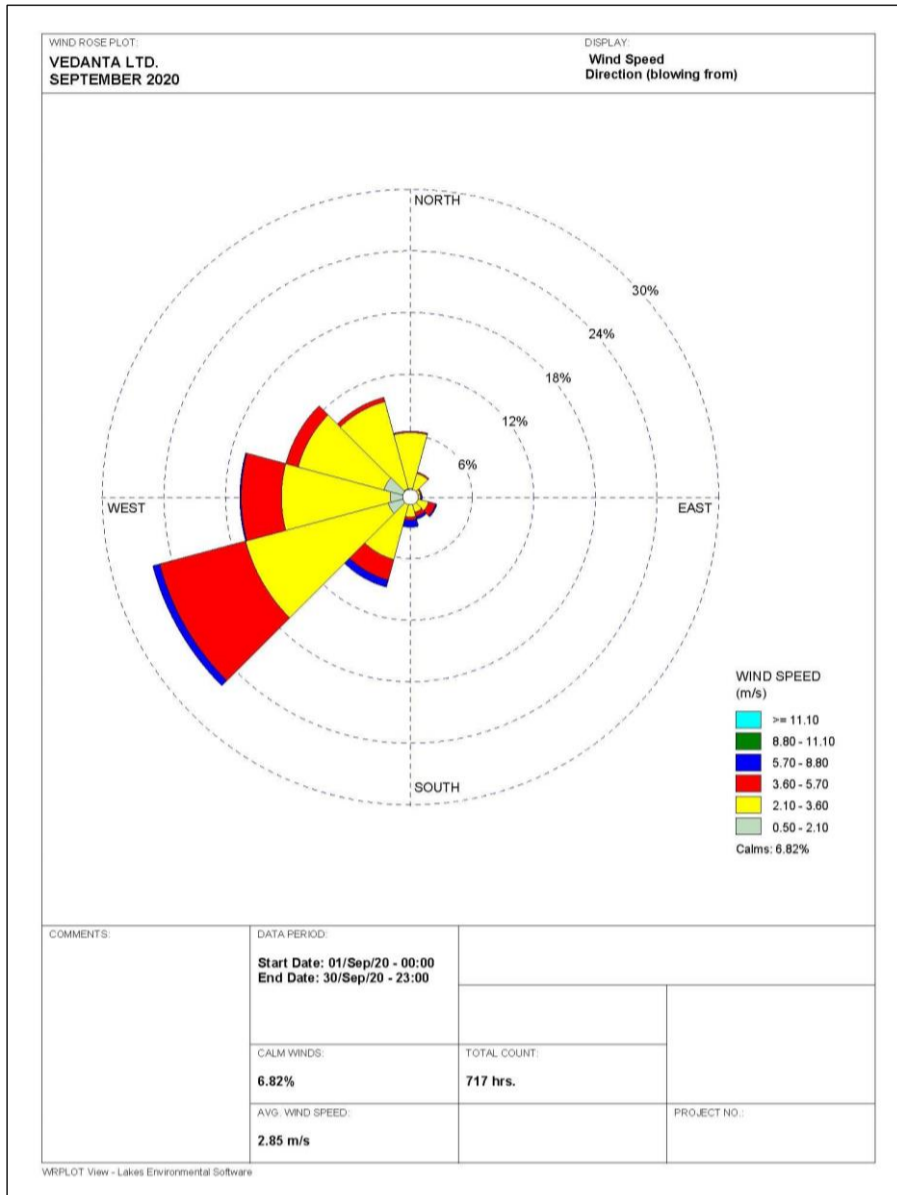


Figure 0-3: Average and Maximum Wind Speed and Gust at Gulf of Khambhat

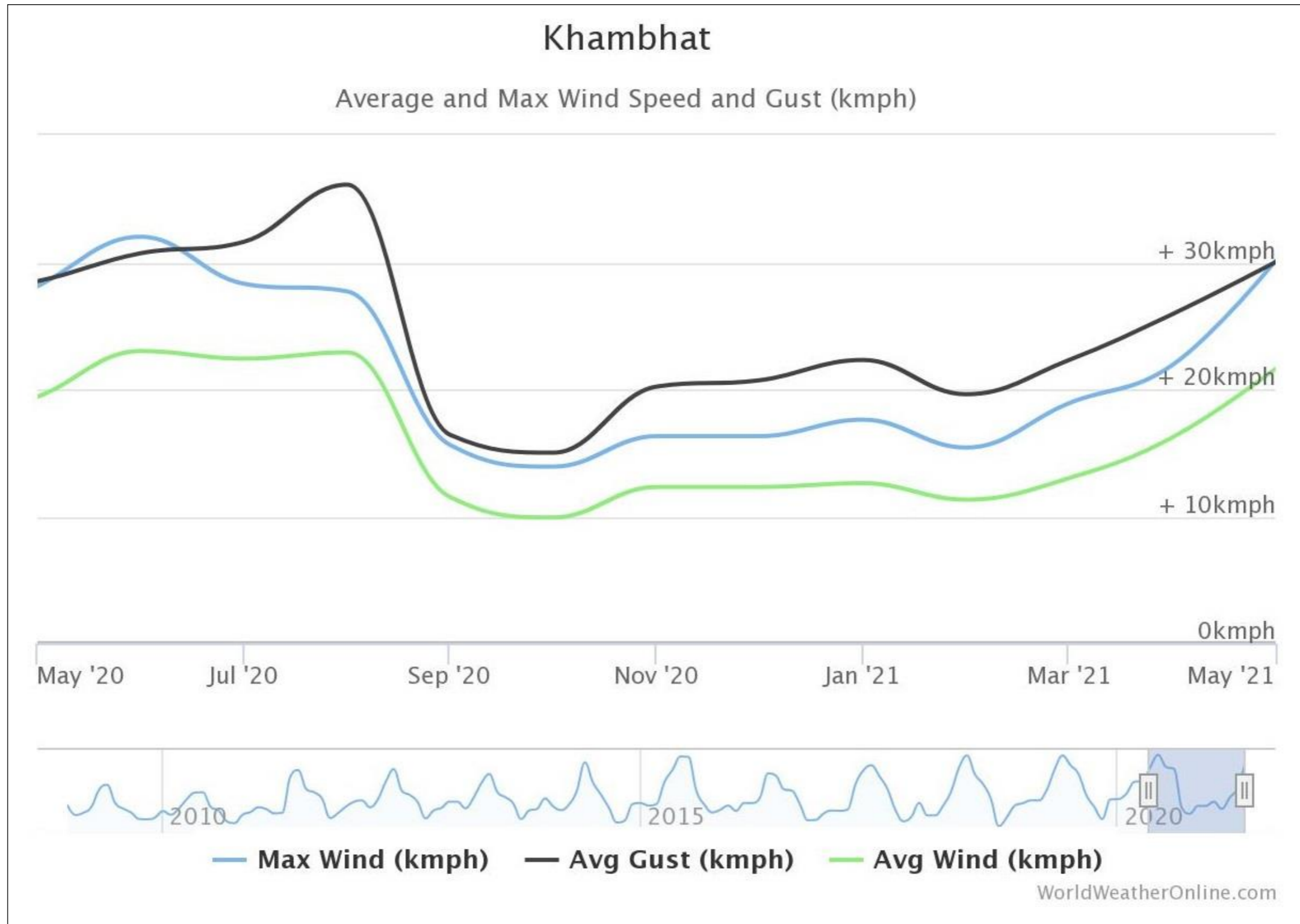


Figure 0-4: Bathymetry details of Gulf of Khambhat (GOK) Region

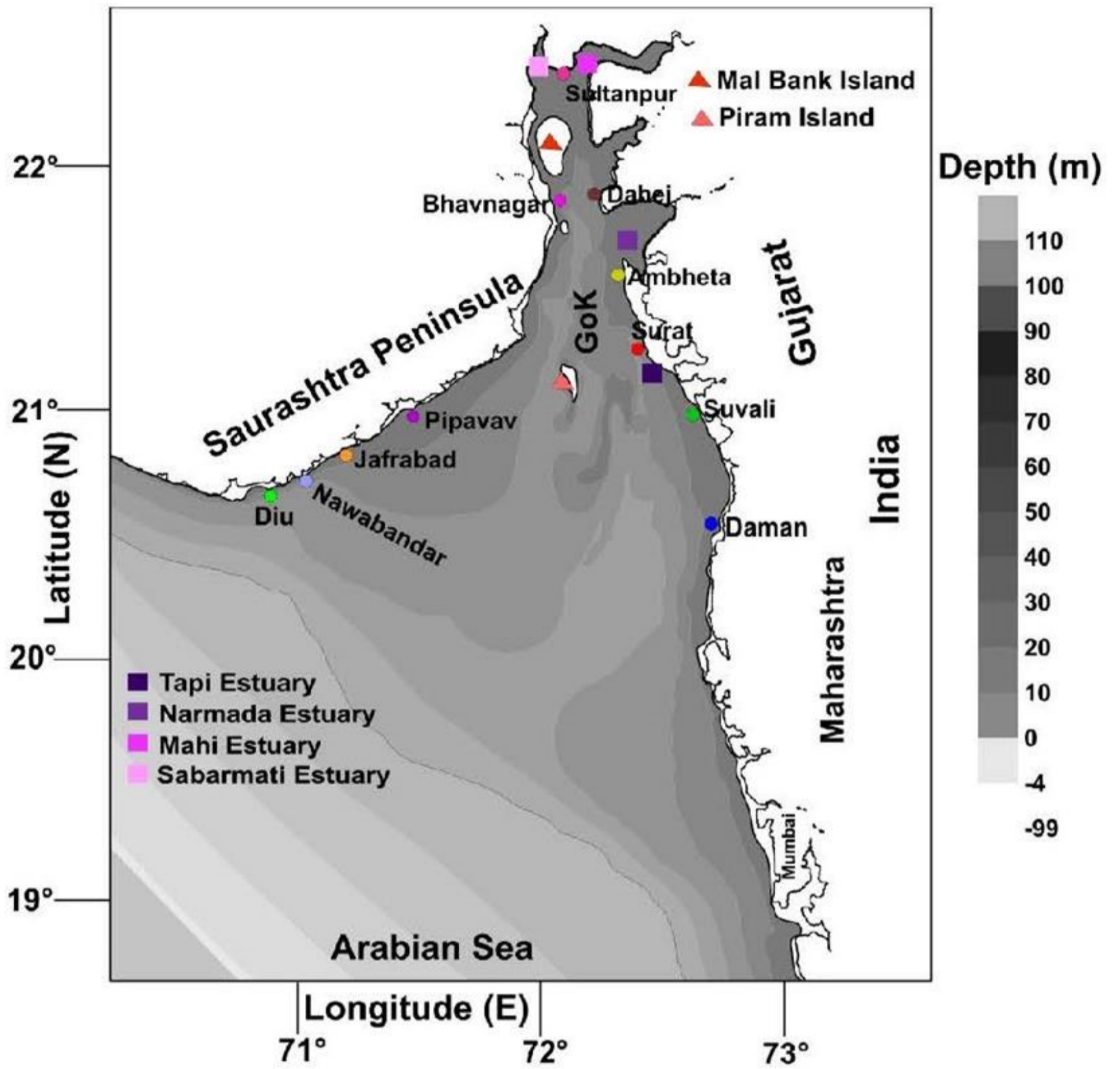


Figure 0-5: Computation study domain showing sensitivity zones and coast type

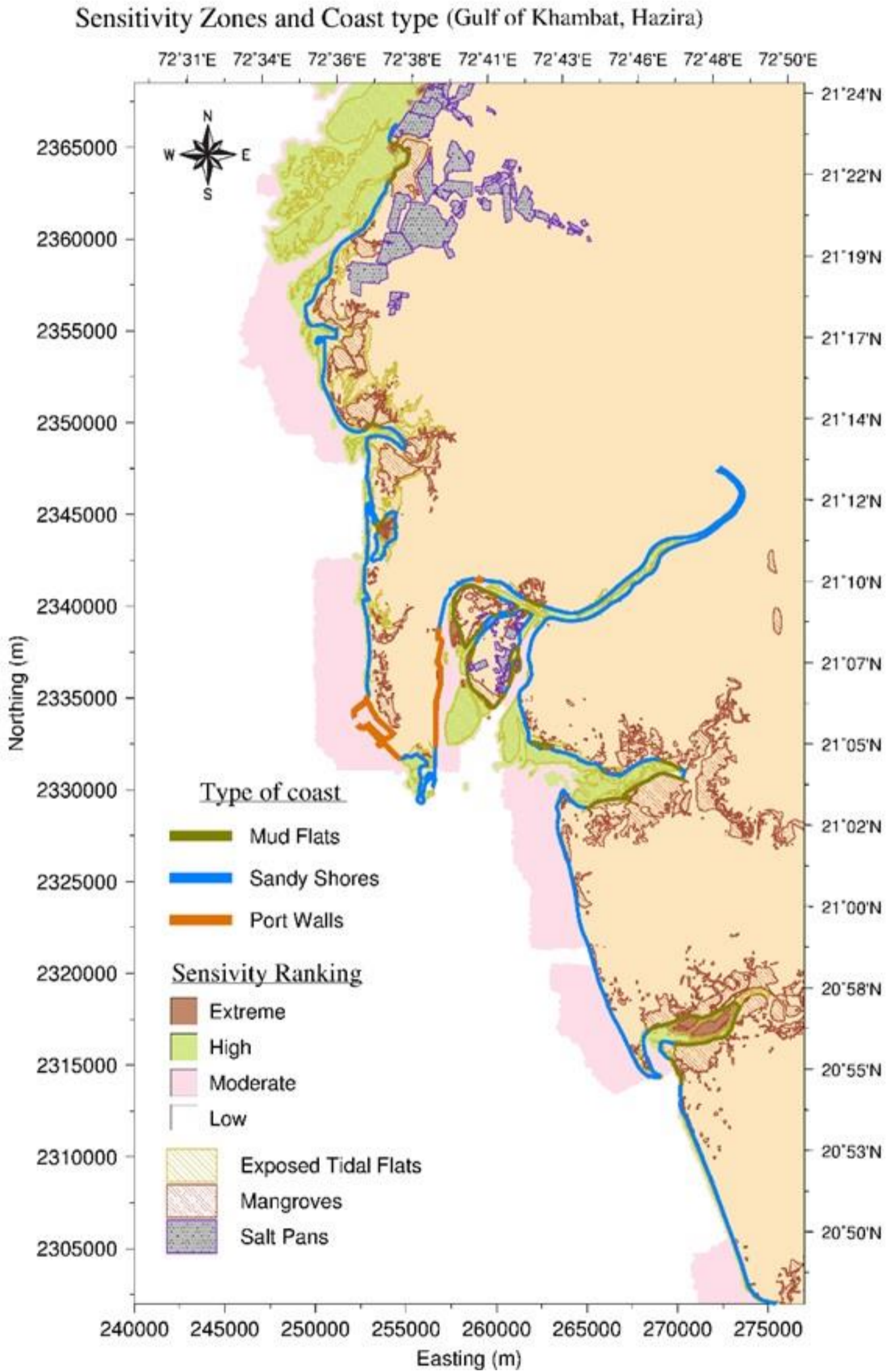
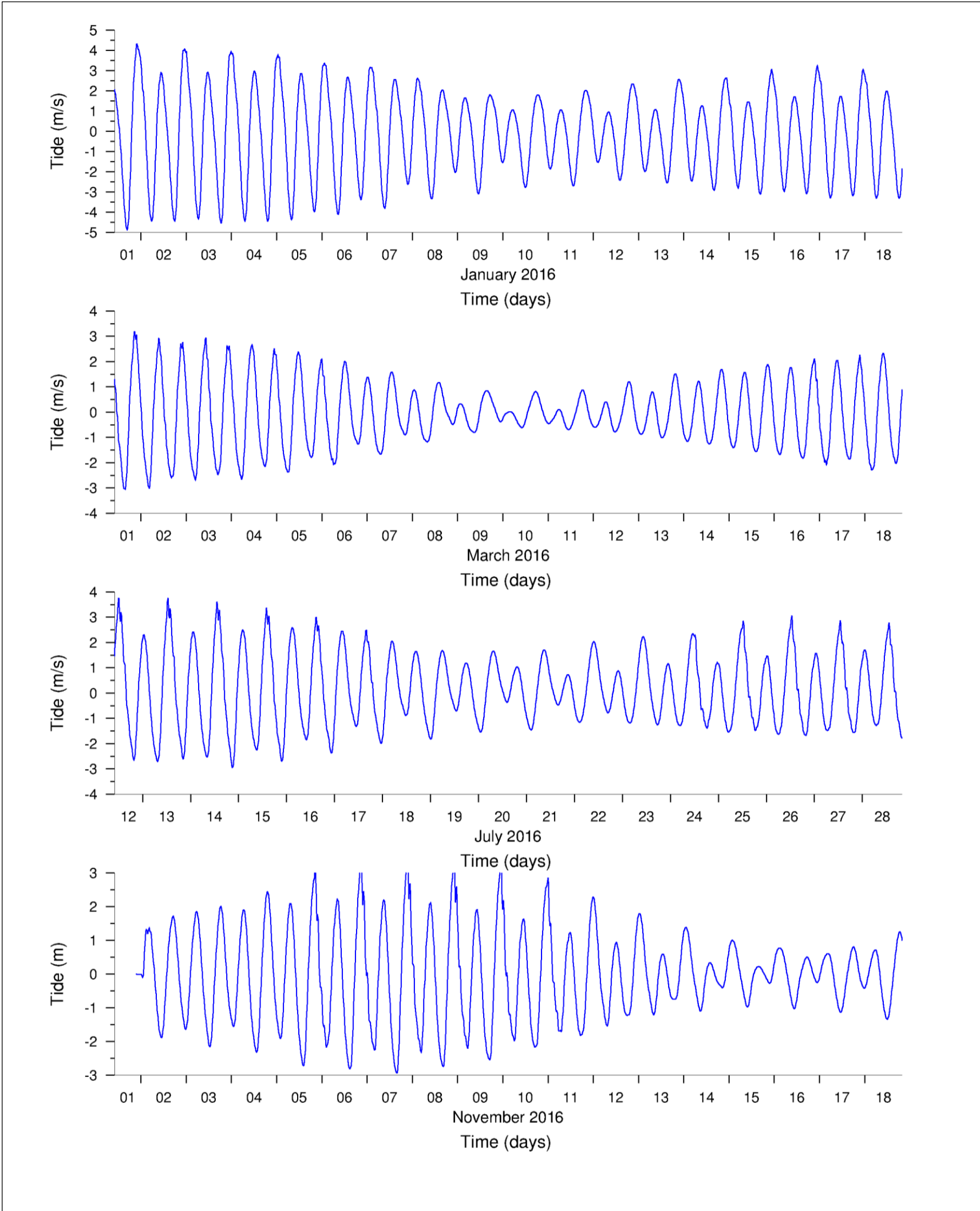


Figure 0-6:Tidal values in the study domain area



Conclusions and Recommendations

Based on the Oil Spill Contingency Plan studies carried out for CB/OS-2 block, West coast of India, the following conclusions can be drawn:



- The hydrodynamic model runs have been made for prediction of tides and currents covering one-year period.
- Oil Spill Modeling studies have been carried for various spill scenarios season wise covering one-year period.
- Sensitivity mapping has been done for the study area considering environmental, ecological, social, economic, and other factors
- NEBA Study has been carried for selecting best response options based on coastal information and spill scenarios.
- The details of spill volume and time taken to reach the coast and losses during its movement have been furnished in the report for preparedness.
- The percentage of spill volume reaching the coast, extent of oiling on the coast in meters, likely vulnerable areas, spill analysis, have been furnished in the report to estimate the fate of the spill.
- OSCP has been prepared as per NOSDCP-2015 guidelines and presented in Strategy Plan. Strategy plans have been discussed in detail and formulated based on the risk analysis. Resources available to combat oil spills have been identified and furnished along with specifications.
- Prepared environmental sensitivity maps based on ecological, environmental, and socio-economic sensitive areas across the block area.
- Sensitivity Atlas has been prepared for coastal areas.

General Considerations

- Oil spill response equipment such as booms, skimmers, dispersants, and other necessary equipment are available. These equipment are placed in Vessels, platforms, Adani Port and Suvali Terminal, so that will be helpful in deploying within a shortest time to combat the oil spills.
- Priority will be given to contain the oil spills by physical means such as booms and skimmers. Oil Spill dispersants after obtaining permission from ICG will be used only if necessary, depending on the clean-up situation and assessment of damage that is likely to occur to the environment.
- Training as per IMO guidelines are provided periodically to the concerned team members, who will be involved in oil spill combating.
- Each year one desktop and one field deployment mock drills will be conducted.

Findings of the oil spill modelling study

- Predicted the hydrodynamic behavior in and around Cairn CB/OS-2 facilities at Suvali for various seasons and for tidal conditions and discussed through graphical representation.
- Oil Spill Modelling studies have been carried out for various probable quantities of spills at the oil well locations and along pipeline route and identified their impact on coastal zones including tidal flats and marine sensitive areas in the coast.

 	Conclusions and Recommendations	Rev. No: 09 Date: 20 th Oct 2023
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Readiness to contain the oil spill

- As soon as intimated, it will take at least 02 hours for the vessel/tugboat, truck trailers to be available.
- Loading of the OSR equipment's by arranging manpower and hydra / crane requirement in Terminal will take 03 hours.
- Distance from Terminal to Adani Port will take 01 hour of time.
- It will take 02 hours in the Port to complete the loading of OSR equipment's considering the customs clearance, berth availability etc.
- It will take 02 hours to reach the offshore spill location from Adani Port considering the Tide plan of the day.
- Thus, in total it will take minimum 8 hours for the Vessel to reach the oil spill location along with the OSR capable equipment's.

The offshore operations consisting of platforms, pipeline and drillings are carried out considering the highest level of safety and asset integrity standards, few key points to highlight are

- The oil and gas wells are fitted with safety valve and SSS valve. A safety device is installed in the upper wellbore to provide emergency closure of the producing conduits in the event of an emergency. In addition to that SSSV (Subsurface safety valve) is also installed to provide the emergency closure in the formation zone itself. In each case, the safety-valve system is designed to be fail-safe, so that the wellbore is isolated in the event of any system failure or damage to the surface production-control facilities
- During drilling the new well, the drilling activity is carried out after installation of BOP. A blowout preventer is a specialized valve used to seal, control and monitor oil and gas wells to prevent blowouts, the uncontrolled release of crude oil or natural gas from a well.
- All the pipelines are continuously studied for their corrosion rate, periodic pigging activities are carried out to enhance the life of the pipeline.

Thus, it is evident that all the operational measures are in place to prevent any type of crude oil spillage. However, in case any accidental spillage occurs,

- then as described in this OSCP, Cairn is equipped with required OSR control equipment in place within and nearer to the Suvali block area.
- Incident Controller are always available (round the clock) in Suvali terminal as the oil and gas upstream business involves high risk operations. So, immediate control of the incident can take place
- Suvali terminal has necessary manpower (> 100 person) working in the plant. Thus, during any emergency it is easier to mobilize.
- Cairn also ensures that its key personnel are trained on OSR as per IMO Level 1 & 2 and also conducts periodic mock drill to check the effectiveness of equipment deployment.
- Helicopter is available in base location to take aerial survey of the marine in case of any spillage occurs to understand the slick movements.

Vedanta Limited is committed in carrying out its operation in a responsible manner and complying to the requirements specified in this OSCP.

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ANNEXURE NO 06

(Compliance to Environmental Management Plan)

Point-Wise Compliance to the Environmental Management Plan prepared in reference to **EC No. J-11011/109/2005-I.A.II(I)**

S.No	Issue	Phase of the proposed development Oil	Management Actions	Compliance Status
1	Accidental Oil spills, Chemical spills and gas releases	Development Planning	<p>Periodic audits to be conducted for planned operations, as well as changes in planning due to operational results to ensure that the</p> <ul style="list-style-type: none"> • project design (power generation equipment, flaring system) aim to minimize air emissions and comply with all legislative requirements • procurement and contractual agreements include considerations relating to equipment & vehicular emission norms. 	Periodic Audits and Review are being conducted as part of Site MOC Meeting.
		Drilling Operations	<p>Regular monitoring of the air emissions from stacks attached to the power generation equipment in the MODU / FPSO will be carried out to ensure that</p> <ul style="list-style-type: none"> • the contractual drilling operations follow the principles of maintenance, optimization of fuel efficiency so that emissions from power generation equipment are minimized • emissions are released at a height sufficient enough to have minimum GLC's of air pollutants; 	No drilling operation carried out in April 2024 to September 2024.
		Production Operations	<p>Regular Monitoring of the power generation equipment to be carried out to meet internationally accepted norms and low sulfur diesel be used as fuel for the power generation</p>	Monthly Monitoring of Stack and Air Emission is carried out for GTG (Gas Turbine Generator), Compressors and Emergency DG Set.

			<p>Associated gas flared to be monitored and reported to ensure that cold venting of produced gas is totally avoided and flaring is minimized during the Production operations.</p> <p>Periodic audits to be carried out to ensure proper maintenance of flaring equipment and operations</p>	<p>Accounting and Monitoring of Gas Flaring is being done at site. Site has stringent Gas Flaring KPIs. No Cold Venting is carried under normal plant operation.</p> <p>Periodic Audits are conducted covering flaring operation.</p>
			<p>Fugitive emissions from process equipment to be minimized by strictly following the maintenance procedures and masks to be provided to workers being exposed to such fugitive emissions. Regular monitoring of hazardous fugitive emissions should be carried out. Use of PPE to be monitored;</p>	<p>Regular Monitoring of Fugitive Emissions is conducted at site and based on exposure adequate PPEs are ensured.</p>
2	Noise Emissions	Development Planning	<p>Periodic audits and noise monitoring should be conducted for planned operations, as well as changes in planning due to operational results to ensure that</p> <ul style="list-style-type: none"> • project design (noise generating equipment / involving moving machinery, flaring system) aim to minimise noise emissions • comply with all legislative requirements. • procurement and contractual agreements include considerations relating to equipment related noise emission abatement & mitigation measures. • Spatial & temporal planning of facilities is designed to ensure minimal noise disturbance to the nearby settlements. For example, location of DG sets in lower deck, to maintain adequate distance from living accommodation module. 	<p>Monthly Noise monitoring (both day and night time) is carried out in the plant area to ensure compliance</p>

		Drilling Operations	<ul style="list-style-type: none"> •Audits & inspection of noise producing equipment for proper maintenance and operational efficiency of noise abatement measures should be done to ensure minimal noise generation from rotary drilling equipment, & other major noise generating equipment by usage of silencers, rubber claddings and noise isolators wherever possible. •Earmuffs and ear plugs should be provided for maintaining good occupational health. 	No drilling operation carried out in April 2024 to September 2024.
		Production Operations	To ensure minimal noise generation from power generating equipment, pumps, vehicular (incl. Helicopter) movements, flaring operation through preventive maintenance of equipment and machinery, flaring, operating conditions and noise level should be regularly monitored.	Monthly Noise monitoring (both day and night time) is carried out in the plant area to ensure compliance
3	Generation & disposal of liquid, solid wastes	Development Planning	Changes in project design due to operational results should be monitored and accordingly necessary changes in waste management design should be made to ensure appropriate handling of all the identified liquid, solid wastes and selection of treatment and disposal options followed by incorporation of required handling, treatment, storage and / or disposal systems in the project design	No drilling operation carried out in April 2024 to September 2024.

		Drilling Operations	<p>Recycling of mud should be maximised and proper washing of cuttings before disposal should be ensured so that offshore disposal meets the MoEF disposal criteria. For this, regular monitoring of the generated, discharged quantity as well as characteristics of the residual mud and drill cuttings should be done periodically.</p>	<p>No drilling operation carried out in April 2024 to September 2024.</p>
			<p>Samples of drill cuttings & drilling mud should be tested for bio-toxicity & heavy metal concentration on a regular basis and records maintained. In case of exceedance, the drilling mud composition is to be modified</p>	<p>No drilling operation carried out in April 2024 to September 2024.</p>
			<p>Water samples to be collected periodically from near the drilling rig and water samples tested for oil content;</p>	<p>No drilling operation carried out in April 2024 to September 2024.</p>
			<p>Offshore marine environment to be sampled for the various environmental attributes (water, sediment, benthos) at least once annually;</p>	<p>Seasonal Offshore Environment Monitoring is being carried out.</p>
			<p>A detailed Waste Management Plan taking into consideration, all the applicable regulations – especially those regulating waste characteristics and the final disposal norms / conditions should be prepared for each phase of development, based on the principles and guidelines presented in the EIA report. Accordingly, treatment / handling / disposal systems to be installed and operated during the drilling operations.</p>	<p>Waste Management Plan is in place covering all regulatory requirements.</p>

			Hazardous Wastes such as used engine oil / lubricating oil should be stored in contained area and sent onshore for disposal to GPCB approved recyclers or sent for permanent landfilling	Used oil is being re-processed within the terminal
		Production Operations	Source reduction as well as treatment of produced water for removal of oil and suspended solids should be ensured to meet the offshore disposal norms prescribed by the GPCB. Further, the existing outfall designed for disposal of liquid effluents to achieve maximum dispersion to be used for disposal of the treated produced water. Periodic Monitoring of marine outfall area should be done to study the impacts due to disposal of produced water.	Produced water is treated in the ETP facility before disposal. Monthly monitoring of the effluent is done to ensure GPCB norms. Existing outfall diffuser for treated effluent discharge is NIO approved.
4	Accidental Oil spills, Chemical spills and gas releases	Entire duration of Oil development	Safety systems to be installed (as a part of design) and safety procedures to be implemented for prevention & emergency response of accidental Oil spills, chemical spills and gas releases	Oil Spill Contingency Plan covering Offshore Spill and Shore Spill is available at site.
			Detailed systems and procedures for prevention and control of accidental releases to be followed	Site has Emergency Response Plan in place.
			Encourage culture to report near miss and investigate root causes and communicate lessons learned	Regular Awareness on Near Miss Reporting and sharing of incident conducted during monthly HSE Meeting and regular field interactions.
			Regular mock drills should be conducted to ensure emergency preparedness and regular safety training should be provided to the operational staff	Regular Mock Drill are conducted as per plan.
			Regular audits should be carried out to ensure complete avoidance of accidental	Regular Audits are carried out as per plan.

			spills/releases, emergency response preparedness	
5	Impacts during installation of offshore structure	Initial and intermediate Production phases of the proposed Oil development	Project Assessment and Planning Controls to be utilized principally by adopting international codes & principles of practice during the process of erection of the relatively permanent structures – offshore well head platforms, sub-sea pipelines and the temporary offshore installations for drilling, processing of crude.	Being Complied as part of Management of Change / Design Engineering.
			Approval from Gujarat maritime Board, & GPCB should be obtained on exact location of platform, anchoring of MOPU & FSO /FPSO	NOC obtained from GPCB & MOEF for production from offshore platforms.
6	Impacts due to presence of offshore infrastructure	Production Phase	Developments around the project area including fishing activities should be checked to ensure corrective actions required for control of events leading to impacts on safety and fishing due to the presence of offshore structures.	Site has deployed 24X7 Production Support vessel to monitor any unauthorized movement near offshore platforms.
			Regular liaison with the State Fisheries Commissionerate to be maintained to appraise CEIL's activities and their locations, so that CEIL ensures a considerable reduction in risk of fishery interactions	Being Complied.
7	Land and marine traffic management	Drilling and Production Phases.	Proper planning with respect to vehicular / marine vessel movements and traffic management should be ensured and Oil development program schedule & locations should be notified using established communication channels	Vessel movements are monitored through AIS. Site has Traffic Management plan in place.

			<p>Tanker movements should be piloted by qualified captains familiar with the Gulf of Khambhat</p>	No Such offshore tanker movement conducted w.r.t our operations.
			<p>Offshore installations and marine vessels should have proper approved communication, navigational and warning systems. Periodic check should be ensured.</p>	Radio Walkies and Landline Communication system provided on all offshore platforms.
8	Decommissioning		<p>All protocols of the National, international and regional conventions /regulations (MOEF, IMO, E&P forum etc) should be strictly adhered.</p> <p>Different decommissioning options should be developed, assessed and selected balancing the environmental factors, cost, technical feasibility, health and safety and public</p> <p>Government should be informed about the cessation of production having proved the reservoir is no longer viable and for securely plugging wells below the surface</p> <p>Government approval must be obtained to proceed with its recommended decommissioning option</p> <p>The parts of the structure removed to shore should be then re-used, recycled or disposed</p>	No Site Decommissioning carried during the reporting period

GPCB-FORM V-2024-09

16th September 2024

The Member Secretary,
Gujarat Pollution Control Board,
Paryavaran Bhavan,
Sector-10A,
Gandhinagar – 382 010.

Sir,

Sub: Submission of Annual Environment Statement (Form-V) for Development activities in CB/OS-2 Block in Surat district for the period April 2023 to March 2024

Please find enclosed the Annual Environment Statement for the period from 1st April 2023 to 31st March 2024 for activities comprising the Production Operations Suvali onshore terminal and development drilling in CB/OS-2 block.

Thanking you,

Yours faithfully,



Samarth Kaji
Installation Manager - CB/OS-2



Copy to: The Regional Officer,
Gujarat Pollution Control Board,
Plot No.11-12/2,3
GIDC Pandesara
Surat – 394 221

VEDANTA LIMITED

Cairn Oil & Gas : Survey No 232 | Village – Suvali | Surat-Hazira Road | Surat - 394510, Gujarat, India
T +91-261 6711444 F +91-261 6711509, 10, 90 | www.cairnindia.com

Registered Office: Vedanta Limited, 1st Floor, 'C' wing, Unit 103, Corporate Avenue, Atul Projects, Chakala, Andheri (East), Mumbai-400093,
Maharashtra, India | T +91-22 664 34500 | F +91-22 664 34530 | www.vedantalimited.com

CIN: L13209MH1965PLC291394

Sensitivity: Internal (C3)

FORM V
(See Rule 14)
ENVIRONMENTAL STATEMENT

ENVIRONMENTAL STATEMENT FOR THE FINANCIAL YEAR 2023-24
FOR

SUVALI ONSHORE TERMINAL
CB-OS 2 BLOCK HYDROCARBON FIELD
VILLAGE: SUVALI DIST: SURAT GUJARAT

PART - A

- I. Name and address of the owner / occupier of the industry operation of process
Installation Manager – Suvali
M/s Vedanta Limited, Cairn Oil & Gas
Suvali Onshore Terminal Survey No. 232, Village
Suvali, Surat Hazira Road, Surat – 394510
- II. Industry category
Primary -- (STC Code)
Secondary -- (SIC Code)
- III. Production capacity – Units
Suvali Onshore Terminal
Crude Oil Processing Capacity **25000 BoPD**
Natural Gas- **150 MMSCFD**
- IV. Year of establishment
November 2002
- V. Date of the last environmental statement submitted
08th August 2023

PART - B

Water and Raw Material Consumption:

i) Water consumption m³/d

Purpose	Quantity in m ³ /d	Remarks
Domestic	34.21 m3/day	Water is sourced through GIDC Supply and used at Administrative buildings, washrooms , etc.
Process/Industrial	41.05 m3/day	Water is sourced through GIDC Supply and used for industrial cleaning etc.
Total	91.12 m3/day	Refer Annexure-1 for month-wise Consumption details

Name of products	Process water consumption per unit of product output	
	During the previous financial year	During the current financial year
Crude (SCM)	0.09 KL/SCM	0.08 KL/SCM
Natural Gas (SCM)	235.91 KL/MMSCM	110.73KL/MMSCM

(ii) Raw material consumption

Name of Raw Materials	Name of Products	Consumption of raw material per unit of output	
		During the previous financial year	During the current financial year
There are no raw materials involved in the production of Crude Oil. The well fluids consisting of oil, water and associated gas is extracted from the hydrocarbon subsurface reservoir and flows directly to the Suvali facility for phase separation and processing.		NA	NA

PART - C

POLLUTANTS	QUANTITY OF POLLUTANTS DISCHARGED (MASS/DAY)	CONCENTRATIONS OF POLLUTANTS IN DISCHARGES (MASS / VOLUME)			PERCENTAGE OF VARIATION FROM PRESCRIBED STANDARDS WITH REASONS	
		Parameter	Annual Avg(mg/l)	Prescribed Std.		
Treated Sewage Water	18.06 KLD	TSS (mg/l)	24	30	Within the specified limits of GPCB	
		BOD (mg/l)	13	20		
		Residual Cl	0.6	>0.5		
Treated Effluent	1471.49 KLD Refer Annexure-2 for Month-wise discharge quantity	TSS (mg/l)	17	100	Within the specified limits of GPCB.	
		BOD (mg/l)	23	30		
		COD (mg/l)	93	100		
B) Air Emissions from Gas Turbines & DG Sets	Fuel Consumption: Avg Natural Gas consumed for running of Gas Turbine Generators & Gas Turbine Compressor, Hot Oil Heater, TEG regenerators= 82502.47 SCM/Day	Name of Source	Quantity of Pollutant (mg/NM³)			The stack emissions are within the prescribed limits of GPCB.
			PM	SO ₂	NO _x	
		GTG	12.98	3.84	11.54	
		EDG	84.27	34.25	28.51	
		GTC	15.01	3.64	9.54	
		Booster Compressor	14.42	3.82	11.41	
		Hot Oil	14.63	4.64	13.22	
		TEG Regenerator	14.16	3.66	10.07	
GPCB Limit	150	100	50			

PART - D
HAZARDOUS WASTE

(As specified under Hazardous & Other Wastes (Management, Handling and Transboundary Movement) Rules 2016)

Hazardous Waste	Total Quantity Generated			
	During the previous financial year		During the current financial year	
a) From Process	Hazardous Waste Description	Generation Quantity (Kgs/ Liters)	Hazardous Waste Description	Generation Quantity (Kgs/ Liters)
	Waste oil (Tank bottom oil/ Sludge, oil emulsions) (3.3. Schedule 1)	Nil	Waste oil (Tank bottom oil/ Sludge, oil emulsions) (3.3. Schedule 1)	130
	Used Oil/ Spent Oil (5.1 Schedule 1)	4850	Used Oil/ Spent Oil (5.1 Schedule 1)	0
	Filters, Liners containing Oil (3.3 Schedule 1)	Nil	Filters, Liners containing Oil (3.3 Schedule 1)	Nil
	Oily Soaked Cotton Rags (5.2 Schedule 1)	Nil	Oily Soaked Cotton Rags (5.2 Schedule 1)	Nil
	Discarded containers (33.3 Schedule 1)	33421	Discarded containers (33.3 Schedule 1)	2400
	Spent Chemicals (32.1 Schedule 1)	Nil	Spent Chemicals (32.1 Schedule 1)	8,620
	Drill Cuttings (2.1 Schedule 1)	949570	Drill Cuttings (2.1 Schedule 1)	Nils
	Drilling Fluid (2.3 Schedule 1)	Nil	Drilling Fluid (2.3 Schedule 1)	Nil
(B) From pollution control facilities	Sludge Generated from ETP Operations	64140 Kgs	Sludge Generated from ETP Operations	19310 Kgs
(C) From Other sources	NIL		NIL	

PART - E

SOLID WASTE

Solid Waste	Total Quantity	
	During the previous financial year	During the current financial year
(a) From process	Mentioned in other waste category	Refer Part D for Hazardous Waste and other solid waste mentioned below
(b) From Pollution control facility (STP Sludge)	The Bio-sludge generated is used as manure for greenbelt maintenance.	The Bio-sludge generated is used as manure for greenbelt maintenance.

Solid Waste	Total Quantity	
	During the previous financial year	During the current financial year
(C) Other wastes from, Ware house, Living quarters and plant housekeeping etc.,	930 Kg Non-Hazardous waste	950 Kg Non-Hazardous waste
(1) Quantity recycled or re-utilized within the unit.	4850 L Used Oil reprocessed within the terminal	130 L Used Oil reprocessed within the terminal
(2) Sold (Waste paper, metal waste, plastic wastes, packaging material, wooden pallets, drinking water bottles etc. are handover to recyclers)	Nil	Nil
(3) Disposed	Segregated solid waste sold to scrap dealers through auction basis time to time.	Segregated solid waste sold to scrap dealers through auction basis time to time.

PART - F

Please specify the characterizations (in terms of composition and quantum) of Hazardous and non-hazardous wastes and indicate disposal practice adopted for both these categories of wastes.

Hazardous Waste: As per Hazardous Waste Authorization. **Refer Annexure-3** for details.

Non-hazardous waste: Domestic waste is generated from the operation and development facilities which mostly consist of bio-degradable organic matter and recyclable wastes. The recyclable waste is handed over to scrap vendor for further recycling process. Food waste is used for composting and manure is being used in green belt development.

PART - G

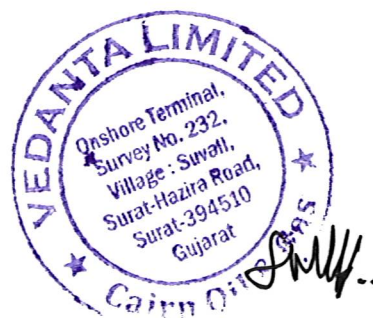
Impact of the pollution abatement measures taken on conservation of natural resource:

- Sewage Treatment Plant of capacity 30 KLD at Suvali Terminal is operational for the treatment of sewage water.
- Organic Waste Convertor for the treatment and conversion of food waste into bio-manure is available.
- Water produced in crude extraction process is treated in Effluent Treatment plant and discharged into the sea as per GPCB Norms.
- Green belt development: 27 Acres of Periphery green belt around the facility to control the noise and air pollution levels generated from Suvali terminal. An MoU has been signed with the forest department for plantation and development of **321.24 Acres** of mangroves.
- Nursery development and mangrove plantation has been carried out by the Surat Forest department in an area of **148.26 Acres** as per the MoU signed in October 2022.
- More than **10,000 KL** of water utilized in the plant has been collected from rainwater harvesting ponds built inside the terminal.

PART - H

Additional measures/investment proposal for environmental protection including abatement/prevention of pollution.

- Fuel control devices are a part of all equipment for fuel conservation.
- Solar panels are installed at the facility to contribute to the overall energy mix.
- Rainwater harvesting facility is built within the terminal to meet 40% of freshwater demand.
- Tree plantation is one of the initiatives taken up by the company regularly.
- All the detergents used at the terminal are bio friendly.
- Oil Spill Response Equipments are available with Organization as per NOSDCP 2015 requirements.
- Awareness sessions on environmental topics are conducted regularly for all employees and business partners.
- As part of CSR initiative, Cairn has developed a rainwater harvesting facility for the community.
- The company has stopped the use of Single-use plastic items at its premises and has been certified as **Single-Use Plastic Free Premises** by the Confederation of Indian Industry
- World Environment Day was celebrated on 5th June 2024 with active engagement from employees, business partners and communities.



Date: 16.09.2024

**Installation Manager – Suvali
(Samarth Kaji)**

ANNEXURE – 1

FRESH WATER CONSUMPTION IN KILOLITERS

FRESH WATER CONSUMPTION (FY 2023-24)							
Month	Potable Water (Domestic), m³	Service Water (Industrial), m³	Fire Water (Industrial) (m3)	Gardening Water (Agriculture), m3	Total Water Consumed in m3	Production in Th. Tons	Sp. Water m3/Th. Tons
Apr-23	1090.000	457.000	676.000	557.000	2780	53.54	51.92
May-23	1084.000	638.000	730.000	582.000	3034	54.48	55.69
Jun-23	987.000	404.000	568.000	394.000	2353	51.59	45.61
Jul-23	934.000	624.000	662.000	202.000	2422	52.81	45.86
Aug-23	1176.000	641.000	571.000	531.000	2919	50.82	57.43
Sep-23	1100.000	715.000	568.000	502.000	2885	46.53	62.01
Oct-23	1289.000	817.000	728.000	553.000	3387	42.57	79.57
Nov-23	1129.000	783.000	758.000	492.000	3162	39.18	80.70
Dec-23	1115.000	888.000	736.000	555.000	3294	38.44	85.70
Jan-24	1101.000	826.000	723.000	519.000	3169	38.77	81.75
Feb-24	938.771	577.705	519.221	516.524	2552.2212	36.60	69.74
Mar-24	542.747	371.718	0.000	387.535	1302	35.92	36.24

ANNEXURE – 2

EFFLUENT WASTEWATER QUANTITY IN KILOLITRES

Months	Wastewater
	Treated Effluent (KL)
Apr-23	43134
May-23	45184
Jun-23	42684
Jul-23	45384
Aug-23	45668
Sep-23	44370
Oct-23	46061
Nov-23	44597
Dec-23	46079
Jan-24	45993
Feb-24	42010
Mar-24	45930
Total	537094

ANNEXURE – 3

HAZARDOUS WASTE (FROM PROCESS)

S. No	Hazardous Waste Description	Authorized Quantity	FY 23-24 Generation Quantity (Kgs/ Liters)	FY 23-24 Disposal Quantity (Kgs/ Liters)
1	ETP Sludge (34.3 Schedule 1)	600 MT/ Year	19310	45700
2	Waste oil (Tank bottom oil/ Sludge, oil emulsions) (5.2 Schedule 1)	800 MT/Year	130	130
3	Used Oil/ Spent Oil (5.1 Schedule 1)	20 MT/Year	0	0
4	Filters, Liners containing Oil (35.1 Schedule 1)	15 MT/ Year	Nil	Nil
5	Oily Soaked Cotton Rags (Z-41 Schedule 1)	6000 Kg/Year	Nil	Nil
6	Discarded containers (33.3 Schedule 1)	8400 Kgs/ year	2400	6280
7	Waste Hot Oil (5.2 Schedule 1)	1000 Lit/year	Nil	Nil
8	Spent Chemicals (32.1 Schedule 1)	10 MT/year	8620	8620
9	Drill Cuttings (2.1 Schedule 1)	800 MT/well	Nil	Nil
10	Drilling Fluid (2.3 Schedule 1)	440 MT/ year	Nil	Nil
11	Expired Paint quantity (21.1 Schedule 1)	600 Kg/year	Nil	Nil

BIO-MEDICAL WASTE

S. No	Waste Description	Characteristics	Authorized Quantity	FY 23-24 Generation Quantity (Kgs)	FY 23-24 Disposal Quantity (Kgs)
1	Yellow Category	Toxic	10 Kg/ Month	7.10	7.10
2	Red Category	Toxic	1 Kg/Month	1.18	1.18
3	White Category	Toxic	10 Kg/Month	Nil	Nil
4	Blue Category	Toxic	1 Kg/Month	1.261	1.261

ANNEXURE NO 08

Offshore Monitoring Report

**OFFSHORE ENVIRONMENTAL MONITORING REPORT
FOR
VEDANTA LIMITED-Cairn OIL & GAS OF THE LAKSHMI AND GAURI
OFFSHORE OIL & GAS FIELDS AT GULF OF CAMBAY IN GUJARAT**

REPORT: SEPTEMBER - 2024

Sponsor:



**M/s Vedanta Limited-Cairn Oil & Gas
Suvali, Gujarat**

Prepared by:



**142, IDA, Phase-II, Cherlapally
Hyderabad – 500 051, Telangana State
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October, 2024

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1.0 INTRODUCTION

1.1 Present Study

Vedanta Limited Cairn oil and gas is the operator of the Lakshmi and Gauri offshore oil & gas fields, which are located on the west coast of India in the Gulf of Cambay in Gujarat state. The afore mentioned fields are covered in block CB/OS-2 in Cambay offshore Basin.

The existing facilities within the offshore block include Lakshmi fields (LA & LB platforms) and Gauri fields-GA platform; sub-sea pipe line connecting to Suvali Onshore terminal.

Vedanta limited- Cairn Oil & Gas awarded Vimta Labs Limited, Hyderabad to conduct offshore environmental monitoring (Marine water, sediment and biological). Vimta Labs conducted offshore environmental monitoring on 26th September, 2024 at existing facilities of offshore block include Lakshmi fields (LA & LB platforms) and Gauri fields-GA platform; sub-sea connecting pipe line.

2.0 SAMPLING LOCATIONS, METHODOLOGY OF SAMPLING & ANALYTICAL PROCEDURES

2.1 Sampling Location Details

TABLE-1.1
SAMPLING LOCATION DETAILS

Sr. No	Location Details	Latitude	Longitude
1	LB - 500 m E	21° 6'12.25"N	72°31'18.86"E
2	LB - 500 m W	21° 6'12.25"N	72°30'44.20"E
3	LB - 1000 m W	21° 6'12.25"N	72°30'26.94"E
4	LA - 500 m E	21° 3'56.25"N	72°31'54.81"E
5	LA - 500 m W	21° 3'56.25"N	72°31'20.13"E
6	LA - 1000 m W	21° 3'56.25"N	72°31'02.81"E
7	GA - 500 m E	21° 1'55.23"N	72°33'34.55"E
8	GA - 500 m W	21° 1'55.23"N	72°32'59.84"E
9	GA - 1000 m W	21° 1'55.23"N	72°32'42.56"E
10	LB TO LA	21° 5'04.66"N	72°31'18.28"E
11	LA TO GA	21° 2'55.88"N	72°32'27.17"E

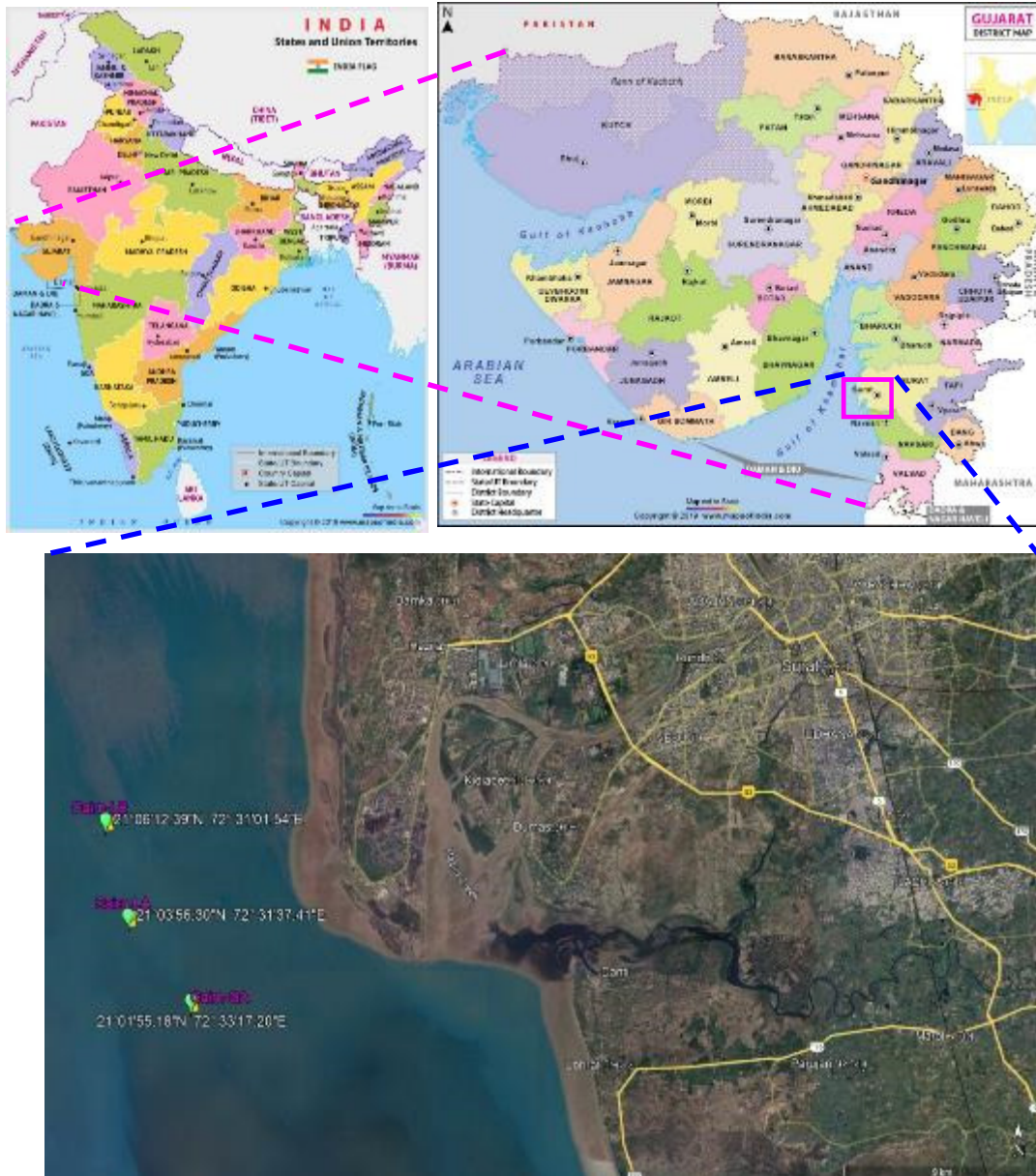


FIGURE-1.1
INDEX MAP

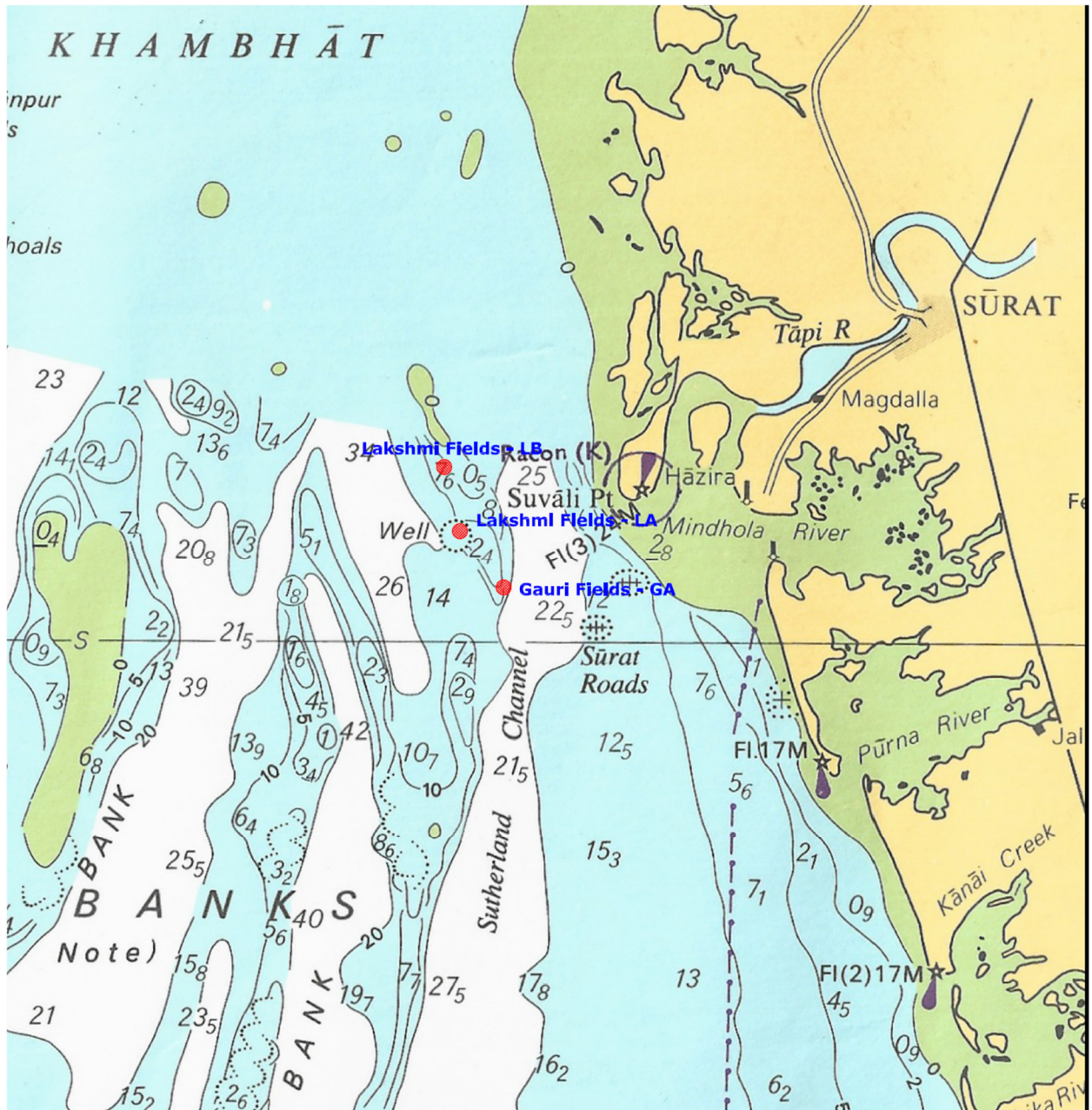


FIGURE-1.2
LOCATION MAP OF THE PROJECT

2.2 Biological Characteristics Report

Chlorophyll-a

Chlorophyll-a varied between 0.35 mg/m³ at GA7 and 0.64 mg/m³ at GA9. **Table-1.2**

TABLE-1.2
CHLOROPHYLL-A DIVERSITY IN CAIRN (VEDANTA)
OFFSHORE SAMPLING LOCATIONS

Sample IDs	GPS Location details	Nearest Asset Facility	Distance from the Platform in meters	Water Depth in m	Chlorophyll-a Concentration
LB1	21° 6'12.25"N, 72°31'18.86"E	Near Platform LB	500 m East	19.5 m	0.39 mg/m ³
LB2	21° 6'12.25"N, 72°30'44.20"E	Near Platform LB	500 m West	18.2 m	0.42 mg/m ³
LB3	21° 6'12.25"N, 72°30'26.94"E	Near Platform LB	1000 m West	21.5 m	0.49 mg/m ³
LA4	21° 3'56.25"N, 72°31'54.81"E	Near Platform LA	500 m East	10.6 m	0.38 mg/m ³
LA5	21° 3'56.25"N, 72°31'20.13"E	Near Platform LA	500 m West	20.0 m	0.50 mg/m ³
LA6	21° 3'56.25"N, 72°31'02.81"E	Near Platform LA	1000 m West	19.4 m	0.47 mg/m ³
GA7	21° 1'55.23"N, 72°33'34.55"E	Near Platform GA	500 m East	18.5 m	0.35 mg/m ³
GA8	21° 1'55.23"N, 72°32'59.84"E	Near Platform GA	500 m West	14.2 m	0.40 mg/m ³
GA9	21° 1'55.23"N, 72°32'42.56"E	Near Platform GA	1000 m West	22.5 m	0.64 mg/m ³
LB TO LA10	21° 5'04.66"N, 72°31'18.28"E	Near Platform between LB & LA	In between LB & LA	15.6 m	0.55 mg/m ³
LA TO GA11	21° 2'55.88"N, 72°32'27.17"E	Near Platform between LA & GA	In between LA & GA	11.6 m	0.46 mg/m ³

2.3 Marine Water and Sediment physico-chemical parameters Analysis

2.3.1 Marine Water Sampling

Niskin Bottle Sampler

The Niskin bottle sampler is a cylindrical sampler closed with water-tight stoppers on both ends. The stoppers are connected through an elastic band that runs through inside of the sample collection cylinder. The stoppers can be pulled out and locked to the outside of the cylinder, leaving both pipe openings unobstructed. After the sampler has been placed at the pre-determined sampling depth, the lock on the stoppers can be triggered to release, causing the stoppers to close. Trigger the closing mechanism and retrieve the sampler. Transfer the water sample slowly from the sampler drain valve into a laboratory supplied sample bottle, allowing the water to flow gently down the inside of the bottle. The marine water samples were collected at three different depths i.e. surface, middle and bottom. The middle depth sample was taken at half of the total depth at that particular sampling location and bottom sample was taken at 1 meter above the sea bottom. The samples will be further analysed at the laboratory for physico-chemical analysis.

For Chlorophyll-a, samples collected were immediately kept away from the sunlight wrapped in aluminum foil for the recommended holding time of four weeks, and should be kept in the freezer for safe keeping, before laboratory analysis.

For chlorophyll-a measurement, water samples were collected from location1(LB1) to location11(LA TO GA11) at 19.5m, 18.2m, 21.5m, 10.6m, 20.0m, 19.4m, 18.5m, 14.2m, 22.5m, 15.6m and 11.6m respectively. These depths were selected to cover euphotic zone that is well ventilated zone for primary production or plankton biomass.

The Chlorophyll-a concentrations were ranged between 0.35 till 0.64 mg/m³, highest concentration of Chlorophyll-a was recorded at GA9 comprising of 0.64 mg/m³ and lowest concentration of 0.35 mg/m³ is recorded at GA7 station.

2.3.2 Marine Sediment Sampling Methodology

Van veen grab sampler (0.1m²) was used for sampling bottom sediments. Prior to deployment, the grab is locked with the safety key in place. The grab is then hoisted over the side, and lowered at 2 m/sec until it is 5 m above the bottom. From this point, it is lowered at 1 m/sec to minimize the effects of bow wave disturbance. After bottom contact has been made (indicated by slack in the lowering wire), the tension on the wire is slowly increased, causing the lever arms to close the grab. Once the grab is back on board, the top doors are opened for inspection.

The macro & micro fauna in the sediments were sieved onboard to separate the organisms. Sieving was performed carefully as possible to avoid any damage to the animals. Sorting of the meiofauna from the sieve is difficult task especially in the

preserved material. The fixation is done by using 4% formalin (Buffered with borate) along with 1% Rose Bengal stain.

The meiofauna were examined under stereo microscope, the faunal count was expressed in number of specimens per unit area (10cm²). Macro fauna were separated and segregated to major groups and quantified as number in an area of 1 m². For sampling macro fauna and meio fauna Van veen grab sampler with a total surface area 0.1 m² was used. Appropriate conversion factor was used while presenting the data for meio fauna in 10 cm² and macro fauna in 1 m² respectively.

The marine water and marine sediment analysis methods followed such as APHA:23rd edition,2017 and IS:3025.

TECHNICAL SPECIFICATIONS OF MARINE WATER & SEDIMENT QUALITY

S.No.	Parameter	Technical Specifications
1	pH	IS:3025 (PART 11) 1983
2	Conductivity	APHA 23rd Edition 2510 B
3	Total Suspended Solids	APHA 23rd Edition 2540 D
4	Turbidity	APHA-23rd ed (2130-B): 2017
5	Dissolved Oxygen	Wrinkler's method
6	Biochemical Oxygen Demand	IS:3025(Part-44): 2009
7	Phosphates as PO ₄	APHA-23rd ed ed. (4500-P,D): 2017
8	Sulphates as SO ₄	IS:3025 PART 24:1986
9	Nitrates as NO ₃	APHA 4500 NO ₃ B-23rd Edition
10	Phenolic Compounds as C ₆ H ₅ OH	IS:3025 PART 43:1992
11	Cadmium as Cd	APHA-3125(23 rd Edition)
12	Copper as Cu	APHA-3125(23 rd Edition)
13	Lead as Pb	APHA-3125(23 rd Edition)
14	Aluminium as Al	APHA-3125(23 rd Edition)
15	Iron as Fe	APHA-3125(23 rd Edition)
16	Barium as Ba	APHA-3125(23 rd Edition)
17	Nickel as Ni	APHA-3125(23 rd Edition)
18	Cobalt as Co	APHA-3125(23 rd Edition)
19	Manganese as Mn	APHA-3125(23 rd Edition)
20	Chromium as Cr+6	APHA 3500 Cr B 23rd edition: 2017
21	Zinc as Zn	APHA-3125(23 rd Edition)
22	Mercury as Hg	APHA-3125(23 rd Edition)
23	Salinity	IS:3025 PART 32:1988
24	Hydrocarbons	ADTM D7678-11
25	Total Phosphorous	USWPA 3050 B:1996
26	Nitrite Nitrogen	APHA 23 rd Ed. 4500-NO ₃ , B:2017
27	Ammonical Nitrogen	APHA 23 rd Ed. 4500-NH ₃ , B6:2017
28	Silicates	APHA 23 rd Ed. 4500-SIO ₃ , B6:2017

**TABLE-1.3
MARINE WATER QUALITY**

Sr.No	Parameters	Unit	LB1			LB2			LB3		
			Surface	Middle	Bottom	Surface	Middle	Bottom	Surface	Middle	Bottom
1	Electrical Conductivity	µS/cm	51400	50800	48600	52200	52600	50900	48000	50900	53000
2	Atmospheric Temperature	°C	32.5			33.5			30.6		
3	Water Temperature	°C	27.2	26.5	26.7	28.0	27.6	26.9	27.8	27.5	26.5
4	TSS	mg/l	23	26	30	27	31	36	20	28	34
5	Turbidity	NTU	76	64	53	59	50	73	64	57	67
6	pH	-	8.12	8.3	7.93	8.23	7.83	8.2	7.91	8.04	8.17
7	Salinity	ppt	38.2	36.0	35.1	34.8	36.4	33.5	34.9	33.9	35.5
8	DO	mg/l	5.5	5.2	5.5	4.9	4.8	5.1	5.3	5.4	5.0
9	BOD	mg/l	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
10	Hydrocarbon	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
11	Inorganic Phosphates	mg/l	0.109	0.115	0.132	0.082	0.091	0.091	0.133	0.153	0.096
12	Total Phosphorous	mg/l	0.16	0.19	0.18	0.25	0.22	0.34	0.2	0.17	0.19
13	Nitrite Nitrogen	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
14	Nitrate Nitrogen	mg/l	3.2	2.5	3.5	1.6	1.7	2.1	3.1	1.5	3.1
15	Ammonia Nitrogen	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
16	Sulphates	mg/l	1735	1788	1787	1695	1656	1767	1655	1677	1760
17	Silicate	mg/l	23.2	13.3	18.6	21.8	10.7	26.7	9.7	12.2	2.1
18	Cadmium as Cd	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
19	Barium as Ba	mg/l	0.017	0.023	0.023	0.027	0.022	0.016	0.03	0.01	0.012
20	Chromium as Cr	mg/l	0.03	0.01	0.05	0.04	0.05	0.04	0.02	0.07	0.05
21	Copper as Cu	mg/l	0.018	0.014	0.019	0.014	0.012	0.006	0.02	0.023	0.014
22	Iron as Fe	mg/l	0.196	0.115	0.191	0.107	0.14	0.117	0.214	0.194	0.138
23	Lead as Pb	mg/l	0.01	<0.01	0.01	0.02	0.01	<0.01	0.02	<0.01	0.03
24	Manganese as Mn	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
25	Mercury as Hg	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
26	Nickel as Ni	mg/l	0.02	0.03	0.02	0.01	0.02	0.03	<0.01	0.02	0.03
27	Zinc as Zn	mg/l	0.176	0.151	0.249	0.149	0.144	0.462	0.147	0.250	0.148
28	Cobalt as Co	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
29	Phenolic Compounds as C ₆ H ₆ OH	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

**TABLE-1.4
MARINE WATER QUALITY**

Sr.No	Parameters	Unit	LA4	LA4	LA4	LA5	LA5	LA5	LA6	LA6	LA6
			Surface	Middle	Bottom	Surface	Middle	Bottom	Surface	Middle	Bottom
1	Electrical Conductivity	µS/cm	48800	50800	50300	51800	48500	49400	52000	50600	49200
2	Atmospheric Temperature	°C	32.6			31.6			32.3		
3	Water Temperature	°C	28.6	27.9	27.5	28.7	27.4	27.1	28.0	27.7	27.3
4	TSS	mg/l	25	31	36	27	35	32	29	22	31
5	Turbidity	NTU	56	59	48	57	66	75	60	76	66
6	pH	-	8.05	8.33	8.18	7.89	8.24	7.96	8.23	8.08	8.18
7	Salinity	ppt	33.3	35.5	34.4	33.2	34.6	35.5	35.3	32.9	32.6
8	DO	mg/l	5.2	4.9	5.4	5.1	4.9	5.5	5	5.2	5.6
9	BOD	mg/l	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
10	Hydrocarbon	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
11	Inorganic Phosphates	mg/l	0.145	0.151	0.175	0.221	0.181	0.171	0.092	0.1	0.091
12	Total Phosphorous	mg/l	0.22	0.3	0.25	0.16	0.14	0.242	0.25	0.2	0.29
13	Nitrite Nitrogen	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
14	Nitrate Nitrogen	mg/l	2.6	3.0	1.0	2.6	3.6	2.7	2.3	3.3	3.5
15	Ammonia Nitrogen	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
16	Sulphates	mg/l	1636	1719	1647	1661	1859	1657	1732	1807	1875
17	Silicate	mg/l	25.9	17.8	43.7	27.1	23.8	17.3	9.2	8.8	33.6
18	Cadmium as Cd	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
19	Barium as Ba	mg/l	0.028	0.029	0.021	0.02	0.015	0.014	0.019	0.024	0.01
20	Chromium as Cr	mg/l	0.01	0.03	0.04	0.04	0.03	0.02	0.02	0.02	0.04
21	Copper as Cu	mg/l	0.009	0.017	0.023	0.007	0.014	0.019	0.017	0.008	0.004
22	Iron as Fe	mg/l	0.161	0.111	0.159	0.184	0.161	0.153	0.113	0.224	0.273
23	Lead as Pb	mg/l	<0.01	0.02	<0.01	0.03	0.01	0.02	<0.01	0.01	<0.01
24	Manganese as Mn	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
25	Mercury as Hg	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
26	Nickel as Ni	mg/l	0.02	0.01	<0.01	0.01	0.03	0.02	0.03	0.01	<0.01
27	Zinc as Zn	mg/l	0.247	0.302	0.179	0.172	0.214	0.179	0.181	0.228	0.347
28	Cobalt as Co	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
29	Phenolic Compounds as C ₆ H ₆ OH	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

**TABLE-1.5
MARINE WATER QUALITY**

Sr.No	Parameters	Unit	GA7	GA7	GA7	GA8	GA8	GA8	GA9	GA9	GA9
1	Electrical Conductivity	µS/cm	52300	49600	49100	50200	48400	49300	51800	48800	52300
2	Atmospheric Temperature	°C	31.8			32			33.6		
3	Water Temperature	°C	27.7	28.1	27.7	27.8	26.4	27	27.5	27.8	26.7
4	TSS	mg/l	33	26	31	33	27	37	30	22	33
5	Turbidity	NTU	82	77	67	54	60	49	51	65	46
6	pH	-	8.34	8.14	8.11	8.19	8.2	8.27	8.02	8.36	8.12
7	Salinity	ppt	34.1	33.6	34.3	32.6	34.3	33.5	34.2	33.7	35.9
8	DO	mg/l	5.1	4.9	5.1	5.5	5	5.2	4.9	5.2	5
9	BOD	mg/l	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
10	Hydrocarbon	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
11	Inorganic Phosphates	mg/l	0.09	0.075	0.076	0.091	0.081	0.1	0.059	0.11	0.095
12	Total Phosphorous	mg/l	0.19	0.22	0.21	0.313	0.25	0.31	0.24	0.21	0.32
13	Nitrite Nitrogen	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
14	Nitrate Nitrogen	mg/l	1.2	1.8	2.9	3.4	2.6	3.9	3.0	2.5	3.2
15	Ammonia Nitrogen	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
16	Sulphates	mg/l	1654	1732	1735	1713	1805	1824	1618	1821	2013
17	Silicate	mg/l	7.9	10.2	19.2	20.7	22.1	30.8	35.1	12.2	13.2
18	Cadmium as Cd	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
19	Barium as Ba	mg/l	0.012	0.025	0.018	0.027	0.008	0.021	0.017	0.035	0.003
20	Chromium as Cr	mg/l	<0.01	0.03	0.01	0.05	0.04	0.02	<0.01	0.04	0.01
21	Copper as Cu	mg/l	0.008	0.021	0.009	0.027	0.019	0.015	0.005	0.015	0.203
22	Iron as Fe	mg/l	0.199	0.139	0.163	0.209	0.111	0.161	0.266	0.126	0.109
23	Lead as Pb	mg/l	0.01	<0.01	0.03	0.02	0.02	<0.01	0.01	<0.01	0.02
24	Manganese as Mn	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
25	Mercury as Hg	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
26	Nickel as Ni	mg/l	0.02	0.02	0.02	<0.01	0.02	0.01	0.01	0.02	0.02
27	Zinc as Zn	mg/l	0.307	0.239	0.158	0.202	0.152	0.178	0.26	0.151	0.17
28	Cobalt as Co	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
29	Phenolic Compounds as C ₆ H ₆ OH	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

**TABLE-1.6
MARINE WATER QUALITY**

Sr. No	Parameters	Unit	LB TO LA10	LB TO LA10	LB TO LA10	LA TO GA11	LA TO GA11	LA TO GA11
1	Electrical Conductivity	µS/cm	49600	48300	48700	51900	47300	47400
2	Atmospheric Temperature	°C	32.8			30.6		
3	Water Temperature	°C	27.6	26.7	26.4	28	27	27.2
4	TSS	mg/l	25	31	31	27	35	23
5	Turbidity	NTU	67	84	71	75	64	72
6	pH	-	8.36	8.13	8.24	8.15	8.08	8.29
7	Salinity	ppt	33.4	34.3	36.7	35	35	34.9
8	DO	mg/l	5.5	5.1	5.2	5.4	5.0	5.4
9	BOD	mg/l	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
10	Hydrocarbon	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
11	Inorganic Phosphates	mg/l	0.152	0.194	0.189	0.159	0.061	0.108
12	Total Phosphorous	mg/l	0.29	0.28	0.23	0.38	0.32	0.27
13	Nitrite Nitrogen	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
14	Nitrate Nitrogen	mg/l	1.6	4.2	3.6	1.8	3.1	2.6
15	Ammonia Nitrogen	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
16	Sulphates	mg/l	1635	1720	1771	1845	1684	1733
17	Silicate	mg/l	30.4	26.2	20.7	30.1	33.4	24.3
18	Cadmium as Cd	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
19	Barium as Ba	mg/l	0.011	0.015	0.012	0.01	0	0.016
20	Chromium as Cr	mg/l	0.03	<0.01	0.02	0.05	0.04	0.02
21	Copper as Cu	mg/l	0.019	0.024	0.007	0.026	0.018	0.023
22	Iron as Fe	mg/l	0.109	0.165	0.128	0.11	0.038	0.095
23	Lead as Pb	mg/l	0.02	<0.01	0.01	0.03	0.01	0.02
24	Manganese as Mn	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
25	Mercury as Hg	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
26	Nickel as Ni	mg/l	0.02	0.01	<0.01	0.02	0.01	<0.01
27	Zinc as Zn	mg/l	0.146	0.243	0.31	0.224	0.217	0.02
28	Cobalt as Co	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
29	Phenolic Compounds as C ₆ H ₅ OH	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

TABLE-1.7
MARINE SEDIMENT QUALITY

Sr.No	Parameters	Unit	LB1	LB2	LB3	LA4	LA5	LA6
			S1	S2	S3	S4	S5	S6
1	Texture	--						
I	Sand	%	63	68	64	69	68	65
Ii	Silt	%	14	15	13	14	14	12
Ii	Clay	%	23	17	23	17	18	23
2	Organic Carbon	%	0.68	0.95	0.79	0.84	0.69	6.33
3	Sulphur as S	%	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
4	Phosphorous as P	mg/kg	159.3	190.0	206.8	142.3	158.9	204.3
5	Mineral Oil	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
6	Total Petroleum Hydrocarbon (TPH)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
7	Aluminium as Al	%	0.54	0.86	1.01	0.65	0.89	0.49
8	Barium as Ba	mg/kg	18.9	22.5	20.6	25.7	17	19.6
9	Chromium as Cr	mg/kg	17.8	20.6	15.0	19.9	22.5	19.6
10	Manganese as Mn	mg/kg	3.53	7.05	5.34	2.93	6.14	3.64
11	Iron as Fe	%	1.35	1.77	1.90	1.40	0.53	1.47
12	Cobalt as Co	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
13	Nickel as Ni	mg/kg	11.4	19.6	18	16.8	17.7	16.3
14	Copper as Cu	mg/kg	45.3	35.3	49.9	46.4	47.2	62.2
15	Zinc as Zn	mg/kg	19.0	14.8	7.3	17.3	14.3	16.4
16	Lead as Pb	mg/kg	7.03	6.72	5.03	6.63	5.85	7.4
17	Cadmium as Cd	mg/kg	0.56	0.38	0.46	0.65	0.62	0.59
18	Mercury as Hg	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

TABLE-1.8
MARINE SEDIMENT QUALITY

Sr.No	Parameters	Unit	GA7 S7	GA8 S8	GA9 S9	10_LB - LA S10	11_LA - GA S11
1	Texture	--					
i	Sand	%	71	66	65	69	65
Ii	Silt	%	13	14	12	14	16
Ii	Clay	%	16	20	23	17	19
2	Organic Carbon	%	0.92	0.69	0.93	0.69	1.06
3	Sulphur a S	%	<0.1	<0.1	<0.1	<0.1	<0.1
4	Phosphorous as P	mg/kg	178.3	213.5	165.3	217.3	151.0
5	Mineral Oil	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
6	Total Petroleum Hydrocarbon (TPH)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
7	Aluminium as Al	%	0.64	0.48	0.74	0.71	0.63
8	Barium as Ba	mg/kg	25.7	17.8	19.9	27.8	18.3
9	Chromium as Cr	mg/kg	23.2	18.8	17.5	18.4	21.3
10	Manganese as Mn	mg/kg	7.32	9.83	0.89	9.6	7.82
11	Iron as Fe	%	1.43	1.75	1.20	1.65	1.42
12	Cobalt as Co	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
13	Nickel as Ni	mg/kg	19.3	18.4	20.0	17.5	24.6
14	Copper as Cu	mg/kg	51.1	42.9	49.5	55.8	40.8
15	Zinc as Zn	mg/kg	9.8	11.7	15.5	12.3	17.4
16	Lead as Pb	mg/kg	1.44	3.88	6.07	4.92	6.81
17	Cadmium as Cd	mg/kg	0.43	0.34	0.51	0.73	0.25
18	Mercury as Hg	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1

Conclusion All of the Marine water & sediment quality parameters are found, as normal as oceanographic environment.

2.4 Phytoplankton

Phytoplankton sampling Methodology

1 ltr of Niskin sampler collected sea water sample was allowed to settle in a separating funnel for 24 hours by adding lugol iodine & 1% formalin, then the bottom settled sample of 50 ml was collected and analyzed for phytoplankton diversity under compound microscope (400X-1000X magnification) equipped with camera. Photographs were taken for the record.

Studies on phytoplankton consisted of species composition and their numerical abundance at 11 selected sampling locations. Overall 11 phytoplankton species out of which diatoms (46.80%), dinoflagellates (25.08%), cyanobacteria (13.81%) and green algae (14.32%) were reported in the present study. Phytoplankton abundance varied from 178 cell/L to 232 cell/L. The highest abundance observed at LB3 which indicates high primary productivity within installation premises. Overall predominant species was *Isochrysis* sp. followed by *Ceratium* sp. (**Table-1.9 & Figure-1.3**).

**TABLE-1.9
PHYTOPLANKTON**

S.No.	Phytoplankton species	LB-500 m E	LB-500 m W	LB-1000 m W	LA-500 m E	LA-500 m W	LA-1000 m W	GA-500 m E	GA-500 m W	GA-1000 m W	LB TO LA	LA TO GA	%
I	Diatoms												
1	<i>Chaetoceros sp.</i>	18	24	22	26	19	26	24	21	13	22	21	10.15
2	<i>Thalassionema sp.</i>	15	16	17	16	21	17	20	10	14	16	16	7.66
3	<i>Biddulphia sp.</i>	11	15	16	13	15	12	15	16	15	10	11	6.41
4	<i>Coscinodiscus sp.</i>	14	13	14	20	21	25	16	18	19	25	24	8.99
5	<i>Pseudo-nitzschia sp.</i>	12	16	16	16	14	9	10	8	13	16	10	6.02
6	<i>Thalassiosira sp.</i>	10	26	19	19	18	10	16	15	14	15	14	7.57
II	Dinoflagellates												
6	<i>Ceratium sp.</i>	28	30	36	25	22	31	25	24	37	32	31	13.81
7	<i>Prorocentrum sp.</i>	20	15	25	23	35	24	18	25	30	25	22	11.27
III	Green algae												
9	<i>Isochrysis sp.</i>	26	24	33	38	32	25	28	25	27	35	40	14.32
IV	Cyanobacteria												
10	<i>Oscillatorium sp.</i>	13	15	19	12	15	16	15	16	16	15	10	6.97
11	<i>Trichodesmium sp.</i>	11	16	15	13	16	15	17	14	14	16	12	6.84
Population density (no./L)		178	210	232	221	228	210	204	192	212	227	211	100.00
Diversity Index (Simpson's Index 1-D)		0.902	0.905	0.902	0.901	0.903	0.900	0.906	0.904	0.898	0.901	0.892	
Margalefs diversity index (Species Richness S)		1.923	1.864	1.830	1.846	1.836	1.864	1.874	1.896	1.861	1.837	1.862	
Shannon Weiner Index H (Log ₁₀)		2.336	2.358	2.346	2.336	2.351	2.327	2.361	2.345	2.323	2.334	2.291	

2.5 Zooplankton

Zooplankton sampling Methodology

Zooplankton samples were obtained from the sub surface layer at each sampling locations by towing the plankton net horizontally with the weight. After the tow for about 15-30 minutes, plankton net was pulled up and collected the plankton adhered to plankton net in the collection bucket attached at the bottom. The plankton collected was preserved with 5% buffered formalin and stored in 1 L plastic container for further analysis in the laboratory. The zooplankton were further analyzed for density and diversity by using rafter cell under stereo microscope (20-40X magnification) equipped with camera. Photographs were taken for the record.

Numerical abundance (no/L) of zooplankton was studied for 11 sampling locations. The zooplankton abundance varied from 63 no./L to 85 no./L. The highest number of zooplankton species was noticed in station LB2, followed by station LB1. Overall 11 components of zooplankton represented by 5 group out of which Crustacea (42.42%), Chordata (22.30%), Protozoa (13.45%), Mollusca (10.79%) and Chaetognatha (11.03%) were recorded in the present study. Among the various groups of zooplankton, crustacea were the dominant group. (**Table-1.10 & Figure-1.3**).

TABLE-1.10
ZOOPLANKTON

S.No.	Zooplankton species	LB-500 m E	LB-500 m W	LB-1000 m W	LA-500 m E	LA-500 m W	LA-1000 m W	GA-500 m E	GA-500 m W	GA-1000 m W	LB TO LA	LA TO GA	%
I	Protozoa												
1	Tintinnids	5	4	6	0	8	9	2	7	8	3	9	7.39
2	Radiolarians	7	6	8	2	0	4	8	3	5	4	3	6.06
II	Chaetognatha												
3	<i>Sagitta</i> sp.	8	10	7	8	12	7	11	14	4	5	5	11.03
III	Crustacea												
4	Calanoid copepod	13	16	12	15	13	12	9	10	12	8	11	15.88
5	Cyclopoid copepod	7	5	8	5	6	5	5	5	2	5	7	7.27
6	Harpacticoid copepod	4	3	4	2		2	4	2		3	2	3.15
7	Nauplius	15	13	8	9	10	17	11	14	9	14	13	16.12
IV	Mollusca												
8	Velliger larva	6	4	3	0	7	6	0	5	3	4	5	5.21
9	Other Larvae	4	5	6	2	3	4	5	6	2	5	4	5.58
V	Chordata												
10	Oikopleura	12	15	18	16	14	12	11	10	14	12	9	17.33
11	Fish eggs	3	4	3	4	0	5	6	7	5	4	0	4.97
	Population density (no./L)	84	85	83	63	73	83	72	83	64	67	68	100.00
	Diversity Index (Simpson's Index 1-D)	0.897	0.886	0.892	0.842	0.868	0.890	0.894	0.896	0.875	0.891	0.887	
	Margalefs diversity index (Species Richness S)	2.250	2.244	2.256	2.406	2.323	2.256	2.331	2.256	2.397	2.371	2.362	
	Shannon Weiner Index H (Log ₁₀)	2.132	2.111	2.115	1.825	1.996	2.154	2.042	2.175	2.113	2.113	2.068	
	BIOMASS DISPLACEMENT Volume ml/m3	0.07	0.07	0.07	0.05	0.06	0.07	0.06	0.08	0.05	0.05	0.05	

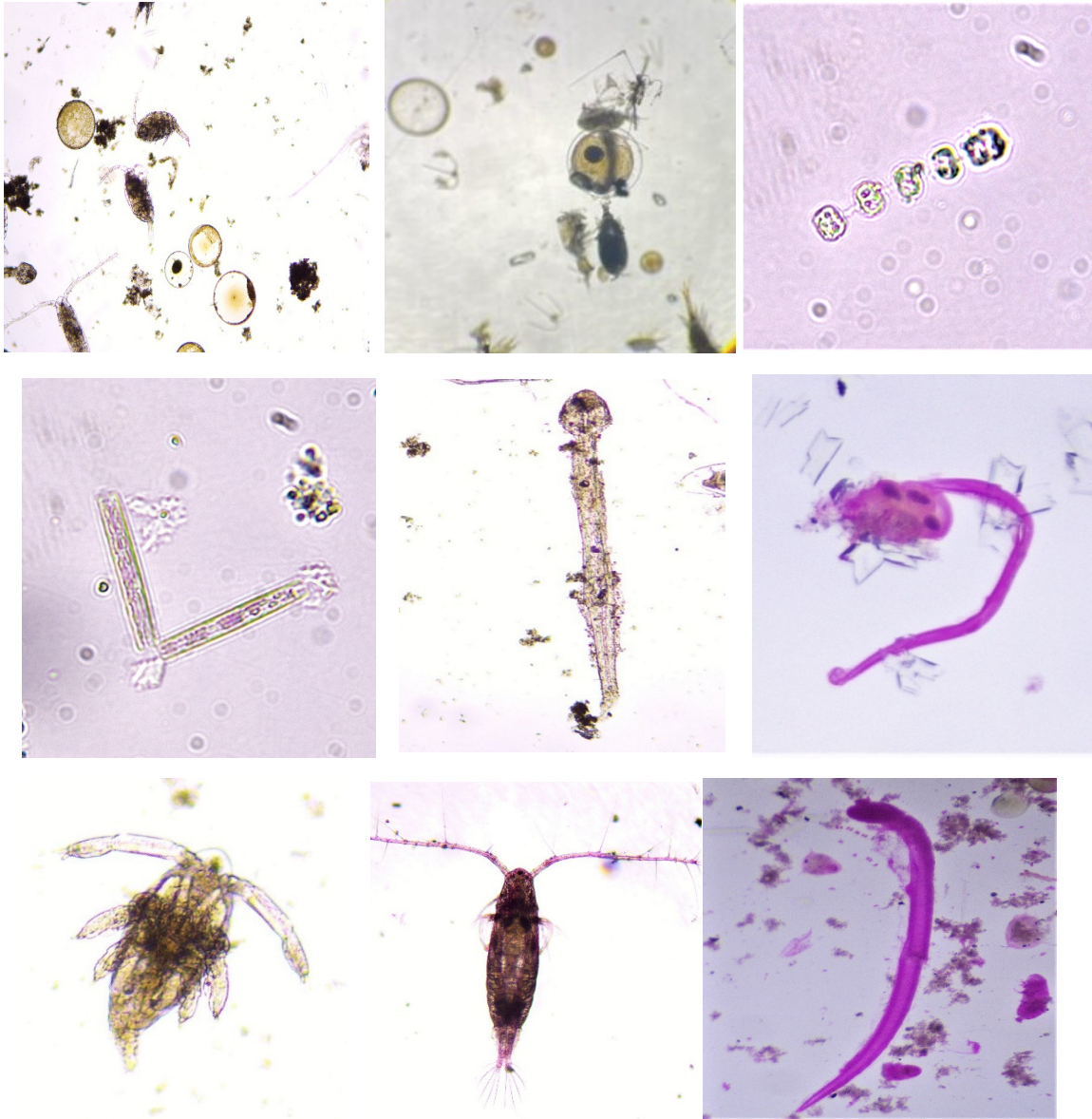


FIGURE-1.3
PHYTOPLANKTON & ZOOPLANKTON

2.6 Benthic

Benthic productivity

Altogether 6 species of macro benthic fauna represented by 4 groups out of which mollusca (43.77%), polychaeta (25.47%), nematodes (20.14%) and Arthropoda (10.62%) were reported in this study. The density varied between 293 and 385 no./m² area. The highest abundance observed at station LA3 and lowest abundance observed at station GA2. Among the macro benthic organisms, mollusca together were the dominant group. Overall productivity is very high in these locations (**Table-1.11 & Figure-1.4**).

**TABLE-1.11
MACROBENTHOS**

S.No	Macrobenthos species	LB-500 m E	LB-500 m W	LB-1000 m W	LA-500 m E	LA-500 m W	LA-1000 m W	GA-500 m E	GA-500 m W	GA-1000 m W	LB TO LA	LA TO GA	%
I	Polychaeta												
1	<i>Nereididae</i> sp.	28	32	38	47	35	58	42	38	48	39	44	11.68
2	<i>Flabelligeridae</i> sp.	42	48	47	40	68	50	45	40	52	42	56	13.79
II	Arthropoda												
3	<i>Balanus</i> sp.	30	38	35	38	30	36	34	30	40	45	52	10.62
III	Mollusca												
4	Gastropoda	75	86	67	58	76	78	64	50	57	78	70	19.75
5	Bivalvia	102	96	85	68	92	87	76	65	82	75	95	24.02
IV	Nematoda												
6	Nematoda	70	65	88	75	68	76	82	70	60	72	48	20.14
	Population density (no./m²)	347	365	360	326	369	385	343	293	339	351	365	100.00
	Diversity Index (Simpson's Index 1-D)	0.799	0.810	0.814	0.825	0.814	0.822	0.819	0.821	0.826	0.822	0.822	
	Margalefs diversity index (Species Richness S)	0.852	0.844	0.846	0.861	0.843	0.837	0.853	0.877	0.855	0.850	0.844	
	Shannon Weiner Index H (Log ₁₀)	1.684	1.714	1.727	1.759	1.722	1.751	1.742	1.747	1.766	1.750	1.754	
	BIOMASS gm/M ²	1.60	1.70	1.65	1.56	1.72	1.78	1.59	1.40	1.52	1.61	1.70	

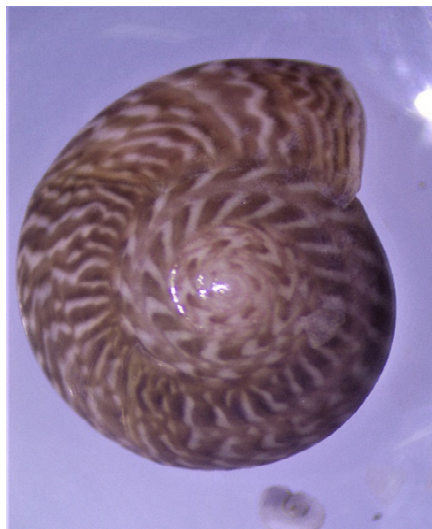


FIGURE-1.4
MACROBENTHOS

Altogether 3 groups of meio benthic fauna represented out of which Foraminifera (22.81%), nematodes (36.86%) and polychaeta (40.33%) were reported in this study. The density varied between 100 and 142 no./m² area. Among the meio benthic organisms, nematodes form the dominant group. Overall productivity is very high in these locations (**Table-1.12 & Figure-1.5**).

TABLE-1.12
MEIOBENTHOS

S.No.	Meiobenthos species	LB-500 m E	LB-500 m W	LB-1000 m W	LA-500 m E	LA-500 m W	LA-1000 m W	GA-500 m E	GA-500 m W	GA-1000 m W	LB TO LA	LA TO GA	%
I	Foraminifera	20	27	28	25	32	30	38	25	23	32	22	22.81
II	Polychaetes	42	30	52	62	30	48	42	30	42	48	62	36.86
III	Nematoda	48	44	57	48	38	40	50	52	37	62	58	40.33
Population density (no./10cm²)		110	101	137	135	100	118	130	107	102	142	142	100.00

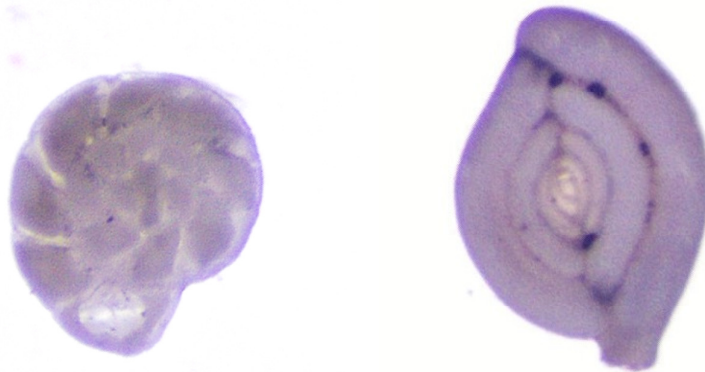


FIGURE-1.5
MEIOBENTHOS

Conclusion from biological analysis

1. All the locations are enriched with benthic productivity.
2. Along with that the availability of fishery is also good due to the presence of phytoplankton and zooplankton.
3. Overall the sampling locations are well abundant with aquatic organisms.

2.7 Marine Biodiversity

The fishery data around the station LA, LB, GA, LB-LA & LA-GA was collected based on observation and also by surveying the local fisherman, who used to conduct fishing activity regularly around the near station LA, LB, GA, LB-LA & LA-GA area of project site.

TABLE-1.13
FISH TISSUE ANALYSIS RESULTS

Metals	UoM	LB1	LB2	LB3	LA4	LA5	LA6	GA7	GA8	GA9	LB-LA	LA-GA
Cadmium as Cd	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Barium as Ba	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium as Cr	mg/kg	0.41	0.35	0.48	0.28	0.39	0.41	0.37	0.42	0.36	0.24	0.36
Copper as Cu	mg/kg	2.94	3.46	3.94	3.46	3.82	3.76	4.16	3.68	3.52	4.34	3.52
Iron as Fe	mg/kg	0.38	0.47	0.38	0.36	0.26	0.34	0.31	0.28	0.36	0.36	0.45
Lead as Pb	mg/kg	0.16	0.11	0.16	0.12	0.14	0.12	0.16	0.13	0.14	0.17	0.12
Manganese as Mn	mg/kg	3.46	3.98	5.31	4.85	3.84	5.62	4.67	5.16	4.06	3.86	3.82
Mercury as Hg	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel as Ni	mg/kg	0.23	0.18	0.17	0.19	0.18	0.19	0.16	0.18	0.20	0.21	0.25
Zinc as Zn	mg/kg	0.48	0.65	0.45	0.38	0.41	0.43	0.34	0.38	0.43	0.46	0.52
Total Petroleum Hydrocarbons	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

*TPH standard for aquatic life 0.1-10 mg/kg (FAO/WHO,2015 and FAO,1982)

TABLE-1.14
FISHERY

S.No.	Fishery species	Common Name
1	<i>Penaeus indicus</i>	White Shrimp
2	<i>Pangasius pangasius</i>	Pangas catfish
3	<i>Lutjanus purpureus</i>	Snapper
4	<i>Rastrelliger kanagartha</i>	Indian mackerel
5	<i>Solea solea</i>	Sole fish
6	<i>Pteroplatytrygon violacea</i>	Sting ray
7	<i>Cyanoglossus</i>	Bengal tongue sole
8	<i>Saurida tumbil</i>	Greater lizard fish
9	<i>Nemipterus japonicus</i>	Japanese thread fin bream
10	<i>Penaeus monodon</i>	Tiger shrimp

Conclusion from fish tissue analysis

The heavy metal and petroleum hydrocarbon content in the fish tissue was present below the standard limits of FAO & WHO.



Penaeus indicus



Pangasius pangasius



Lutjanus purpureus



Rastrelliger kanagurta



Solea solea



Pteroplatytrygon violacea



Cyanoglossus sp.



Saurida tumbil

FIGURE-1.6
FISHERY SPECIES



Nemipterus japonicus



Penaeus monodon

FIGURE-1.7
FISHERY SPECIES