Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat

M/s Bharat PetroResources Ltd.

Submitted by

Prepared by
Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.

UNDERTAKING

I, Mr. Tushar Datta, Vice President (Assets) of Bharat PetroResources Limited (BPRL), willing to submit this undertaking with respect to TOR prescribed by Expert Appraisal Committee (EAC-Industry-II), MoEF&CC, New Delhi vide F.No. IA-I-11011/324/2013-IA-I (II) dated 2nd September 2018 for the Onshore Oil and gas development and production activities in the Block CB-ONN-2010/8, Cambay basin, Gujarat.

M/s Bharat PetroResources Limited has been complied with and data/information submitted are correct to best of knowledge.

For M/s Bharat PetroResources Limited.

Mr. Tushar Datta
Vice President (Assets)
Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.
**PROJECT DETAILS**

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<th>Version</th>
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Declaration by experts contributing to the Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.

I, hereby, certify that I was a part of the EIA team in the following capacity that developed the above EIA/EMP.

EIA Coordinator

Name: Mr. Abhik Saha
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Period of involvement: April 2018 – Till date
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<th>Involvement (Period)</th>
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Mr. Sameer Despande
April 2018– Till date

Declaration by the head of the Accredited Consultant Organization

I, Mr. G. Murugesh, hereby confirm that the above mentioned experts prepared the EIA/EMP Report for the proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd. I also confirm that ABC Techno Labs India Pvt. Ltd. shall be fully accountable for any misleading information mentioned in this statement.

Signature :  

Name : Mr. G. Murugesh  
Designation : Chairman & Managing Director  
Name of the EIA Consultant Organization: ABC Techno Labs India Private Limited  
NABET Certificate No. & Issue Date: NABET/EIA/1619/RA0048 date 29th May 2017
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<td>APHA</td>
<td>American Public Health Association</td>
</tr>
<tr>
<td>ASTM</td>
<td>American Society for Testing and Materials</td>
</tr>
<tr>
<td>AWWA</td>
<td>American Water Works Association</td>
</tr>
<tr>
<td>bbl</td>
<td>Billion Barrels</td>
</tr>
<tr>
<td>BDL</td>
<td>Below Detection Level</td>
</tr>
<tr>
<td>BOD</td>
<td>Biological Oxygen Demand</td>
</tr>
<tr>
<td>BTEX</td>
<td>Benzene Toluene Ethylene Xylene</td>
</tr>
<tr>
<td>CAGR</td>
<td>Compound Annual Growth Rate</td>
</tr>
<tr>
<td>CCoE</td>
<td>Chief Controller of Explosives</td>
</tr>
<tr>
<td>CF</td>
<td>Contamination Factor</td>
</tr>
<tr>
<td>CI</td>
<td>Corrosion Inhibitor</td>
</tr>
<tr>
<td>COD</td>
<td>Chemical Oxygen Demand</td>
</tr>
<tr>
<td>CPCB</td>
<td>Central Pollution Control Board</td>
</tr>
<tr>
<td>CRZ</td>
<td>Coastal Regulation Zone</td>
</tr>
<tr>
<td>DGH</td>
<td>Directorate General of Hydrocarbons</td>
</tr>
<tr>
<td>DO</td>
<td>Dissolved Oxygen</td>
</tr>
<tr>
<td>DTS</td>
<td>Distributed Temperature System</td>
</tr>
<tr>
<td>EC</td>
<td>Electrical Conductivity</td>
</tr>
<tr>
<td>ECP</td>
<td>External Casing Packers</td>
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<td>EIA</td>
<td>Environmental Impact Assessment</td>
</tr>
<tr>
<td>EMMP</td>
<td>Environmental Monitoring and Management Plan</td>
</tr>
<tr>
<td>GPS</td>
<td>Geographical Positioning System</td>
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<tr>
<td>GPCB</td>
<td>Gujarat Pollution Control Board</td>
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<tr>
<td>HAZOP</td>
<td>Hazard Operability</td>
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<tr>
<td>HC</td>
<td>Hydrocarbons</td>
</tr>
<tr>
<td>HDPE</td>
<td>High Density Poly Ethylene</td>
</tr>
<tr>
<td>HSE</td>
<td>Health Safety &amp; Environment</td>
</tr>
<tr>
<td>IPSEM</td>
<td>Institute of Petroleum Safety and Environment Management</td>
</tr>
<tr>
<td>ISRS</td>
<td>International Safety Rating System</td>
</tr>
<tr>
<td>MMSCMD</td>
<td>Metric Standard Cubic Meters per Day</td>
</tr>
<tr>
<td>MOEF&amp;CC</td>
<td>Ministry of Environment, Forests &amp; Climate Change</td>
</tr>
<tr>
<td>MSDS</td>
<td>Material Safety Data Sheet</td>
</tr>
<tr>
<td>NABET</td>
<td>National Accreditation Board of Education and Training</td>
</tr>
<tr>
<td>ND</td>
<td>Not Detected</td>
</tr>
<tr>
<td>NELP</td>
<td>New Exploration Licensing Policy</td>
</tr>
<tr>
<td>OHSMS</td>
<td>Occupational Health &amp; Safety Management System</td>
</tr>
<tr>
<td>PAH</td>
<td>Polycyclic Aromatic Hydrocarbon</td>
</tr>
<tr>
<td>PEL</td>
<td>Petroleum Exploration License</td>
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<tr>
<td>PFP</td>
<td>Flare Platform</td>
</tr>
<tr>
<td>PHC</td>
<td>Petroleum Hydrocarbon Content</td>
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<tr>
<td>PPE</td>
<td>Personal Protective Equipment</td>
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<td>PVC</td>
<td>Polyvinyl Chloride</td>
</tr>
<tr>
<td>QCI</td>
<td>Quality Council of India</td>
</tr>
<tr>
<td>SS</td>
<td>Suspended Solids</td>
</tr>
<tr>
<td>TDS</td>
<td>Total Dissolved Solids</td>
</tr>
<tr>
<td>TOR</td>
<td>Terms of Reference</td>
</tr>
<tr>
<td>TPH</td>
<td>Total Petroleum Hydrocarbon</td>
</tr>
<tr>
<td>TSS</td>
<td>Total Suspended Solids</td>
</tr>
<tr>
<td>USEPA</td>
<td>United States Environmental Protection Agency</td>
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Environmental Impact Assessment Report for proposed Onshore Oil and Gas
development and production activities in the Block CB-ONN-2010/8, Cambay,
Gujarat by M/s Bharat PetroResources Ltd.

No.J-11011/324/2013-JA-II (I)
Government of India
Minister of Environment, Forest and Climate Change
Impact Assessment Division

Indira Paryavaran Bhavan,
Vayu Wing, 3rd Floor, Aliganj,
Jor Bagh Road, New Delhi-110003
02 Sep 2018

To,
M/s Bharat PetroResources Ltd.
Bharat PetroResources Ltd. 12th Floor, Maker Tower, F wing, cuffe Parade, Mumbai,
Maharashtra,
Mumbai City-400005
Maharashtra

Tel.No.22-22175677; Email: ranjan.b@bharatpetroresources.in

Sir/Madam,

This has reference to the proposal submitted in the Ministry of Environment, Forest
and Climate Change to prescribe the Terms of Reference (TOR) for undertaking detailed EIA
study for the purpose of obtaining Environmental Clearance in accordance with the provisions of
the EIA Notification, 2006. For this purpose, the proponent had submitted online information in the
prescribed format (Form-1) along with a Pre-feasibility Report. The details of the proposal are
given below:

1. Proposal No.: IA/G/JIND2/75954/2018
2. Name of the Proposal: Onshore Oil and Gas development and production activities in the Block CB-ONN-
2010/8, Cambay, Gujarat
4. Project/Activity applied for: 1(b) Offshore and onshore oil and gas
exploration, development & production
5. Date of submission for TOR: 31 Jul 2018
In this regard, under the provisions of the EIA Notification 2006 as amended, the Standard TOR for the purpose of preparing environment impact assessment report and environment management plan for obtaining prior environment clearance is prescribed with public consultation as follows:
STANDARD TERMS OF REFERENCE (TOR) FOR EIA/EMP REPORT FOR PROJECTS/ACTIVITIES REQUIRING ENVIRONMENT CLEARANCE

1(b): STANDARD TERMS OF REFERENCE FOR CONDUCTING ENVIRONMENT IMPACT ASSESSMENT STUDY FOR OFFSHORE AND ONSHORE OIL AND GAS EXPLORATION, DEVELOPMENT AND PRODUCTION PROJECTS AND INFORMATION TO BE INCLUDED IN EIA/EMP REPORT

B. STANDARD TOR FOR ONSHORE OIL AND GAS EXPLORATION, DEVELOPMENT & PRODUCTION

1. Executive summary of a project.
2. Project description, project objectives and project benefits.
3. Cost of project and period of completion.
4. Site details within 1 km of the each proposed well, any habitation, any other installations/activity, flora and fauna, approachability to site, other activities including agriculture/land, satellite imagery for 10 km area. All the geological details shall be mentioned in the Topo sheet of 1:40000 scale, superimposing the well locations and other structures of the projects. Topography of the project site.
5. Details of sensitive areas such as National Park, Wildlife sanctuary and any other eco-sensitive area alongwith map indicating distance.
6. Approval for the forest land from the State/Central Govt, under Forest (Conservation) Act, 1980, if applicable.
8. Distance from nearby critically/severely polluted area as per Notification, if applicable. Status of moratorium imposed on the area.
10. Environmental consideration in the selection of the drilling locations for which environmental clearance is being sought. Present any analysis suggested for minimizing the footprint giving details of drilling and development options considered.
11. Baseline data collection for air, water and soil for one season leaving the monsoon season in an area of 10 km radius with centre of Oil Field as its centre covering the area of all proposed drilling wells.
12. Climatology and Meteorology including wind speed, wind direction, temperature rainfall relative humidity etc.
13. Details of Ambient Air Quality monitoring at 8 locations for PM2.5, PM10, SO2, NOx, CO, VOCs, Methane and non-methane HC.
14. Soil sample analysis (physical and chemical properties) at the areas located at 5 locations.
15. Ground and surface water quality in the vicinity of the proposed wells site.
STANDARD TERMS OF REFERENCE (TOR) FOR EIA/EMP REPORT FOR PROJECTS/ACTIVITIES REQUIRING ENVIRONMENT CLEARANCE

16. Measurement of Noise levels within 1 km radius of the proposed wells.
17. Vegetation and land use; flora/fauna in the block area with details of endangered species, if any.
18. Incremental GLC as a result of DG set operation, flaring etc.
19. Potential environmental impact envisaged during various stages of project activities such as site activation, development, operation/maintenance and decommissioning.
20. Actual source of water and ‘Permission’ for the draw of water from the Competent Authority. Detailed water balance, wastewater generation and discharge.
21. Noise abatement measures and measures to minimize disturbance due to light and visual intrusions.
22. Details on wastewater generation, treatment and utilization/discharge for produced water/formation water, cooling waters, other wastewaters, etc. during all project phases.
23. Details on solid waste management for drill cuttings, drilling mud and oil sludge, produced sand, radio actinomaterials, other hazardous materials, etc. including its disposal options during all project phases.
24. Disposal of spent oil and lube.
25. Storage of chemicals and diesel at site. Hazardous material usage, storage and accounting.
26. Commitment for the use of water based mud (WBM) only
27. Oil spill emergency plans for recovery/reclamation.
28. H2S emissions control.
29. Produced oil/gas handling, processing and storage/transportation.
30. Details of control of air, water and noise pollution during production phase.
31. Measures to protect ground water and shallow aquifers from contamination.
32. Whether any burn pits being utilised for well test operations.
33. Risk assessment and disaster management plan for independent reviews of well designed construction etc. for prevention of blow out. Blowout preventer installation.
34. Environmental management plan.
35. Total capital and recurring cost for environmental control measures.
36. Emergency preparedness plan.
37. Decommissioning and restoration plans.
38. Documentary proof of membership of common disposal facilities, if any.
39. Details of environmental and safety related documentation within the company including documentation and proposed occupational health and safety Surveillance Safety Programme for all personnel at site. This shall also include monitoring programme for the environmental.
40. A copy of Corporate Environment Policy of the company as per the Ministry’s O.M. No. 3-I1013/4/2006-I(1)(1) dated 26th April, 2011 available on the Ministry’s website.
41. Any litigation pending against the project and or any direction/order passed by any court of law against the project. If so details thereof.
TOR COMPLIANCE
## TOR Compliance


<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description</th>
<th>Details</th>
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<tbody>
<tr>
<td><strong>A. STANDARD TERMS OF REFERENCE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Executive summary of a project</td>
<td>Attached separately</td>
</tr>
<tr>
<td>2</td>
<td>Project description, project objectives and project benefits</td>
<td>Project Description in section 2.5 of Chapter 2 (Page No. 60), project objectives in section 2.2 of Chapter 2 (Page No. 51), project benefits in Chapter 8 of EIA (Page No. 331)</td>
</tr>
<tr>
<td>3</td>
<td>Cost of project and period of completion</td>
<td>Cost of project provided in section 2.8 of Chapter 2. (Page No. 91)</td>
</tr>
<tr>
<td>4</td>
<td>Site details within 1 km of the each proposed well, any habitation, any other installation/activity, flora and fauna, approachability to site, other activities including agriculture/land, satellite imagery for 10 km area. All the geological details shall be mentioned in the Topo sheet of 1:40000 scale, superimposing the well locations and other structures of the projects. Topography of the project site</td>
<td>The areas within 1 km of the proposed wells are open land and agricultural land area. The site details within 1 km radius of each well are provided at section 2.3 of chapter 2 (Page No. 52), Satellite imagery provided at section 3.8 of chapter 3 (Page No. 112). Geological structure description provided in section 3.6 (Page No. 109).</td>
</tr>
<tr>
<td>5</td>
<td>Details of sensitive areas such as National Park, Wildlife sanctuary and any other eco-sensitive area along with map indicating distance</td>
<td>No Reserve Forest found around 10 km radius from the project. There are no National Parks/ wildlife sanctuary present with 10 km radius of any of the block. (Page No. 52)</td>
</tr>
<tr>
<td>6</td>
<td>Approval for the forest land from the State/Central Govt. under Forest (Conservation) Act, 1980, if applicable.</td>
<td>Not applicable</td>
</tr>
<tr>
<td>7</td>
<td>Recommendation of SCZMA/CRZ clearance as per CRZ Notification dated 6th January, 2011 (if applicable).</td>
<td>Not applicable</td>
</tr>
<tr>
<td>8</td>
<td>Distance from nearby critically/severely polluted area as per Notification, if applicable. Status of moratorium imposed</td>
<td>No critically/severely polluted area is present within 10 Km radius of the CB-ONN-2010/8 block (Page No. 52)</td>
</tr>
<tr>
<td>Sl. No.</td>
<td>Description</td>
<td>Details</td>
</tr>
<tr>
<td>--------</td>
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</tr>
<tr>
<td>9</td>
<td>Does proposal involve rehabilitation and resettlement? If yes, details thereof.</td>
<td>The proposed project will not require rehabilitation and resettlement. Details provided in section 2.5.1.1 of Chapter 2. (Page No. 69)</td>
</tr>
<tr>
<td>10</td>
<td>Environmental considerations in the selection of the drilling locations for which environmental clearance is being sought. Present any analysis suggested for minimizing the foot print giving details of drilling and development options considered.</td>
<td>The environmental considerations are given in Section 2.3 of chapter 2. (Page No. 52)</td>
</tr>
<tr>
<td>11</td>
<td>Baseline data collection for air, water and soil for one season leaving the monsoon season in an area of 10 km radius with centre of Oil Field as its centre covering the area of all proposed drilling wells</td>
<td>Please refer Section 3.9 for baseline air quality (Page No. 122), Section 3.11 baseline water quality (Page No. 133), Section 3.12 for baseline soil quality (Page No. 152) respectively.</td>
</tr>
<tr>
<td>12</td>
<td>Climatology and Meteorology including wind speed, wind direction, temperature rainfall relative humidity etc.</td>
<td>Provided at section 3.3 of Chapter 3 (Page No. 96)</td>
</tr>
<tr>
<td>13</td>
<td>Details of Ambient Air Quality monitoring at 8 locations for PM2.5, PM10, SO2, NOx, CO, VOCs, Methane and non-methane HC.</td>
<td>Ambient Air Quality provided in Section 3.9 of Chapter 3, table 3.10 (Page No. 122-129)</td>
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<td>14</td>
<td>Soil sample analysis (physical and chemical properties) at the areas located at 5 locations.</td>
<td>Result of Soil Sample Analyses Section 3.12 of Chapter 3, table 3.17 (Page No. 152)</td>
</tr>
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<td>15</td>
<td>Ground and surface water quality in the vicinity of the proposed wells site.</td>
<td>Result of Ground and Surface Water given in Section 3.11 of Chapter 3 table 3.14 and 3.15 (Page No. 133-150)</td>
</tr>
<tr>
<td>16</td>
<td>Measurement of Noise levels within 1 km radius of the proposed wells.</td>
<td>Provided at Section 3.10 of Chapter 3, table 3.12 (Page No. 129-132),</td>
</tr>
<tr>
<td>17</td>
<td>Vegetation and land use; flora/fauna in the block area with details of endangered species, if any.</td>
<td>LU details provided at section 3.8 (Page No. 112) Ecological details provided in 3.13 (Page No. 155-178)</td>
</tr>
<tr>
<td>18</td>
<td>Incremental GLC as a result of DG set operation, flaring etc.</td>
<td>Incremental GLC Concentrations are provided at section 4.8 of Chapter 4 (Page No. 200)</td>
</tr>
<tr>
<td>Sl. No.</td>
<td>Description</td>
<td>Details</td>
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<td>-------------------------------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>19</td>
<td>Potential environmental impact envisaged during various stages of project activities such as site activation, development, operation/maintenance and decommissioning.</td>
<td>Potential Environmental Impacts envisaged during various stages of Project activities is given in Chapter 4 (Page No. 190-243)</td>
</tr>
<tr>
<td>20</td>
<td>Actual source of water and 'Permission' for the drawl of water from the Competent Authority. Detailed water balance, wastewater generation and discharge.</td>
<td>Refer section 2.6.2 of chapter 2. (Page No. 81)</td>
</tr>
<tr>
<td>21</td>
<td>Noise abatement measures and measures to minimize disturbance due to light and visual intrusions.</td>
<td>Abatement of visual intrusions and noise have been provided at Sections 4.9 of Chapter 4 (Page No. 217)</td>
</tr>
<tr>
<td>22</td>
<td>Details on wastewater generation, treatment and utilization/discharge for produced water/formation water, cooling waters, other wastewaters, etc. during all project phases</td>
<td>Chapter 2, section 2.7.3 (Wastewater treatment scheme) (Page No. 87)</td>
</tr>
<tr>
<td>23</td>
<td>Details on solid waste management for drill cuttings, drilling mud and oil sludge, produced sand, radioactive materials, other hazardous materials, etc. including its disposal options during all project phases.</td>
<td>Details provided in section 2.7.4 of chapter 2 (Page No. 89) and section 9.6.2 of chapter 9 (Page No. 355)</td>
</tr>
<tr>
<td>24</td>
<td>Disposal of spent oil and lube.</td>
<td>Details provided in section 2.7.4 of chapter 2 (Page No. 89) and section 9.6.2 of chapter 9 (Page No. 355)</td>
</tr>
<tr>
<td>25</td>
<td>Storage of chemicals and diesel at site. Hazardous material usage, storage and accounting.</td>
<td>Chemicals and diesels will be stored on paved areas, Bund wall will be provided to diesel storage area, Spill kits will be made available in chemical and diesel storage area, covered shed will be constructed for storage areas. Details in section 2.7.4 of Chapter 2 (Page No. 89)</td>
</tr>
<tr>
<td>26</td>
<td>Commitment for the use of water based mud (WBM) only.</td>
<td>Water based mud would be used for drilling activity. Details provided at table 2.5 (Drilling fluids) (Page No. 72)</td>
</tr>
<tr>
<td>27</td>
<td>Oil spill emergency plans for recovery/reclamation.</td>
<td>Detail plan provided in section 7.2.1 of chapter 7 (Page No. 271) and in</td>
</tr>
<tr>
<td>Sl. No.</td>
<td>Description</td>
<td>Details</td>
</tr>
<tr>
<td>--------</td>
<td>------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>28</td>
<td>H₂S emissions control.</td>
<td>As per available data, there is no chance of presence of H₂S in the hydrocarbon present within block, however, as a hypothetical case, scenario of presence of 3% H₂S has been considered for consequence analysis. Detail plan provided in section 7.2.2 (Page No. 273)</td>
</tr>
<tr>
<td>29</td>
<td>Produced oil/gas handling, processing and storage/transportation.</td>
<td>Oil produced at the time of well testing operations will be transported to proposed QPF (Quick Production Facility) facility within block area. Refer section 2.5. (Page No. 81-86)</td>
</tr>
<tr>
<td>30</td>
<td>Details of control of air, water and noise pollution during production phase.</td>
<td>Details provided in section 9.6 of chapter 9. (Page No. 341-354)</td>
</tr>
<tr>
<td>31</td>
<td>Measures to protect ground water and shallow aquifers from contamination.</td>
<td>Measures to protect groundwater and shallow aquifers provided in section 9.6 of chapter 9. (Page No. 341-354)</td>
</tr>
<tr>
<td>32</td>
<td>Whether any burn pits being utilised for well test operations.</td>
<td>Burn Pits will not be used.</td>
</tr>
<tr>
<td>33</td>
<td>Risk assessment and disaster management plan for independent reviews of well designed construction etc. for prevention of blow out. Blowout preventer installation.</td>
<td>Please refer Chapter 7 (Page No. 268-330)</td>
</tr>
<tr>
<td>34</td>
<td>Environmental management plan.</td>
<td>Please refer Chapter 9 (Page No. 334-363)</td>
</tr>
<tr>
<td>35</td>
<td>Total capital and recurring cost for environmental control measures.</td>
<td>Please refer section 9.7 of Chapter 9 (Page No. 363)</td>
</tr>
<tr>
<td>36</td>
<td>Emergency preparedness plan.</td>
<td>Details provided in section 7.5.5 of chapter 7. (Page No. 292)</td>
</tr>
<tr>
<td>37</td>
<td>Decommissioning and restoration plans</td>
<td>Details provided in section 9.6.3 of chapter 9. (Page No. 360)</td>
</tr>
<tr>
<td>38</td>
<td>Documentary proof of membership of common disposal facilities, if any.</td>
<td>Agreement with Common TSDF facility provided in Annexure 3 (Page No. 385)</td>
</tr>
<tr>
<td>39</td>
<td>Details of environmental and safety</td>
<td>Regular health check up of personnel</td>
</tr>
<tr>
<td>Sl. No.</td>
<td>Description</td>
<td>Details</td>
</tr>
<tr>
<td>---------</td>
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</tr>
<tr>
<td></td>
<td>related documentation within the company including documentation and proposed occupational health and safety Surveillance Safety Programme for all personnel at site. This shall also include monitoring programme for the environmental.</td>
<td>conducted as per BPRL EHS Policy. Surveillance safety programs carried at regular intervals and documented. Details in section 9.6, Chapter 9. (Page No. 341)</td>
</tr>
<tr>
<td>40</td>
<td>A copy of Corporate Environment Policy of the company as per the Ministry’s O.M. No. J-11013/41/2006-IA.II(I) dated 26th April, 2011 available on the Ministry’s website</td>
<td>Refer Chapter 9, section 9.5 (Page No. 341)</td>
</tr>
<tr>
<td>41</td>
<td>Any litigation pending against the project and or any direction/order passed by any court of law against the project. If so details thereof.</td>
<td>Not Applicable Annexure 1 (Page No. 382)</td>
</tr>
</tbody>
</table>
CHAPTER 1

INTRODUCTION
CHAPTER 1: INTRODUCTION

1.1 PREAMBLE

Bharat Petroleum Corporation Limited (BPCL) entered the upstream sector in 2003 with an aim to provide partial supply security of crude and hedging of price risks and to become a vertically integrated oil company. A wholly owned subsidiary company of Bharat Petroleum Corporation Limited (BPCL), by the name Bharat PetroResources Limited (BPRL) was incorporated in October 2006.

With the present consumption pattern of hydrocarbon energy, the available reservoirs in the country will be depleted to a larger extent by the next decade. It is expected that increased hydrocarbon exploration and production operations can boost up the energy supply and can help to reduce the supply-demand gap.

Under NELP-IX bid round, BPRL led consortium has been awarded on-land block CB-ONN-2010/8 in Cambay basin. BPRL is the Lead Operator with 25% Participating Interest (PI) and the other consortium partners are GAIL (India) Ltd- 25% PI (Joint Operator), Engineers India Ltd (EIL) - 20% PI, BF Infrastructure Ltd (BFIL) - 20% PI and Monnet Ispat & Energy Ltd (MIEL) - 10% PI. As per Minimum Work Programme (MWP), committed to Government of India (GoI), BPRL had completed 2D/3D seismic data acquisition, processing interpretation and drilling of six wells Pasunia#01 (PA#01), Pasunia#02 (PA#02), Vadod#01 (VA#01), Chandiyal#01 (CH#01), Demaliya#01 (DE#01), Bhavda#01 (BH#01) and testing of five wells. There were two discoveries made in PA#01 and PA#02 wells. During testing, oil flowed @ 25-30 bbl/day to the surface on self-flow, confirming the presence of producible hydrocarbon from the reservoirs from these two wells (PA#01 & PA#02) The API of produced oil is about 29°.

BPRL along with GAIL & EIL proposed to develop this discovery and had submitted a Field Development Plan (FDP) to Directorate General of Hydrocarbon (DGH). The FDP has been approved by DGH/Management Committee (MC) on 11th June 2018.

ABC Techno Labs India Pvt. Ltd., NABET Accredited Environmental Consultant Organization has been engaged by Bharat PetroResources Limited to carry out Environment Impact Assessment (EIA) study and to prepare an Environment Management Plan (EMP) for getting environment clearance for Proposed Onshore Oil and Gas development and production activities in the Block at Dehgam, Daskroi, Mehmdavad,
District: Gandhinagar, Ahmedabad and Kheda, State- Gujarat. The study has been carried out as per the guidelines of Ministry of Environment, Forests & Climate Change (MoEF&CC).

1.2 IDENTIFICATION OF THE PROJECT

The block CB-ONN-2010/8, is ‘S’ type block, covers total on-land area of 42 km². The block is comprised of two parts (Part A & B). The northern Part 'A' is 14 km² and the southern Part 'B' is 28 km². The block is located 25 Km East of Ahmadabad city in Gujarat. MoEF&CC has granted Environment Clearance for drilling 8 exploratory wells in the Block vide its letter J-11011-324/2013 IA II (I) dated 22nd June 2015.

The Exploration Period is for seven consecutive years consisting of Initial Exploration Period (4 years) and Subsequent Exploration Period (3 years). The Initial Exploration Period of the block has been ended on 19.03.2018.

The MWP related activities comprises of Acquisition, Processing and Interpretation (API) of 2D (10 LKM) and 3D (42 Km²) seismic data and drilling of 8 exploratory wells. As per minimum work commitment, consortium has completed 2D and 3D API of 10 LKM & 42 Km² seismic data respectively. Drilling of six out of eight commitment wells have also been completed. Further, the consortium has successfully tested 5 wells. There are two discoveries made in Pasunia#01 (PA#01) and Pasunia#02 (PA#02) wells, which has been accepted by GoI.

To monetize the Pasunia Field, BPRL plans to start production from two existing exploratory wells i.e. Pasunia#01 (PA#01) & Pasunia#02 (PA#02) and 8 new development wells (DW#01, DW#02 & DW#03, DW#04, DW#05, DW#06, DW#07 & DW#08). Quick Production Facility (QPF) is planned at well sites to store the produced oil and the same would be transported to nearest ONGC facility for further processing before selling it to buyer.

As per notification dated 14th September 2006, proposed exploratory & Developmental drilling of wells & testing of hydrocarbons within block is designated as “Category A” project and require environment clearance from Ministry of Environment, Forest and Climate Change, Govt. of India, Delhi. The present proposal is classified under Schedule 1 (b) - Offshore and Onshore oil and gas exploration, development & production, Category ‘A’ according to EIA Notification 2006 & subsequent amendments.
The well locations with Village and Taluka as follows:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Well Name</th>
<th>Type of well</th>
<th>Remarks</th>
<th>Village Name</th>
<th>Taluka</th>
<th>District</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PA#01</td>
<td>Exploratory well to be converted to Development well</td>
<td>Existing well</td>
<td>Karoli</td>
<td>Dahegam</td>
<td>Gandhinagar</td>
</tr>
<tr>
<td>2</td>
<td>PA#02</td>
<td>Exploratory well to be converted to Development well</td>
<td>Existing well</td>
<td>Kuha</td>
<td>Dascroi</td>
<td>Ahmedabad</td>
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<td>3</td>
<td>DW#01</td>
<td>Development well</td>
<td>New</td>
<td>Kodrali</td>
<td>Dahegam</td>
<td>Gandhinagar</td>
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<td>Development well</td>
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<td>Pasunj</td>
<td>Dascroi</td>
<td>Ahmedabad</td>
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<td>5</td>
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<td>Ahmedabad</td>
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<td>Karoli</td>
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<td>Gandhinagar</td>
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<td>DW#05</td>
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<td>Kuha</td>
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<td>Ahmedabad</td>
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<tr>
<td>8</td>
<td>DW#06</td>
<td>Development well</td>
<td>New</td>
<td>Kuha</td>
<td>Dascroi</td>
<td>Ahmedabad</td>
</tr>
<tr>
<td>9</td>
<td>DW#07</td>
<td>Development wells will be drilled from same location</td>
<td>New</td>
<td>Pasunj</td>
<td>Dascroi</td>
<td>Ahmedabad</td>
</tr>
<tr>
<td>10</td>
<td>DW#08</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Bharat PetroResources Limited

None of the wells falls within Kheda district.

1.3 Identification of the Project Proponent

Bharat Petroleum Corporation Limited entered the upstream sector in 2003 with an aim to provide partial supply security of crude and hedging of price risks and to become a vertically integrated oil company. A wholly owned subsidiary company of Bharat Petroleum Corporation Ltd, by the name **Bharat PetroResources Limited (BPRL)** was incorporated in October 2006.

**BPRL’s E&P experience includes:**

Portfolio of 25 blocks across 8 countries, which are in various stages of exploration, appraisal, development and production, including presence in the Lower Zakum concession in offshore Abu Dhabi, along with equity stake in 2 Russian entities holding the license to 4 producing assets. The total acreage of BPRL is 25,533 km², of which approx. 77% is offshore. BPRL, as part of various consortia, has total of 26 discoveries till date including world-class discoveries in Mozambique and Brazil. BPRL is also the Lead
Operator of an onland block in India in the Cambay basin, where the field development plan for 2 discoveries has been approved by the regulator. BPRL has also been awarded 5 blocks in India as Operator (2 Offshore blocks and 3 onshore) in the Discovered Small Fields Bid Round 2016 and 1 onshore block as Operator in the Open Acreage Licensing Bid Window – 1 in 2018.

Project Proponent:

<table>
<thead>
<tr>
<th>Name of the Company</th>
<th>M/s. Bharat PetroResources Limited (BPRL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registered Address</td>
<td>Bharat Bhavan, 4 and 6 Currimbhoy Road, Ballard Estate, Mumbai 400001</td>
</tr>
<tr>
<td>Address for correspondence</td>
<td>12th Floor, Maker Tower, F wing, cufte Parade, Mumbai, Maharashtra,400005</td>
</tr>
<tr>
<td>Name of the Applicant</td>
<td>Mr. Tushar Datta</td>
</tr>
<tr>
<td>Designation (Owner/ Partner/ CEO)</td>
<td>Vice President (Assets)</td>
</tr>
<tr>
<td>E-mail</td>
<td><a href="mailto:ranjan.b@bharatpetroresources.in">ranjan.b@bharatpetroresources.in</a></td>
</tr>
<tr>
<td></td>
<td><a href="mailto:tushar.d@bharatpetroresources.in">tushar.d@bharatpetroresources.in</a></td>
</tr>
<tr>
<td>Telephone No.</td>
<td>022-22175677/ 022-22175674</td>
</tr>
<tr>
<td>Mobile No.</td>
<td>+91 9619132241/9833987929</td>
</tr>
</tbody>
</table>

1.4 Brief Description of the Project

1.4.1 Need for the Project and Its Importance

India’s demand for petroleum products is growing at a rapid rate, having virtually doubled from 30 million tonnes in 1980-81 to about 70 million tonnes in 1995-96 to 155 million tons in 2006-07. The oil and gas sector is among the six core industries in India and plays a major role in influencing decision making for all the other important sections of the economy. In June 2015, total crude oil imports were valued at US$ 8.7 billion. In FY-14, imports accounted for more than 80% of the country’s total oil demand with India developing gas-fired power stations, consumption is up more than 160% since 1995. Gas consumption is likely to expand at a Compound Annual Growth Rate (CAGR) of 21% during FY08–17 With a view to meeting this growing demand, the new hydrocarbon policy aims at encouraging investments in oil/gas exploration and production. Current projections for demand and supply indicate that the level of self-sufficiency is likely to decline to about 30% over the next few years.

Substantial efforts are, therefore, necessary to boost the level of exploration activity in the country so that new reservoirs can be identified to significantly enhance production of crude oil and gas in the years to come. India today remains one of the least explored
regions with oil well density per thousand sq. km being among the lowest. It is also evident that large amounts of capital investments are necessary if exploration efforts are to be substantially augmented. It is therefore required to attract both the national as well as, private sector oil companies to invest in this critical area. With this background, a New Exploration Licensing Policy (NELP) was formulated by the government in 1997-98 to provide a level playing field in which all parties could compete on equal terms for the award of exploration acreage. In the coming time, exploration for oil & gas in critical areas will be based on social, cultural, environmental, recreational, economic, legal, national and international needs and would invite development of innovative and supporting technologies for clean operations. Hence this project of production drilling block will help in establishing the oil/gas prospects in the block for commercial recovery which is a need of the country for its economic development. It is expected that the proposed development drilling activities lead to augment the production of hydrocarbons, in the present scenario of growing demand of oil and gas in the country.

1.4.2 Description of Block Location
The Cambay basin, a rich petroleum province of India, is a narrow, elongated rift graben, extending from Surat in the south to Sanchor in the north. In the north, the basin narrows, but tectonically continues beyond Sanchor to pass into the Barmer Basin of Rajasthan. On the southern side, the basin merges with the Bombay Offshore Basin in the Arabian Sea. The basin has more than 50 years of active hydrocarbon exploration history. The total area of the basin is about 53,500 Km² including 6,880 Km² in the shallow waters (Gulf of Cambay). It is flanked by the Saurashtra-Kutch uplift on the west and rock exposures of the Aravalli-Delhi system and Deccan Plateau basalt on the east.

It is a narrow N-S trending rift basin which extends from Sanchor in the North to Surat in the South and is divided into several tectonic blocks separated by prominent transverse faults. The Ahmedabad – Mehsana tectonic block is one of the most prolific producing blocks in the Cambay Basin. It is bounded by the Patan-Unawa /Saraswati cross trends on the north and Vatrak cross trend in the south. The relatively weak South Kadi - Nandasan cross trend separates the Mehsana area to the north from the Ahmedabad area to the south. The block CB-ONN-2010/8 is located towards Eastern margin of Ahmadabad – Mehsana tectonic block.
The block CB-ONN-2010/8 is situated near the eastern rising margin of the Ahmadabad area. A part of the eastern rising margin lies within the eastern parts of the block. The Nardipur – Walod – Nenpur low passes along the western part of the block. In the western part the sediments dip with low angles towards the west, while in the eastern part the dips are higher. The Gamij field with listric fault lies to the east of the block. On the west, the Bakrol field is present, through which the western rising flank of the Nardipur – Walod – Nenpur low passes. The producing Gamij and Bakrol fields operated by ONGC and Selan Exploration Ltd. respectively, flank the block on the East and West.

Figure 1.1: Location of Cambay Basin showing Faults and Oil & Gas Fields
The rift initiated at the end of Cretaceous. In the later part of Late Cretaceous, Seychelles islands were separated from the Indian Plate and the Indian sub-continent drifted northward. Rifting in the basin is marked by eruption of massive amount of flood basalt (Deccan Trap). The basalt constitutes the basement for subsequent tertiary sediments. The structural elements of the basin indicate influence of the tree major tectonic trends viz. Dharwar (NNW-SSE), Satpura (ENE- WSW) and Aravalli-Delhit (NE-SW) trends of Precambrian time. Several cross trends related to Satpura and Delhi-Arvalli tectonic trends are responsible for creation of tectonic blocks. The basin is divided into five tectonic blocks. They are (i) Sanchor-Patan (ii) Mehsana-Ahmedabad (iii) Tarapur-Cambay (iv) Broach-Jambusar (v) Narmada-Tapi blocks from north to south.

The basin has two distinct fault systems: (i) N-S to NNWSSE trending listric normal faults of Dharwanian trend and (ii) NE-SW to ENE-WSW trending faults of Aravalli-Delhi and Satpura trends. The basin evolved in three different stages – (i) Synrift stage (extensional stage) during Paleocene-Early Eocene (ii) Postrift stage-I (thermal subsidence) during Middle Eocene-Early Miocene (iii) Postrift stage-II (structural inversion stage) during Middle Miocene- recent.
Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.

**Figure 1.2: Stratigraphy of the Cambay Basin**

Generalized stratigraphy of Cambay basin exhibits presence of rocks from Upper Cretaceous to Recent. Deccan Basalt constitutes the basement rock for the major part of the basin over which 8-11 km thick pile of tertiary sediments have been deposited in synrift and post rift phases.

**Exploration History**

Three wells (Hirapur#4, Gamij#76 & Gamij#68) were drilled in this block by the earlier operator ONGC to explore Kalol and Chhatral pay sands. These wells were dry due to lack of proper entrapment conditions (Hirapur-4) and reservoir development (Gamij-68 & Gamij-76).

Subsequently, The Block CB-ONN-2010/8 was awarded to BPRL led consortium under ninth NELP round. As per minimum work commitment of the block, 2D-3D API of 10LKM
& 42 Km² seismic data and drilling of six exploratory wells were carried out by BPRL. Out of these six exploratory wells, five wells Pasunia#01 (PA#01), Pasunia#02 (PA#02), Vadod #01 (VA#01), Demaliya#01 (DE#01) and Chandiyal#01 (CH#01) have encountered oil & gas shows in K-III+IV sands of Kalol Formation, whereas sixth well Bhavda#01 (BH#01) has been dry. Testing have been performed in four wells and testing results of K-III+IV sands in Pasunia#01 (PA#01) & Pasunia#02 (PA#02) wells have established potential commercial flow of oil, while Vadod#01 (VA#01), Demaliya#01 (DE#01) & Chandiyal#01 (CH#01) have resulted in oil recovery during reverse circulation from Kalol & Older Cambay Shale objects. Due to insignificant testing result of VA#01, DE#01 & CH#01 wells, which confirmed poor reservoir characteristics of the pay sands, they have been permanently plugged and abandoned. Two discovery wells PA#01 & PA#02 are planned to be put under production.
Figure 1.3: Toposheet of CB-ONN-2010/8 block

Source: Survey of India
1.5 Environmental Status

In the year 2009 the Central Pollution Control Board (CPCB) has developed a Comprehensive Environmental Pollution Index (CEPI) and revised the same in subsequent year upto April, 2016. It involved a nation-wide environmental assessment of Industrial Clusters based on CEPI and 43 such industrial clusters in 16 States having CEPI greater than 70, on a scale of 0 to 100, has been identified as Critically Polluted Area (CPA).

The proposed development drilling location at CB-ONN-2010/8 block in Cambay basin, Ahmedabad, Kheda and Gandhinagar District, Gujarat does not fall in the list of 43 Critically Polluted Area (CPA) identified by CPCB. Hence, carrying out developmental drilling work at CB-ONN-2010/8 block in Cambay basin shall not constitute any statutory binding related to existing environment in and around the proposed project.

1.6 Statutory Requirements and Legal Aspects

The relevant NOC’s and licenses will be obtained from the statutory agencies under the following Acts, Rules and amendments and BPRL will adhere to the guidelines specified in:

2. Petroleum and Natural Gas (Amendment) Rules, 2003 under Oilfields (Regulation and Development) Act, 1948
3. Oil Mines Regulations 2017 (OMR) under the Mines Act 1952
5. The Hazardous And Other Wastes (Management and Transboundary Movement) Rules, 2016
6. OISD Standard 144 Latest Revision
7. OISD Standard 150 Latest Revision
9. Explosives Act 1884 with rules
10. Electrical Installation Under Electricity Rules, 2005
ONGC will comply with the prescribed limits laid down for air, effluent and noise emissions for protection of the environment under the following Acts, Rules and amendments:

1. The Environment (Protection) Act, 1986 which is also called umbrella act or legislation
2. The Water (Prevention and Control of Pollution) Act, 1974 and amendment 2003
3. The Water (Prevention and Control of Pollution) Cess Act, 1977
4. The Air (Prevention and Control of Pollution) Act, 1981
5. Noise Pollution (Regulation and Control) Rules, 2000

Compliance to State Rules and Notifications will also be ensured.

1.7 **Objectives and Need of EIA Study**

The EIA/EMP study is a planning tool to confirm the environmental acceptability, in addition to the statutory requirements. This report presents the results of the EIA process, which is intended to:

- Establish and review the existing baseline conditions within CB-ONN-2010/8 block in Cambay basin, Ahmedabad, Kheda and Gandhinagar District, Gujarat and its surrounding area;
- Identify and assess the environmental impacts during proposed developmental drilling and Quick Processing Facility; and
- Advise and assist in identification of appropriate measures, for mitigation of adverse impacts, to be adopted under the Environment Management Plan (EMP), for all specified significant environmental impacts that are likely to emerge.

The proposed onshore developmental drilling and Quick Processing Facilities designated to be developed under the Environmental Impact Assessment (EIA) Notification and amendments under Environment (Protection) Act, 1986. All the projects related to offshore and onshore Oil and Gas exploration, development and production are listed in
para 1(b) of schedule of EIA Notification, 2006 covered under category ‘A’ and appraised at central level by the MOEF&CC.

1.8 APPROACH METHODOLOGY

The primary objective of the EIA studies is to internalize and integrate the environmental concerns/aspects and mitigation measures due to the developmental drilling of wells within CB-ONN-2010/8 block in Cambay basin, Ahmedabad, Kheda and Gandhinagar District, Gujarat.

This EIA/ EMP report is based on the observations made by the ABC team during visits to the study area and collection of primary and secondary environmental data. Literatures were reviewed and relevant information was collected for environmental and social baseline. Reconnaissance surveys were conducted to identify the major environmental issues in the study area. The sampling locations were identified on the basis of:

- Existing topography;
- Location of water bodies;
- Location of villages/ towns/ sensitive areas;
- Accessibility, power availability, security of monitoring equipment;
- Areas which represent baseline conditions.

EIA study has been carried out with the following objectives:

- A collection of baseline attributes within the study area (10 Km radius of with centre of Oil Field as its centre covering the area of all proposed drilling wells.) The EIA covered one season baseline environmental data, as per the guidelines of MoEF&CC, New Delhi. The scope includes a collection of baseline data, identify the various environmental parameters such as Ambient Air Quality, Meteorology, Water Quality, Soil Quality, Noise levels, Biological Environment, Socio - economic factors, land use factors, within the study area of CB-ONN-2010/8 block in Cambay basin.

- Identification, prediction, evaluation & mitigation of biophysical, social & other relevant effects of development on the environment during the operational phase of the proposed development drilling of wells using mathematical / simulation models as per applicable Indian law. Accordingly mitigation measures to be adopted have been recommended for critical environment impacts.
- Preparation of Environmental Management Plan (EMP) to be adopted for mitigation of the anticipated adverse impacts of the developmental drilling of wells during the operational phase.
  - Pollution control measures proposed to meet the emission, effluent, noise standards etc.
  - Scheme for effluent recycling, Solid/hazardous waste management.
  - Social welfare schemes.
  - Post-Project Environmental Quality Monitoring and Management Program.
  - Occupational health related mitigation measures; etc.
- Delineation of the post-project environmental quality monitoring program as per the requirements of the regulatory authorities.

The EIA/EMP report is prepared for obtaining Environmental Clearance on the basis of Terms of Reference (TOR) prescribed by the MoEF&CC vide F. No. J-11011/324/2013-IA-II (I) Dated 2nd September 2018 for generation of site specific baseline data, environment monitoring and surveys within block and in surrounding area of 10 km radius have been conducted for three (3) months continuously from 20th April 2018 to 9th July 2018 by ABC Techno Labs India Pvt. Ltd. and sampling locations for various environmental parameters were identified on the basis of:

- Predominant wind direction expected during the period of baseline monitoring in the study area
- Topography,
- Location of village/towns/sensitive areas
- Identified pollution pockets, if any within the study area
- Areas, which represent baseline conditions;
- Collection, collation and analysis of baseline data for various environmental attributes.

The study area around CB-ONN-2010/8 block in Cambay basin could have impact on the physical, chemical and biological attributes of surrounding environment. In assessing the
environmental impacts, collection, collation and interpretation of baseline data is of prime importance. Environmental impact analysis and assessment carried out at the planning stage itself.

1.9 Need for EIA

As per EIA Notification dated 14th Sept., 2006 as amended from time to time, this project falls under S. No. 1 (Mining, extraction of natural resources and power generation), Project activity “1 (b)- Offshore and onshore oil and gas exploration, development & production). All project falls under Category A, and will be appraised by Expert Appraisal Committee (EAC-Industry 2) of MoEF&CC, New Delhi.

Accordingly, the EIA Report has been prepared based on the Terms of Reference (TOR) issued by EAC-Industry 2 of MoEF&CC, New Delhi vide F.No. IA-J-11011/324/2013-IA-II(I) date 2nd September 2018.

1.10 Structure of EIA Report

The EIA report has been presented in order to group the environmental parameters under physical, biological, demographic & socio-economic environments, anticipated impacts and mitigation measures. The EIA report has been prepared as contents given in EIA Notification 2006 and subsequent amendments. The structure of EIA Report is as given below:

- **Executive Summary:** Given in the beginning of the report
- **Chapter 1: Introduction**
  - This chapter provides background information, brief location settings of the area along with the scope and objectives of the EIA/ EMP study also been described in this chapter
- **Chapter 2: Project Description**
  - This chapter deals project details, project layout, process details, operating parameters, power requirements, water requirement and sources pollution and it management, cost etc
- **Chapter 3: Description of the Environment**
  - This chapter presents existing environmental status of the 10km radius (from centre of the block) study area around the block including topography, geological, drainage pattern, water environment, climate & meteorology, ambient air
Chapter 4: Anticipated Environmental Impacts and its Mitigation Measures

This chapter describes the anticipated impact on the environment and mitigation measures for proposed development drilling project. It gives the details of the impact on the baseline parameters, both during the construction and operational phases and suggests the mitigation measures to be implemented by the BPRL.

Chapter 5: Alternative Analysis

This chapter examines alternative means for the proposed development drilling activity at CB-ONN-2010/8 block in Cambay basin, Gujarat.

Chapter 6: Environmental Monitoring Plan

This chapter describes Environmental Monitoring Plan for the development drilling of CB-ONN-2010/8 block in Cambay basin during construction and operation phases.

Chapter 7: Risk Assessment and Disaster Management Plan

This chapter spelled out hazard identification, risk analysis and disaster management plan for an unlikely event of emergency at developmental drilling of wells.

Chapter 8: Project Benefits

This chapter includes the benefits in terms of improvement in physical infrastructure, social infrastructure, employment potential, etc.

Chapter 9: Environmental Management Plan

This chapter describes environmental management plan to mitigate adverse environmental impacts and to strengthen beneficial impacts.

Chapter 10: Additional Studies

This chapter provides details of Public Hearing

Chapter 11: Summary & Conclusions

This chapter provides summary and conclusion of the EIA study

Chapter 12: Disclosure of Consultants

This chapter comprises the name of consultants engaged with their brief resume and nature of consultancy rendered.
CHAPTER 2

PROJECT DESCRIPTION
CHAPTER 2: PROJECT DESCRIPTION

2.1 INTRODUCTION

The Block CB-ONN-2010/8 situated in Dehgam, Daskroi, Mehdavad, District-Gandhinagar, Ahmedabad and Kheda, State- Gujarat was awarded to BPRL led consortium under ninth NELP round. As per minimum work commitment given to Government of India (GoI), consortium has completed 2D and 3D API of 10LKM & 42 Km² seismic data respectively and drilling of 6 wells. Further, the consortium has successfully tested 5 wells. There are two discoveries in the block from Pasunia#01 (PA#01) & Pasunia#02 (PA#02) wells. BPRL is planning to drill total 10 Nos. of development wells (2 discovered wells already drilled to be converted to production wells). Initially, BPRL plans to start production from two existing exploratory wells i.e PA#01 and PA#02 from first year by rentry and reperforation. From second year onwards, additional 3 development wells (DW#01, DW#02, DW#03) will be drilled and commence producing subsequently in phase I. It has also planned to drill 5 new additional development wells (DW#04, DW#05, DW#06, DW#07 & DW#08) within the 42 Km² of CB-ONN-2010/8 block in Cambay Basin of District- Gandhinagar, Ahmedabad and Kheda, State- Gujarat, in a phase II at later stage and put them into production.

Based on the hydrocarbon potential of the field established through drilling and testing of wells PA#01 & PA#02, it has been decided to exploit five fault bounded oil pools with the help of existing two wells PA#01 & PA#02 and one development wells each in other three pools (Pool-I, II & VI). Existing two wells will be put on production after work over operations. After observing the production performance of existing two wells (PA#01 & PA#02, drilling of other 8 development wells will be initiated and will be put on production after one year in phased manner.

Total five oil production wells (including existing PA#01 & PA#02 wells) have been considered in Phase I. It is proposed to drill two development wells for Pool-I & II from a single pad and from a common drill site subject to availability of land. Two wells may be drilled with short horizontal sections. Minimum processing facilities will be constructed for collection of oil in each well site and PA#02 well site will have a Quick Production Facility (QPF) for water separation, if any.
The wells are planned for completion by using artificial lift (Sucker Rod Pump). Since, associated gas found during testing is negligible and cannot be produced commercially; it will be primarily used for internal consumption if feasible and rest will be flared, if any. Produced oil will be stored at site in storage tanks and then transported to nearest surface facility (ONGC) at Nawagam (Near Ahmedabad) as per allocation by MOP&NG through tankers. After further processing of crude oil at ONGC, the same will be transported to allocated refinery for selling.

BPRL also planned to install processing facility located close to individual well is designed to handle respective well crude production locally. Minimum processing at site will be done so that crude oil having Basic Sand & Water is less than 5%. The crude will delivered to nearest ONGC's installation by tankers for further processing and treatment. Crude from storage tank is loaded to trucks using loading pumps on trucks, through flexible connection. Vapor formed during loading operation is vented to atmosphere at safe location using high point vent.

Produced waste, if any, will be disposed by state register agencies. Proper program of the operations will be prepared and shared to DGMS/OISD/DGH as applicable, prior to starting operation for review and guidance. Details of the operation will be sent to DGH and Department of Petroleum (DOP), Government of Gujarat on regular basis.

**Table 2.1: Salient Features of the proposed Oil block**

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company Name</td>
<td>M/s Bharat PetroResources Limited (BPRL)</td>
</tr>
<tr>
<td>Name of block</td>
<td>CB-ONN-2010/8</td>
</tr>
<tr>
<td>Area of block</td>
<td>42 Km²</td>
</tr>
<tr>
<td>Category of the Project</td>
<td>As per EIA Notification dated 14th Sept., 2006 as amended from time to time, this project falls under S. No. 1 (Mining, extraction of natural resources and power generation), Project activity “1 (b)”- Offshore and onshore oil and gas exploration, development &amp; production</td>
</tr>
<tr>
<td>Land required</td>
<td>For well site during drilling will be 1.8 ha, including site facilities and for camp site</td>
</tr>
<tr>
<td>Coordinates of wells</td>
<td>Refer Table 2.2</td>
</tr>
<tr>
<td>Development plan in case of strike</td>
<td>Storage and minimum processing facility will be constructed at well sites. Produced oil will be transported to nearest ONGC CTF at Nawagam, Ahmedabad</td>
</tr>
<tr>
<td>Particulars</td>
<td>Details</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>----------------------------------------------</td>
</tr>
<tr>
<td>Test flaring, duration</td>
<td>30 Days (approx.)</td>
</tr>
<tr>
<td>Depth of well</td>
<td>1300-1500 m</td>
</tr>
<tr>
<td>Duration of Drilling</td>
<td>45 Days per Well (approx.)</td>
</tr>
<tr>
<td>Quantity of waste mud</td>
<td>500 Ton per well (approx.)</td>
</tr>
<tr>
<td>Quantity of drill cutting</td>
<td>1000 Ton per well (approx.) per well</td>
</tr>
<tr>
<td>Quantity of waste water generated from drilling</td>
<td>5 KLD per well</td>
</tr>
<tr>
<td>Estimated life of well</td>
<td>15 years</td>
</tr>
<tr>
<td>Estimated peak production rate</td>
<td>380 BBL per Day (Total production)</td>
</tr>
<tr>
<td>Estimated operational loss</td>
<td>1% (max)</td>
</tr>
<tr>
<td>Presence of H2S</td>
<td>No H₂S content observed in a nearby well and during drilling of exploratory wells. Hence, H₂S content is not anticipated in the proposed well.</td>
</tr>
<tr>
<td>Estimated project cost</td>
<td>INR 43 Crores</td>
</tr>
<tr>
<td>Manpower Requirement</td>
<td>Total Manpower: 40-50 (Construction Phase), 40-50 (during drilling), 10-15 (during operation/production)</td>
</tr>
<tr>
<td>Seismic zone</td>
<td>The proposed plant-site area falls in Seismic Zone IV as per IS 1893:2002 (Part-1), which is a Moderately sensitive seismic zone.</td>
</tr>
</tbody>
</table>

Source: Bharat PetroResources Limited

2.2 Need for the Project

Developmental Drilling of the identified wells in CB-ONN-2010/8 block in an area of 42 Km² of Cambay basin within Gandhinagar, Ahmedabad and Kheda district, Gujarat under for hydrocarbon prospect (with associated quick processing facilities- QPF). The increased production would generate additional revenue for the State Government as well as for the Central Government by way of payments on account of Royalty, CESS, and taxation. This will also assist in the economic development of this less developed area in Gujarat by means of generating direct and indirect employment opportunities for the local people of the region.

Demand & Supply

Energy, be it conventional or non-conventional is the basic requirement for the mankind. In present day scenario, the consumption of energy has been increased with the growth of...
population and their demand for improved amenities. Keeping the required growth rate and rising energy demand for hydrocarbons, the Government of India has come out with plans to encourage national, private and foreign companies to explore and develop the hydrocarbon prospects. The proposed wells will definitely play part in reducing the gap between the demand and supply of Crude Oil and Gas in the country, which will help in reducing the import burden of the country.

India is an energy deficit country, as such all indigenous oil and gas production is consumed domestically. The proposed project would not have any export.

2.3 SITE CHARACTERISTICS

2.3.1 LOCATION

The total area of CB-ONN-2010/8 block is 42 Km². Block CB-ONN-2010/8 is geographically located in Gandhinagar, Ahmedabad and Kheda district, Gujarat. The well locations with Village and Taluka as follows:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Well Name</th>
<th>Type of well</th>
<th>Remarks</th>
<th>Village Name</th>
<th>Taluka</th>
<th>District</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PA#01</td>
<td>Exploratory well to be converted to Development well</td>
<td>Existing well</td>
<td>Karoli</td>
<td>Dahegam</td>
<td>Gandhinagar</td>
</tr>
<tr>
<td>2</td>
<td>PA#02</td>
<td>Exploratory well to be converted to Development well</td>
<td>Existing well</td>
<td>Kuha</td>
<td>Dascroi</td>
<td>Ahmedabad</td>
</tr>
<tr>
<td>3</td>
<td>DW#01</td>
<td>Development well</td>
<td>New</td>
<td>Kodrali</td>
<td>Dahegam</td>
<td>Gandhinagar</td>
</tr>
<tr>
<td>4</td>
<td>DW#02</td>
<td>Development well</td>
<td>New</td>
<td>Pasunj</td>
<td>Dascroi</td>
<td>Ahmedabad</td>
</tr>
<tr>
<td>5</td>
<td>DW#03</td>
<td>Development well</td>
<td>New</td>
<td>Kuha</td>
<td>Dascroi</td>
<td>Ahmedabad</td>
</tr>
<tr>
<td>6</td>
<td>DW#04</td>
<td>Development well</td>
<td>New</td>
<td>Karoli</td>
<td>Dahegam</td>
<td>Gandhinagar</td>
</tr>
<tr>
<td>7</td>
<td>DW#05</td>
<td>Development well</td>
<td>New</td>
<td>Kuha</td>
<td>Dascroi</td>
<td>Ahmedabad</td>
</tr>
<tr>
<td>8</td>
<td>DW#06</td>
<td>Development well</td>
<td>New</td>
<td>Kuha</td>
<td>Dascroi</td>
<td>Ahmedabad</td>
</tr>
<tr>
<td>9</td>
<td>DW#07</td>
<td>Development wells will be drilled from same location</td>
<td>New</td>
<td>Pasunj</td>
<td>Dascroi</td>
<td>Ahmedabad</td>
</tr>
<tr>
<td>10</td>
<td>DW#08</td>
<td>Exploratory well to be converted to Development well</td>
<td>Existing well</td>
<td>Karoli</td>
<td>Dahegam</td>
<td>Gandhinagar</td>
</tr>
</tbody>
</table>

Source: Bharat PetroResources Limited

None of the wells falls within Kheda district.
The boundary coordinates of the CB-ONN-2010/8 block are given hereunder:

### Table 2.2: Coordinates of the CB-ONN-2010/8 block

<table>
<thead>
<tr>
<th>Name of block</th>
<th>Points</th>
<th>Coordinates</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Part A</td>
<td>A</td>
<td>23°00'54” N 72°50’10” E</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>23°00'54” N 72°48’6” E</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>23°03’00” N 72°48’6” E</td>
<td></td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>23°03’00” N 72°50’11” E</td>
<td></td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>23°00'54” N 72°50’10” E</td>
<td></td>
</tr>
<tr>
<td>Part B</td>
<td>A</td>
<td>23°00'00” N 72°46’38” E</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>23°00'00” N 72°50’10” E</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>22°57’26” N 72°50’8” E</td>
<td></td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>22°57’26” N 72°46’38” E</td>
<td></td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>23°00'00” N 72°46’38” E</td>
<td></td>
</tr>
</tbody>
</table>

Source: Bharat PetroResources Limited

The location of the project area is shown in Figure 2.1.
Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.

Source: Bharat PetroResources Limited

Figure 2.2: Location map of Project site
CB-ONN-2010/8 Block

Source: Bharat PetroResources Limited

Figure 2.3: Map showing the location of the project site

2.3.2 Connectivity

The area is well connected by all-weather roads. The block is located to the South-South East of Gandhinagar city. The Ahmedabad-Delhi National Highway No. 8 passes near Gandhinagar city. The National Highway No. 8 and 59 passes in the vicinity of the block. The nearest international and domestic airports are located at Ahmedabad situated in the proximity of the block. The towns Ahmedabad, Sabarmati, Gandhigram, Vatva and Nandol, Dahegam lie in the vicinity of the block and are interconnected by railway. The CB-ONN-2010/8 Block is located at Cambay basin situated within Gandhinagar, Ahmedabad and Kheda district, Gujarat.
CB-ONN-2010/8 Block connectivity:

1. The CB-ONN-2010/8 block is connected to through Roads (Ahmedabad-Zalod highway which connects to SH-144).
2. Nearest city is Ahmedabad which is 17 Km towards West direction from the block boundary.
3. Meswo River is flowing within the CB-ONN-2010/8 block.
4. Nearest Railway Station is Sardargram Railway Station which is about 15 Km from the block boundary on North Western side.
5. Nearest airport is Sardar Ballabh Bhai Patel International Airport (Ahmedabad) which is about 17 Km from block boundary towards West direction.

The map showing the road network around the site is given in Figure 2.4.

Figure 2.4: Connectivity shows in the map
Figure 2.5: Drill Site Layout- Pasunia#01 (PA#01)
Figure 2.6: Drill Site Layout- Pasunia#02 (PA#02)

Source: Bharat PetroResources Limited
2.4 Magnitude of Operation

CB-ONN-2010/8 block of Cambay basin within Gandhinagar, Ahmedabad and Kheda district, Gujarat has been awarded to BPRL. The total allocated area of the block is 42 Km². The entire Block (covering the area of 42 Km² in Part A and Part B) has been explored by BPRL.

Table 2.3: Coordinates of Proposed Wells

<table>
<thead>
<tr>
<th>Block</th>
<th>Well</th>
<th>North</th>
<th>East</th>
<th>Type of Well</th>
<th>Primary Target</th>
<th>Forest Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>CB-ONN-2010/8</td>
<td>Pasunia#01 (PA#01)</td>
<td>23° 02'56.45&quot;N 72°48'9.71&quot;E</td>
<td>Exploratory well to be converted to production well.</td>
<td>1300-1500 m</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Pasunia#02</td>
<td>23° 01'2.93&quot;N 72°48'27.01&quot;E</td>
<td>Exploratory</td>
<td>1300-</td>
<td>NA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.

<table>
<thead>
<tr>
<th>Block</th>
<th>Well</th>
<th>North</th>
<th>East</th>
<th>Type of Well</th>
<th>Primary Target</th>
<th>Forest Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>(PA#02)</td>
<td>DW#01</td>
<td>23° 2'5.75&quot;N</td>
<td>72°48'21.37&quot;E</td>
<td>Development well</td>
<td>1300-1500 m</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>DW#02</td>
<td>23° 1'44.07&quot;N</td>
<td>72°48'18.57&quot;E</td>
<td>Development well</td>
<td>1300-1500 m</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>DW#03</td>
<td>22°59'48.33&quot;N</td>
<td>72°47'35.14&quot;E</td>
<td>Development well</td>
<td>1300-1500 m</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>DW#04</td>
<td>23° 2'39.62&quot;N</td>
<td>72°48'38.60&quot;E</td>
<td>Development well</td>
<td>1300-1500 m</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>DW#05</td>
<td>23° 0'58.41&quot;N</td>
<td>72°48'8.43&quot;E</td>
<td>Development well</td>
<td>1300-1500 m</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>DW#06</td>
<td>23° 1'11.07&quot;N</td>
<td>72°48'7.41&quot;E</td>
<td>Development well</td>
<td>1300-1500 m</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>DW#07</td>
<td>23° 1'59.97&quot;N</td>
<td>72°48'24.44&quot;E</td>
<td>Development wells will be drilled from same location</td>
<td>1300-1500 m</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>DW#08</td>
<td>23° 1'59.97&quot;N</td>
<td>72°48'24.44&quot;E</td>
<td>Development wells will be drilled from same location</td>
<td>1300-1500 m</td>
<td>NA</td>
</tr>
</tbody>
</table>

Source: Bharat PetroResources Limited

After getting environment clearance from MoEF&CC, BPRL plan to test the wells (PA#1 & PA#2) and put them into production. With the result of existing wells, company may drill 8 more new wells (DW#01, DW#02, DW#03, DW#04, DW#05, DW#06, DW#07, DW#08) to maximize hydrocarbon exploitation. Government regulations will be taken into account for well spacing. Old data are being reviewed to know the details of the existing wells. Initially Company will do work over on existing wells to start production.

Development drilling operation will be carried out in accordance and guideline prescribes by OISD/ DGMS and international standards. Waste will be disposed by state register agencies. Proper program of the operations will be prepared and shared to DGMS/ OISD /DGH prior to starting operation for review and guidance. Details of the operation (DPRs) will be sent to DGH /OISD and state government on regular basis.

2.5 PROJECT ACTIVITIES

The project envisages monetization of Pasunia Field. The proposed project would comprise of following:
A. Conversion of exploratory wells into Development/production wells:
The exploratory wells Pasunia#01 (PA#01) & Pasunia#02 (PA#02) have been drilled up to a depth of 2043 m and 2130 m respectively during exploration period in the Block. It is proposed to convert these 2 exploratory wells into production wells.

B. Drilling of Development wells for production:
It is proposed to drill 8 additional new development wells in a phased manner. The tentative surface and sub-surface Latitude and Longitude of the location of the new development is given in table below. However, the actual location may vary which depends upon the availability of free land on the surface and considering geological object.

---

Source: Bharat PetroResources Limited

Figure 2.8: Process Flow Chart

C. Construction of Production Facility
It is proposed to have storage tank facility for storing of produced oil in all the production sites and a Quick Production Facility (QPF) at PA#02 well sites for water separation, if required. The QPF facility would include the following:
✓ Sucker Rod Pump
✓ Water bath heater
✓ 3-phase separator (Can perform to produce oil with BS&W < 5%)
✓ Crude storage tank
✓ Tanker loading system
✓ Evaporation pond for produced water
✓ Flare stack with Flare KOD.
✓ Fire Fighting System.

Gas and water producing from the wells can be separated through this system. This option will be installed at least at one well-site, preferably at PA#02 well site so as to enable water removal from produced crude from any of the wells. The crude with high water content more than the permissible limit of BS&W (i.e. < 5%) will be transported by tanker to this well-site for treatment. The crude oil having less than 5% BS&W would be sent to nearest ONGC GCS/ Installation for further processing, treatment.

Analysis of oil rate vs FBHP data indicates that the recorded flowing bottom hole pressure are still above bubble point pressure in wells PA#01 & PA#02. With well production depth of about 1250 m and having oil of low GOR & high pour point, the wells may not sustain economic self-flow and shall have to be put on artificial mode for getting continuous and sustained flow from the reservoir.

This is to be mentioned here that other operators are producing similar type of reservoir oil with similar depth by completing the reservoir with Sucker Rod Pumps (SRP) as artificial lift mode.

Artificial lift is a mean of overcoming low bottom hole pressure so that a well can produce at some desired rate, either by injecting gas into the producing fluid column to reduce its hydrostatic pressure, or using a down hole pump to provide additional lift pressure down hole. Artificial lifts are also used in fields from initial stage of exploration to increase production rates and improve project economics. Hence, SRP is proposed to be installed in each well from the beginning itself.

Because of its long history of successfully lifting well fluids, the sucker-rod lift method is normally considered the first choice for most onshore, and even some offshore, installations all over the world. This method is limited by:
- Size of the casing, tubing, and down hole pump
- Strength and size of the various rods
- Speed with which they can be reciprocated

Source: Bharat PetroResources Limited

Figure 2.9: Sucker rod Pumping System

The process flow diagram is shown below:

1. **Processing Facilities located near each well site (except PA#02):**

Processing Facility located close to individual well is designed to handle respective well crude production locally. Minimum processing at site will be done so that crude oil having BS&W is less than 5%. The crude will delivered to nearest ONGC's GGS/CTF/Installation by tankers for further processing and treatment, before selling to the buyers.

The minimum facility envisaged to handle crude for such type of wells is as under:

- Sucker Rod Pump
- Crude storage tank with heating system (Insulated)
Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.

- Water bath heater
- 2-phase separator
- Tanker loading system

The SRP facility is conceptualized for low or no gas production. Hence no gas flaring system has been proposed as of now. Sucker Rod Pump will pump oil from well to atmospheric storage tank. The Tank is venting to atmosphere through a flame arrestor at safe location. The tank capacity is 280 barrel (45 m³). Tanks are insulated and have heating coil installed. The coil can be connected to mobile heating unit when required.

Crude from storage tank is loaded to trucks using loading pumps on trucks, through flexible connection. Vapor formed during loading operation is vented to atmosphere at safe location using high point vent.

2. Processing Facilities located near the PA#02 well (Quick Production Facility):

Processing Facility located close to individual wells is designed to handle respective well crude production locally. Minimum processing at site will be done so that crude oil having BS&W is less than 5%. The crude will delivered to nearest ONGC's GGS/CTF/Installation by tankers for further processing and treatment.

Well fluid from Sucker Rod Pump on well flows down to a vertical separator (operating at atmospheric pressure) from SRP discharge. The separator is sized for oil and gas separation. If water is present in the crude, it will be decanted from tank bottom. The small amount of gas is expected to be produced; which will be vented at safe location from separator.

Crude from separator is flows down under gravity to atmospheric storage tank. The tank is venting to atmosphere through a flame arrestor. The Tank capacity is 280 barrel (45 m³) capacity. Tanks are insulated and have heating coil installed to heat up oil. The coil can be connected to mobile heating unit when required.

Crude from storage tank is loaded to trucks using loading pumps on trucks, through flexible connection. Vapor formed during loading operation is vented to atmosphere at safe location using high point vent.
Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.

Source: Bharat PetroResources Limited

Figure 2.10: Process flow- Production facility
Table 2.4: List of Equipment (tentative) for well-site PA#02

<table>
<thead>
<tr>
<th>EQUIPMENT DESCRIPTION</th>
<th>QTY</th>
<th>TOTAL</th>
<th>OPERATING</th>
<th>STAND BY</th>
<th>DRIVE</th>
<th>POSITION</th>
<th>DETAILS/ TYPE</th>
<th>CAP/ DUTY</th>
<th>TEMP. C</th>
<th>PRESSURE, barg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sucker Rod Pumps</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>E</td>
<td>V</td>
<td>RECIP</td>
<td>TBA</td>
<td>m³/hr/kW</td>
<td></td>
<td>40-50 85</td>
</tr>
<tr>
<td>3-Phase Separator</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>H</td>
<td></td>
<td></td>
<td>50</td>
<td>50 85</td>
<td>2.00</td>
<td>4.50</td>
</tr>
<tr>
<td>Water Bath Heater</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>E H</td>
<td></td>
<td></td>
<td>15 kW</td>
<td>75 105 6</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Crude Storage Tank (with Heating Coil)</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>H</td>
<td></td>
<td></td>
<td>45 m³</td>
<td>50 85 Atm.</td>
<td></td>
<td>Atm+F.O. W</td>
</tr>
<tr>
<td>Flare K.O.D. (Boot)</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>V</td>
<td></td>
<td></td>
<td>1500 kg/hr, (Design)</td>
<td>136 170 0.5</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Flare Package (Stack, Ignition System, LPG Rack)</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td>148 kg/hr (Normal)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Produced Water Evaporation Pond</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>HDPE LINED PIT</td>
<td></td>
<td></td>
<td>20 m³/hr</td>
<td>60 100 3</td>
<td></td>
<td>6.0</td>
</tr>
<tr>
<td>Truck Loading Pumps</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>E H</td>
<td></td>
<td></td>
<td>20 m³/hr</td>
<td>60 100 3</td>
<td></td>
<td>6.0</td>
</tr>
<tr>
<td>Wax Inhibitor /'Pour Point</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Equipment Description

<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>QTY</th>
<th>Operating</th>
<th>Standby</th>
<th>Drive Position</th>
<th>Details/Type</th>
<th>Cap/Duty</th>
<th>Temp. C</th>
<th>Pressure, barg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depressent Package</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demulsifier Injection Package</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrosion Inhibitor / Scale Inhibitor Injection Package</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire Extinguishers</td>
<td>6</td>
<td>6</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instrument Air System</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire Water Tank (U/G Concrete)</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td>350 m³</td>
<td></td>
</tr>
<tr>
<td>Fire Water Pumps</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>D</td>
<td></td>
<td>110 m³/hr</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Disclaimer - The list of equipment is tentative in nature and may undergo minor changes to suit requirement.

Source: Bharat PetroResources Limited
2.5.1 Drilling of Development Well

Three development wells are proposed to be drilled namely DW#01, DW#02, DW#03, DW#04, DW#05, DW#06, DW#07, DW#08. The tentative subsurface Latitude and Longitude of the location of the new development is given in table below:

<table>
<thead>
<tr>
<th>Well Name</th>
<th>Longitude</th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>DW#01</td>
<td>23° 2'5.75&quot;N</td>
<td>72°48'21.37&quot;E</td>
<td></td>
</tr>
<tr>
<td>DW#02</td>
<td>23° 1'44.07&quot;N</td>
<td>72°48'18.57&quot;E</td>
<td></td>
</tr>
<tr>
<td>DW#03</td>
<td>22°59'48.33&quot;N</td>
<td>72°47'35.14&quot;E</td>
<td></td>
</tr>
<tr>
<td>DW#04</td>
<td>23° 2'39.62&quot;N</td>
<td>72°48'38.60&quot;E</td>
<td></td>
</tr>
<tr>
<td>DW#05</td>
<td>23° 0'58.41&quot;N</td>
<td>72°48'8.43&quot;E</td>
<td></td>
</tr>
<tr>
<td>DW#06</td>
<td>23° 1'11.07&quot;N</td>
<td>72°48'7.41&quot;E</td>
<td></td>
</tr>
<tr>
<td>DW#07</td>
<td>23° 1'59.97&quot;N</td>
<td>72°48'24.44&quot;E</td>
<td></td>
</tr>
<tr>
<td>DW#08</td>
<td>23° 1'59.97&quot;N</td>
<td>72°48'24.44&quot;E</td>
<td></td>
</tr>
</tbody>
</table>

Source: Bharat PetroResources Limited

The existing 2 wells (Blue) and proposed additional development well (Red) locations are shown in the Figure 2.11. However, the exact location for the development wells will be finalized after the site survey and availability of suitable open land for drilling purposes.

Figure 2.11: Map showing Well Locations
2.5.1.1 Pre-drilling activity

Proposed well locations are away from human habitation. Land shall be taken on lease from land owners hence no rehabilitation is required. The pre-drilling phase will involve the following:

☐ Site Preparation and Access

A. Drill Site Construction

Drilling of proposed wells shall be carried out at site and following activities shall be completed:

♦ **Fencing:** The proposed well site & campsite will be duly fenced to a height of about 2-2.5 m using chain link and barbed wires to restrict unlawful entry into the site.

♦ **Leveling:** The depth of the top soil of the entire drill site will be gauged, scraped and stored in designated top soil storage site for future use (site reclamation and rehabilitation).

♦ **Construction of Drill Platform:** Once the top soil removal process is completed, the entire drill site will be elevated and leveled and compacted. The drill site may require filling of earth to elevate the drilling platform based on local topography and High Flood Level (HFL) from Meswo river. Fill material will be met from excavated material for pit required for drill site and balance amount will be sourced from authorized quarry area. Pits will be required for storage of mud, drill cutting, waste water, formation water, etc. These include the following:

  ● **Construction of Drill Pad:** A flat rectangular/square drilling pad of 15X15 m (approximate) at site to facilitate drilling and testing of hydrocarbons will be required. Reinforced Cement Concrete (RCC) will be used for the construction of foundation system.

  ● **Excavation of Pits**

The following pits would be excavated within the well site:

- Construction of cellar pit 3m X 3m X 3 m for installation of well head and BOP
- Construction of 1 HDPE lined pit of dimensions approx 30’X 33’X 5’ at well site for temporary storage and disposal of drill cutting / solid waste.
- Construction of 2 HDPE lined pit of dimensions, approx. 38’X 33’X 5’ and 23’X 20’X 5’ for temporary storage and disposal of drilling mud and effluent water.
Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.

- Construction of 1 Oil pit of dimension of 3’X 3’X 4’, if required.
- Septic tanks and Soak pits will be constructed to dispose the domestic wastewater and sewage at the drill site.

- **Construction of Bunds & Strom Water Drains:** The soil excavated from the pits will be used to build a raised bund/ embankment bordering the periphery of the drill site. A storm water drain is constructed before the bund. Oil-water separator and silt-trap will be constructed at one end of the storm water drain.

- **Construction of Access road:** The existing two well sites have WBM access roads. The roads will be strengthened for transporting the rig and ancillary equipments and approximately, 0.02 ha [(50 m) length x 4.0m width] land will be required for extension of existing road to proposed site. For new development well sites, necessary soiling and WBM will be done to strengthen the approach road.

**B. Mobilization of Rig**

The proposed drilling shall be carried out by using a standard land rig or a “Mobile Land Rig” with standard water based drilling fluid treatment system. This rig will be suitable for deep drilling up to the desired depth of maximum 1500 m as planned for the project. The typical configuration of a Drilling Rig is shown in the Figure 2.12 and given in Table 2.5. Additionally, there will be other ancillary facilities like Drilling mud system, ETP, Cuttings disposal, Drill Cementing equipment etc. and utilities to supply power (DG sets), water, fuel (HSD) to the drilling process and will be set up as a part of the Project.

**Table 2.5: Details of the drilling rig**

<table>
<thead>
<tr>
<th>Type of rig</th>
<th>Electrical Rig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drilling mud composition</td>
<td>Water based Drilling Fluid</td>
</tr>
<tr>
<td>Power generator type &amp; nos.</td>
<td>AC – SCR Type. (03 Nos.)</td>
</tr>
<tr>
<td>Details of solids handling system on rig</td>
<td>Shale Shakers - 1200 GPM Capacity Desander – 1200 GPM Capacity Desilter – 1200 GPM Capacity</td>
</tr>
</tbody>
</table>

*Source: Bharat PetroResources Limited*
Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.

Figure 2.12: Configuration of Drilling Rig

2.5.1.2 DRILLING ACTIVITY

A rig will be installed at the potential site of drilling after thorough inspection for its working capability and quality standards. Well spudding shall be the start of drilling activity. Top-hole section will be drilled to a desired depth based on well design. After drilling top-hole section, it will be cased with a pipe called “Casing”. “Casing” provides support to hole wall and secures hole section. Other than that, it isolates problematic hole sections such as loss zones, shale sections, over pressurized formations etc. After running casing, space between hole wall and “Casing” (annulus) will be cemented. This process of drilling and casing the hole section continues until the final well depth (target) is achieved. Drilling process is associated with various hazards such as well active situation (kicks), blowouts, H₂S situation etc.

Drilling shall be undertaken for a maximum up to 1500 m depth and the size starting from around 16” and decreasing in depth up to 6”. The area of drill site is about 130m x 130m for each well. The process of drilling includes following:

A. Well kick situation

While drilling, if the formation pressure exceeds the hydrostatic pressure exerted by the drilling fluid, formation fluids break out in to the well bore. This is called kick. Primary
means of well control is to have sufficient over-balance over formation pressure. For some reason if an unexpected over-pressurized formation is encountered while drilling and if the well control situation arises, rig is equipped with equipment to control this situation.

B. Blowout
Uncontrolled “well control situation” eventually leads to a blowout. Blow out can cause a partial or total destruction of drilling rig. Blowouts are often associated with hydrocarbon spill followed by fire.

C. Well control
This set of equipment is called “Blowout Preventers (BOP)”. Blow Out Preventer consists of, “Annular Preventer”, which can generally close on any size or shape of tubular in the well bore and closes the annular space between drill string and casing. Another type of blowout preventer is a “Ram Preventer”. Ram preventers are of two types i.e., Pipe Rams and Shear Rams. Pipe rams also close the annulus between drill string and casing, but they have a fixed size. As such a specific pipe rams can be closed on a specific size of pipe. Shear rams are generally the last choice of preventer to be operated as they shear drill string and shut off the well bore. After determining the existing formation pressure and other geological complexities from the seismic data, appropriate BOP will be used as per standard oil field guideline for the same.

D. Drilling Fluid (Mud)
The role of the drilling fluid (mud) in pressure control is especially important. If the drill bit penetrates a formation containing oil, gas or water under pressure, these fluids are prevented from flowing into the borehole by ensuring that the drilling mud is of sufficient density to the natural formation pressures. The density of the mud can be increased by the addition of barite weighting material. Bentonite is employed to improve the rheological properties and enable the drill cuttings to be transported from the hole while drilling and also be suspended in the fluid while the drill bit is being changed. The barite used in the drilling mud would be as per API standard specifications. Based on geological prognosis and predicted formation pressures, Water Based Mud (WBM) will be used for all the wells considering environmental constraints and hazards. The main components of drilling mud are slurry of inert solids suspended in a liquid phase. The main constituents
of the WBM are bentonite and barites, both of which are natural minerals. In case if the WBM is not able to be used due to geological formation complexities then low toxic oil base mud with less than 1% aromatic contents can be used after intimating the MOEF&CC and/or Gujarat Pollution Control Board. The composition of WBM is as per given in Table 2.6 & 2.7.

Table 2.6: Chemical list for KCl-PHPA polymer mud System

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Name of chemicals</th>
<th>Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BARYTE</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>BENTONITE</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>CAUSTIC SODA</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>CMC (LVG)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>CMC (HVG)</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>PHPA</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>PAC-LVG</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>PAC-RG</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>XC POLYMER</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>POTASSIUM CHLORIDE</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>POLYOL GD-I</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>POLYOL GD-II</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>BACTERICIDE ALDEHYDE</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>DRILLING DETERGENT</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>LINSEED OIL</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>EP LUBE</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>SPOTTING FLUID (NW)</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>ALKALI SODA ASH</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>SODA ASH</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>SODIUM SULPHITE</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>SULPHONATED ASPHALT</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>LIMESTONE POWDER</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>SODIUM CHLORIDE</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>ALUMINIUM STEARATE</td>
<td></td>
</tr>
</tbody>
</table>

Source: Bharat PetroResources Limited

Table 2.7: Functions of Special additives in WBM

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Chemicals</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sodium bicarbonate</td>
<td>Eliminate excess calcium ions due to cement contamination</td>
</tr>
<tr>
<td>2</td>
<td>Sodium chloride</td>
<td>Minimize borehole washout in salt zone</td>
</tr>
<tr>
<td>3</td>
<td>Groundnut shells, mica of celophane</td>
<td>Minimise loss of drilling mud to formation</td>
</tr>
<tr>
<td>4</td>
<td>Cellulose polymers or starch</td>
<td>Counter thick, sticky filter cake, decrease filter loss to formation</td>
</tr>
<tr>
<td>5</td>
<td>Aluminium stearate</td>
<td>Minimize foaming</td>
</tr>
<tr>
<td>Sl.No.</td>
<td>Chemicals</td>
<td>Functions</td>
</tr>
<tr>
<td>-------</td>
<td>------------------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>6</td>
<td>Vegetable oil lubricant</td>
<td>Reduce torque and drag on drill string</td>
</tr>
<tr>
<td>7</td>
<td>Potassium chloride</td>
<td>Stabilisation of shale</td>
</tr>
</tbody>
</table>

Source: Bharat PetroResources Limited

The mud pump takes in mud from the mud pits and sends it out a discharge line to a standpipe. The standpipe is a steel pipe mounted vertically on one leg of the derrick. The mud is pumped up the standpipe into a flexible reinforced rubber hose called the Kelly hose. The Kelly hose is connected to the swivel; goes down the Kelly, drill pipe and drill collars and exits at the bit. The mud then does a sharp U-turn and heads back up the hole in the annulus. The annulus is the space between the outside of the drill string and the wall of the hole. Finally, the mud leaves the hole through a steel pipe called the mud return pipe and falls over a vibrating screen like device called the shale shaker. The shaker screens out the cuttings from the mud. The mud drains back into the mud tanks and is recycled back into the well via the mud pump, while the drill cuttings which are inert materials of shale, sand, and clay fall into the lined waste pits. The drilling fluids left over at the end of the particular well will be discharged into the lined waste pits and dried. The pits will be provided with plastic liners to maintain integrity and prevent any leakage. The drill cuttings cut by the bit are removed from the mud by the shale shakers and other solids removal equipment and transferred to the waste pits. Once the mud is cleaned it is pumped down the drill string again.

The drilling mud, which is pumped through the drill string, through the drill bit and then returns up the annulus between the drill string and bore hole, serves a number of important functions, including:

- **Removal of drilled solids (i.e. cuttings) from the bottom of the hole and their transport to the surface for separation from the mud;**
- **Lubrication and cooling of the drill bit and string;**
- **Deposition of an impermeable cake on the well bore wall to seal the formation being drilled; and**
- **Countering the natural formation pressures and preventing uncontrolled flow of fluid from the formations.**

Once the cuttings have been separated, the drilling fluid will be reused or processed after further treatment in a Chemically Enhanced Dewatering (CED) system designed to
remove suspended solids that are too fine for mechanical separation in solids control package producing inlet particles called ‘flocs’. The flocs will be removed in the decanting centrifuges and the resultant sludge disposed off in High Density Polyethylene (HDPE) lined pit (of approximately 2 X 140 m\(^3\) area). The cleaned waste water will also be stored in HDPE lined pits and disposed off, after testing and any necessary treatment, to meet the regulatory requirements. At the end of drilling of each well, whatever the fluid left in the pits will be treated & transported to the next drilling location or Disposed off in CETP.

Several additives are mixed into the mud system to give the required properties. Water based mud will be used to the possible extent in developmental drilling but use of synthetic based mud may require due to complexities associated with the geological formations and associated hole stability problems. Drilling fluid is important to the operation of drilling rig, as it performs the following functions:

- Control the down hole pressure;
- Lift soil/rock cuttings from the bottom of the borehole and carry them to a settling pit;
- Allow cuttings to drop out in the mud pit so that they are not re-circulated (influenced by mud thickness, flow rate in the settling pits and shape /size of the pits);
✓ Prevent cuttings from rapidly settling while another length of drill pipe is being added (if cuttings drop too fast, they can build up on top of the bit and seize it in the hole);

✓ Create a film of small particles on the borehole wall to prevent caving and to ensure that the upward flowing stream of drilling fluid does not erode the adjacent formation;

✓ Seal the borehole wall to reduce fluid loss (minimizing volumes of drilling fluid is especially important in dry areas where water must be carried from far away);

✓ Cool & clean the drill bit; and

✓ Lubricate the bit, bearings, mud pump and drill pipe.

Source: Bharat PetroResources Limited

E. Drilling Cutting

Mud used during the operation will flush out formation cuttings from the well hole. These cuttings will be separated from the drilling mud by thoroughly washing. Cuttings will then be stored in the HDPE lined pits (of approximately 2 X 140 m³ capacity) and after completion of the drilling activities, cuttings will be tested for hazardous nature and
based on nature of the drill cuttings, final disposal pathway will be finalized by BPRL as per Sl No 72 C of GSR 546 (E) dated 30th August, 2005. The total amount of cuttings expected during the entire drilling period will be about 1000 Ton/well.

**F. Drill-stem testing**

A drill-stem test is frequently performed to evaluate the formation or zone from which the oil & gas show was observed. Drill-stem tests may also be performed when the driller observes a decrease in the time required to drill a foot of rock, known as a "drilling break." Since porous rock may be drilled easier than nonporous or less porous rock, a drilling break indicates the presence of porosity, one of the qualities of reservoir rock. A drill-stem test enables the exploration company to obtain a sample of the fluids and gases contained in the formation or interval being tested as well as pressure information, which is determined by special gauges within the test tool.

Drill-stem testing is accomplished by removing the drill string from the bore hole. The drill bit is removed and a drill-stem test tool with a packer is attached. The test tool, packer, and drill string are inserted back into the bore hole to the desired depth. The packer, which is an expandable device, is set and expanded at the predetermined depth to isolate the zone to be tested. The test tool contains a valve which may be opened and closed to allow formation fluids to enter the test tool and drill string. If there is sufficient fluid and pressure within the zone being tested, the formation fluid may rise to the surface and flow into special test tanks used for that purpose. If gas is present, it is burned at the surface as a flare. By analyzing the rate of flow or the amount of formation fluid recovered in the drill string and the formation pressures recorded, obtaining a good indication of reservoir characteristics such as porosity, permeability, and the nature of the fluids or gas contained therein is possible.

**G. Surface Testing & Flaring**

In case hydrocarbons are detected in the well, the quantity and quality will be tested. The fluids & gases coming out from the well will be flared. The flaring will be intermittent and last only for few days and it will not pollute environment. However, for flaring all the flaring guidelines for onshore wells will be followed and the design, size and location of flaring stack will be decided based on surrounding habitations and the flaring guidelines.
Extremities of flare lines will be located at least 90 m from roads, public works, processing units or tanks. They will be at least 50 m from a well, gas/oil separator, site drainage or other possible source of ignitable vapours. It should be ensured that a flare line will be:

- Equipped with a pilot flame or other ignition device to ensure continuous Ignition of vented gas; and
- Equipped with a guard to protect the flame from being extinguished by the wind.

The zones expected to be Gas bearing will be identified based on the wire line log data and same will undergo testing to confirm the same. Approximately duration of the test flaring is around six hours per day and for five days during developmental drilling. Temporary test separators with facilities for flow metering will be provided which will separate oil, gas and water.

**H. Well Logging**

Drilling operations continue until the predetermined total depth of the well is reached. The drill string is removed from the well bore to allow the insertion of logging tools, which are lowered all the way to the bottom of the hole by means of a special cable. This cable contains numerous electrical circuits. Signals detected by the tools are recorded in a recording truck at the surface by means of the electrical circuits contained in the cable.

Electrical logs measure the natural electric potential and the effect of induced electricity on the formations. Radioactivity logs measure the natural radioactivity and the effect of induced radioactivity on the formations. Sonic logs measure the velocity of sound waves in the formations. By analyzing these logs, experienced geologists and engineers can determine the depth from the surface to various formations and intervals, formation characteristics such as rock type and porosity, and indications of the presence of oil or gas and quantity.

**I. Completing the well**

When drill-stem testing and well-logging operations have been completed and the results have been analyzed, the company management must decide whether to complete the well as a producing well or to plug it as a dry hole. If the evidence indicates that no oil or gas are present, or they are not present in sufficient quantity to allow for the recovery of drilling, completion, and production costs and provide a profit on investment, the well
will probably be plugged and abandoned as a dry hole. If, on the other hand, evidence indicates the presence of oil or gas in sufficient quantity to allow the recovery of these costs and provide a profit to the company, an attempt will be made to complete the well as a producer.

If the well is to be plugged and abandoned as a dry hole, the well bore is filled with drilling fluid, which contains additives which give it special properties that prevent its movement from the well bore into the surrounding rock. Cement plugs are required within the well bore at intervals where porosity has been detected to isolate these porosity zones and prevent the movement of formation fluids from one formation to another. The cement is pumped into the well bore through the drill string. The cement is mixed at the surface in special trucks which are equipped with high-volume pumps. The pumps are connected to the drill string which has been inserted into the well bore to a predetermined depth. A quantity of cement is pumped into the well bore through the drill string and displaced out of the bottom of the drill string with drilling fluid. The drill string is then pulled up to the next interval that is to be cemented. This process is repeated until all the required plugs have been set. A cement plug is also set at the base of the surface casing, which remains in the hole, and another plug is set at the surface. In cultivated areas the surface casing is cut off below plow depth. A steel plate is welded at the top of the surface casing. All drilling equipment and materials are removed from the drill site. The pits are allowed to dry up and are backfilled and the site is restored as nearly as possible to its original condition.

J. Restoration of Cutting Containment Area

At the conclusion of drilling, solar drying will dewater the waste pits. All residual solids and liner will be disposed off in TSDF or SPCB approved secured Landfill. As the cutting mud is inert and HDPE (High Density Poly-ethylene) linings of the pit are in place, scope for soil & ground water contamination is insignificant. Grading will take place to ensure natural run-off. Any remaining topsoil that has been stocked during the site clearance will be re-spread over appropriate portions of the site. Plantation/green belt development will be commenced during the next rainy seasons to restore the site.
2.6 PROPOSED INFRASTRUCTURE

The Infrastructure demand will be very less as the number of employee at drilling wells is about 40-50. Temporary road facility will be taken up by BPRL for the drilling well site for the movement of heavy equipment.

The amenities/ facilities will be in the scope of Contractor.

- Potable drinking water
- Firefighting/ alarm system and ambulance is available in case of emergency
- Drinking water, canteen and electricity facilities is provided
- Separate sanitation facilities will be provided for men and women.
- PPE’s and facilities related to safety will be provided.
- Occupational Health Centre with qualified doctor is available for periodical health check-up of employees.
- Greenbelt is development.

Drilling operations will be carried out using rig for onshore well. Drilling unit for drilling of oil and gas wells consists of a derrick at the top of which is mounted a crown block and a hoisting block with a hook. From the swivel is suspended a Kelly stem which passes through a square or hexagonal Kelly bush which fits into the rotary table. The rotary table receives the power to drive it from an electric motor. The electric motor rotates the rotary table, through which passes the Kelly bush, and the rotations are transmitted to the bit as the drilling progresses, the drill pipes in singles are added to continue the drilling process. In addition to existing prim movers set up, rig will have provision of top drive system. At the end of the bit life, the drill pipes are pulled out in stands and stacked on the derrick platform. A stand normally has 2 single drill pipes. After changing the bit, the drill string is run back into the hole and further drilling is continued. This process continues till the target depth is reached.

During the course of drilling, cuttings are generated due to crushing action of the bit. These cuttings are removed by flushing the well with duplex/triplex mud pumps. The mud from the pump discharge through the rotary hose connected to stationary part of the swivel, the drill string and bit nozzles. The mud coming out of the bit nozzles pushes the cuttings up hole and transports them to the surface through the annular space between the drill string and the hole. The mud not only carries away crushed rock from the bottom
of the hole but it also cools the bit as it gets heated due to friction with formation while rotating. The mud also helps in balancing subsurface formation pressures and by forming a cake on the walls of the well also diminishes the possibility of crumbling or caving of the well bore.

At the surface, the mud coming out from well along with the cuttings falls in a trough, passes through the solids control equipment's i.e. shale shaker, de-sander/ de-salter and mud cleaner. This equipment's remove the solids of different sizes, which get mixed with the mud during the course of drilling. The cleaned mudflows back to the suction tanks to be again pumped into the well. The drilling mud/fluid circulation is thus a continuous cyclic operation. The most suitable clay for mud preparation is bentonite, which is capable of forming highly dispersed colloidal solutions. Various other chemicals are also used in mud preparation as per requirements dictated by the temperature/pressure conditions of the wells. The mud is continuously tested for its density, viscosity, yield point, water loss, pH value etc. to ensure that the drilling operations can be sustained without any complications.

2.6.1 Drilling Facilities

Drilling is a temporary activity, which will continue for about 45 Days. The rigs are self-contained for all routine jobs. Once the drilling operations are completed, and if sufficient indications of hydrocarbons are noticed while drilling, the well is tested by perforation in the production casing. This normally takes 30 days. If the well is found to be a successful hydrocarbon bearing structure, it is sealed off for future development, if any.

2.6.2 General Requirements of Drilling Activities

Development drilling programme requires the following common facilities:

1. Power Requirement

The drilling process requires movement of drill bit through the draw works, which require power. The power requirement of the drilling rig will be met by using the 6 No.s Diesel Generator (500 KVA X 4, 250 KVA X 1, 100 KVA X 1) with diesel consumption of about 6 KLD. The exhaust stacks of the DG sets of land based rigs vent the emissions.
Table 2.8: Details of D.G sets

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Capacity (KVA)</th>
<th>Number</th>
<th>Fuel used</th>
<th>Stack diameter (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>500</td>
<td>4</td>
<td>HSD BS III</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>100</td>
<td>1</td>
<td>HSD BS III</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>250</td>
<td>1</td>
<td>HSD BS III</td>
<td>12</td>
</tr>
</tbody>
</table>

Source: Bharat PetroResources Limited

2. Fuel Requirement

Estimated consumption of HSD shall be about 6 KLD and shall be stored in about 40 KL of storage tank. Estimated consumption of HSD shall be about 6 KLD and majority of it will be used for power generation via DG sets and stored temporarily only during site preparation or rig building phase till HSD reserve tanks are installed.

During the drilling phase, the consumption of diesel by the drilling rig will be about 6 KLD. 85% of the fuel will be used for rig operation and 15% will be used in the campsite.

3. Water Requirements

Fresh Water Requirement

Water is basically required for preparing drilling mud, direct washing of drill cuttings, cooling of engines and for meeting domestic needs of the campsite. Typically, the water consumption for each well will be 35 KLD. The camp will normally operate with around 40 personnel and will consume water @ 5 KLD for domestic purpose only. However, the drilling and domestic water requirement would depend on the time required to drill the well, which is primarily dependent on the proposed depth. One fire water storage of capacity of 50 KL is proposed during drilling and workover operation and two water storage of minimum 40 KL is proposed for production facility. The water balance diagram is depicted in Figure 2.13.

Water requirement for the operation will be met primarily from transporting the water from nearby sources with water tankers. Further, in case of more requirements during drilling and production activity, water bore well will be drilled and necessary prior permission will be obtained from authorities for bore well accordingly.
Figure 2.13: Water Balance

Table 2.8: Water balance table

<table>
<thead>
<tr>
<th>Water Consumption (in KLD)</th>
<th>Waste Water Generation (in KLD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rig Wash 5</td>
<td>Rig Wash 5</td>
</tr>
<tr>
<td>Mud Preparation 25</td>
<td>Mud Preparation 25</td>
</tr>
<tr>
<td>Domestic Usage 5</td>
<td>Domestic Usage 5</td>
</tr>
<tr>
<td>Sewage 4</td>
<td>Sewage 4</td>
</tr>
<tr>
<td>Effluent 4.5</td>
<td>Effluent 4.5</td>
</tr>
</tbody>
</table>

Source: Bharat PetroResources Limited

4. Domestic Wastewater

The operating personnel in onshore drilling site accommodation (DSA) are housed in the vicinity of the location. Sewage will be and disposed off through septic tanks followed by soak pits.
5. Solids Removal
The rock cuttings and fragments of shale, sand and silt associated with the return drilling fluid during well drilling will be separated using shale shakers and other solids removal equipment like de-sanders and de-salters. The recovered mud will be reused while the rejected solids will be collected and disposed of in a line waste pit in the drill site.

6. Drill Cuttings and Waste Residual Mud
During drilling operations, approximately 1000 tonnes/ well of drill cuttings and 500 Tons/Well of waste residual muds are expected to be generated depending on the type of formation and depth of drilling. Drill cutting will be separated from water based mud (WBM) and unusable drilling fluid will be stored in HDPE lined pit for solar drying for temporary storage. The cuttings/mud residues so stored will then be treated and disposed in accordance with CPCB regulations specified for onshore oil & gas industry. In addition to the cuttings 5 KLD of wastewater is likely to be generated during well drilling and rig wash. Drilling waste water including DC wash water should be collected in the disposal pit evaporated or treated in Mobile ETP. After compliance of notified standards for on-shore disposal, liquid effluents will be disposed locally with intimation to GPCB or else sent to GPCB approved CETP for further treatment and disposal.

7. Testing
Testing facilities will be available at drilling rig for separation of liquid phase and burning of all hydrocarbons during testing. The test flare boom will be located at a distance from the drilling rig.

8. Chemical Storage
The drilling rig will have normal storage facilities for fuel oil, required chemicals and the necessary tubulars and equipment. The storage places will be clearly marked with safe operating facilities and practices.

9. Manpower
The project will be employing considerable manpower for all the phases. The sites preparation phase of 60 days will employ on an average about 40-50 workmen. The total number of personnel involved in the drilling activities is expected to be about 40. At any time there will be around 40 staff including security personnel on the well site,
thus a camp site will be set up to provide boarding & logding. Rest of the staff (if required), will be housed in nearby hotels or in the temporary camps within the nearby villages and will continue to travel regularly to the well site.

It is to be mentioned here, that the site preparation activities including the transportation of heavy equipment and machinery to site may involve temporary shifting of some existing utilities like overhead power lines, water pipelines which will be restored by BPRL on top priority basis.

At the time of production, the Quick Production Facility will have 10-15 personnel during general shift which include Installation manager, accountants, general workmen and security staff etc.

10. Logistics
Crew transfers to and from the drilling rig, materials, diesel and chemicals will be made through light vehicles, trucks and trailers.

11. Residential Area (Non - Processing Area)
The campsite will encompass an area of approximately 0.2 Ha.

12. Greenbelt
The entire area will be restored back to its original form and tree plantation will be carried out to further increase the density of plantation.

13. Drinking Water Management
The source of water will be provided by Contractor of BPRL.

14. Sewerage System
Proper Sewage system with septic tank and soak pits will be provided by Contractor of BPRL.

15. Drilling Waste Management
Waste management plans will be prepared in-line with the best international practices for the project and the same will be implemented during the project execution stage. A separate waste management plan will be prepared and implemented for the steady state operational phase of the project in line with the regulatory requirements and best international practices. All the waste will be segregated and disposed as per the applicable Indian regulatory requirements and best international practices.
All hazardous wastes shall be securely stored, under a shed for eventual transportation to the GPCB authorized TSDF; the solid domestic waste shall be stored within the premises temporarily and then sent to common solid waste disposal facility.

16. Solid Waste Management

The drilling mud and drill cuttings will be separated in the solid control system and conveyed to a specially designed pit (lined with HDPE) for temporary storage. The cuttings so stored will then be treated and disposed in accordance with CPCB regulations specified for onshore oil & gas industry. The domestic waste will be separated based on their types & will be sent through the contractors to approved municipal sites. All the other solid waste (like kitchen waste, paper, plastics etc) generated will be collected and given to nearby municipal facility.

17. HSE Plan

Project HSE plans will be prepared prior to start of each phase of the project (FEED, detailed engineering, fabrication, construction, installation, pre-commissioning and commissioning stages) to address the health, safety, environmental, and fire protection issues associated with execution of the project.

The HSE plans will aim to:

a. Address health, safety, environment as well as social performance issues as appropriate to the Project Stage;
b. Define HSE targets;
c. Support an implementation strategy;
d. Address any deficiencies identified during the review process;
e. Include any improvement arising from audits and reviews;

Apart from the HSE Plan, necessary bridging documents will be prepared between Operator and vendor, wherever necessary to address project specific interfaces.

18. Emergency and Crisis Management

Risk based 3 tiers approach, in case of emergency or crisis, is followed for Emergency and Crisis Management. Immediate response to the emergency is handled by Emergency Response Team (ERT), depending on the escalation of the emergency; Emergency Management Team (EMT) and Crisis Management Team (CMT) are involved during tier 2 and 3 emergencies/crisis. Roles, procedures, communication, escalation protocols are
clearly defined and documented. An Emergency Response and Crisis Management Plan, which comply with relevant local legislation, will be developed, will be tested on regularly basis and it will be maintained properly.

2.7 Pollution Control Measures Proposed

2.7.1 Air Pollution Control

Air emissions from point sources are expected mainly from combustion of diesel in the diesel engines for power generation. The principal pollutants will comprise of Particulate Matter (PM), Sulphur Dioxides, Nitrogen oxides and other Hydro Carbons (HC). Additionally, flaring of gas during testing of the well will also lead to release of some pollutants such as Nitrogen Oxides and un-burnt hydrocarbons to the atmosphere. SO$_2$ is not anticipated as H$_2$S presence in gas to be flared is nil. Some fugitive emissions of dust and air pollutants from vehicular exhaust will also happen during the project lifecycle, mostly during the construction and decommissioning activities.

2.7.2 Noise Generation and its Control

Noise will be generated from development drill site during site preparation, drilling and decommissioning phases. The major noise generating operations from the proposed activity includes during drilling are operation of rotary drilling equipment, diesel engines for power generation, mud pumps and operation of vehicles. Noise during the site preparatory phase will primarily be contributed by heavy construction machinery operating on site and vehicular sources. Average noise emission ranges for different types of drilling rig and its equipments are as per given in the Table 2.9.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Equivalent Noise Levels dB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average</td>
</tr>
<tr>
<td>Drilling Rig</td>
<td>88</td>
</tr>
<tr>
<td>Mud Pumps</td>
<td>86.5</td>
</tr>
<tr>
<td>Diesel Generators</td>
<td>96</td>
</tr>
<tr>
<td>Shale Shakers</td>
<td>90</td>
</tr>
</tbody>
</table>

Table 2.9: Operational Equipment Noise Level

2.7.3 Wastewater Treatment & Disposal

During drilling operations, approximately 5 KLD of drilling waste water will be generated as a result of rig wash and dewatering of spent mud, effluents from washing of drill
cuttings, floor washings, pump, seal leakages etc. The characteristics of drilling and wash wastewater will be primarily dependent on type and composition of drilling fluid used for drilling.

As BPRL is proposing the use of water-based drilling mud, the potential for contamination of such waste water is significantly lower. The drilling wastewater will contain spent drilling fluid generated as a result of washings. The rig wash water and drilling wastewater generated is proposed to be recycled through a mobile Effluent Treatment Plant installed at the drilling site. Domestic waste water generated (about 4 KLD for the drilling camp) will be treated through a soak pit/septic tank arrangement. The quantities of the liquid wastes, their characteristics and anticipated disposal methods are given in Table 2.10.

Table 2.10: Liquid Wastes Generated During Drilling and Disposal

<table>
<thead>
<tr>
<th>Type of wastewater</th>
<th>Amount (KLD)</th>
<th>Disposal method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drilling and rig wash wastewater</td>
<td>5</td>
<td>Drilling waste water including DC wash water should be collected in the disposal pit evaporated or treated in Mobile ETP. After compliance of notified standards for on-shore disposal liquid effluents will be disposed locally with intimation to GPCB or else sent to GPCB approved CETP for further treatment and disposal.</td>
</tr>
<tr>
<td>Domestic Wastewater (Sewage)</td>
<td>4</td>
<td>4 KLD of domestic waste water generated at site will be disposed through septic tanks followed by soak pits</td>
</tr>
</tbody>
</table>

Source: Bharat PetroResources Limited

**Effluent Treatment scheme**

As depicted in Figure 2.14, a detail of mobile ETP is described hereunder:

- **Stage 1** - From the Raw Effluent Collection Pit, the liquid Effluent is lifted by a centrifugal pump and chemically treated with coagulants in a flash mixing chamber (coagulation method) and then flocculated in a flocculation chamber (flocculation method).

- **Stage 2** - The flocculated particles are separated next in clarification units where the separated solids are collected at the bottom of the unit, and discharged to Sludge Pit.
Stage 3 - The separated effluent coming from the previous process are further processed in a corrugated plate interceptor (CPI). This CPI unit removes all the free and floating oil and settable fine solids from the effluent. The low density oil floats on the tank surface and collected through an Oil Skimmer channel. The heavy solids are collected at the bottom of the unit, and discharged to Sludge Pit.

Stage 4 - The clarified effluent coming from the previous process is filtered through a multi-media filter and RO for removing all the colloidal fine particles from the effluent. In this filtration process the solid particles from the previous stage are arrested.

Stage 5 - The treated effluent is collected in a treated water collection tank, from which it is re-circulated for drilling equipment washing, plantation and dust suppression purposes.

Source: Bharat PetroResources Limited

**Figure 2.14: Mobile ETP Layout**

Concrete channels will be built to collect wastewater from kitchens, toilets, bathing and washing areas. Wastewater from toilets shall be sent to soak pit after passing through Septic tank while same from other sources shall be sent to soak pit for final disposal.
2.7.4 **Solid and Hazardous Waste Generation & Disposal**

The hazardous waste generated from the drilling site/ process units may consists of drill cuttings, drilling mud, brine, Acid, Chemicals, used oil from maintenance activities etc. The wastes will be classified as per the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 and Solid Waste Management Rules 2016 and be collected, stored, treated and disposed as per rules.

The estimated details of waste that would generate from drilling of well is given in Table 2.11 & 2.12.

### Table 2.11: Hazardous waste details per well

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Hazardous waste</th>
<th>Categ ory</th>
<th>Quantity</th>
<th>Method of disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sludge containing oil</td>
<td>2.2</td>
<td>Generation is dependent on type and duration of testing operations and well kick / blowout situations (10 m³/Year)</td>
<td>Disposed to GPCB/ CPCB registered waste oil reprocessor</td>
</tr>
<tr>
<td>2</td>
<td>Used/ spent oil</td>
<td>5.1</td>
<td>15 Litre per year per well</td>
<td>Used oil will be collected in metal drums kept in secured dyked area and will be disposed to CPCB/ GPCB registered used oil reprocessor</td>
</tr>
<tr>
<td>3</td>
<td>Wastes/ residues containing oil</td>
<td>5.2</td>
<td>--</td>
<td>Disposed on-site in HDPE lined pits located on site as per S No. 72 C.1.a Schedule I Standards for Emission or Discharge of Environmental Pollutants from Oil Drilling and Gas Extraction Industry of CPCB as modified in 2005.</td>
</tr>
<tr>
<td>4</td>
<td>Lead Acid batteries</td>
<td>17 (Sche dule IV)</td>
<td>2-3 Batteries per drilling of well</td>
<td>Will be recycled through the vendors supplying acid – lead batteries as required under the Batteries (Management &amp; Handling) Rules, 2001 and amended thereof.</td>
</tr>
</tbody>
</table>

*Source: Bharat PetroResources Limited*
Table 2.12: Solid Waste details and disposal methods

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Non Hazardous waste</th>
<th>Quantity</th>
<th>Method of disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Domestic Waste</td>
<td>10 – 20 kg per day</td>
<td>The domestic waste will be separated based on their types &amp; will be sent to approved municipal sites for disposal through the contractors. All the other solid waste (like kitchen waste, paper, plastics etc generated will be collected and given to nearby municipal facility.</td>
</tr>
<tr>
<td>2</td>
<td>Recyclable waste like papers, plastics,</td>
<td>Small</td>
<td>Proper segregation and storage of recyclable waste in designated bins onsite. Recyclables will be periodically sold to local waste recyclers.</td>
</tr>
<tr>
<td>3</td>
<td>Packaging wastes</td>
<td>Small</td>
<td>Proper segregation and storage at designated stackyard onsite. Packaging wastes will be periodically sold to local waste recyclers.</td>
</tr>
<tr>
<td>4</td>
<td>Drill Cuttings</td>
<td>1000 ton/well (Approx.)</td>
<td>Drill cutting will be separated from water based mud (WBM) and unusable drilling fluid will be stored in HDPE lined pit for solar drying for temporary storage. The cuttings/mud residues so stored will then be treated and disposed in accordance with CPCB regulations specified for onshore oil &amp; gas industry.</td>
</tr>
<tr>
<td>5</td>
<td>Waste Drilling mud generated from Water based Mud, not contaminated with oil.</td>
<td>500 ton/well (Approx.)</td>
<td></td>
</tr>
</tbody>
</table>

Source: Bharat PetroResources Limited

2.8 PROJECT COST

The total investment for the proposed project works out to approximately INR 43 Crores.

The estimated Investment Cost for the project is based on the requirement of fixed and non fixed assets.

Table 2.13: Details of Project cost

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Particulars / activities</th>
<th>Capital Cost in Lacs INR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Facilities Cost</td>
<td>1015</td>
</tr>
<tr>
<td>2</td>
<td>Development Well Cost</td>
<td>2495</td>
</tr>
<tr>
<td>3</td>
<td>Work over Cost</td>
<td>790</td>
</tr>
<tr>
<td></td>
<td><strong>Total Project cost</strong></td>
<td><strong>4300</strong></td>
</tr>
</tbody>
</table>

Source: Bharat PetroResources Limited
CHAPTER 3

DESCRIPTION OF ENVIRONMENT
CHAPTER 3: DESCRIPTION OF ENVIRONMENT

3.1 INTRODUCTION

Generation of environmental baseline of a project area is an important phase of any Environmental Assessment process. Baseline data provide vital information on the existing environmental quality in which a development is planned. In this study, the environmental characteristics of the project area were established through extensive literature search, field sampling/measurements, laboratory analysis, consultation and data interpretation.

The reconnaissance survey of the area around the CB-ONN-2010/8 Block, Cambay basin of Gujarat was carried out from 20th April 2018 to 9th July 2018 and the field studies were carried out for one season during Summer season for the EIA studies to collect baseline primary and secondary data for the present environmental scenario in the study area.

A comprehensive primary and secondary data collection program were undertaken to assess the status of baseline environment conditions within the study area, as per the Terms of Reference (TOR) issued by EAC-Industry 2 of MoEF&CC, New Delhi vide letter no. J-11011/324/2013-IA-II (I) dated 2nd September 2018 for carrying out the EIA/EMP study for one season. The area covered by 10 Km radius around the proposed blocks from centre of Oil Field as its centre covering the area of all proposed drilling wells has been considered for study.

Baseline Environmental Studies have been conducted to determine the existing status of various Environmental attributes viz., Climate and Atmospheric conditions, Air, Water, Noise, Soil, Hydrogeological, Land use pattern, Ecological and Socio-Economical environment, prior to drilling of proposed wells within 2 parts of the block. This study would help to undertake corrective mitigation measures for the protection of the environment on account of any change, deviation of attributes due to the activities of the proposed development and production activities in the Block CB-ONN-2010/8, Cambay basin, Gujarat.

3.2 SCOPE OF BASELINE STUDY

An area, covering a 10 Km radius around the proposed blocks from centre of Oil Field as its centre covering the area of all proposed drilling wells for the purpose of the baseline
studies. Primary data on Water, Air, Land, Flora, Fauna & Socio-Economic data were collected by a team of Engineers and Scientists. Secondary data was collected from various Departments of State/Central Government Organizations, Semi-Government and Public Sector Organizations. Table 3.1 gives various environmental attributes considered for formulating environmental baseline and Table 3.2 gives the frequency and monitoring methodology for various environmental attributes.

Table 3.1: Environmental Attributes

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Attribute</th>
<th>Parameter</th>
<th>Source of Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Climatology &amp; Meteorology</td>
<td>Wind Speed, Wind direction, Relative humidity, Rainfall and Temperature</td>
<td>Indian Meteorological Department and Site specific Data</td>
</tr>
<tr>
<td>2</td>
<td>Water Quality</td>
<td>Physical and Chemical parameters</td>
<td>Monitored Data (Surface water – 5 locations and Ground water – 9 locations)</td>
</tr>
<tr>
<td>3</td>
<td>Ambient Air Quality</td>
<td>PM10, PM2.5, SO₂, NOx, CO, NH₃, O₃, VOC, Methane &amp; Non Methane</td>
<td>Monitored Data (8 locations)</td>
</tr>
<tr>
<td>4</td>
<td>Noise levels</td>
<td>Noise levels in dB (A)</td>
<td>Monitored Data (9 locations)</td>
</tr>
<tr>
<td>5</td>
<td>Ecology</td>
<td>Existing terrestrial flora and fauna within the study area</td>
<td>Field survey and Secondary sources</td>
</tr>
<tr>
<td>6</td>
<td>Geology</td>
<td>Geological history</td>
<td>Field survey and Secondary sources</td>
</tr>
<tr>
<td>7</td>
<td>Soil</td>
<td>Soil types and samples analyzed for physical and chemical parameters.</td>
<td>Analysis of soil samples at 8 locations</td>
</tr>
<tr>
<td>8</td>
<td>Socioeconomic Aspects</td>
<td>Socioeconomic characteristics of the affected area</td>
<td>Based on field survey and data collected from secondary sources</td>
</tr>
<tr>
<td>9</td>
<td>Land Use</td>
<td>Trend of land use change for different categories</td>
<td>Secondary data/ Satellite imagery/ Topo sheet etc.</td>
</tr>
</tbody>
</table>

Source: ABC Techno Labs India Pvt. Ltd.
### Table 3.2: Frequency and Monitoring Methodology

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Sampling Network</th>
<th>Frequency</th>
<th>Measurement Method</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Meteorology</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wind Speed, Wind direction, Relative</td>
<td>Project site</td>
<td>Continuous for 3 months</td>
<td>Weather monitors with the database</td>
<td></td>
</tr>
<tr>
<td>humidity, Rainfall and Temperature</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>B. Air Environment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Particulate Matter (PM10)</td>
<td>Requisite locations in the project influence area</td>
<td>24 hourly- Twice a week for 3 months in Non-Monsoon season</td>
<td>Gravimetric (High-Volume with Cyclone)</td>
<td>As per CPCB standards under 18th November 2009</td>
</tr>
<tr>
<td>Particulate Matter (PM2.5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oxides of Sulphur (SO₂)</td>
<td></td>
<td></td>
<td>EPA Modified West &amp; Gaeke method</td>
<td></td>
</tr>
<tr>
<td>Oxides of Nitrogen (NOₓ)</td>
<td></td>
<td></td>
<td>Arsenite Modified Jacob &amp; Hochheiser</td>
<td></td>
</tr>
<tr>
<td>Carbon Monoxide (CO)</td>
<td></td>
<td></td>
<td>Gas Analyzer (NDIR)</td>
<td>Notification for National Ambient Air Quality Standards (NAAQS)</td>
</tr>
<tr>
<td>Ozone (O₃)</td>
<td></td>
<td></td>
<td>UV photometric</td>
<td></td>
</tr>
<tr>
<td>Ammonia (NH₃)</td>
<td></td>
<td></td>
<td>Indophenol Blue Method</td>
<td></td>
</tr>
<tr>
<td>Volatile Organic Compound (VOC)</td>
<td></td>
<td></td>
<td>Ion Sense PID Detector</td>
<td></td>
</tr>
<tr>
<td>Methane</td>
<td></td>
<td></td>
<td>ABCTL/ SOP/INS/32</td>
<td></td>
</tr>
<tr>
<td>Non Methane</td>
<td></td>
<td></td>
<td>GC-FID</td>
<td></td>
</tr>
<tr>
<td><strong>C. Noise</strong></td>
<td></td>
<td></td>
<td></td>
<td>IS: 4954 1968</td>
</tr>
<tr>
<td>Hourly equivalent noise levels</td>
<td>Requisite locations in the project influence area</td>
<td>Once</td>
<td>Instrument: Sound level meter</td>
<td></td>
</tr>
<tr>
<td><strong>D. Water</strong></td>
<td></td>
<td></td>
<td></td>
<td>IS:10500:2012 (GW) CPCB Class C (SW)</td>
</tr>
<tr>
<td>Parameters for water quality: Colour,</td>
<td>Set of grab samples At requisite locations for ground and</td>
<td>Once in season</td>
<td>Samples for water quality collected and analyzed as per IS: 2488 (Part 1-5) methods for sampling</td>
<td></td>
</tr>
<tr>
<td>Odour, Temperature, pH, Conductivity,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attributes</td>
<td>Sampling</td>
<td>Measurement Method</td>
<td>Remarks</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Turbidity, TDS, Total Hardness, Total Alkalinity, Cl, SO₄, F, NO₃, NH₃, Na, K, Ca, Mg, Fe, Phenolic compounds, Mn, Cu, Hg, Cd, As, CN, Pb, Zn, Cr, Ni, Se, Al, As, Pb, Zn, COD, BOD, DO, Total Coliform, Faecal Coliform etc</td>
<td>surface water</td>
<td>and testing of Industrial effluents Standard methods for the examination of water and wastewater analysis published by American Public Health Association.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**E. Land Environment**


| Requisite soil samples were collected as per BIS specification within project influence area | Once in season | Collected and analyzed as per soil analysis reference book, M.L. Jackson |

**F. Biological Environment**

Terrestrial & Aquatic Flora and Fauna

| Requisite locations in the project influence area | Once in season | Collected and analyzed as per IUCN Red Data book. |

**Source:** ABC Techno Labs India Pvt. Ltd.

### 3.3 Meteorology and Climate

#### 3.3.1 Climatic Condition

The region experiences a semi-arid hot climate. The weather and climate in the region is largely influenced by the Arabian Sea. The average temperature of the area ranges in between 12°C to 41°C. Aside from the monsoon season, the climate is extremely dry. The weather is hot from March to June; the average summer maximum is 43°C, and the average minimum is 24°C. From November to February, the average maximum
temperature is 30°C, the average minimum is 13°C, and the climate is extremely dry. Cold northerly winds are responsible for a mild chill in January. The southwest monsoon brings a humid climate from mid-July to mid-September. The average annual rainfall is about 800 millimetres (31 inch), but infrequent heavy torrential rains cause local rivers to flood and it is not uncommon for droughts to occur when the monsoon does not extend as far west as usual.

A meteorological station equipped with continuous monitoring equipment was installed on at project site, at a height ~ 5.0m above ground level to record wind speed, wind direction, relative humidity and temperature.

3.3.2 REGIONAL METEOROLOGY

Historical data on meteorological parameters will also play an important role in identifying the general meteorological will also play an important role in identifying the general meteorological regime of the region.

The study area is primarily semi arid zone and climate of the region is characterised by its dryness and erratic rainfall. There are four seasons each characterised by a different set of weather conditions:

- Northeast monsoon season (winter) from November to March;
- Summer season during April to June;
- Southwest monsoon or rainy season during mid of July to September; and
- Transition or postmonsoon season from October to mid November.

The regional meteorology summary details (from 1971 to 2000) monitored at nearest IMD station at Ahmedabad are given below;

A. Temperature

The monthly mean maximum temperature varied from 28.1°C in January to 41.6°C in May while monthly mean minimum varied from 12°C in January to 26.5°C in May indicating January as the coldest while May as hottest month.
B. Relative Humidity
During the month of August the relative humidity was highest (87%). The annual average Relative humidity is 67.4% (at 0830 Hours) and 40.9% (at 1730 Hours). Generally, the weather during other seasons was observed to be dry.

C. Rainfall
The rainfall occurred maximum in July (281.3 mm) followed by August (234.6 mm). The total rainfall received in the year is about 741 mm. Total rainy days observed about 33.3 days. The monsoon sets in the month of July and continues till September.
D. Atmospheric Pressure

The maximum pressure observed was 1010.5 mb occurring during the winter season, in the month of December. The minimum pressure observed was 995.7 mb occurring during the month of July in the monsoon season. The pressure levels are found to be fairly consistent over the region.

E. Cloud cover

During the month of July the cloud cover was highest (6.5 Octas). The annual average cloud cover is 2.9 Octas (at 0830 Hours) and 2.7 Octas (at 1730 Hours).
F. Wind Speed/ Direction

The maximum wind speed observed during the month of June is 11.8 Kmph and minimum wind speed observed during the month of December is 5.5 Kmph. The annual average wind speed calculated is 7.6 Kmph.

**0830 Hours:**

The predominant winds are mostly from SW & West directions. Calm conditions prevailed for 19% of the total time.

**1730 Hours:**

The predominant winds are mostly from NE and N directions. Calm conditions prevailed for 14% of the total time.
Table 3.3: Historical Meteorological Data at IMD Ahmedabad (1971-2000)

<table>
<thead>
<tr>
<th>Month</th>
<th>Daily mean Temp. (°C)</th>
<th>Relative Humidity (%)</th>
<th>Rainfall (mm)</th>
<th>Cloud cover (in Okta)</th>
<th>Station Level Pressure (hPa)</th>
<th>Mean Wind Speed (KMPH)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Max</td>
<td>Min</td>
<td>08:30</td>
<td>17:30</td>
<td>Monthly Total</td>
<td>No. of Rainy days</td>
</tr>
<tr>
<td>January</td>
<td>28.1</td>
<td>12</td>
<td>64</td>
<td>35</td>
<td>1.9</td>
<td>0.2</td>
</tr>
<tr>
<td>February</td>
<td>30.5</td>
<td>14</td>
<td>57</td>
<td>28</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>March</td>
<td>35.7</td>
<td>19.1</td>
<td>50</td>
<td>21</td>
<td>0.5</td>
<td>0</td>
</tr>
<tr>
<td>April</td>
<td>39.7</td>
<td>23.7</td>
<td>57</td>
<td>22</td>
<td>2.7</td>
<td>0.3</td>
</tr>
<tr>
<td>May</td>
<td>41.6</td>
<td>26.5</td>
<td>66</td>
<td>25</td>
<td>10.2</td>
<td>0.7</td>
</tr>
<tr>
<td>June</td>
<td>38.7</td>
<td>27.3</td>
<td>75</td>
<td>45</td>
<td>95.1</td>
<td>4</td>
</tr>
<tr>
<td>July</td>
<td>33.5</td>
<td>25.7</td>
<td>85</td>
<td>69</td>
<td>281.3</td>
<td>11.4</td>
</tr>
<tr>
<td>August</td>
<td>32</td>
<td>24.9</td>
<td>87</td>
<td>71</td>
<td>234.6</td>
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<tr>
<td>September</td>
<td>33.8</td>
<td>24.3</td>
<td>82</td>
<td>60</td>
<td>95.8</td>
<td>4.9</td>
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<tr>
<td>October</td>
<td>35.7</td>
<td>21.3</td>
<td>67</td>
<td>41</td>
<td>12.3</td>
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<tr>
<td>November</td>
<td>32.8</td>
<td>16.6</td>
<td>58</td>
<td>37</td>
<td>4.3</td>
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</tr>
<tr>
<td>December</td>
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<td>13.2</td>
<td>61</td>
<td>37</td>
<td>0.8</td>
<td>0.2</td>
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<tr>
<td>Annual or Mean</td>
<td>34.3</td>
<td>20.7</td>
<td>67.4</td>
<td>40.9</td>
<td>740.5</td>
<td>33.3</td>
</tr>
</tbody>
</table>

Source: IMD Station, Ahmedabad

Figure 3.1: Windrose diagrams for the month of April, May, June & July - IMD, Ahmedabad
Table 3: Predominant Wind direction at IMD Ahmedabad (1971 – 2000)

<table>
<thead>
<tr>
<th>Months</th>
<th>N</th>
<th>NE</th>
<th>E</th>
<th>SE</th>
<th>S</th>
<th>SW</th>
<th>W</th>
<th>NW</th>
<th>Calm (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AT 0830</td>
<td>AT 1730</td>
<td>AT 0830</td>
<td>AT 1730</td>
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<td>AT 0830</td>
</tr>
<tr>
<td>January</td>
<td>16</td>
<td>31</td>
<td>21</td>
<td>16</td>
<td>22</td>
<td>10</td>
<td>1</td>
<td>2</td>
<td>1</td>
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<tr>
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<td>2</td>
<td>0</td>
</tr>
<tr>
<td>March</td>
<td>10</td>
<td>15</td>
<td>8</td>
<td>5</td>
<td>12</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>April</td>
<td>6</td>
<td>9</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
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<tr>
<td>August</td>
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<td>1</td>
<td>0</td>
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<td>1</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>September</td>
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<td>3</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>October</td>
<td>10</td>
<td>14</td>
<td>8</td>
<td>9</td>
<td>14</td>
<td>10</td>
<td>6</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
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<td>11</td>
<td>6</td>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>

Source: IMD Station, Ahmedabad
3.3.3 Site Specific Meteorology

On site monitoring was undertaken for various meteorological parameters in order to generate the site specific data. The Central Monitoring Station (CMS), equipped with continuous monitoring equipment to record wind speed, wind direction, temperature, humidity and rain fall was set up at the top of the building at a height of ~ 5.0m above the ground level. The methodology adopted for monitoring surface observations was as per the Standard norms laid down by the Bureau of Indian Standards (IS: 8829:1978) and IMD. Data was collected at every hour continuously from 20th April 2018 to 9th July 2018.

Table 3.5: Site specific Weather Report for the Study period

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Location:</th>
<th>Observations (20th April 2018 to 9th July 2018)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Parameters</td>
<td>April 2018 (20th to 30th)</td>
</tr>
<tr>
<td>1</td>
<td>Dry Bulb Temperature (°C)</td>
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</tr>
<tr>
<td></td>
<td>Maximum</td>
<td>40.9</td>
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<tr>
<td></td>
<td>Minimum</td>
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<td>2</td>
<td>Relative Humidity (%)</td>
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<td></td>
<td>Maximum</td>
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<tr>
<td></td>
<td>Minimum</td>
<td>30.00</td>
</tr>
<tr>
<td>3</td>
<td>Wind Speed (mph)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>1.8</td>
</tr>
<tr>
<td></td>
<td>Predominant Wind Direction (From)</td>
<td>SW, W</td>
</tr>
<tr>
<td>4</td>
<td>Rainfall</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maximum</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Source: ABC Techno Labs India Pvt. Ltd.

The wind rose for the month of study period (20th April 2018 to 9th July 2018) is given in Figure 3.1.
3.4 Physiography and Drainage Pattern

Ahmedabad and Gandhinagar entire area is covered with thick pile of Quaternary sediments except few patchy outcrops of Basalt in SW portion of the Ahmadabad district. Topographically, entire area is almost plain terrain made up of mudflats and sand sheets. Some patches show rolling topography because of Aeolian deposits in the form of sand dunes. Gandhinagar district is almost plain covered by recent or sub recent alluvium consisting of Goradu, Sandy and Khari soils. The plain is traversed by deeply flowing Sabarmati River. Sabarmati River passes through the alluvial plains from North to South divides the district into two parts and has given rise to fluvial terraces and deep gullies.

Kheda district is bounded by the districts of Gandhinagar and Sabarkantha to the north side, Panchmahal to the east side, Ahmedabad to the west side, and Anand and Vadodara to the south side. Topographically, Kheda district can be divided into two main units viz., NE part of district near Virpur having high relief in contrast to rest of the district having almost flat terrain. Ridges exposed near Virpur are almost linear and trending NE-SW.
direction. The rest of the part is almost plain covered by recent alluvium deposits. Vatrak river is passing through almost centre of the district and meet gulf of Khambhat in SW. River Sabarmati is the principal river of the district. It originates from Dhebar Lake in Aravalli Range of Udaipur District, Rajasthan and finally debauches into Gulf of Khambat near Vataman village of Dholka taluka. Sabarmati forms the eastern boundary of the district flowing from NE to SW direction in Ahmedabad and Gandhinagar districts. The river Vatrak flows for a smaller length and joins Sabarmati near village Wauta of Dholka taluka. The Khari River and the Meshwo river drain Dascroi taluka. The river Bhogavo with its branches Chatori and Omkar drains Dholka and Dhandhuka talukas. The Bhadar River with its branch Goma, Lilka, Utavali and Ghela drains Dhandhuka taluka of the district. River Rodh drains Sanand and Dholka talukas. Rivers Shelwa and Andhli drain Dholka taluka. There is no river or rivulet in Viramgam taluka.

The Drainage Map (10 km) of the CB-ONN-2010/8 block is given as Figure 3.3.

![Drainage Map (10 km) of the CB-ONN-2010/8 Block](source)

**Figure 3.3: Drainage Map (10 km) of the CB-ONN-2010/8 Block**
3.5 Hydrogeology

Ahmedabad districts forms a part of the Cambay basin. The groundwater in the study area occurred in porous formations i.e. sedimentaries which occupies the major part (93.5%) of the district. It includes the post-Miocene alluvial deposits at the top underlined by older Miocene formations. The sedimentary formations mainly consist of fine to coarse-grained sand, gravel, silt, clay, clay stone, siltstone and kankar. The thickness of the post-Miocene alluvial formations exceeds 419m near Dholka at Rampur Ground water occurs under phreatic as well as confined conditions in the granular horizons with in the sedimentaries.

Gandhinagar district forms a part of Cambay basin and is occupied by quaternary alluvium comprising mainly of sand, gravel, silt clay and Kankar etc. There is a sequence of alternating layers of granular sandy and clayey horizons, the uppermost granular zone varies in thickness from 5 to 65 m. it is underlain by a thick clay bed followed by alternating sequence of arenaceous and argillaceous horizons. The granular horizons occurring at various depths forms potential aquifers. Groundwater occurs both under phreatic and confined conditions. The occurrence and movement of groundwater is mainly controlled by inter-granular pore spaces. Depth of water level range is from 100-150 m and total depth is ranging from 100-300 m. Discharge is ranging from 600-1200 lpm.

Kheda District is underlain by alluvium which intern is underlain by Tertiary sedimentary formations with in the Cambay Sedimentary Basin. The alluvium mainly consists of fine to coarse grained sand, gravel, silt, clay and kankar. The thickness of alluvium gradually increases from piedmonts zone in the northeast towards west and southwest. Maximum thickness of alluvium in the district is estimated to be about 250-300 m in the south western part. In western and south western part ground water occurs both under phreatic and confined conditions in arenaceous horizons that form a multi-layered aquifer system. The occurrence and movement of groundwater is mainly controlled by inter-granular pore spaces. In Alluvium two major aquifers can be identified within the explored depth. Groundwater in the upper unit occurs under phreatic conditions, which at places becomes semi-confined to confined .The lower unit, comprising a few hundred meters of alternating sandy and clayey horizons, forms a multiple confined aquifer.
system. In this region the depth to water level range is from 150-200 m and total depth is ranging from 100-150 m. Discharge is ranging from 500-1000 lpm.

Ground Water Occurrence:

Ground water systems are a result of the complex combination of different lithological and structural types within an area that together constitute an aquifer within which ground water accumulates and moves. Rather than describing individual lithologies and their tendencies to form aquifers or otherwise, it is useful to describe the ground water as one continuous across various lithological types (Kulkarni and Deolankar, 1995).

Ahmedabad District: The Deccan trap and the limestone formations occupying the western part of the Dandhuka taluka form the only hard rock aquifers in the district. It occupies the south western extremity of the district and can be termed as fissured formation. Occurrence and movement of ground water is governed by the extent and thickness of weathered zone, presence and interconnections of joint and fracture systems, which provides secondary porosity. The thickness of the weathered zone of the basalt ranges from less than one meter to more than 6 m and the joints and fracture system is prevalent down to a maximum depth of 80 to 90 mbgl in the basaltic terrain. The occurrence of vesicles and amygdales in the flows of the trap rocks and solution cavities in the limestone formations and the geological contact between limestone and basalt are other factors favourable for ground water storage and movement. Ground water occurs in the weathered and fissured zones mainly under water table conditions. It occasionally occurs under semi-confined conditions in the event of comparatively deeper fracture system in these formations. These fissured formations do not form good repository of groundwater, compared to porous unconsolidated sedimentary formations. Groundwater is being developed in these formations by means of dug and dug-cum-bored wells. Depth of dugwells ranges between 5 and 38.5 mbgl whereas depth of dug-cum-bored wells varies between 15 and 78 mbgl in the case of fissured basaltic formations. Depth of dugwells in the limestone formations varies between 12 and 38 mbgl. Deeper wells are constructed in the western part in these formations. Depth to water levels in basaltic formation varies between 4 and 25 mbgl. In the limestone formation it varies between 12 and 33 mbgl. The deeper water levels are recorded towards western part of the area. The
average yield of the wells in the trap formations varies between 50 and 1000 cu.m/day and of the wells in the limestone varies between 50 and 200 cu.m/day.

**Gandhinagar District:** The district forms a part of Cambay basin and is occupied by quaternary alluvium comprising mainly of sand, gravel, silt clay and Kankar etc. The ONGC has established that the thickness of alluvium in the North Gujarat is about 700 m. However, as per the studies carried out by CGWB under UNDP Project the Miocene formations were encountered within 611 m at the deepest borehole drilled in the district at Sardhao. There is a sequence of alternating layers of granular sandy and clayey horizons, the uppermost granular zone varies in thickness from 5 to 65 m. it is underlain by a thick clay bed followed by alternating sequence of arenaceous and argillaceous horizons. The granular horizons occurring at various depths forms potential aquifers.

**Kheda District:** In the piedmont plain in central part of district, the nature of sediments is more uniform and only phreatic aquifer is present. This belt forms the principal recharge zone for the deeper aquifers. The argillaceous beds in the central and western parts, mainly act as confining layers. In the north eastern part covered by hard rock formation groundwater occurs in top weathered and fractured formation. Groundwater is extensively developed by dug, dug-cum-bored and tube wells in areas underlain by alluvium. Depth of dug and dug-cum-bored wells varies 5 m to 38 mbgl whereas depth to water level, in general, varies from 5 to 15 mbgl. The depth to water level in the district ranges between 2m to about 40m during May 2012. Nearly 7% area of the district is covered by the water level of less than 2m bgl. Nearly 18% area of the district is covered by the water level of 2m to 5m bgl. Nearly 35% area of the district is covered by the water level of 5m to 10m bgl. Nearly 19% area of the district is covered by the water level of 10m to 20m bgl. Nearly 16% area of the district is covered by the water level of 20m to 40m bgl. Nearly 5% area of the district is covered by the water level of greater than 40m bgl.

- **Ground Water Recharge**

The main source of ground water recharge is by the rainfall by direct percolation to the zone of saturation. A significant part of the rainfall is lost as runoff from area while a limited percentage of rainfall therefore reaches zone of saturation and becomes the part of ground water storage after meeting the evaporation and evapo-transpiration losses.
There is also ground water recharge from the return flow of irrigation water from dug wells and tube wells operated by the cultivators and from canals.

**Ahmedabad:** The Annual Ground Water Recharge varies from 1601.62 ha.m (Barwala taluka) to 20271.87 ha.m (City-Dascroi Taluka). The Gross Annual Ground Water Recharge in the district is 61686.37 ha.m. The net available recharge after leaving natural discharge from monsoon period varies from 1521.54 ha.m (Barvala Taluka) to 19258.28 ha.m (City-Dascroi Taluka). The net available recharge in the district is 58309.42 ha.m. The Existing Gross Ground Water Draft for all uses varies form 942.90 ha.m (Barwala taluka) to 19977.50 ha.m (City-Dascroi Taluka). The Gross Ground Water Draft for All uses in the district is 45693.67 ha.m.

**Gandhinagar:** The Annual Ground Water Recharge varies from 9836.37 ha.m (Mansa taluka) to 14114.01 ha.m (Dehgam Taluka). The Gross Annual Ground Water Recharge in the district is 48837.83 ha.m. The net available recharge after leaving natural discharge from monsoon period varies from 8852.73 ha.m (Mansa Taluka) to 13408.31 ha.m (Dehgam Taluka). The net available recharge in the district is 45300.05 ha.m. The Existing Gross Ground Water Draft for all uses varies from 13142.70 ha.m (Mansa taluka) to 14077.80 ha.m (Gandhinagar Taluka). The Gross Ground Water Draft for All uses in the district is 54384.00 ha.m.

**Kheda:** The annual ground water recharge varies from 2486.17 ha.m in Virpur Taluka to 13180.65 ha.m in Thasra Taluka and total gross recharge for the district is 78037.32 ha.m. The net available recharge, after leaving natural discharge for non-monsoon period varies from 129.09 (Balasinor) to 659.03 ha.m (Thasra), the recharge for district is 4026.17 ha.m.

### 3.6 Geomorphology

- **Ahmedabad district:**

  Geomorphologically the major portion of it forms a flat planar topography except for a few rocky features in the extreme southern portion.

- **Flat Alluvial Peneplain**

  It includes the low-lying land of Dholka and Dhandhuka taluka (falling below 20 m) contour characterised by marshy land, which is believed to be under sea in the past. Water logging is common in these tracts at high tides during monsoon. This barren low land is
termed as “The Bhal” area and characterised by high coastal salinity. The spreading of alluvial bed of Sabarmati River from end to end of the district is an important natural feature being observed. Below the city, on the left bank of the river and also midway between it and the Khari River is few small rises. But every where else, the surface of the ground is unbroken on every side, except the north, with groves of various trees. Along the Right Bank of Sabarmati River, the prominent characteristics of Dascroi pass into Dholka. However towards west and south-west they pass into fertile but absolutely flat and monotonous black soil of the Bhal. The area from Dholka to Bavliari creek along the coast is characterised by salty and marshy land. Along the western border, the land passes into a reddish form.

The soils in the district can broadly be classified as:

**Black Soils:** Black soils cover the southern part of Dholka and eastern part of Dhandhuka taluka popularly known as „Bhal“ tract, where cotton is grown in the initial stage of monsoon. It is not very clayey and contains above 20% of clay and about 40% of sand. Sub-soil invariably contains horizons of lime nodules. This type of soil is highly suitable for cultivation of Rabi wheat, which is the main crop raised on this soil. If rains are sufficient in the late monsoon, Rabi jowar and grams are sown. Medium Black Soils are found in Viramgam, Sanand and Dholka talukas. This soil is suitable for growing bajri, jowar and cotton.

**Goradu Soils:** Goradu soils vary from fertile brown to sandy loam and are found in City, Dascroi and parts of Sanand, Dholka and Viramgam talukas. This soil is mostly fertile and responds very well to irrigation and manuring. Practically all kinds of crops can grow on this soil.

**Kyari:** Kyari soils are found in several parts of City, Dascroi, Sanand, Dholka and Viramgam talukas. It is the most fertile soil with very good moisture and retentive capacity. Well known varieties of paddy such as Pankali, kamod, Jirasar, Sukhvel, Sutarsal and Basumati are grown on this soil.

**Rocky soils:** Rocky soils are found in Dhandhuka taluka and are known as Kaner tract. It is shallow, light in texture and fit for early maturing crops like cotton, Bajri, Jowar and Math.
Gandhinagar district:
Geomorphologically the district as whole has a flat planar topography. The soils in the district are generally sandy loam type with grey to brown colour. They are generally deep and have moderate to good permeability and drainability. In the western part of the district the soils are alkali type and saline. They are typically deep, grey, calcareous sandy loam of very low permeability.

Kheda District:
Quaternary, Post Miocene and Tertiary in the area were deposited over a sinking basement in the western part whereas eastern part is predominantly occupied by formations varying in age from Archean to Tertiary age. In the western part the main formation is of quaternary age, formed by alluvium deposited by Mahi, Sabarmati and Wattrak rivers. They comprise multilayered formations of gravel, sand, clay and kankers intermixed at places. The clay and sand horizons from alternate layers having pinching and swelling nature. Thekankers, pebbles and the gravels form lenses. Thickness of alluvium increase form north and North West towards south and south west direction .Alluvium is underlain by Deccan traps in general with intervening blue clays at some places. TheDeccan trap is also exposed in eastern area near Dakor. Balasinor area is occupied by limestone formation of Mesozoic age which is famous for occurrence of Dinosaur fossils. Aravalli formations exposed in Virpur area, they are intruded by post Aravalli Granites.

The soils of the district can be classified into the following Cropping main types: goradu (gravelly), black, sandy and Pattern rocky type. The principal crops grown in Kheda are the ordinary millets and pulses, rice, wheat, tobacco and a little indigo. Bajri is the principal crop and the staple grain food. Tobacco is the most valuable crop produced in the district. It is grown mostly in the charotar tract. Castor seed and sesame are the only oilseeds grown in the district.

3.7 Seismicity
There are 4 major seismic zones (zones II, III, IV and V) in India, based on the seismotectonic parameters, history of seismicity and certain geophysical parameters. The Study Area is categorized in the seismic zone III, which is classified as having a fairly high probability of earthquake shocks measuring 5 or 6 on the Richter scale, low probability of
3.8 LAND USE PATTERN

As per our seeking towards areas of critical concern for environmental control such as flood plains and wetlands, energy resource development and production areas, wildlife habitat, recreational lands and areas such as major residential and industrial development sites, we require the analysis of Land use Land Cover for establishing / Expansion of an Industry. The survey and studies of past several years conclude that the Remote Sensor data is acquiring a vital area in the field of land use and land cover mapping. The knowledge of Land Use/ Land Cover is important for many planning and management activities as it is considered as an essential element for modeling and understanding the earth system. The term Land Use relates to the human activity or economic function associated with a specific piece of Land, while the term Land Cover...
relates to the type of feature present on the surface of the earth (*Lillesand and Kiefer, 2000*).

The Cambay Basin is a narrow N-S trending rift basin which extends from Sanchor in the North to Surat in the South and is divided into several tectonic blocks separated by prominent transverse faults. The Ahmedabad – Mehsana tectonic block is one of the most prolific producing blocks in the Cambay Basin. It is bounded by the Patan-Unawa / Saraswati cross trends on the north and Vatrak cross trend in the south. The relatively weak South Kadi - Nandasan cross trend separates the Mehsana area to the north from the Ahmedabad area to the south. The block CB-ONN-2010/8 is located towards Eastern margin of Ahmadabad – Mehsana tectonic block.

The block CB-ONN-2010/8 is situated near the eastern rising margin of the Ahmedabad area. A part of the eastern rising margin lies within the eastern parts of the block. The Nardipur – Walod – Nenpur low passes along the western part of the block. In the western part the sediments dip with low angles towards the west, while in the eastern part the dips are higher. The Gamij field with listric fault lies to the east of the block. On the west, the Bakrol field is present, through which the western rising flank of the Nardipur–Walod–Nenpur low passes. The producing Gamij and Bakrol fields operated by ONGC and Selan Exploration Ltd. respectively, flank the block on the East and West.

**Project Site**

M/s. BPRL Cambay Basin, CB-ONN-2010/8 (Pasunia)

1. Block CB-ONN-2010/8 geographically located in Ahmedabad, Gandhinagar and Kheda districts of Gujarat. Location details of the block are as follows: Taluka: Dehgam, Daskroi, Mehmadavad
2. District: Gandhinagar, Ahmedabad and Kheda
3. Closely connected to Ahmedabad through road. The National Highway No. 8 and 59 passes in the vicinity of the block.
4. The nearest international and domestic airports are located at Ahmedabad situated in the proximity of the block.
Data Acquisition:

**Topographical Data:** Topographical maps of Survey of India (SOI) were obtained for land use study as well to develop contour and drainages pattern of area from F43A12, F43A16, F43G9, F43G13.

**Satellite Data:** The Satellite IRS P-6 LISSIV images are obtained from National Remote Sensing Centre (NRSC) Hyderabad. The latitude and longitudes as observed in the site by GPS are:
- Pasunia#01 (PA#01) 23° 02’ 56.45” N 72° 48’ 09.71’’ E
- Pasunia#02 (PA#02) 23° 01’ 02.93” N 72° 48’ 27.01’’E.

**Methodology**

The overall methodology adopted and followed to achieve the objectives of the present study involves the following steps:

- Collection of source data of Survey of India (SOI) toposheets. These are the main inputs for the preparation of essential layers
- Satellite data of IRS P-6 LISSIV sensor is geometrically corrected and enhanced using principal component method and nearest neighborhood resampling technique
- Preparation of basic themes like layout map, transport & settlement map and contour map from the source data. Then updating of layout map, transport map and drainage map from the satellite image by visual interpretation
- Essential maps (related to natural resources) like Land use / Land cover map are prepared by visual interpretation of the satellite imagery. Visual interpretation is carried out based on the image characteristics like tone, size, shape, pattern, texture, location, association, background etc. in conjunction with existing maps/ literature
- Preliminary quality check and necessary corrections are carried out for all the maps prepared
- All the maps prepared are converted into soft copy by digitization of contours and drainages. In that process editing, labeling, mosaicking, quality checking, data integration etc. are done, finally Land use areas are measured in Sq.km.
Flow Chart of Methodology

Land use Map Analysis
Land use Map Analysis done based on the image color, texture, tone etc. Following steps are used to analyze the Land use pattern of project site:

- Collection of scanned toposheets and Geo-reference the scanned image using the available coordinates
- Collection of IRS LISS IV images and made fused and blended the images for color combinations using Image interpreter-Utilities and Layer stack option available in ERDAS
- Identification Area of interest (AOI) and made a buffer of 10 km radius.
- Enhance the Fused and blended LISS IV image using the Spatial, Radiometric and Temporal options in ERDAS
- Rectified the LISS IV image using Geo-referencing technique, Toposheet to get UTM coordinate system
Subset the LISS images and Toposheet using 10 km buffer AOI
- Automatic classifications done for LISS IV images using maximum iterations and number of options in unsupervised classification options
- Created the signature file by selecting the more samples of different features with AOI on Unsupervised classification image
- Visual interpretation and supervised classification mixed with recoding practice
- Verified through the QC / QA and finalized the data.

**Spatial Data from SOI Topographical Sheets**

Creating a GIS spatial database is a complex operation, and is the heart of the entire work; it involves data capture, verification and structuring processes. Raw geographical data are available in many different analogue and digital form such as toposheets, aerial photographs, satellite imageries and tables. Out of all these sources, the source of toposheets is of much concern to natural resource scientist and an environmentalist.

In the present study, the essential maps generated from SOI topographical maps. Using the topographical maps, the drainage map and contour Map were also developed. The maps are prepared to a certain scale and with attributes complying with the requirement of terms of reference (ToR). The location of entities on the earth's surface is then specified by means of an agreed co-ordinate system. For most GIS, the common frame of co-ordinate system used for the study is UTM co-ordinates system. All the maps are first Geo-referenced. The same procedure is also applied on remote sensing data before it is used to prepare the Essential maps.

Map showing site location, Rivers, canals, Lakes, drains are connected to Vatrak River & Meshwa River.

There is a road network connecting built-up areas. As the terrain conditions are black cotton soil and site elevation bit undulations also there is a drainage network around the site location, there is no chance of flooding. Hence risk factors are less.

**National Park/Wild life sanctuary/ReserveForest within 10 km radius of the project:**

- Reserve Forest found around 10 Km radius about 8 Km from the block towards eastern side. However, no reserve forest area falls within the block area.
- No National parks and wild life sanctuaries located in the study area.
The contours in Toposheet have been digitized in the GIS environment and assigned the respective elevation values in meters with reference to the mean sea level. Using the SRTM (Shuttle Radar Topography Mission) data, the elevation values have been verified. Thereafter, the final contour map has been prepared with a combination of Toposheet and SRTM, with contour interval of 10 m. Project site contours vary from 50 m to 60 m above MSL and the study area contours vary from 30 m to 80 m above MSL. From the project site, the high range hill area was observed towards the North West direction and the lowest contours were observed in the South direction. While the remaining areas showed variations with respect to contours. Contour Map and Elevations of Study Area is presented in Fig.3.6.
Topography (Digital Elevation Model)

A digital elevation model (DEM) is a digital representation of ground surface topography or terrain (Fig. 3.7). It is also widely known as a digital terrain model (DTM). A DEM can be represented as a raster (a grid of squares, also known as a height map when representing elevation) or as a triangular irregular network. The proposed plant location is shown in that Relief map. For the relief study of the area very higher quality SRTM (Shuttle Radar Topography Mission) and DEM is downloaded. These DEMs of the Terra represents elevation at a 30 m resolution.
Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.

Figure 3.7: DEM of the Study Area (CB-ONN-2010/8 Block)

Figure 3.8: Satellite Image of the study area (CB-ONN-2010/8 Block)
Map for the Land Use Land Cover in the study area of CB-ONN-2010/8 Block

Land use map Figure 3.9 showing the classifications of the land with different colors. While classifying many remote sensing techniques like supervisory – unsupervisory classification methodologies applied and also sampling techniques used for better results.

It is clearly that the area is mostly covered with Agricultural Fallow land around 59% respectively of the total area, which is taken up for cultivation but is temporarily allowed to rest, un-cropped for one or more season, but not less than one year. Thus, total cultivable land is 59%. The land with Open Jungle is with 1%, Other class is Around the Agricultural land edges the Settlement (Built-up area) is located and occupies around 9 %, and open scrub are around 2% and Roads 12% of the total study area. It is an area of human habitation developed due to non-agricultural use and that has a cover of buildings, transport and communication, utilities in association with water, vegetation and vacant lands. The Railways is 6.1% respectively in the total study area. Forest and Dense scrub area are 1% and 2%. The proposed project is on Agricultural fallow with waterbody Land and does not have any significant impact on the surrounding villages and habitation. The water bodies cover 7% of the total area. The water bodies cover Maheshwa River, Vatrak River. These area have a very prominent signature and can be seen as almost Dark blue and light blue in the satellite image. The statistical break-up of the land use classes of buffer zone are presented in Table 3.6 and depicted in Fig. 3.9.

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>LULC Class</th>
<th>Area (Ha)</th>
<th>Area (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Water Bodies</td>
<td>8500.31</td>
<td>7%</td>
</tr>
<tr>
<td>2</td>
<td>Agricultural Fallow Land</td>
<td>72002.00</td>
<td>59%</td>
</tr>
<tr>
<td>3</td>
<td>Open Scrub</td>
<td>2760.13</td>
<td>2%</td>
</tr>
<tr>
<td>4</td>
<td>Dense Scrub</td>
<td>2900.12</td>
<td>2%</td>
</tr>
<tr>
<td>5</td>
<td>BuiltUp</td>
<td>11134.13</td>
<td>9%</td>
</tr>
<tr>
<td>6</td>
<td>Forest</td>
<td>1500.12</td>
<td>1%</td>
</tr>
<tr>
<td>7</td>
<td>Open Jungle</td>
<td>1801.44</td>
<td>1%</td>
</tr>
<tr>
<td>8</td>
<td>Railways</td>
<td>7500.00</td>
<td>6.13%</td>
</tr>
<tr>
<td>9</td>
<td>Roads</td>
<td>14266.75</td>
<td>12%</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>122364.99</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Source: ABC Techno Labs India Pvt. Ltd.
Figure 3.9: Graphical Presentation of Land use Land Cover statistics (CB-ONN-2010/8 Block)

Source: ABC Techno Labs India Pvt. Ltd.

Figure 3.10: Land Use / Land Cover Map within 10 km Study Area (CB-ONN-2010/8 Block)

Source: ABC Techno Labs India Pvt. Ltd.
3.9 AIR ENVIRONMENT

The prime objective of baseline air monitoring is to evaluate the existing air quality of the study area around each block. This will also be useful for assessing the conformity to standards of the ambient air quality during the developmental operation of the proposed wells within the CB-ONN-2010/8 block, Cambay basin. This section describes the selection of sampling locations, the methodology adopted for sampling, analysis techniques and frequency of sampling. The results of ambient air monitoring carried out during the study during 20th April 2018 to 9th July 2018.

Ambient air quality of the study area has been assessed through a network of 8 ambient air quality stations designed keeping in view the meteorological conditions of the study region and others such as major habitation, environment sensitivity etc. It was observed that no habitats present near the well locations and all the proposed developmental wells fall within the open land area. The AAQ locations selected based on the predominant wind directions and major habitation area. The methodology adopted for the air quality survey is given below.

3.9.1 SELECTION OF SAMPLING LOCATIONS

The locations for air quality monitoring were scientifically selected based on the following considerations using climatological data.

- Topography / Terrain of the study area
- Human Settlements
- Health status
- Accessibility of monitoring site
- Resource Availability
- Representativeness of the region for establishing baseline status
- Representativeness with respect to likely impact areas.

The Ambient Air Quality monitoring locations are given in Table 3.7.
Table 3.7: Ambient Air Quality Monitoring Locations

<table>
<thead>
<tr>
<th>Air sampling location code</th>
<th>Location</th>
<th>Coordinates</th>
<th>Direction with respect to project site</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAQ1</td>
<td>Karoli</td>
<td>23° 3’38.83&quot;N 72°48’30.27&quot;E</td>
<td>N</td>
<td>Downwind</td>
</tr>
<tr>
<td>AAQ2</td>
<td>Pallano math</td>
<td>23° 2’20.31&quot;N 72°50’3.56&quot;E</td>
<td>NNE</td>
<td>Downwind</td>
</tr>
<tr>
<td>AAQ3</td>
<td>Shiyapur</td>
<td>23° 1’24.24&quot;N 72°50’50.00&quot;E</td>
<td>NE</td>
<td>Downwind</td>
</tr>
<tr>
<td>AAQ4</td>
<td>Kuha</td>
<td>23° 0’4.49&quot;N 72°47’49.25&quot;E</td>
<td>-</td>
<td>Centre</td>
</tr>
<tr>
<td>AAQ5</td>
<td>Ranodra</td>
<td>22°57’20.57&quot;N 72°47’46.68&quot;E</td>
<td>S</td>
<td>Upwind</td>
</tr>
<tr>
<td>AAQ6</td>
<td>Bhavda</td>
<td>22°58’16.38&quot;N 72°46’27.39&quot;E</td>
<td>SW</td>
<td>Upwind</td>
</tr>
<tr>
<td>AAQ7</td>
<td>Mirjapur</td>
<td>22°59’31.77&quot;N 72°51’14.82&quot;E</td>
<td>EES</td>
<td>Crosswind</td>
</tr>
<tr>
<td>AAQ8</td>
<td>Pasunj</td>
<td>23° 2’18.89&quot;N 72°47’58.89&quot;E</td>
<td>NNW</td>
<td>Downwind</td>
</tr>
</tbody>
</table>

Source: ABC Techno Labs India Pvt. Ltd.

Figure 3.11: Ambient Air quality monitoring locations
3.9.2 Parameters For Sampling

Ambient air quality monitoring was carried out at a frequency of two days per week at each location for continuous three months. The baseline data of air environment was generated for the parameters namely Particulate Matter size less than 10 µm (PM10), Particulate Matter size less than 2.5 µm (PM2.5), Sulphur dioxide (SO₂), Nitrogen dioxide (NOX), Carbon Monoxide (CO), Carbon Monoxide (CO), Ammonia (NH₃), Ozone (O₃), Volatile Organic Compounds (VOCs) and Hydrocarbon (Methane& Non-Methane). Concentrations of pollutant parameter monitored have been compared with National Ambient Air Quality standards.

3.9.3 Instruments Used For Sampling

Respirable Dust Samplers APM 460 BL of Envirotech, Fine Particulate Samplers APM 550 of Envirotech & Combo PM10 & PM 2.5 sampler and AAS 271 of Envirotech were used for monitoring the Particulate matter PM10 & PM 2.5. The Gaseous pollutant samplers AAS 109 of Ecotech & APM 411 along with APM 460 Envirotech were used for sampling of gaseous pollutant like SO2, NOX, VOCs & BTX, HC. Carbon Monoxide was measured by electro chemical sensor method. The instruments used for monitoring are periodically calibrated every year or after in case of any repair.

3.9.4 Sampling and Analytical Techniques

The sampling and analytical techniques used for the monitoring of Ambient Air quality is given in Table 3.8. The power supply for operation of AAQ instruments were utilized from nearest available sources like Government building as Panchayat office, Schools, Temple or residential buildings at each AAQ station.

Table 3.8: Techniques used for Ambient Air Quality Monitoring

<table>
<thead>
<tr>
<th>S. No</th>
<th>Parameter</th>
<th>Technique</th>
<th>Technical Protocol</th>
<th>Detectable Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Particulate Matter of size less than 10 µm (PM₁₀)</td>
<td>Gravimetric method</td>
<td>IS 5182 Pt.23 : 2006 (Reaff. 2017)</td>
<td>5 µg/m³</td>
</tr>
<tr>
<td>2</td>
<td>Particulate Matter of size less than 2.5 µm (PM₂.₅)</td>
<td>Gravimetric method</td>
<td>EPA- 40 Appendix L To CFR PART 50</td>
<td>5 µg/m³</td>
</tr>
<tr>
<td>3</td>
<td>Sulphur dioxide (SO₂)</td>
<td>Improved West and Gaeke</td>
<td>IS 5182: Part 2:2001 (Reaff.</td>
<td>5.0 µg/m³</td>
</tr>
</tbody>
</table>
Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.

<table>
<thead>
<tr>
<th>S. No</th>
<th>Parameter</th>
<th>Technique</th>
<th>Technical Protocol</th>
<th>Detectable Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Nitrogen dioxide (NO₂)</td>
<td>Modified Jacob &amp; Hochheiser</td>
<td>IS 5182: Part 6:2006 (Reaff. 2017)</td>
<td>5.0 µg/m³</td>
</tr>
<tr>
<td>5</td>
<td>Carbon monoxide (CO)</td>
<td>Non Dispersive Infra Red (NDIR)</td>
<td>IS 5182:Part 10: 1999 (Reaff. 2014)</td>
<td>0.1 mg/m³</td>
</tr>
<tr>
<td>6</td>
<td>Ozone (O₃)</td>
<td>UV photometric</td>
<td>IS 5182 part 9, 1974</td>
<td>5.0 µg/m³</td>
</tr>
<tr>
<td>7</td>
<td>Ammonia (NH₃)</td>
<td>Indophenol Method Solvent extraction followed by HPLC</td>
<td>AAFA Edition 21st IS 5182 part 12, 2004</td>
<td>5.0 µg/m³</td>
</tr>
<tr>
<td>8</td>
<td>VOCs &amp; BTX</td>
<td>GC-MS/MS</td>
<td>ABCTL/INS/SOP/035</td>
<td>1 µg/m³</td>
</tr>
<tr>
<td>9</td>
<td>Methane HC</td>
<td>GC FID</td>
<td>ABCTL/INS/SOP/038</td>
<td>0.1 µg/m³</td>
</tr>
<tr>
<td>10</td>
<td>Non-Methane HC</td>
<td>GC FID</td>
<td>ABCTL/INS/SOP/038</td>
<td>0.1 µg/m³</td>
</tr>
</tbody>
</table>

Source: ABC Techno Labs India Pvt. Ltd.

3.9.5 NATIONAL AMBIENT AIR QUALITY STANDARDS
The national ambient air quality standards are given in Table 3.9. Monitored values for study have been compared with the National Ambient Air Quality Standards.

Table 3.9: National Ambient Air Quality Standards

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Pollutants</th>
<th>Time weighted average</th>
<th>Concentration in ambient air</th>
<th>Methods of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sulphur Dioxide (SO₂), µg/m³</td>
<td>Annual*</td>
<td>Industrial, Residential, Rural &amp; Other Areas Areas</td>
<td>Improved West &amp; Gaekke</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>24 hours**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Nitrogen Dioxides (NO₂), µg/m³</td>
<td>Annual*</td>
<td>Ecologically Sensitive Area (notified by Central Government)</td>
<td>Modified Jacob &amp; Hochheiser (Na-Arsenite)</td>
</tr>
</tbody>
</table>
Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Pollutants</th>
<th>Time weighted average</th>
<th>Concentration in ambient air</th>
<th>Methods of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Industrial, Residential, Rural &amp; Other Areas Areas</td>
<td>Ecologically Sensitive Area (notified by Central Government)</td>
</tr>
<tr>
<td>3</td>
<td>Particulate Matter (size less than 10 μm) or PM10 μg/m³</td>
<td>24 hours**</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Annual*</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>24 hours**</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>4</td>
<td>Particulate Matter (size less than 2.5 μm) or PM2.5 μg/m³</td>
<td>24 hours**</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Annual*</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Ozone (O₃) μg/m³</td>
<td>24 hours**</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 hour**</td>
<td>180</td>
<td>180</td>
</tr>
<tr>
<td>6</td>
<td>Lead (Pb) μg/m³</td>
<td>24 hours**</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Annual*</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>7</td>
<td>Carbon Monoxide (CO) mg/m³</td>
<td>24 hours**</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8 hours**</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 hour**</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>Ammonia (NH₃) μg/m³</td>
<td>24 hours**</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Annual*</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

**Note:**
*Annual arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.

**24 hourly /8 hourly values should be met 98% of the time in a year. However 2% of the time, it may exceed but not on two consecutive days.

### 3.9.6 Results

Various parameters like maximum, minimum and average have been computed from the monitored data for all the locations and summary of Ambient Air Quality test results are presented in Tables 3.10.
### Table 3.10: Summary of Ambient Air Quality Result

<table>
<thead>
<tr>
<th>Location</th>
<th>Statistics</th>
<th>PM 2.5 μg/m³</th>
<th>PM 10 μg/m³</th>
<th>SO₂ μg/m³</th>
<th>NO₂ μg/m³</th>
<th>CO mg/m³</th>
<th>NH₃ μg/m³</th>
<th>O₃ μg/m³</th>
<th>VOC &amp; BTX μg/m³</th>
<th>Methane HC μg/m³</th>
<th>Non Methane HC μg/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAQ1</td>
<td>Maximum</td>
<td>34.6</td>
<td>71.0</td>
<td>7.2</td>
<td>21.6</td>
<td>0.2</td>
<td>BDL(&lt;5)</td>
<td>BDL(&lt;5)</td>
<td>BDL(&lt;0.1)</td>
<td>BDL(&lt;0.01)</td>
<td>BDL(&lt;1)</td>
</tr>
<tr>
<td></td>
<td>Minimum</td>
<td>22.5</td>
<td>58.2</td>
<td>5.1</td>
<td>9.5</td>
<td>0.1</td>
<td>BDL(&lt;5)</td>
<td>BDL(&lt;5)</td>
<td>BDL(&lt;0.1)</td>
<td>BDL(&lt;0.01)</td>
<td>BDL(&lt;1)</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>26.3</td>
<td>63.7</td>
<td>5.7</td>
<td>14.8</td>
<td>0.2</td>
<td>BDL(&lt;5)</td>
<td>BDL(&lt;5)</td>
<td>BDL(&lt;0.1)</td>
<td>BDL(&lt;0.01)</td>
<td>BDL(&lt;1)</td>
</tr>
<tr>
<td></td>
<td>98th Percentile</td>
<td>34.1</td>
<td>70.4</td>
<td>6.9</td>
<td>21.2</td>
<td>0.2</td>
<td>BDL(&lt;5)</td>
<td>BDL(&lt;5)</td>
<td>BDL(&lt;0.1)</td>
<td>BDL(&lt;0.01)</td>
<td>BDL(&lt;1)</td>
</tr>
<tr>
<td>AAQ2</td>
<td>Maximum</td>
<td>34.7</td>
<td>68.9</td>
<td>7.5</td>
<td>15.2</td>
<td>0.2</td>
<td>BDL(&lt;5)</td>
<td>BDL(&lt;5)</td>
<td>BDL(&lt;0.1)</td>
<td>BDL(&lt;0.01)</td>
<td>BDL(&lt;1)</td>
</tr>
<tr>
<td></td>
<td>Minimum</td>
<td>21.5</td>
<td>55.8</td>
<td>5.2</td>
<td>10.1</td>
<td>0.1</td>
<td>BDL(&lt;5)</td>
<td>BDL(&lt;5)</td>
<td>BDL(&lt;0.1)</td>
<td>BDL(&lt;0.01)</td>
<td>BDL(&lt;1)</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>26.1</td>
<td>60.6</td>
<td>6.2</td>
<td>12.1</td>
<td>0.1</td>
<td>BDL(&lt;5)</td>
<td>BDL(&lt;5)</td>
<td>BDL(&lt;0.1)</td>
<td>BDL(&lt;0.01)</td>
<td>BDL(&lt;1)</td>
</tr>
<tr>
<td></td>
<td>98th Percentile</td>
<td>32.9</td>
<td>67.6</td>
<td>7.4</td>
<td>15.2</td>
<td>0.2</td>
<td>BDL(&lt;5)</td>
<td>BDL(&lt;5)</td>
<td>BDL(&lt;0.1)</td>
<td>BDL(&lt;0.01)</td>
<td>BDL(&lt;1)</td>
</tr>
<tr>
<td>AAQ3</td>
<td>Maximum</td>
<td>33.1</td>
<td>69.9</td>
<td>7.3</td>
<td>14.1</td>
<td>0.2</td>
<td>BDL(&lt;5)</td>
<td>BDL(&lt;5)</td>
<td>BDL(&lt;0.1)</td>
<td>BDL(&lt;0.01)</td>
<td>BDL(&lt;1)</td>
</tr>
<tr>
<td></td>
<td>Minimum</td>
<td>23.1</td>
<td>52.5</td>
<td>5.7</td>
<td>6.4</td>
<td>0.1</td>
<td>BDL(&lt;5)</td>
<td>BDL(&lt;5)</td>
<td>BDL(&lt;0.1)</td>
<td>BDL(&lt;0.01)</td>
<td>BDL(&lt;1)</td>
</tr>
<tr>
<td></td>
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<td>61.4</td>
<td>6.3</td>
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<td>BDL(&lt;0.01)</td>
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<tr>
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<td>BDL(&lt;0.01)</td>
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<tr>
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<td>BDL(&lt;5)</td>
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<td>7.5</td>
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<td>BDL(&lt;5)</td>
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<td>0.2</td>
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<td>BDL(&lt;5)</td>
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<td>BDL(&lt;0.01)</td>
<td>BDL(&lt;1)</td>
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**Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.**

<table>
<thead>
<tr>
<th>Location</th>
<th>Statistics</th>
<th>PM 2.5 µg/m³</th>
<th>PM 10 µg/m³</th>
<th>SO₂ µg/m³</th>
<th>NO₂ µg/m³</th>
<th>CO mg/m³</th>
<th>NH₃ µg/m³</th>
<th>O₃ µg/m³</th>
<th>VOC &amp; BTX µg/m³</th>
<th>Methane HC µg/m³</th>
<th>Non Methane HC µg/m³</th>
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<tr>
<td>Minimum</td>
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<td>5.3</td>
<td>9.5</td>
<td>0.1</td>
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<td>BDL(&lt;5)</td>
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<td>BDL(&lt;0.01)</td>
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<td>BDL(&lt;1)</td>
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<tr>
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<td>6.4</td>
<td>11.4</td>
<td>0.1</td>
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<td>BDL(&lt;5)</td>
<td>BDL(&lt;0.1)</td>
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<tr>
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<td>14.6</td>
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<td>BDL(&lt;5)</td>
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<td>BDL(&lt;0.01)</td>
<td>BDL(&lt;1)</td>
<td>BDL(&lt;1)</td>
</tr>
<tr>
<td>Minimum</td>
<td>22.3</td>
<td>41.3</td>
<td>5.1</td>
<td>9.9</td>
<td>0.1</td>
<td>BDL(&lt;5)</td>
<td>BDL(&lt;5)</td>
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<td>BDL(&lt;0.01)</td>
<td>BDL(&lt;1)</td>
<td>BDL(&lt;1)</td>
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<tr>
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<td>27.1</td>
<td>50.2</td>
<td>5.8</td>
<td>11.9</td>
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<td>BDL(&lt;5)</td>
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<tr>
<td>98th Percentile</td>
<td>31.3</td>
<td>57.5</td>
<td>6.8</td>
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</table>

**NAAQS Standard**

<table>
<thead>
<tr>
<th>PM 2.5</th>
<th>PM 10</th>
<th>SO₂</th>
<th>NO₂</th>
<th>CO</th>
<th>NH₃</th>
<th>O₃</th>
<th>VOC &amp; BTX</th>
<th>Methane HC</th>
<th>Non Methane HC</th>
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<td>60.0</td>
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<td>80.0</td>
<td>80.0</td>
<td>2.0</td>
<td>400.0</td>
<td>100.0</td>
<td>5.0</td>
<td>1.0</td>
<td>6.0</td>
</tr>
</tbody>
</table>

Source: ABC Techno Labs India Pvt. Ltd.
3.9.7 Observations

PM10: The maximum and minimum concentrations of PM10 were recorded as 71.4 µg/m³ and 41.2 µg/m³ respectively. The maximum concentration was recorded at the Ranodra (AAQ5) and the minimum concentration was recorded at Mirjapur (AAQ7). The average concentrations were ranged between 50.2 to 64.5 µg/m³.

PM2.5: The maximum and minimum concentrations for PM2.5 were recorded as 45.1 µg/m³ and 21.5 µg/m³ respectively. The maximum concentration was recorded at the Bhavda (AAQ6) and the minimum concentration was recorded at Pallano math (AAQ2). The average values were observed to be in the range of 25.1 to 30.9 µg/m³.

SO₂: The maximum and minimum SO₂ concentrations were recorded as 10.8 µg/m³ and 5.1 µg/m³. The maximum concentration was recorded at Mirjapur (AAQ7) and the minimum concentration was recorded at Karoli (AAQ1), Ranodra (AAQ5), Bhavda (AAQ6) & Pasunj (AAQ8). The average values were observed to be in the range of 5.6 µg/m³ to 6.4 µg/m³.

NOx: The maximum and minimum NOx concentrations were recorded as 21.6 µg/m³ and 6.4 µg/m³. The maximum concentration was recorded at Karoli (AAQ1) and the minimum concentration was recorded at Shiyapur (AAQ3). The average values were observed to be in the range of 9.9 to 14.8 µg/m³.

HC (methane and non-methane) and Volatile Organic Compounds (VOCs): The HC and VOCs at all the location were observed below detection limit.

The concentrations of PM10, PM2.5, SO₂, NOx, CO and other parameters are observed to be well within the standards prescribed by the Central Pollution Control Board (CPCB) for Industrial, Rural, Residential and Other area.

3.10 Noise Environment

Noise can be defined as an unwanted sound. It interferes with speech and hearing and is intense enough to damage hearing or is otherwise annoying. The definition of noise as unwanted sound implies that it has an adverse effect on human beings and their environment. Noise can also disturb wildlife and ecological system.

The main objective of monitoring of ambient noise levels was to establish the baseline noise levels in the surrounding areas and to assess the total noise level in the environment of the study area.
3.10.1 Identification of Sampling Locations

A preliminary reconnaissance survey was undertaken to identify the major noise sources in the area. The noise monitoring has been conducted at 9 locations within 1 Km of each developmental well which are presented in Table 3.11.

Table 3.11: Noise Quality monitoring stations

<table>
<thead>
<tr>
<th>Sampling Location Code &amp; Name</th>
<th>Location</th>
<th>Coordinates</th>
<th></th>
<th></th>
</tr>
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<tbody>
<tr>
<td>N1 Near PA#1</td>
<td>23° 3'1.62&quot;N 72°47'53.55&quot;E</td>
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<td></td>
<td></td>
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<tr>
<td>N2 Near PA#1 &amp; DW#4</td>
<td>23° 2'52.72&quot;N 72°48'15.83&quot;E</td>
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<td></td>
<td></td>
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<tr>
<td>N3 Near DW#1 &amp; DW#7</td>
<td>23° 2'8.19&quot;N 72°48'9.61&quot;E</td>
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<td></td>
<td></td>
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<tr>
<td>N4 Near DW#7</td>
<td>23° 1'55.48&quot;N 72°48'40.96&quot;E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N5 Near DW#2</td>
<td>23° 1'45.91&quot;N 72°48'12.13&quot;E</td>
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<td></td>
<td></td>
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<tr>
<td>N6 Near DW#5 &amp; PA#2</td>
<td>23° 1'3.88&quot;N 72°48'14.96&quot;E</td>
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<td>N7 Near DW#6</td>
<td>23° 1'15.88&quot;N 72°48'5.81&quot;E</td>
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<tr>
<td>N8 Near DW#3a</td>
<td>23° 0'2.92&quot;N 72°47'44.13&quot;E</td>
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<td></td>
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<tr>
<td>N9 Near DW#3b</td>
<td>22°59'47.98&quot;N 72°48'8.91&quot;E</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: ABC Techno Labs India Pvt. Ltd.

Figure 3.12: Ambient Noise monitoring locations
3.10.2 **Instrument Used for Sampling**

Noise levels were measured using a sound level meter. The sound level meter measures the equivalent continuous noise level (Leq) by switching to the corresponding function mode.

3.10.3 **Method of Monitoring**

Noise, in general, is sound which is composed of many frequency components of various types of loudness distributed over the audible frequency range. Equivalent sound pressure levels of day time i.e. Leq (day) and night time Leq (night) are calculated from the hourly measured noise level and compared to Ambient Noise Level Standards as per the "Noise Pollution (Regulation and Control) Rules, 2000" stipulated for daytime and night time for residential land use.

Various noise scales have been introduced to describe, in a single number, the response of an average human to a complex sound made up of various frequencies at different loudness levels. The most common and universally accepted scale is the ‘A’ weighted Scale which is measured as dB (A). This is more suitable for an audible range of 20 to 20,000 Hz. The scale has been designed to weigh various components of noise, according to the response of a human ear.

Sound Pressure Level (SPL) measurements were measured at all locations. The readings were taken for every hour for 24 hours. The day noise levels have been monitored during 6 am to 10 pm and night levels during 10 pm to 6 am at all the locations covered in a 10-km radius of the study area. The noise levels were measured once during the study period. These readings were later tabulated and the frequency distribution table was prepared. Finally, hourly and 24 hourly values for various noise parameters viz. L\text{day} and L\text{night} were calculated.

For noise levels measured over a given period of time, it is possible to describe important features of noise using statistical quantities. This is calculated using the percent of the time certain noise levels exceed the time interval. The notations for the statistical quantities of noise levels are described below:

- \(L_{10}\) is the noise level exceeded 10 percent of the time
- \(L_{50}\) is the noise level exceeded 50 percent of the time and
- \(L_{90}\) is the noise level exceeded 90 percent of the time
Equivalent Sound Pressure Level (Leq)

The Leq is the equivalent continuous sound level, which is equivalent to the same sound energy as the actual fluctuating sound measured in the same period. This is necessary because the sound from a noise source often fluctuates widely during a given period of time. This is calculated from the following equation:

\[ Leq = L_{50} + (L_{10} - L_{90})^2/60 \]

Parameters Measured During Monitoring

For noise levels measured over a given period of the time interval, it is possible to describe important features of noise using statistical quantities. This is calculated using the percent of the time, certain noise levels are exceeded during the time interval. The notation for the statistical quantities of noise levels is described below:

- **Hourly**  
  - Leq day: Equivalent noise levels between 6.00 hours to 22.00 hours.  
  - Leq night: Equivalent noise levels between 22.00 hours to 6.00 hours.

3.10.4 RESULTS

The summary of computed ambient noise level parameters like \( L_{\text{day}} \) and \( L_{\text{night}} \) are presented in Table 3.12 and compared to the standards specified by CPCB mentioned.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Location code</th>
<th>Location</th>
<th>Zone</th>
<th>Limit (as per CPCB Guidelines)</th>
<th>Observed value Leq, dB(A)</th>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>( \text{Leq dB(A)} )</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>( \text{DAY*} )</td>
<td>( \text{NIGHT**} )</td>
</tr>
<tr>
<td>1</td>
<td>N1</td>
<td>Near PA#1</td>
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<td>45</td>
</tr>
<tr>
<td>2</td>
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<td>45</td>
</tr>
<tr>
<td>3</td>
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<td>Residential</td>
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<td>45</td>
</tr>
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<td>45</td>
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<tr>
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<td>45</td>
</tr>
<tr>
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<td>Residential</td>
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<td>45</td>
</tr>
<tr>
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<td>45</td>
</tr>
<tr>
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<td>N9</td>
<td>Near DW#3b</td>
<td>Residential</td>
<td>55</td>
<td>45</td>
</tr>
</tbody>
</table>

Note: Daytime shall mean from 6.00 a.m. to 10.00 p.m.  
Night time shall mean from 10.00 p.m. to 6.00 a.m.
3.10.5 Observations

Daytime Noise Levels

Noise levels during daytime were found to be in the range 47.9 to 54.5 dB(A). The maximum noise level was observed to be 54.5 dB(A) at near well no. DW#6 (N7) and a minimum of 47.9 dB(A) was observed at near well no. PA#1 (N1).

Nighttime Noise Levels

Noise levels observed to fall in the range 40.8 to 42 dB(A) during the night time. A maximum of 42 dB(A) was observed at near well no. DW#6 (N7) and a minimum of 40.8 dB(A) was observed near well no. DW#3b (N9). Measured noise levels are observed to be in compliance with prescribed standards for ambient noise for the respective applicable categories.

3.11 Water Environment

The quality of ground and surface water is influenced by surface and sub-surface environmental conditions. The quantity and quality of water entering the underground regime is another important parameter which influences underground water quality.

Water sampling has been conducted to establish baseline water quality in the area. Water analysis was carried out for physical and chemical parameters as per the methods prescribed in IS and “Standard Methods for the Examination of Water and Wastewater...
The water samples were collected as grab samples and were analyzed for physical, chemical and biological characteristics.

### 3.11.1 Sampling Locations

The sampling locations were selected based on reconnaissance survey with the following consideration:

- Location of water courses; and
- Location of residential areas representing different activities

The details of the water sampling stations are presented in the Table 3.13.

#### Table 3.13: Water quality monitoring locations

<table>
<thead>
<tr>
<th>Location Code</th>
<th>Location</th>
<th>Geographical location</th>
<th>Type of water</th>
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</tr>
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<td>Pasunia</td>
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</tr>
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<td>Pasunj</td>
<td>23° 2'9.75&quot;N</td>
<td>72°48'9.19&quot;E</td>
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<tr>
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<td>Demaliya</td>
<td>23° 1'7.36&quot;N</td>
<td>72°49'47.94&quot;E</td>
</tr>
<tr>
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<td>Kuha</td>
<td>22°59'55.14&quot;N</td>
<td>72°47'46.00&quot;E</td>
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<td>Bhavda</td>
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<td>Chamla</td>
<td>23° 0'30.29&quot;N</td>
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Source: ABC Techno Labs India Pvt. Ltd.
Figure 3.13: Ground Water quality monitoring locations

Figure 3.14: Surface Water quality monitoring locations
Ground water samples for chemical analysis were collected in polyethylene carboys. Water samples collected for metal content were acidified with 1 ml HNO₃. Selected physico-chemical and heavy metal have been analysed for ground water quality status in the study area.

3.11.2 RESULTS

A. Ground Water

The physicochemical characteristics of ground water in the study area are presented in the Tables 3.14 and is compared with the standards (IS 10500: Indian Standards/Specifications for Drinking Water) reference values.

- **Colour:** The colour of ground water samples was Nil to 2 Hazen unit and meets the desirable limit of drinking water standards.
- **Odour:** Ground water samples were found odourless.
- **pH:** The pH value of all ground water samples ranges from 7.47 to 7.94 and meets the desirable limit of drinking water standards.
- **Turbidity:** The turbidity of water samples ranges from BDL (<0.5 NTU) to 1.6 NTU and meets permissible limit at all the ground water sampling locations.
- **Total Dissolved Solids (TDS):** The TDS in ground water samples range from 217 to 1512 mg/l and meets permissible limit of 2000 mg/l in the ground water sampling locations.
- **Total Hardness:** The total hardness of ground water samples range between 140 mg/l to 620 mg/l, and meet the permissible limit of drinking water standards except GW4.
- **Total Alkalinity:** Total alkalinity in ground water samples ranges from 124 mg/l to 290 mg/l and meets permissible limit of 600 mg/l at all the ground water sampling locations.
- **Chloride:** The chloride content in ground water samples range from 55 mg/l to 635 mg/l and meets permissible limit of 1000 mg/l at the ground water sampling locations.
- **Iron:** The iron content in all ground water sample ranges from BDL(< 0.05 mg/l) to 0.3 mg/l and meets acceptable limit of 0.3 mg/l at all the ground water sampling locations.
- **Calcium:** The Calcium content in ground water samples range from 26 mg/l to 112 mg/l and meets permissible limit of 200 mg/l at the ground water sampling locations.

- **Magnesium:** The Magnesium content in ground water samples range from 18 mg/l to 83 mg/l and meets permissible limit of 100 mg/l at the ground water sampling locations.

- **Sulphate:** Sulphate content in ground water sample ranges from 6 mg/l to 98 mg/l and meets the acceptable limit of 200 mg/l at all the ground water sampling locations.

- **Nitrate:** Nitrate content in ground water samples ranges from BDL (1 mg/l) to 35 mg/l and meets the acceptable limit of 45 mg/l at all the ground water sampling locations.

- **Fluoride:** Fluoride content in ground water samples ranges from 0.1 mg/l to 1.27 mg/l and meets the permissible limit of drinking water standards.

- **Manganese:** Manganese content in ground water samples found to be Below Detection Level (<0.02 mg/l).

- **Sodium:** Sodium content in ground water samples ranges from 32 mg/l to 306 mg/l.

- **Potassium:** Potassium content in ground water samples ranges from 3 mg/l to 12 mg/l.

- **Zinc:** Zinc content in ground water samples ranges from 0.05 mg/l to 0.24 mg/l and meets the acceptable limit 5 mg/l at all the ground water sampling locations.

- **Lead:** Lead content in ground water samples found to be Below Detection Level (<0.01 mg/l) at all the ground water sampling locations.

- **Total Coliform:** Total coliform found to present in GW1, GW2, GW3, GW7, GW8, GW9 which doesn’t meet the IS 10500:2012 standards for drinking water.

- **Other Parameters:** Aluminium, Selenium, Phenolic Compounds, Copper, Cadmium, Mercury, Nickel, Total Arsenic, Total Chromium, and Cyanide in all ground water samples were found below detection limit (BDL).
Conclusions

The results of ground water samples were compared to Indian Standard Specification of drinking water IS: 10500:2012. Analysed parameters meet permissible limits for drinking standards except at the GW6 but not meet the acceptable limits. Only GW5 can be considered suitable for drinking purposes. Other ground water samples needs filtration and other treatment before usage. Presence of Total coliform in all the ground water samples doesn’t meet the IS 10500:2012 standards for drinking water.
### Table 3.14: Results for Ground Water Analysis
#### Part 1

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## Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.

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<th>GW7</th>
<th>GW8</th>
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Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.

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<td>&lt; 2</td>
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</table>

Source: ABC Techno Labs India Pvt. Ltd.

Date of sampling: 22nd June 2018
B. Surface Water

The collected surface water samples were analyzed and results of surface water analysis are given in Table 3.15.

- **Colour:** The colour of surface water samples was found in the range of 8 Hazen unit to 55 Hazen unit.
- **Odour:** Surface water samples were found odourless except SW2.
- **Turbidity:** The turbidity of surface water samples was found in the range 4.1 to 14.1 NTU.
- **pH:** The pH value of all surface water samples ranges from 6.66 to 7.3.
- **Electrical Conductivity:** Electrical conductivity in surface water samples ranges from 270 μS/cm to 1680 μS/cm.
- **Total Dissolved Solids (TDS):** The TDS in surface water samples range from 304 to 980 mg/l.
- **Total Hardness:** The total hardness of surface water samples range between 130 mg/l to 330 mg/l.
- **Iron:** The iron content in all surface water sample ranges from 1.3 to 5.46 mg/l.
- **Chloride:** The chloride content in surface water samples range from 68 mg/l to 457 mg/l.
- **Sulphate:** Sulphate content in surface water sample ranges from 8 to 76 mg/l.
- **Nitrate:** Nitrate content in surface water samples ranges from 10 mg/l to 29 mg/l.
- **Calcium:** The Calcium content in surface water samples range from 24 mg/l to 56 mg/l.
- **Magnesium:** The Magnesium content in surface water samples range from 12 mg/l to 46 mg/l.
- **Fluoride:** Fluoride content in surface water samples ranges from 0.32 mg/l to 0.56 mg/l.
- **Sodium:** Sodium content in surface water samples ranges from 54 mg/l to 224 mg/l.
- **Potassium:** Potassium content in surface water samples ranges from 5.6 mg/l to 130 mg/l.
- **Zinc:** Zinc content in all surface water samples found to be 0.15 mg/l to 1.63 mg/l.
Bio-chemical Oxygen Demand (BOD): The BOD level of the SW samples found to be in the range between 2.1 mg/l to 8.7 mg/l.

Chemical Oxygen Demand (COD): The COD level of the SW samples found to be in the range between 14 mg/l to 42 mg/l.

Dissolved Oxygen (DO): The DO level of the SW samples found to be in the range between 3.5 mg/l to 6.3 mg/l.

Total Coliform Count: Total Coliform Count in surface water samples ranges from 17 to 2500 MPN/100ml.

Faecal Coliform: Faecal Coliform in surface water samples ranges from 4 to 262 MPN/100ml.
<table>
<thead>
<tr>
<th>S.No</th>
<th>Parameters</th>
<th>Unit</th>
<th>Test method</th>
<th>SW1</th>
<th>SW2</th>
<th>SW3</th>
<th>SW4</th>
<th>SW5</th>
<th>Tolerance Limits For Inland Surface Waters, (IS: 2296-1982) CLASS – C</th>
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<td>24</td>
<td>Dissolved Oxygen as O2</td>
<td>mg/l</td>
<td>IS:3025:Part-38:1989 (Reaff:2003)</td>
<td>6.3</td>
<td>4.8</td>
<td>4.8</td>
<td>5</td>
<td>3.5</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>25</td>
<td>Chemical Oxygen Demand</td>
<td>mg/l</td>
<td>IS:3025:Part-58:2006</td>
<td>14</td>
<td>28</td>
<td>40</td>
<td>33</td>
<td>42</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>26</td>
<td>Bio-Chemical Oxygen Demand at 27°C for 3 days</td>
<td>mg/l</td>
<td>IS:3025:Part-44:1993 (Reaff:2003)</td>
<td>2.1</td>
<td>4.9</td>
<td>6.2</td>
<td>5.8</td>
<td>8.7</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>27</td>
<td>Aluminum as Al</td>
<td>mg/l</td>
<td>APHA 22nd EDN -3500-Al-B 2012</td>
<td>BDL (&lt;0.05)</td>
<td>BDL (&lt;0.05)</td>
<td>BDL (&lt;0.05)</td>
<td>BDL (&lt;0.05)</td>
<td>BDL (&lt;0.05)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>S.No</td>
<td>Parameters</td>
<td>Unit</td>
<td>Test method</td>
<td>SW1</td>
<td>SW2</td>
<td>SW3</td>
<td>SW4</td>
<td>SW5</td>
<td>Tolerance Limits For Inland Surface Waters, (IS: 2296-1982) CLASS – C</td>
<td>Tolerance Limits For Inland Surface Waters, (IS: 2296-1982) CLASS – E</td>
</tr>
<tr>
<td>------</td>
<td>------------------------------------------</td>
<td>-------</td>
<td>------------------------------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>-------------------------------------------------</td>
<td>-------------------------------------------------</td>
</tr>
<tr>
<td>28</td>
<td>Phenolic compounds as Phenol</td>
<td>mg/l</td>
<td>APHA 22nd EDN 5530 B,C,D</td>
<td>BDL (&lt;0.001)</td>
<td>BDL (&lt;0.001)</td>
<td>BDL (&lt;0.001)</td>
<td>BDL (&lt;0.001)</td>
<td>BDL (&lt;0.001)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Copper as Cu</td>
<td>mg/l</td>
<td>IS:3025 Part 42 (Reaff:2003)</td>
<td>BDL (&lt;0.03)</td>
<td>BDL (&lt;0.03)</td>
<td>BDL (&lt;0.03)</td>
<td>BDL (&lt;0.03)</td>
<td>BDL (0.15)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Mercury as Hg</td>
<td>mg/l</td>
<td>APHA 22nd EDN -3112B</td>
<td>BDL (&lt;0.001)</td>
<td>BDL (&lt;0.001)</td>
<td>BDL (&lt;0.001)</td>
<td>BDL (&lt;0.001)</td>
<td>BDL (&lt;0.001)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>Cadmium as Cd</td>
<td>mg/l</td>
<td>APHA 22nd EDN -3113 B</td>
<td>BDL (&lt;0.003)</td>
<td>BDL (&lt;0.003)</td>
<td>BDL (&lt;0.003)</td>
<td>BDL (&lt;0.003)</td>
<td>BDL (&lt;0.003)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>Selenium as Se</td>
<td>mg/l</td>
<td>APHA 22nd EDN -3113 B</td>
<td>BDL (&lt;0.01)</td>
<td>BDL (&lt;0.01)</td>
<td>BDL (&lt;0.01)</td>
<td>BDL (&lt;0.01)</td>
<td>BDL (&lt;0.01)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>Total Arsenic as As</td>
<td>mg/l</td>
<td>APHA 22nd EDN -3113 B</td>
<td>BDL (&lt;0.01)</td>
<td>BDL (&lt;0.01)</td>
<td>BDL (&lt;0.01)</td>
<td>BDL (&lt;0.01)</td>
<td>BDL (&lt;0.01)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>Cyanide as CN</td>
<td>mg/l</td>
<td>APHA 22nd EDN -4500-CN E</td>
<td>BDL (&lt;0.05)</td>
<td>BDL (&lt;0.05)</td>
<td>BDL (&lt;0.05)</td>
<td>BDL (&lt;0.05)</td>
<td>BDL (&lt;0.05)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>Lead as Pd</td>
<td>mg/l</td>
<td>APHA 22nd EDN -3113 B</td>
<td>BDL (&lt;0.01)</td>
<td>0.013</td>
<td>BDL (&lt;0.01)</td>
<td>BDL (&lt;0.01)</td>
<td>BDL (&lt;0.01)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>Zinc as Zn</td>
<td>mg/l</td>
<td>APHA 22nd EDN -3111 B</td>
<td>0.15</td>
<td>0.396</td>
<td>0.71</td>
<td>0.378</td>
<td>1.63</td>
<td></td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>Total Chromium as Cr</td>
<td>mg/l</td>
<td>APHA 22nd EDN -3113 B</td>
<td>BDL (&lt;0.02)</td>
<td>BDL (&lt;0.02)</td>
<td>BDL (&lt;0.02)</td>
<td>BDL (&lt;0.02)</td>
<td>BDL (&lt;0.02)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>Nickel</td>
<td>mg/l</td>
<td>APHA 22nd EDN -3113 B</td>
<td>BDL (&lt;0.02)</td>
<td>BDL (&lt;0.02)</td>
<td>BDL (&lt;0.02)</td>
<td>BDL (&lt;0.02)</td>
<td>BDL (&lt;0.02)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S.No</td>
<td>Parameters</td>
<td>Unit</td>
<td>Test method</td>
<td>SW1</td>
<td>SW2</td>
<td>SW3</td>
<td>SW4</td>
<td>SW5</td>
<td>Tolerance Limits For Inland Surface Waters, (IS: 2296-1982) CLASS – C</td>
<td>Tolerance Limits For Inland Surface Waters, (IS: 2296-1982) CLASS – E</td>
</tr>
<tr>
<td>------</td>
<td>--------------</td>
<td>---------------</td>
<td>--------------------------------------------------</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>--------------------------------------------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>39</td>
<td>Total Coliform</td>
<td>MPN/100ml</td>
<td>IS 10500 – 1622 (1981) (Reaff – 2014)</td>
<td>50</td>
<td>170</td>
<td>17</td>
<td>2200</td>
<td>2500</td>
<td>5000</td>
<td>-</td>
</tr>
<tr>
<td>40</td>
<td>E coli</td>
<td>MPN/100ml</td>
<td>IS 10500 – 1622 (1981) (Reaff – 2014)</td>
<td>7</td>
<td>33</td>
<td>4</td>
<td>260</td>
<td>262</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Source: ABC Techno Labs India Pvt. Ltd.

Date of sampling: 22nd June 2018
3.12 Soil Environment

3.12.1 Soil analysis

The present study of the soil quality establishes the baseline characteristics and this will help in future in identifying the incremental concentrations if any, due to the operation of the proposed development drilling of wells. The sampling locations have been identified with the following objectives;

- To determine the baseline soil characteristics of the study area and
- To determine the impact of the proposed development drilling of wells in CB-ONN-2010/8 block on soil characteristics

Seven locations within the study area were selected for soil sampling. At each location, soil samples were collected from three different depths viz., 30 cm, 60 cm and 100 cm below the surface. The samples were analyzed for physical and chemical characteristics. The details of the soil sampling location are presented in Table 3.16. The results are presented in Table 3.17 and compared with Standard Soil Classification presented in Table 3.18.

Table 3.16: Soil Sampling Locations

<table>
<thead>
<tr>
<th>Location Code</th>
<th>Sample location</th>
<th>Geographical location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Latitude</td>
</tr>
<tr>
<td>S1</td>
<td>Near PA#1</td>
<td>23° 2'53.05&quot;N</td>
</tr>
<tr>
<td>S2</td>
<td>Pasunj</td>
<td>23° 2'10.73&quot;N</td>
</tr>
<tr>
<td>S3</td>
<td>Pasunia</td>
<td>23° 1'44.28&quot;N</td>
</tr>
<tr>
<td>S4</td>
<td>Near PA#2</td>
<td>23° 1'0.92&quot;N</td>
</tr>
<tr>
<td>S5</td>
<td>Kuha</td>
<td>22°59'55.02&quot;N</td>
</tr>
<tr>
<td>S6</td>
<td>Vadod</td>
<td>22°58'18.01&quot;N</td>
</tr>
<tr>
<td>S7</td>
<td>Chandial</td>
<td>22°59'42.23&quot;N</td>
</tr>
<tr>
<td>S8</td>
<td>Chamla</td>
<td>23° 0'26.25&quot;N</td>
</tr>
</tbody>
</table>

Source: ABC Techno Labs India Pvt. Ltd.

3.12.2 Results

The results of the soil analysis are tabulated in Table 3.17. Standard soil classification is given in Table 3.18.
### Table 3.17: Soil Quality Results

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Parameters</th>
<th>Unit</th>
<th>Test Method</th>
<th>S1</th>
<th>S2</th>
<th>S3</th>
<th>S4</th>
<th>S5</th>
<th>S6</th>
<th>S7</th>
<th>S8</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Moisture</td>
<td>%</td>
<td></td>
<td>1.00</td>
<td>0.86</td>
<td>1.23</td>
<td>1.15</td>
<td>1.17</td>
<td>1.22</td>
<td>1.3</td>
<td>1.27</td>
</tr>
<tr>
<td>3</td>
<td>Porosity</td>
<td>%</td>
<td></td>
<td>33.8</td>
<td>31.7</td>
<td>33.6</td>
<td>28.7</td>
<td>35.7</td>
<td>33.5</td>
<td>36.4</td>
<td>34.5</td>
</tr>
<tr>
<td>4</td>
<td>Bulk Density</td>
<td>g/cc</td>
<td>FAO Chapter 3, ABCTL/SOIL/SOP 1</td>
<td>0.65</td>
<td>0.73</td>
<td>0.77</td>
<td>0.67</td>
<td>0.81</td>
<td>0.73</td>
<td>0.6</td>
<td>0.75</td>
</tr>
<tr>
<td>5</td>
<td>Electrical conductivity (1:5 Soil Suspension)</td>
<td>mS/cm</td>
<td>IS - 14684:1999, Reaff:2008</td>
<td>165.5</td>
<td>177.4</td>
<td>174.5</td>
<td>192.5</td>
<td>190.2</td>
<td>176.5</td>
<td>187</td>
<td>188</td>
</tr>
<tr>
<td>6</td>
<td>Available Nitrogen</td>
<td>kg/ha</td>
<td>FAO Chapter 3, ABCTL/SOIL/SOP 2</td>
<td>125</td>
<td>94</td>
<td>66</td>
<td>105</td>
<td>114</td>
<td>124</td>
<td>116</td>
<td>123</td>
</tr>
<tr>
<td>7</td>
<td>Available Phosphorous</td>
<td>kg/ha</td>
<td>FAO Chapter 3, ABCTL/SOIL/SOP 2</td>
<td>1040</td>
<td>1621</td>
<td>1852</td>
<td>1688</td>
<td>1618</td>
<td>1892</td>
<td>1687</td>
<td>1890</td>
</tr>
<tr>
<td>8</td>
<td>Available Potassium</td>
<td>kg/ha</td>
<td>FAO Chapter 3, ABCTL/SOIL/SOP 2</td>
<td>1040</td>
<td>1621</td>
<td>1852</td>
<td>1688</td>
<td>1618</td>
<td>1892</td>
<td>1687</td>
<td>1890</td>
</tr>
<tr>
<td>9</td>
<td>Exchangeable Calcium as Ca</td>
<td>m.eq/100g</td>
<td>FAO Chapter 3, ABCTL/SOIL/SOP 4</td>
<td>7.8</td>
<td>72.8</td>
<td>38.9</td>
<td>1.07</td>
<td>1.03</td>
<td>4.51</td>
<td>9.85</td>
<td>35.5</td>
</tr>
<tr>
<td>10</td>
<td>Exchangeable Magnesium as Mg</td>
<td>m.eq/100g</td>
<td>FAO Chapter 3, ABCTL/SOIL/SOP 4</td>
<td>9.2</td>
<td>10.6</td>
<td>11</td>
<td>12.9</td>
<td>11.3</td>
<td>8.95</td>
<td>7.3</td>
<td>10.7</td>
</tr>
<tr>
<td>11</td>
<td>Exchangeable Sodium as Na</td>
<td>m.eq/100g</td>
<td>FAO Chapter 3, ABCTL/SOIL/SOP 4</td>
<td>3.05</td>
<td>6.15</td>
<td>5.96</td>
<td>4.55</td>
<td>4.04</td>
<td>5.2</td>
<td>4.15</td>
<td>5.28</td>
</tr>
<tr>
<td>12</td>
<td>Organic matter</td>
<td>(%)</td>
<td>IS 2720 (Part 22):1972, Reaff:2010</td>
<td>0.27</td>
<td>0.18</td>
<td>0.2</td>
<td>0.32</td>
<td>0.37</td>
<td>0.24</td>
<td>0.31</td>
<td>0.27</td>
</tr>
<tr>
<td>13</td>
<td>Texture Classification</td>
<td>-</td>
<td>Robinson Pipette Method</td>
<td>Silt Loam</td>
<td>Silt Loam</td>
<td>Silt Loam</td>
<td>Silty Clay Loam</td>
<td>Silty Clay Loam</td>
<td>Sandy loam</td>
<td>Silty Clay Loam</td>
<td>Loam</td>
</tr>
<tr>
<td>14</td>
<td>Sand</td>
<td>(%)</td>
<td></td>
<td>53.3</td>
<td>48.2</td>
<td>57.3</td>
<td>52.2</td>
<td>52</td>
<td>62</td>
<td>57</td>
<td>46.1</td>
</tr>
<tr>
<td>15</td>
<td>Clay</td>
<td>(%)</td>
<td></td>
<td>24.1</td>
<td>22.2</td>
<td>19.6</td>
<td>30.4</td>
<td>28.4</td>
<td>20.4</td>
<td>24.6</td>
<td>26.8</td>
</tr>
<tr>
<td>16</td>
<td>Silt</td>
<td>(%)</td>
<td></td>
<td>22.6</td>
<td>29.6</td>
<td>23.1</td>
<td>17.4</td>
<td>19.6</td>
<td>17.6</td>
<td>18.4</td>
<td>27.1</td>
</tr>
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</table>

Source: ABC Techno Labs India Pvt. Ltd.

Date of sampling: 24th June 2018
Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.

### Table 3.18: Standard Soil Classification

<table>
<thead>
<tr>
<th>Chemical Parameters</th>
<th>Very Low</th>
<th>Low</th>
<th>Moderate</th>
<th>High</th>
<th>Very High</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>&lt;4, very Strongly Acidic</td>
<td>4-5, Strongly Acidic</td>
<td>5-8, Ideal for Plant Growth</td>
<td>8-9 Strongly Basic</td>
<td>&gt;9 Very Strongly Basic</td>
</tr>
<tr>
<td>Electrical conductivity (μS/cm)</td>
<td>&lt;2000, Non-saline</td>
<td>2000-4000 Saline</td>
<td>4000-8000 Moderately Saline</td>
<td>8000-16000 Highly Saline</td>
<td>&gt;16000 Extremely Saline</td>
</tr>
<tr>
<td>Total Nitrogen (%)</td>
<td>&lt;0.05 Very Low</td>
<td>0.05-0.15 Low</td>
<td>0.15-0.25 Moderate</td>
<td>0.25-0.5 High</td>
<td>&gt;0.5 Very High</td>
</tr>
<tr>
<td>Total Phosphorous (mg/kg)</td>
<td>&lt;5 Very Low</td>
<td>5-10 Low</td>
<td>10-30 Moderate</td>
<td>30-60 High</td>
<td>&gt;60 Very High</td>
</tr>
<tr>
<td>Sodium (mg/kg)</td>
<td>-</td>
<td>&lt;200 Non Sodic</td>
<td>200-500 Moderate</td>
<td>&gt;500 Sodic</td>
<td></td>
</tr>
<tr>
<td>Potassium (mg/kg)</td>
<td>-</td>
<td>&lt;150 Low</td>
<td>150-250 Moderate</td>
<td>250-800 High</td>
<td>&gt;800 Very High</td>
</tr>
<tr>
<td>Calcium (mg/kg)</td>
<td>-</td>
<td>&lt;1000 Low</td>
<td>1000-2000 Moderate</td>
<td>&gt;2000 High</td>
<td></td>
</tr>
<tr>
<td>Magnesium (mg/kg)</td>
<td>&lt;40 Very Low</td>
<td>40-100 Low</td>
<td>100-300 Moderate</td>
<td>&gt;300 High</td>
<td></td>
</tr>
<tr>
<td>% Organic Matter</td>
<td>0.5-1.0 Very Low</td>
<td>1.0-2.0 Low</td>
<td>2.0-3.0 Moderate</td>
<td>3.0-5.0 High</td>
<td>&gt;5 Very High</td>
</tr>
</tbody>
</table>

#### 3.12.3 Observation

- The soil results were compared to soil standards. It has been observed that the pH of the soil was ranging from 6.57 to 7.33 indicating the soils are Moderate in nature. The conductivity of the soil ranges from 0.13 to 0.25 mS/cm. Since the EC value is more than 2000 μS/cm, the soil is said to be saline in nature.

- The texture of the soil sample is predominantly Silty Clay Loam in most of the places with Silt Loam in some locations. Sand percentage ranges from 52.2% to 62%.

- Soil organic content varied from 0.2 to 0.37 %, which indicates the very low level of organic matter.

- The available nitrogen content ranges between 165.5 to 192.5 kg/Ha in the locality and the value of phosphorus content varies between 66 to 125 kg/Ha. This indicates that the soil has very high quantities of Nitrogen and Phosphorus.
The potassium content varies from 1040 to 1892 kg/Ha, which indicates that the soils have very high quantities of potassium.

From the above observations, it was found that the soil in the Study area shows moderate fertility.

3.13 ECOLOGICAL ENVIRONMENT

Ecosystem shows complex inter-relationships between biotic and abiotic components leading to dependence, competition and mutualism. Biotic components comprise both plant and animal communities, interacting not only within and between themselves but also with the abiotic components of the environment. The map showing the biogeographic provinces of India is shown in Figure 3.13.

Generally, biological communities are good indicators of climatic and edaphic factors because of their strong relationships with them. The studies on the biological aspects of the ecosystem are important in Environment Impact Assessment studies for the suitability of natural flora & fauna. Information on the impact of environment stress on the community structure serves as an inexpensive and efficient early warning system to check the damage on a particular ecosystem. The biological environment includes mainly terrestrial and aquatic ecosystem.

A change in the composition of biotic communities under stress is reflected through a change in the distribution pattern, density, diversity, frequency, dominance and abundance of natural species of fauna and flora existing in the ecosystem. These changes over a span of times can be quantified and related to the existing environment.

3.13.1 OBJECTIVES OF ECOLOGICAL STUDIES

The objectives of ecological study during the study period of EIA study may be outlined as follows:

- To characterize the environmental components like land, water, flora and fauna;
- To understand their present status;
- To understand carrying capacity of the ecosystem;
- To assess present bio-diversity; and
- To identify susceptible and sensitive areas.

This study has been carried out during the summer season during June 2018 of study period for the purpose of providing an independent and comprehensive baseline.
assessment of the flora, terrestrial vertebrate, aquatic fauna and associated habitat values of the site and within 1 km radius of each well and a subsequent assessment of potential ecological impacts. The study area falls under semi arid category as far as the Indian biogeographical zones (Rodger, Panwar, Mathur 2000) are concerned. Under the biogeographical provinces, the study area falls under the category of 4B- Gujarat Rajputana. The study area does not have any forest land or permanent natural vegetation and the main land use feature of the study area is comprised habitation and cultivating lands. From the primary observation, the tree species recorded in the plantation area were Acacia nilotica, Azadirachta indica, Acacia leucophloea, Cocos nucifera, Cordia gharaf, Dendrocalamus strictus, Delonix regia etc.

Figure 3.15: Map showing the Bio-geographic Provinces of India

The detailed ecological assessment of the study area has been carried out with the following objectives:
• To establish the present status of ecological conditions surrounding the well location and block;
• To study the existing anthropogenic stresses on the prevailing ecosystem.
• To identify and predict the likely impacts on the local ecosystem from the proposed development drilling of wells activities;
• To list out floral species, terrestrial vertebrate and aquatic flora and fauna present within the study area, and significance status under The Wildlife (Protection) Act, 1972;
• To define ecological/conservation status of each species as per IUCN categories (Red Data List).
• To formulate mitigatory measures and a sustainable Environmental Management Plan (EMP) basing upon the likely impacts.

During survey, following aspects were considered for ecological studies:
• Assessment of present status of flora and fauna;
• Identification of rare and endangered species of plants and animals (if any);
• Identification of ecologically sensitive areas within the study area;
• Assessment of migratory route of wildlife (if any); and
• Assessment of Aquatic Ecology with specific reference to aquatic birds and fishery resources.

### 3.13.2 Methodology Adopted for the Study

Terrestrial investigations for flora and fauna records were collected by random field survey and a checklist was prepared. During field survey, discussions with the local people were carried-out to collect information related to local biodiversity in and around the villages. The ecological status of the study area has been assessed based on the following methodology:

• Primary field surveys to establish primary baseline of the study area;
• Compilation of secondary information available in published literatures/ working plan was referred from State Forest Department.
• Site Verification and finalization in consultation with Project proponent, local inhabitants.
• Vegetation analysis through quadrate method using sampling plots of 20m x 20m.
- 20m X 20m for tree species (record trees >20 cm in GBHOB /species);
- 5m X 5m [four plots] was laid along diagonals wherein all the shrubs recorded.
- 1m X 1m [five plots], one at the centre and four at one per quadrate] was laid and herbs, grasses in five plots to be noted.

### Protocol for Sampling through Quadrates Method

The standard method chosen for the assessment of plant diversity involves the use of square vegetation quadrates ('plots'). These quadrates were used to measure most vegetation attributes in most vegetation types. Quadrates were marked by pegs or sometimes by grid system.

The study area is demarcated as 1 km surrounding well locations based on the MoEF&CC guidelines. After demarcation, the areas which are approximately true representative of the whole area, and were sampled for the identification of plant and animal species.

#### A. Floral Study

The assessment of the flora of the study area is done by an extensive field survey of the area.

- Plants species were identified based on their specific diagnostics characters of family, genus and species using available floral, other related literature.
- Besides the identification of plant species, information was collected on the vernacular names and uses of plants made by local inhabitants.
- Qualitative analysis of vegetation is made by two different methods such as floristic (by simple studying various genera and species of various plant groups i.e. herbs, shrubs, trees etc).

#### B. Phyto-sociology

A nested quadrates technique was used for sampling the vegetation. All the plots sampled were representative of most common types, sampling 20m x 20m for trees and 5m x 5m for shrubs, 1m x 1m for herbs square meter quadrates were laid. Selection of sites for sampling of vegetation is done by random sampling procedure. However, in general to study the phytosociological attributes, quadrates of 20 m × 20 m size for tree species are randomly laid out at each site at different elevations. Then the observation on the following parameters is recorded:
1. Name of the species.

2. Number of the occurrence of each species in each quadrat.

The field data for phytosociological studies was collected in the study area. Vegetation data was quantitatively analyzed for frequency, density, and dominance using standard methodologies. The relative values of frequency, density, and dominance of all the recorded species was summed up to represent Importance Value Index (IVI). Not only IVI facilitates comparison between species of a community, but also the data collected on dispersion, number and cover can be profitably used in comparing the vegetation structure of two or more stands or of the same stand over a period of time. Vegetation structure with respect of varying environmental factors can also be studied through such studies in sets of varying environmental conditions. The IVI was determined as the sum of the relative frequency, relative density and relative dominance. It thus incorporate three important parameters that measures of productivity and diversity of every species therefore.

\[ IVI = \text{Relative frequency} + \text{Relative density} + \text{Relative dominance} \]

C. Faunal Study

Ground surveys are carried out by trekking the study area for identification of important animal groups such as birds, mammals and reptiles for sampling of animals through the following methods.

- For sampling birds/ avifauna ‘point sampling’ along the fixed transects (foot trails) were done to record all the species of birds with the help of binoculars; field guides and photography for more than 1 hour on each transect (n=4).
- For sampling mammals, ‘direct count on open width (20 m) transect’ were used on the same transects. Besides, information on recent sightings/records of mammals by the locals was also collected from the study areas.
- ‘Reptiles’ mainly lizards were sampled by ‘direct count on open width transects’.
- Secondary information collected from local villagers, published government data etc.

- List of the endangered and endemic species as per the schedule of The Wildlife Protection Act, 1972
Emphasis is given to identify avifauna and mammals to determine the presence and absence of Schedule-1 species, listed in The Wildlife Protection Act 1972, as well as in Red List of IUCN. Various methods used for study animals are as follows:

1. Point Survey Method: Observations were made at each site for 15-20 min duration.

2. Road Side Counts: The observer travelled by motor vehicles from site to site and all sightings were recorded.

### 3.13.3 Sampling Locations

The ecology and diversity survey was conducted in 8 sampling locations within the 2 blocks near the well locations. It is observed that human settlements present within the block area and many of villages had ponds harboring moderate diversity of water birds. During site assessment several floral species encountered within the block area. The Following species were enlisted within the block area during the field visits as given in Table 3.19.

#### Table 3.19: Details of locations for plot survey

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Name of village</th>
<th>Plot No.</th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Near PA#1 well</td>
<td>EB1</td>
<td>23° 2'56.19&quot;N</td>
<td>72°48'24.69&quot;E</td>
</tr>
<tr>
<td>2</td>
<td>Near Kodrahi</td>
<td>EB2</td>
<td>23° 2'45.40&quot;N</td>
<td>72°49'27.31&quot;E</td>
</tr>
<tr>
<td>3</td>
<td>Near DW#1 &amp; DW#7 well</td>
<td>EB3</td>
<td>23° 2'2.45&quot;N</td>
<td>72°48'28.20&quot;E</td>
</tr>
<tr>
<td>4</td>
<td>Near DW#2 well</td>
<td>EB4</td>
<td>23° 1'41.08&quot;N</td>
<td>72°48'12.63&quot;E</td>
</tr>
<tr>
<td>5</td>
<td>Near PA#2 well</td>
<td>EB5</td>
<td>23° 0'58.77&quot;N</td>
<td>72°48'38.43&quot;E</td>
</tr>
<tr>
<td>6</td>
<td>Near Pasunia</td>
<td>EB6</td>
<td>23° 1'46.89&quot;N</td>
<td>72°49'17.69&quot;E</td>
</tr>
<tr>
<td>7</td>
<td>Near Kuha</td>
<td>EB7</td>
<td>22°59'52.26&quot;N</td>
<td>72°47'47.50&quot;E</td>
</tr>
<tr>
<td>8</td>
<td>Near Chandial</td>
<td>EB8</td>
<td>22°59'27.73&quot;N</td>
<td>72°49'16.68&quot;E</td>
</tr>
</tbody>
</table>

Source: ABC Techno Labs India Pvt. Ltd.

### 3.13.4 Flora in the Study Area

The type of soil varied from yellow brown to reddish-dark brown and silty in nature. Apart from agriculture locals of the all the villages were involved in livestock keeping and each of the individual had a substantial number of cattle. However there is no sanctuary or national park or reserve/ protected forest within study area of 10 Km radius. There is no notified/ protected ecologically sensitive area including national park, sanctuary, Elephant/ Tiger reserves existing in the study area covering 10 Km radial distance.

Most of the block area is covered with agriculture lands and the dominant agriculture crops in these region are Rice, cotton, Tomato, Wheat and Ricinus.
Dominant tree species in the farmland was dominated *Acacia nilotica, Acacia auriculiformis, Azadirachta indica, Ficus religiosa*; Trees in the study area are restricted to homestead/farmland/road side plantation.

Most dominant shrubs in the core zone and buffer zone were *Nerium indicum, Calotropis procera, Datura metel, Prosopis juliflora, Mimosa hamata*. Among the herb species observed are *Achyranthes aspera, Cassia tora, Commelina benghalensis, Cynodon dactylon, Typha angustata* etc.

The list of flora observed in the buffer zone is given below:

**Table 3.20: List of Flora observed in the study area**

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Scientific Name</th>
<th>Local name</th>
<th>Family</th>
<th>IUCN Conservation Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><em>Acacia nilotica</em></td>
<td>Babool</td>
<td>Mimosaceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>2</td>
<td><em>Acacia auriculiformis</em></td>
<td>Khair</td>
<td>Fabaceae</td>
<td>Least Concern</td>
</tr>
<tr>
<td>3</td>
<td><em>Ziziphus mauritiana</em></td>
<td>Ber</td>
<td>Rhamnaceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>4</td>
<td><em>Acacia jacomorbi</em></td>
<td>kher</td>
<td>Fabaceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>5</td>
<td><em>Azadirachta indica</em></td>
<td>Neem</td>
<td>Meliaceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>6</td>
<td><em>Ailanthus excelsa</em></td>
<td>Araduso</td>
<td>Simaroubaceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>7</td>
<td><em>Salvadora oleoides</em></td>
<td>Pilu</td>
<td>Salvadoraceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>8</td>
<td><em>Emblica officinalis</em></td>
<td>Ambala</td>
<td>Phyllanthaceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>9</td>
<td><em>Mangifera indica</em></td>
<td>Aam</td>
<td>Anacardiaceae</td>
<td>Data Deficient</td>
</tr>
<tr>
<td>10</td>
<td><em>Polyalthia longifolia</em></td>
<td>Debadaru</td>
<td>Anonaceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>11</td>
<td><em>Plumeria rubra</em></td>
<td>Golenchi</td>
<td>Apocynaceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>12</td>
<td><em>Cocos nucifera</em></td>
<td>Naariyal</td>
<td>Areaceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>13</td>
<td><em>Bombax ceiba</em></td>
<td>Sawar</td>
<td>Bombacaceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>14</td>
<td><em>Delonix regia</em></td>
<td>gulmoha</td>
<td>Ceasalpiniaeae</td>
<td>Least Concern</td>
</tr>
<tr>
<td>15</td>
<td><em>Cassia fistula</em></td>
<td>Amaltas</td>
<td>Ceasalpiniaeae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>16</td>
<td><em>Tamarindus indica</em></td>
<td>Mange</td>
<td>Fabaceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>17</td>
<td><em>Peltophorum pterocarpum</em></td>
<td>Peela gulmohar</td>
<td>Fabaceae</td>
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</tr>
<tr>
<td>18</td>
<td><em>Carica papaya</em></td>
<td>Papaiya</td>
<td>Caricaceae</td>
<td>Data Deficient</td>
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<tr>
<td>19</td>
<td><em>Terminalia catappa</em></td>
<td>Badamalili</td>
<td>Combretaceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>20</td>
<td><em>Casuarina equisetifolia</em></td>
<td>Junglisaru</td>
<td>Casuarinaceae</td>
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</tr>
<tr>
<td>21</td>
<td><em>Anogeissus latifolia</em></td>
<td>Dhaura</td>
<td>Combretaceae</td>
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</tr>
<tr>
<td>22</td>
<td><em>Thespesia populnea</em></td>
<td>Paras pipal</td>
<td>Malvaceae</td>
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</tr>
<tr>
<td>23</td>
<td><em>Albizia procera</em></td>
<td>Siris</td>
<td>Fabaceae</td>
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</tr>
<tr>
<td>24</td>
<td><em>Acacia catechu</em></td>
<td>Mulga</td>
<td>Fabaceae</td>
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</tr>
<tr>
<td>25</td>
<td><em>Albizia lebbeck</em></td>
<td>Kala siris</td>
<td>Fabaceae</td>
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</tr>
<tr>
<td>26</td>
<td><em>Pithecellobium dulce</em></td>
<td>Vilayati ambl</td>
<td>Fabaceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>Sl.No</td>
<td>Scientific Name</td>
<td>Local name</td>
<td>Family</td>
<td>IUCN Conservation Status</td>
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<tr>
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<td>----------------------</td>
<td>------------</td>
<td>---------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>27</td>
<td>Ficus benghalensis</td>
<td>Bargat</td>
<td>Moraceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>28</td>
<td>Moringa oleifera</td>
<td>Suragavo</td>
<td>Moringaceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>29</td>
<td>Ficus religiosa</td>
<td>Peepal</td>
<td>Moraceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>30</td>
<td>Butea monosperma</td>
<td>Palash</td>
<td>Fabaceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>31</td>
<td>Dalbergia latifolia</td>
<td>kala-shisham</td>
<td>Fabaceae</td>
<td>Vulnerable</td>
</tr>
<tr>
<td>32</td>
<td>Bauhinia purpurea</td>
<td>Jasud</td>
<td>Fabaceae</td>
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<tr>
<td>33</td>
<td>Manilkara zapota</td>
<td>Chikoo</td>
<td>Sapotaceae</td>
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</tr>
<tr>
<td>34</td>
<td>Tectona grandis</td>
<td>saag</td>
<td>Lamiaceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>35</td>
<td>Phoenix sylvestris</td>
<td>Khajuri</td>
<td>Areceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>36</td>
<td>Eucalyptus sp</td>
<td>Safeda</td>
<td>Myrtaceae</td>
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</tr>
</tbody>
</table>

**Shrub**

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Scientific Name</th>
<th>Local name</th>
<th>Family</th>
<th>IUCN Conservation Status</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Nerium indicum</td>
<td>Lalkaren</td>
<td>Apocynaceae</td>
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</tr>
<tr>
<td>2</td>
<td>Calotropis procera</td>
<td>Akado</td>
<td>Apocynaceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>3</td>
<td>Tecoma stans</td>
<td>Peilafol</td>
<td>Bignoniaceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>4</td>
<td>Xanthium strumarium</td>
<td>Gokhru</td>
<td>Asteraceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>5</td>
<td>Cassia auriculata</td>
<td>Awala</td>
<td>Fabaceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>6</td>
<td>Ipomea fistulosa</td>
<td>Nasarmon</td>
<td>Convolvulaceae</td>
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</tr>
<tr>
<td>7</td>
<td>Euphorbia neriifolia</td>
<td>Thor</td>
<td>Euphorbiaceae</td>
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</tr>
<tr>
<td>8</td>
<td>Jatropha curcas</td>
<td>Ratanjot</td>
<td>Euphorbiaceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>9</td>
<td>Lawsonia inermis</td>
<td>Mendhi</td>
<td>Lythraceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>10</td>
<td>Abelmoschus manihot</td>
<td>Jagali bhindi</td>
<td>Malvaceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>11</td>
<td>Abutilon indicum</td>
<td>Khapat</td>
<td>Malvaceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>12</td>
<td>Gossypium herbaceum</td>
<td>Kpas</td>
<td>Malvaceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>13</td>
<td>Musa Paradisiaca</td>
<td>Kela</td>
<td>Musaceae</td>
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</tr>
<tr>
<td>14</td>
<td>Prosopis juliflora</td>
<td>Gando baval</td>
<td>Fabaceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>15</td>
<td>Mimosa hamata</td>
<td>Kai baval</td>
<td>Fabaceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>16</td>
<td>Bougainvillea spectabilis</td>
<td>Bougainvel</td>
<td>Nyctaginaceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>17</td>
<td>Datura metel</td>
<td>Datro</td>
<td>Solanaceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>18</td>
<td>Solanum incanum</td>
<td>Ubhi ringan</td>
<td>Solanaceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>19</td>
<td>Lantana camara</td>
<td>Putush</td>
<td>Verbenaceae</td>
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</tr>
<tr>
<td>20</td>
<td>Clerodendrum inerme</td>
<td>Madhi</td>
<td>Verbenaceae</td>
<td>Not assessed</td>
</tr>
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</table>

**Herb & Grasses**

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Scientific Name</th>
<th>Local name</th>
<th>Family</th>
<th>IUCN Conservation Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Achyranthes aspera</td>
<td>Anghedi</td>
<td>Amaranthaceae</td>
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</tr>
<tr>
<td>2</td>
<td>Hygrophila auriculata</td>
<td>Akaro</td>
<td>Acanthaceae</td>
<td>Least Concern</td>
</tr>
<tr>
<td>3</td>
<td>Aerva javanica</td>
<td>Gorakghanj</td>
<td>Amaranthaceae</td>
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</tr>
<tr>
<td>4</td>
<td>Celosia argentea</td>
<td>Survali</td>
<td>Amaranthaceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>5</td>
<td>Pistia stratiotes</td>
<td>Jalasankhala</td>
<td>Araceae</td>
<td>Least Concern</td>
</tr>
<tr>
<td>6</td>
<td>Blumea eriantha</td>
<td>Kalhar</td>
<td>Asteraceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>7</td>
<td>Eclipta prostrata</td>
<td>Bhangro</td>
<td>Asteraceae</td>
<td>Least Concern</td>
</tr>
</tbody>
</table>
Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Scientific Name</th>
<th>Local name</th>
<th>Family</th>
<th>IUCN Conservation Status</th>
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<tbody>
<tr>
<td>8</td>
<td>Cassia tora</td>
<td>Kuvandio</td>
<td>Caesalpinaceae</td>
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<tr>
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<td>Tridax procumbens</td>
<td>Pardesi Bhangro</td>
<td>Asteraceae</td>
<td>Not assessed</td>
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<td>Trichodesma indicum</td>
<td>Undhanphuli</td>
<td>Boraginaceae</td>
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</tr>
<tr>
<td>11</td>
<td>Ocimum sanctum</td>
<td>Tulsi</td>
<td>Labiatae</td>
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<td>Commelina benghalensis</td>
<td>Kanshira</td>
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<tr>
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<td>Lajwanti</td>
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<tr>
<td>14</td>
<td>Euphorbia hirta</td>
<td>Ghaopata</td>
<td>Euphorbiaceae</td>
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<td>Jungli Dungli</td>
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</tr>
<tr>
<td>16</td>
<td>Boerhavia diffusa</td>
<td>Satodi</td>
<td>Nyctagineaceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>17</td>
<td>Crotalaria burhia</td>
<td>Kharshani</td>
<td>Nyctagineaceae</td>
<td>Not assessed</td>
</tr>
<tr>
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<td>Cajanus cajan</td>
<td>Tuvar</td>
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</tr>
<tr>
<td>19</td>
<td>Cynodon dactylon</td>
<td>Durba</td>
<td>Poaceae</td>
<td>Not assessed</td>
</tr>
<tr>
<td>20</td>
<td>Typha angustata</td>
<td>Ramban</td>
<td>Poaceae</td>
<td>Least Concern</td>
</tr>
</tbody>
</table>

Source: ABC Techno Labs India Pvt. Ltd.

- Economically Important Flora of the study area

**Agricultural Crops:** Apart from agriculture locals of the all the villages were involved in livestock keeping and each of the individual had a substantial number of cattle. Most of the villages in the study area are engaged in monsoon depended agriculture activities. The major agricultural crops practiced during monsoon season in the study area are; Rice (*Oryza sativa*) and Castor (*Ricinus communis*), while during winter Wheat (*Triticum aestivum*) is cultivated as major crop. Bajra (*Pennisetum typhoides*) cultivation practiced
in restricted fields by villagers for their own consumption. Minor crop practiced in this region during monsoon season is Cotton (*Gossypium herbaceum*), and Variyali (*Foeniculum vulgare*). Vegetables growing in this region are Bhindi (*Abelmoschus esculentus*), Brinjal (*Solanum melongena*).

**Horticulture plant species:** Bor (*Zizyphus glabrata*) and Amla (*Emblica officinalis*) cultivation were observed at many parts of study area. Mango (*Mangifera indica*), were observed in most of the villages the study area. Other fruit yielding varieties observed in the study area were Chikoo (*Manilkara zapota*), Papaya (*Carica papaya*), Gundi (*Cordia ghrarf*), Rayan (*Manilkara hexandra*), Gorsamali (*Pithelellobium dulce*), and Amali (*Tamarindus indicum*).

**Rare and Endangered Floral Species:** Among the enumerated flora in the study area, none of them were assigned any threat category by RED data book of Indian Plants, (Nayar and Sastry, 1990) and Red list of threatened Vascular plants (IUCN, 2010, BSI, 2003)’. No species observed in the study region comes under the category of threatened species out of 76 plant species.

**Phytosociological Analysis**

Regeneration of trees in the study area is better than herbs and shrubs. The density and composition of vegetation is more near the forest area whereas low in the agricultural and village areas. Grasses mainly cover open degraded land. Herbs and shrubs are abundant mostly during monsoon whereas during the summer land turns dry.

Phytosociological parameters, such as, density, frequency, basal area and importance value index of individual species were determined in randomly placed quadrats of different sizes in the study area. Relative frequency, relative basal area and relative density were calculated and the sum of these three represented Importance Value Index (IVI) for various species. For shrubs, herbs and seedlings, the IVI was calculated by summing up relative frequency, relative density and relative abundance.

Sample plots were selected in such a way to get maximum representation of different types of vegetation and plots were laid out in different part of the study area of 10 km radius. Analysis of the vegetation will help in determining the relative importance of each species in the study area and to reveal if any economically valuable species is threatened in the process. Phytosociological analysis of tree species is shown in Table 3.21.
Table 3.21: Phytosociological Analysis of Tree Species

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<tr>
<th>Sl.No.</th>
<th>Scientific name</th>
<th>Local name</th>
<th>Total No.</th>
<th>Total no. of quad with sp.</th>
<th>Total No. of quad</th>
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<th>Relative Density</th>
<th>Frequency %</th>
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### Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.

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<td>25.0</td>
<td>2.3</td>
<td>1.50</td>
<td>0.03</td>
<td>5.69</td>
</tr>
<tr>
<td>9</td>
<td><em>Lawsonia inermis</em></td>
<td>Mendhi</td>
<td>2</td>
<td>2</td>
<td>8</td>
<td>0.25</td>
<td>2.22</td>
<td>25.0</td>
<td>2.3</td>
<td>1.00</td>
<td>0.02</td>
<td>4.57</td>
</tr>
<tr>
<td>10</td>
<td><em>Abelmoschus manihot</em></td>
<td>Jagali bhindi</td>
<td>2</td>
<td>2</td>
<td>8</td>
<td>0.25</td>
<td>2.22</td>
<td>25.0</td>
<td>2.3</td>
<td>1.00</td>
<td>0.02</td>
<td>4.57</td>
</tr>
<tr>
<td>11</td>
<td><em>Abutilon indicum</em></td>
<td>Khapat</td>
<td>2</td>
<td>2</td>
<td>8</td>
<td>0.25</td>
<td>2.22</td>
<td>25.0</td>
<td>2.3</td>
<td>1.00</td>
<td>0.02</td>
<td>4.57</td>
</tr>
<tr>
<td>12</td>
<td><em>Gossypium herbaceum</em></td>
<td>Kapas</td>
<td>2</td>
<td>1</td>
<td>8</td>
<td>0.25</td>
<td>2.22</td>
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<td>2.00</td>
<td>0.02</td>
<td>3.41</td>
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<td>13</td>
<td><em>Musa Paradisiaca</em></td>
<td>Kela</td>
<td>5</td>
<td>4</td>
<td>8</td>
<td>0.63</td>
<td>5.56</td>
<td>50.0</td>
<td>4.7</td>
<td>1.25</td>
<td>0.06</td>
<td>10.26</td>
</tr>
<tr>
<td>14</td>
<td><em>Prosopis juliflora</em></td>
<td>Gando baval</td>
<td>6</td>
<td>5</td>
<td>8</td>
<td>0.75</td>
<td>6.67</td>
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<td>1.20</td>
<td>0.07</td>
<td>12.55</td>
</tr>
<tr>
<td>15</td>
<td><em>Mimosa hamata</em></td>
<td>Kai baval</td>
<td>5</td>
<td>4</td>
<td>8</td>
<td>0.63</td>
<td>5.56</td>
<td>50.0</td>
<td>4.7</td>
<td>1.25</td>
<td>0.06</td>
<td>10.26</td>
</tr>
<tr>
<td>16</td>
<td><em>Bougainvillea spectabilis</em></td>
<td>Bougainvel</td>
<td>3</td>
<td>2</td>
<td>8</td>
<td>0.38</td>
<td>3.33</td>
<td>25.0</td>
<td>2.3</td>
<td>1.50</td>
<td>0.03</td>
<td>5.69</td>
</tr>
<tr>
<td>17</td>
<td><em>Datura metel</em></td>
<td>Daturo</td>
<td>7</td>
<td>6</td>
<td>8</td>
<td>0.88</td>
<td>7.78</td>
<td>75.0</td>
<td>7.0</td>
<td>1.17</td>
<td>0.08</td>
<td>14.83</td>
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<tr>
<td>18</td>
<td><em>Solanum incanum</em></td>
<td>Ubhi ringan</td>
<td>3</td>
<td>3</td>
<td>8</td>
<td>0.38</td>
<td>3.33</td>
<td>37.5</td>
<td>3.5</td>
<td>1.00</td>
<td>0.03</td>
<td>6.86</td>
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<tr>
<td>19</td>
<td><em>Lantana camara</em></td>
<td>Pushush</td>
<td>10</td>
<td>8</td>
<td>8</td>
<td>1.25</td>
<td>11.11</td>
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<td>1.25</td>
<td>0.11</td>
<td>20.52</td>
</tr>
<tr>
<td>20</td>
<td><em>Clerodendrum inerme</em></td>
<td>Madhi</td>
<td>4</td>
<td>4</td>
<td>8</td>
<td>0.50</td>
<td>4.44</td>
<td>50.0</td>
<td>4.7</td>
<td>1.00</td>
<td>0.04</td>
<td>9.14</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td>81</td>
<td>70</td>
<td>160</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Herb Species**

1. *Achyranthes aspera*  - Anghedi - 5 5 8 0.63 5.56 62.5 5.8 1.00 0.06 11.43
2. *Hygrophila auriculata* - Akaro - 4 4 8 0.50 4.44 50.0 4.7 1.00 0.04 9.14
3. *Aerva javanica* - Gorakhganjo - 3 3 8 0.38 3.33 37.5 3.5 1.00 0.03 6.86
## Sl.No. | Scientific name | Local name | Total No. | Total no. of quad with sp. | Total No. of quad | Density | Relative Density | Frequency % | Relative Frequency | Abundance | Relative Abundance | IVI  
---|---|---|---|---|---|---|---|---|---|---|---|---|---  
4 | Celosia argentea | Survali | 3 | 3 | 8 | 0.38 | 3.33 | 37.5 | 3.5 | 1.00 | 0.03 | 6.86  
5 | Pistia stratiotes | Jalasankhala | 2 | 2 | 8 | 0.25 | 2.22 | 25.0 | 2.3 | 1.00 | 0.02 | 4.57  
6 | Blumea eriantha | Kalhar | 3 | 3 | 8 | 0.38 | 3.33 | 37.5 | 3.5 | 1.00 | 0.03 | 6.86  
7 | Eclipta prostrata | Bhangro | 3 | 3 | 8 | 0.38 | 3.33 | 37.5 | 3.5 | 1.00 | 0.03 | 6.86  
8 | Cassia tora | Kuvandio | 5 | 5 | 8 | 0.63 | 5.56 | 62.5 | 5.8 | 1.00 | 0.06 | 11.43  
9 | Tridax procumbens | Pardesi Bhangro | 4 | 4 | 8 | 0.50 | 4.44 | 50.0 | 4.7 | 1.00 | 0.04 | 9.14  
10 | Trichodesma indicum | Undhanphuli | 3 | 3 | 8 | 0.38 | 3.33 | 37.5 | 3.5 | 1.00 | 0.03 | 6.86  
11 | Ocimum sanctum | Tulsi | 2 | 2 | 8 | 0.25 | 2.22 | 25.0 | 2.3 | 1.00 | 0.02 | 4.57  
12 | Commelina benghalensis | Kanshira | 4 | 4 | 8 | 0.50 | 4.44 | 50.0 | 4.7 | 1.00 | 0.04 | 9.14  
13 | Mimosa pudica | Lajwanti | 3 | 2 | 8 | 0.38 | 3.33 | 25.0 | 2.3 | 1.50 | 0.03 | 5.69  
14 | Euphorbia hirta | Ghaopata | 3 | 3 | 8 | 0.38 | 3.33 | 37.5 | 3.5 | 1.00 | 0.03 | 6.86  
15 | Urginea indica | Jungli Dungli | 4 | 4 | 8 | 0.50 | 4.44 | 50.0 | 4.7 | 1.00 | 0.04 | 9.14  
16 | Boerhavia diffusa | Satodi | 3 | 3 | 8 | 0.38 | 3.33 | 37.5 | 3.5 | 1.00 | 0.03 | 6.86  
17 | Crotalaria burhia | Kharshan | 3 | 3 | 8 | 0.38 | 3.33 | 37.5 | 3.5 | 1.00 | 0.03 | 6.86  
18 | Cajanus cajan | Tuvar | 2 | 2 | 8 | 0.25 | 2.22 | 25.0 | 2.3 | 1.00 | 0.02 | 4.57  
19 | Cynodon dactylon | Durba | 26 | 8 | 8 | 3.25 | 28.89 | 100.0 | 9.3 | 3.25 | 0.29 | 38.48  
20 | Typha angustata | Ramban | 15 | 8 | 8 | 1.88 | 16.67 | 100.0 | 9.3 | 1.88 | 0.17 | 26.14  

**Total** | 100 | 74 | 160  

*Source: ABC Techno Labs India Pvt. Ltd.*
The interpretation vegetation study results of the study area are presented in the following Table 3.22.

**Table 3.22: Interpretation of Vegetation Results in the Study Area**

<table>
<thead>
<tr>
<th><strong>Relative density</strong></th>
<th>Relative density is found to be maximum for <em>Acacia nilotica</em> – 11.11</th>
<th>Density of primary species is found to be much higher in comparison with the other species.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Relative frequency</strong></td>
<td>Maximum RF found to be 9.3 in case of <em>Acacia nilotica</em></td>
<td>Vegetation community is heterogenous in nature</td>
</tr>
<tr>
<td><strong>Relative Abundance</strong></td>
<td>Maximum value observed in case of <em>Acacia nilotica</em> is about 0.11.</td>
<td><em>Acacia nilotica</em> is the most common species found in the area.</td>
</tr>
<tr>
<td><strong>Importance Value Index (IVI)</strong></td>
<td>The maximum IVI value observed in case of <em>Acacia nilotica</em> is about 20.56.</td>
<td>The dominant species are <em>Acacia nilotica</em>.</td>
</tr>
</tbody>
</table>

Source: ABC Techno Labs India Pvt. Ltd.
Biodiversity Indices

Biodiversity index is a quantitative measure that reflects how many different types of species, there are in a dataset, and simultaneously takes into account how evenly the basic entities (such as individuals) are distributed among those types of species. The value of biodiversity index increases both when the number of types increases and when evenness increases. For a given number of type of species, the value of a biodiversity index is maximized when all type of species are equally abundant. Interpretation of Vegetation results in the study area is given in Table 3.23.

Table 3.23: Interpretation of Vegetation results in the Study Area

<table>
<thead>
<tr>
<th>Community</th>
<th>Biodiversity indices</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Shannon-Wiener Index (H)</td>
</tr>
<tr>
<td>Tree</td>
<td>3.39</td>
</tr>
<tr>
<td>Shrub</td>
<td>2.67</td>
</tr>
<tr>
<td>Herbs</td>
<td>2.81</td>
</tr>
</tbody>
</table>

Source: ABC Techno Labs India Pvt. Ltd.

From Table 3.23, it can be interpreted that tree community has highest diversity. While the shrub community shows less diversity. It is also observed that most of the quadrates have controlled generation of plant species with older strands. Higher tree species diversity can be interpreted as a greater number of successful species and a more stable ecosystem where more ecological niches are available and the environment is less likely to be hostile, environmental change is less likely to be damaging to the ecosystem as a whole.

3.13.5 Fauna in the Study Area

To prepare a detailed report on the status of faunal diversity within study area of 10 Km radius around CB-ONN-2010/8 block area, field studies were conducted. Both direct (sighting) and indirect (evidences) observations methods were used to survey the faunal species around the study area. Additionally reference of relevant literatures (published/unpublished) and dialogues with local villagers were also carried out to consolidate the presence of faunal distribution in the area (Smith 1933-43, Ali and Ripley 1983, Daniel 1983, Prater 1993, Murthy and Chandrasekhar 1988).

Mammals: No wild mammalian species was directly sighted during the field survey. Dialogue with local villagers located within the study area also could not confirm
presence of any wild animal in that area. Indian porcupine, Common five Stripped Squirrel, Rhesus Monkey, Common Indian Mongoose, Indian rabbit, Large Indian squirrel were observed during primary survey.

**Avifauna**: Since birds are considered to be the indicators for monitoring and understanding human impacts on ecological systems (*Lawton, 1996*) attempt was made to gather quantitative data on the avifauna by walk through survey within the entire block area and surrounding area. From the primary survey, a total of 29 species of avifauna were identified and recorded from the entire block area and surrounding area. The diversity of avifauna from this region was found to be quite high and encouraging. None of the bird species found to be of threatened or endangered category as per IUCN Red list.

List of animals present in the study area are given below:

**Table 3.24: List of Fauna observed in the study area**

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Scientific name</th>
<th>English Name</th>
<th>Schedule of Wildlife Protection Act</th>
<th>Status as per IUCN Red Data List</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mammals</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td><em>Funambulus pennantii</em></td>
<td>Five striped squirrel</td>
<td>IV</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td>2</td>
<td><em>Lepus nigricollis</em></td>
<td>Indian Hare</td>
<td>IV</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td>3</td>
<td><em>Herpestes edwardsii</em></td>
<td>Indian Grey Mongoose</td>
<td>II</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td>4</td>
<td><em>Mus booduga</em></td>
<td>Indian Field Mouse</td>
<td>V</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td>5</td>
<td><em>Presbytis entellus</em></td>
<td>Common Langur</td>
<td>II</td>
<td>Not assessed</td>
<td>DS</td>
</tr>
<tr>
<td>6</td>
<td><em>Canis aureus</em></td>
<td>Jackal</td>
<td>II</td>
<td>Least Concern</td>
<td>NS</td>
</tr>
<tr>
<td>7</td>
<td><em>Hystrix indica</em></td>
<td>Indian Crested porcupine</td>
<td>IV</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td>8</td>
<td><em>Macaca mulatta</em></td>
<td>Rhesus Macaque</td>
<td>II</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td>9</td>
<td><em>Boselaphus tragocamelus</em></td>
<td>Nilgai</td>
<td>III</td>
<td>Least Concern</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td><em>Rattus rattus</em></td>
<td>Common house Rat</td>
<td>V</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td></td>
<td>Birds</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td><em>Anas crecca</em></td>
<td>Common Teal</td>
<td>IV</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td>2</td>
<td><em>Milvus migrans</em></td>
<td>Common Pariah Kite</td>
<td>IV</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td>3</td>
<td><em>Vanellus indicus</em></td>
<td>Red-wattled Lapwing</td>
<td>IV</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td>4</td>
<td><em>Pavo cristatus</em></td>
<td>Common Peafowl</td>
<td>I</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td>5</td>
<td><em>Phalacrocorax fuscicollis</em></td>
<td>Indian Cormorant</td>
<td>IV</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td>6</td>
<td><em>Streptopelia orientalis</em></td>
<td>Oriental Turtle-Dove</td>
<td>IV</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td>7</td>
<td><em>Coracias benghalensis</em></td>
<td>Indian Roller</td>
<td>IV</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td>8</td>
<td><em>Francolinus pondicerianus</em></td>
<td>Grey Francolin</td>
<td>IV</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
</tbody>
</table>
### Scientific Name and English Name Table

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Scientific name</th>
<th>English Name</th>
<th>Schedule of Wildlife Protection Act</th>
<th>Status as per IUCN Red Data List</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td><em>Ardeola grayii</em></td>
<td>Indian Pond-Heron</td>
<td>IV</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td>10</td>
<td><em>Mesophoyx intermedia</em></td>
<td>Intermediate Egret</td>
<td>IV</td>
<td>Not assessed</td>
<td>DS</td>
</tr>
<tr>
<td>11</td>
<td><em>Acridotheres tristis</em></td>
<td>Common Myna</td>
<td>IV</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td>12</td>
<td><em>Turdoides caudatus</em></td>
<td>Common Babbler</td>
<td>IV</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td>13</td>
<td><em>Orthotomus sutorius</em></td>
<td>Common Tailorbird</td>
<td>IV</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td>14</td>
<td><em>Merops orientalis</em></td>
<td>Green bee eater</td>
<td>IV</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td>15</td>
<td><em>Pterocles exustus</em></td>
<td>Chestnut-bellied sandgrouse</td>
<td>IV</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td>16</td>
<td><em>Columba livia</em></td>
<td>Rock Pigeon</td>
<td>IV</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td>17</td>
<td><em>Corvus splendens</em></td>
<td>House crow</td>
<td>V</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td>18</td>
<td><em>Egretta garzetta</em></td>
<td>Little Egret</td>
<td>IV</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td>19</td>
<td><em>Ardea alba</em></td>
<td>Great White Egret</td>
<td>IV</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td>20</td>
<td><em>Himantopus himantopus</em></td>
<td>Black-winged Stilt</td>
<td>IV</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td>21</td>
<td><em>Grus grus</em></td>
<td>Common crane</td>
<td>IV (16)</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td>22</td>
<td><em>Alcedo atthis</em></td>
<td>Common kingfisher</td>
<td>IV (37)</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td>23</td>
<td><em>Acridotheres tristis</em></td>
<td>Common Maina</td>
<td>IV (45)</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td>24</td>
<td><em>Psittacula krameri</em></td>
<td>Rose ringed Parakeet</td>
<td>IV</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td>25</td>
<td><em>Hirundo rustica</em></td>
<td>Common Swallow</td>
<td>IV</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td>26</td>
<td><em>Fulica atra</em></td>
<td>Common Coot</td>
<td>IV</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td>27</td>
<td><em>Copsychus saularis</em></td>
<td>Magpie - Robin</td>
<td>IV</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td>28</td>
<td><em>Prinia buchanani</em></td>
<td>Rufous fronted prinia</td>
<td>IV</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td>29</td>
<td><em>Saxicoloides fulicata</em></td>
<td>Indian Robin</td>
<td>IV</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
</tbody>
</table>

### Reptiles & Amphibians

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Scientific name</th>
<th>English Name</th>
<th>Schedule of Wildlife Protection Act</th>
<th>Status as per IUCN Red Data List</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><em>Naja naja</em></td>
<td>King Cobra</td>
<td>II</td>
<td>Least Concern</td>
<td>NS</td>
</tr>
<tr>
<td>2</td>
<td><em>Ptyas mucosa</em></td>
<td>Yellow Rat Snake</td>
<td>II</td>
<td>Not assessed</td>
<td>NS</td>
</tr>
<tr>
<td>3</td>
<td><em>Calotes versicolor</em></td>
<td>Common garden Snake</td>
<td>Common garden Snake</td>
<td>Not assessed</td>
<td>NS</td>
</tr>
<tr>
<td>4</td>
<td><em>Hemidactylus flaviviridis</em></td>
<td>House Lizard</td>
<td>IV</td>
<td>Not assessed</td>
<td>DS</td>
</tr>
<tr>
<td>5</td>
<td><em>Bufo melanostictus</em></td>
<td>Common Indian Toad</td>
<td>IV</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
<tr>
<td>6</td>
<td><em>Rana limnocharis</em></td>
<td>Paddy-field Frog</td>
<td>IV</td>
<td>Not assessed</td>
<td>DS</td>
</tr>
<tr>
<td>7</td>
<td><em>Rana tigrina</em></td>
<td>Indian bull frog</td>
<td>IV</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
</tbody>
</table>

### Butterflies

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Scientific name</th>
<th>English Name</th>
<th>Schedule of Wildlife Protection Act</th>
<th>Status as per IUCN Red Data List</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><em>Neptis hylas</em></td>
<td>Common sailor</td>
<td>-</td>
<td>Not assessed</td>
<td>DS</td>
</tr>
<tr>
<td>2</td>
<td><em>Pachliopta hector</em></td>
<td>Crimson rose</td>
<td>-</td>
<td>Not assessed</td>
<td>DS</td>
</tr>
<tr>
<td>3</td>
<td><em>Papilio demoleus</em></td>
<td>Lime Butterfly</td>
<td>-</td>
<td>Not assessed</td>
<td>DS</td>
</tr>
<tr>
<td>4</td>
<td><em>Junonia almana</em></td>
<td>Peacock pansey</td>
<td>-</td>
<td>Least Concern</td>
<td>DS</td>
</tr>
</tbody>
</table>

N.B: NS= Not sighted but included as per the information provided by villagers, DS = Direct Sighting

Source: ABC Techno Labs India Pvt. Ltd.
Livestock like cattle, goat, poultry, duck, and pig are reared for dairy products, meat, egg and for agriculture purpose. Majority of cattles are of local variety. Backyard poultry farms are mostly common in this area; however, some commercial poultry farms are also recorded in the study area.

Some of the sighted fauna were given protection by the Indian Wild Life (Protection) Act, 1972 by including them in different schedules. Among the birds in the study area, Peafowl (*Pavo cristatus*), is included in schedule I of Wild life protection Act (1972), while many other birds are included in schedule IV.

There is no rare or endangered fauna observed in the 1 km radius of the each well location. None of the sighted animal species can be assigned endemic species category of the study area.

The list of floral species is prepared based on visual observation during site visit and through review of site literatures and secondary data available with various government offices is referred for identifying rare or endangered species in the region.
The study area is marked with moderate population of flora and fauna. With reference to the Wildlife Protection Act 1972 total number of wildlife tabulated in this study can be characterized as given in the Table 3.25.

Table 3.25: Characterization of Fauna in the Study Area (As Per W.P Act, 1972)

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Schedule of Wildlife Protection Act 1972</th>
<th>No. of species</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Schedule I</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Schedule II</td>
<td>6</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>Schedule III</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>Schedule IV</td>
<td>34</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>Schedule V</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>Schedule VI</td>
<td>0</td>
<td>-</td>
</tr>
</tbody>
</table>

Source: ABC Techno Labs India Pvt. Ltd.
The detailed interpretation of flora and fauna identified within 10 km radius of the project site are tabulated in Table 3.26.

**Table 3.26: Description of Flora & Fauna**

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Type of Species</th>
<th>Core Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Flora</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Endangered species</td>
<td>None of the species found</td>
</tr>
<tr>
<td>2</td>
<td>Endemic species</td>
<td>None of the species found</td>
</tr>
<tr>
<td>3</td>
<td>Grass lands</td>
<td>No grass lands</td>
</tr>
<tr>
<td>4</td>
<td>Natural vegetation/ Forest type</td>
<td>Type 5A Tropical Dry Deciduous Forest</td>
</tr>
<tr>
<td></td>
<td><strong>Fauna</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Endangered species</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>Endemic Species</td>
<td>Not present</td>
</tr>
<tr>
<td>3</td>
<td>Migratory species</td>
<td>None</td>
</tr>
<tr>
<td>4</td>
<td>Migratory Corridors &amp; Flight Paths</td>
<td>No corridors &amp; flight paths</td>
</tr>
<tr>
<td>5</td>
<td>Breeding &amp; Spawning grounds</td>
<td>None within Study area</td>
</tr>
</tbody>
</table>

*Source: ABC Techno Labs India Pvt. Ltd.*

### 3.13.6 Aquatic Ecology

An essential pre requisite for the successful solution to these problems is to evaluate ecological impacts from the baseline information and undertake effective management plan. So the objective of aquatic ecological study may be outlined as follows:

- To characterize water bodies like fresh waters;
- To understand their present biological status;
- To characterize water bodies with the help of biota;
To understand the impact of industrial and urbanization activities; and
To suggest recommendations to counter adverse impacts, if any on the ecosystem.

To meet these objectives following methods were followed:

- Generating data by actual field sampling and analysis in these areas through field visits during study period; and
- Discussion with local people to get the information for aquatic plants and aquatic animals.

A number of samples were investigated for enumeration of aquatic fauna. In order to study aquatic flora and faunal life one time survey was conducted during the summer season. Major component of the aquatic life under the study area are listed below.

- **Aquatic macrophytes**
- **Phytoplankton and zooplankton**
- **Aquatic vertebrates like fish, amphibians etc.**

To assess the planktonic profile of Phytoplankton and Zooplankton, 2 water samples from Mesawah River, Pond near Kuha were collected at sub surface level. The aquatic ecological study was conducted in different water bodies of the study area and the flora and fauna was recorded.

**Phytoplankton and Zooplankton**

Planktons can be broadly grouped into two categories those with plant origin are called ‘Phytoplankton’ and those with animal origin are called ‘Zooplankton’.

**A. Phytoplankton**

Phytoplanktons are the major primary producers of organic matter in the aquatic ecosystem and especially oceans whose 90% productivity is from the planktons. Collectively, they directly or indirectly support the entire animal population. When the water column becomes shallow in spring, phytoplanktons are exposed to higher light intensity in the upper sunlight. Light is one of the major abiotic factors that favour the growth of phytoplankton. The massive build up of phytoplankton in spring directly contributes new organic carbon to support the zooplankton, which, in turn, benefits larger aquatic animals including fish, crustaceans, molluscs, birds.

Phytoplankton samples were collected without filtering the water. To preserve, 0.3 mL lugol’s solution was added to 100 ml sample. Subsequently phytoplankton were
concentrated by centrifugation and analysed microscopically in laboratory. Identification of phytoplankton was done using standard taxonomic keys.

The Lackey Drop (microtransect) method (Lackey 1938) is a simple method for obtaining counts of considerable accuracy (APHA 2012).

**Chemicals/reagents used:** Lugol's iodine

**Equipments used:** Centrifuge tubes of 15ml capacity, cover slips, glass slides, dropper, plastic bottles (100 ml capacity)

**Instruments used:** Centrifuge and Microscope.

### Table 3.27: Phytoplankton Species

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Phytoplankton</th>
<th>Family</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Navicula sp.</td>
<td><strong>Bacillariophyceae</strong></td>
</tr>
<tr>
<td>2</td>
<td>Melosira sp.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Cyclotella sp.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Synedra sp.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Fragillaria sp.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Nitzschia sp.</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Gomphonema sp.</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Merismopedia sp.</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Spirulina sp.</td>
<td><strong>Cyanophyceae</strong></td>
</tr>
<tr>
<td>10</td>
<td>Anabaena sp.</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Oscillatoria sp.</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Anacytis sp.</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Spirulina sp.</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Scenedesmus quadricauda</td>
<td><strong>Chlorophyceae</strong></td>
</tr>
<tr>
<td>15</td>
<td>Ankistrodesmus sp.</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Chlorella Vulgaris</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Chlorococcum sp.</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Cosmerium sp.</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Ankistrodesmus sp.</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Oocystis sp.</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Euglena sp.</td>
<td><strong>Euglenophyceae</strong></td>
</tr>
</tbody>
</table>

Source: ABC Techno Labs India Pvt. Ltd.

**B. Zooplankton**

The significance of zooplanktons is found in their role in transferring biological production from phytoplankton to larger organisms in the food web. A large number of phytoplankton species are grazed upon by the microscopic protozoans, tunicates, copepods and other crustaceans. These in turn become food for other animals further...
linking the food web. Therefore, variability in the production of planktons would affect the survival of young fish that depend on them.

Sample collection was carried out in the similar method as that of phytoplankton. The result of the zooplankton analysis is tabulated in table 3.28.

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Phytoplankton</th>
<th>Family</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nauplius larvae</td>
<td>Copepoda</td>
</tr>
<tr>
<td>2</td>
<td>Cyclops sp.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Diaptomus sp.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Brachionus calyciflorus</td>
<td>Rotifera</td>
</tr>
<tr>
<td>5</td>
<td>Brachionus angularis</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Keratella cochlearis</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Tricocerca sp.</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Filinia sp.</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Ceriodaphnia sp.</td>
<td>Cladocera</td>
</tr>
</tbody>
</table>

Source: ABC Techno Labs India Pvt. Ltd.

3.13.7 Environmental Sensitivity

The 2 blocks are well connected by road through road and by rail network. The CB-ONN-2010/8 block located at Cambay basin of Gujarat.

- National Parks and Wild Life Sanctuaries

There is Reserve Forest found around 10 km radius from the project site.

There are no National Parks/ wildlife sanctuary present with 10 Km radius of any of the block.

- Airport

Nearest airport is Ahmedabad which is about 20 Km from block boundary towards North West direction.

3.14 Socioeconomic Environment

The assessment of the socio-economic environment forms an integral part of an EIA study. Socio -Economic status of the population is an indicator of the development of the region. Any developmental project of any magnitude will have a bearing on the living conditions and on the economic base of the population in particular and the region as a whole. Similarly, the proposed developmental drilling activities will have its share of socio-economic influence in the study area. The section delineates the overall appraisal of society relevant attributes. The data collection for evaluation of the impact of the proposed development drilling within CB-ONN-2010/8 block on socioeconomic aspects.
in the study area has been done through a primary household survey and through the analysis of secondary data available for the study area.

3.14.1 Methodology
The methodology adopted in the assessment of socio-economic condition in the study area is as given below:

- The primary data on socioeconomic profile was collected through site observation, interviews with the key-informants and group discussions in the selected villages. Pradhan of Gram Panchayat, respondent (male-female) and school teachers were interviewed for the collection of socio-economic baseline information during the site visit by ABC team. The secondary data includes demographic profile, and employment pattern have been sourced from Primary Census Abstract-2011 of Gujarat and Infrastructure resource base has been extracted from District Census Handbook; Census of India, 2011. (http://www.censusindia.gov.in/2011census/dchb/DCHB.html)

- The socio-economic survey pertaining to the subjective analysis of the socio-economic indicators was carried in 6 habitations/villages viz. Kodrali, Pallano math, Pasuniya, Demaliya, Kuha, Vadod within block area.

- The survey focused on these selected 6 villages with aimed to collect relevant information for understanding the perception of the local inhabitants and affected people about the proposed development drilling of wells activities as these villages are located in close vicinity of CB-ONN-2010/8 Block.

3.14.2 Sources of Information
As per the scope of this study, the information on socio-economic aspects has been gathered and compiled from several secondary sources. These include Taluk Office, Collectorate, Agriculture Department, Irrigation Department, Central Ground Water Board, Directorate of Census Operation, Gujarat etc. The demographic data have mainly been compiled from the Census of India 2011. The socio-economic details are briefly described in the following sections. This section includes the present status of the Socio-Economic Environment in the study area. To determine the baseline socio-economic pattern, at and around the project site, the required data have been obtained from the published data. Socio-economic baseline data were collected for the following indicators:

- Demographic Structure
- Economic Structure
- Availability of Basic Amenities

The major demographic and economic structure of the study area are classified into the population, literacy rate and workers details.

### 3.14.3 STUDY AREA

The entire study area of 10 km radius from centre of CB-ONN-2010/8 block, villages has been categorized in core zone and buffer zone for studying the socio-economic profile.

The well locations with Village and Taluka as follows:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Well Name</th>
<th>Type of well</th>
<th>Remarks</th>
<th>Village Name</th>
<th>Taluka</th>
<th>District</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PA#01</td>
<td>Exploratory well to be converted to Development well</td>
<td>Existing well</td>
<td>Karoli</td>
<td>Dahegam</td>
<td>Gandhinagar</td>
</tr>
<tr>
<td>2</td>
<td>PA#02</td>
<td>Exploratory well to be converted to Development well</td>
<td>Existing well</td>
<td>Kuha</td>
<td>Dascroi</td>
<td>Ahmedabad</td>
</tr>
<tr>
<td>3</td>
<td>DW#01</td>
<td>Development well</td>
<td>New</td>
<td>Kodrali</td>
<td>Dahegam</td>
<td>Gandhinagar</td>
</tr>
<tr>
<td>4</td>
<td>DW#02</td>
<td>Development well</td>
<td>New</td>
<td>Pasunj</td>
<td>Dascroi</td>
<td>Ahmedabad</td>
</tr>
<tr>
<td>5</td>
<td>DW#03</td>
<td>Development well</td>
<td>New</td>
<td>Kuha</td>
<td>Dascroi</td>
<td>Ahmedabad</td>
</tr>
<tr>
<td>6</td>
<td>DW#04</td>
<td>Development well</td>
<td>New</td>
<td>Karoli</td>
<td>Dahegam</td>
<td>Gandhinagar</td>
</tr>
<tr>
<td>7</td>
<td>DW#05</td>
<td>Development well</td>
<td>New</td>
<td>Kuha</td>
<td>Dascroi</td>
<td>Ahmedabad</td>
</tr>
<tr>
<td>8</td>
<td>DW#06</td>
<td>Development well</td>
<td>New</td>
<td>Kuha</td>
<td>Dascroi</td>
<td>Ahmedabad</td>
</tr>
<tr>
<td>9</td>
<td>DW#07</td>
<td>Development wells will be drilled from same location</td>
<td>New</td>
<td>Pasunj</td>
<td>Dascroi</td>
<td>Ahmedabad</td>
</tr>
<tr>
<td>10</td>
<td>DW#08</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

None of the wells falls within Kheda district.

The villages which are falling within the CB-ONN-2010/8 block are designated as core zone and villages beyond the 2 blocks are designated as buffer zone as per details given in Table 3.29.
Table 3.29: Details of villages falling in the study area

<table>
<thead>
<tr>
<th>District</th>
<th>Oil Block</th>
<th>No of villages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Core Zone</td>
<td>Buffer Zone</td>
</tr>
<tr>
<td>Ahmedabad</td>
<td>CB-ONN-2010/8</td>
<td>4</td>
</tr>
<tr>
<td>Gandhinagar</td>
<td>CB-ONN-2010/8</td>
<td>5</td>
</tr>
<tr>
<td>Kheda</td>
<td>CB-ONN-2010/8</td>
<td>1</td>
</tr>
</tbody>
</table>

3.14.3.1 Population

According to the 2011 census, the entire study area has a population of 141564 and 28152 Households. Male population is about 72163 & female population is 69401 with sex ratio of 961 females for every 1000 males and a literacy of 68.3%; Scheduled Castes and Scheduled Tribes accounted for 4597 and 310 of the total population respectively. There were a total of 41809 main workers, 13453 marginal workers, 86302 non-workers. About 29.5% employment rate found within the entire study area.

3.14.3.2 Distribution of Population

The distribution of the population in the study area of 10 Km radius of CB-ONN-2010/8 Block is given in Table 3.30.
### Table 3.30: Distribution of population in the Study area of CB-ONN-2010/8 block

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Name of Village</th>
<th>Total Household</th>
<th>Total Population</th>
<th>Total Male</th>
<th>Total Female</th>
<th>Total SC</th>
<th>SC Male</th>
<th>SC Female</th>
<th>Total ST</th>
<th>ST Male</th>
<th>ST Female</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gandhinagar</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Kadadara</td>
<td>850</td>
<td>4329</td>
<td>2203</td>
<td>2126</td>
<td>120</td>
<td>64</td>
<td>56</td>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>Krishnanagar</td>
<td>392</td>
<td>2045</td>
<td>1045</td>
<td>1000</td>
<td>57</td>
<td>25</td>
<td>32</td>
<td>4</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Ramnagar</td>
<td>157</td>
<td>765</td>
<td>413</td>
<td>352</td>
<td>57</td>
<td>30</td>
<td>27</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>Karoli</td>
<td>703</td>
<td>3451</td>
<td>1754</td>
<td>1697</td>
<td>141</td>
<td>68</td>
<td>73</td>
<td>8</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Kodrali</td>
<td>241</td>
<td>1346</td>
<td>684</td>
<td>662</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>Ghamij</td>
<td>654</td>
<td>2996</td>
<td>1554</td>
<td>1442</td>
<td>120</td>
<td>66</td>
<td>54</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>Mirapur</td>
<td>192</td>
<td>939</td>
<td>481</td>
<td>458</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>7</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>Pallano Math</td>
<td>126</td>
<td>598</td>
<td>300</td>
<td>298</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>Pasuniya</td>
<td>164</td>
<td>852</td>
<td>436</td>
<td>416</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>Shiyapur</td>
<td>120</td>
<td>567</td>
<td>292</td>
<td>275</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>11</td>
<td>Hilol</td>
<td>587</td>
<td>2966</td>
<td>1517</td>
<td>1449</td>
<td>85</td>
<td>41</td>
<td>44</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>12</td>
<td>Demaliya</td>
<td>241</td>
<td>1184</td>
<td>628</td>
<td>556</td>
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Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.

Table 3.31: Distribution of Literacy rate & Working population in the study area of CB-ONN-2010/8 Block

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*Source: ABC Techno Labs India Pvt. Ltd.*
3.14.4 Availability of Infrastructure

Availability of infrastructure and facilities denote the level of overall development in the study area. The availability of community facility as education, health, potable water, electricity, communication and transport facilities are important indicators of the well being and Quality of Life (QoL) of villagers. It is observed that infrastructure facilities are poor in the project study area, which consists of education, health care, drinking water facilities, communications, transportation, etc.

- **Education Facilities**
  
  Literacy rate found to be quite encouraging within the study area as that education level in the villages are comparatively good, i.e. more than 68% people are literate. Primary education and high schools are available within the villages. Government is putting up many efforts to promote primary education. In the village people mindset have been changed compare to past, parents are taking interest in their children education.

- **Health Facilities**
  
  The number of PHCs served by a CHC is yet another indicator by which the physical accessibility can be judged. As per national norms, 1 PHCs should be served by one CHC. There is 1 primary health centre in Kuha available. There are government hospitals in Ahmedabad and Gandhinagar.

  No major diseases were reported by local people in the study area except routine cough, cold and fever etc. Local people mentioned about the lack of equipments, infrastructure and poor coverage of the existing health services. The PHCs in the study area are lack of basic equipments and trained staffs and hence people are expecting health infrastructure with adequate staff.

- **Sanitation and Drinking water facilities**
  
  One of the most important factors responsible for the emergence of a settlement is availability of water. Many water sources such as wells, hand pumps, tube well, tank etc. are available in rural areas. In the villages under study, the main source of water is tank, followed by tap. The water of the hand-pump is used for drinking for animals, bathing and household purposes. There are fewer ponds in the area and are mostly dry except for monsoon months. The water from the ponds is generally not used by the villagers except for bathing animals. However, more than half the hand pumps in these villages were not
functional and required repair. It is found that all villages are mostly dependent on hand pump water, tube well and borehole.

During the field study and interaction with local people, it is observed that sanitation is very poor except Bhavda and Karoli village. Government has launched the scheme for sanitation and gives subsidy for toilet construction, but still they are not ready to build toilets at home. From the data we can say that there is good facility of the drinking water in all the study villages except Ranodra and Kodrali villages. Awareness level about sanitation is very low because they still prefer to go outside despite of they received government subsidy to construct toilets.

3.14.5 LIVELIHOOD IN THE LOCAL VILLAGES

During survey and interaction with local people it was revealed that majority of people are engaged as agricultural works, small business etc. as a source of livelihood. Most of the farmers are taking 3 crops (Wheat, Rice and Bajra). Castor and cotton plantation were also observed and practiced by small farmers.

Proposed study area does not involve any major place with religious, archaeological and historical importance but Ahmedabad being a historical city has bored numbers of historical monuments which are the major attractions for the tourist.
CHAPTER 4

ANTICIPATED ENVIRONMENTAL IMPACTS & MITIGATION MEASURES
CHAPTER 4: ANTICIPATED ENVIRONMENTAL IMPACTS & MİTİGATİON MÈASURES

4.1 INTRODUCTION

The anticipated impacts of the proposed Production and Development Drilling wells and Testing of Hydrocarbons, QPF and laying of pipeline in CB-ONN-2010/8 block in Cambay basin, Ahmedabad, Kheda and Gandhinagar District, Gujarat on the environment have been evaluated and predicted based on the information collected at the site and the information provided by the Bharat PetroResources Limited. The environmental and social impacts can be categorized as either primary or secondary. Primary impacts are those, which are attributed directly by the project and secondary impacts are those, which are indirectly induced and typically include the associated investment and changed patterns of social and economic activities by the proposed actions. The details of criteria opted for impacts assessment are as per described hereunder:

Actual and foreseeable events, including operational and typical events are discussed in this chapter. Processes that may create risk to the environment are considered and are analyzed in terms of key potential environmental impacts.

The environmental impacts can be categorized as either primary or secondary. Primary impacts are those which are attributed directly by the construction and operation of the project, secondary impacts are those which are indirectly induced and typically include the associated investment and changed patterns of social and economic activities by the construction and operation of the proposed Production and Development Drilling wells and Testing of Hydrocarbons, QPF and laying of pipeline in CB-ONN-2010/8 block in Cambay basin, Ahmedabad, Kheda and Gandhinagar District, Gujarat.

There is no sensitive location of ecological, historical or strategic importance around the CB-ONN-2010/8 block area. Therefore, no such impact is anticipated during construction and operation phases of proposed Production and Development Drilling wells and Testing of Hydrocarbons, QPF and laying of pipeline in CB-ONN-2010/8 block in Cambay basin, Ahmedabad, Kheda and Gandhinagar District.
The proposed Production and development drilling of wells, QPF and laying of pipeline within CB-ONN-2010/8 block in would create an impact on the environment in two distinct phases:

- During the construction phase as temporary or short-term;
- During the operational phase which would have long-term effects during the life cycle of the project.

The construction and operation phases of the Production and development drilling of wells, QPF and laying of pipeline within CB-ONN-2010/8 block in comprises various activities, which have been considered to assess the impact on one or other environmental parameters.

- Topography,
- Soil,
- Water Resources and Quality,
- Climatology and Meteorology,
- Air Quality,
- Noise Levels,
- Land Use Pattern,
- Terrestrial Ecology,
- Aquatic Ecology,
- Demographic and socioeconomic.

The main procedural steps of environmental impact assessment can be summarized as follows:

**4.2 Identification**

This involves identification of the major project activities, environmental attributes, the impacts of the activities on the environmental attributes and formulation of ‘activity-impact’ matrix. The impact rating assessment matrix is presented below in Table 4.1.

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<td>Adverse Negative</td>
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<tr>
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<td>Short term Impacts shall be confined to a stipulated time</td>
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<tr>
<td></td>
<td>Long term Impacts shall be continued till the end of life of proposal</td>
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</table>
Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.

<table>
<thead>
<tr>
<th>Impact</th>
<th>Criteria</th>
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</thead>
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<tr>
<td></td>
<td>Impacts shall be confined within study area</td>
</tr>
<tr>
<td></td>
<td>Regional</td>
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<tr>
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<td>Impacts shall be continued beyond study area</td>
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Source: ABC Techno Labs India Pvt. Ltd.

The impact of proposed Production and development drilling of wells, QPF and laying of pipeline with in CB-ONN-2010/8 block on each environmental attribute was assessed. The operation phase considered to identify the possible impacts due to developmental drilling activities and testing of hydrocarbons. The matrix method has been chosen to list the potential impacts of the proposed Production and development drilling of wells, QPF and laying of pipeline with in CB-ONN-2010/8 block. The activities have been arranged in columns and the environmental attributes in the row of the matrix. The beneficial and adverse impacts have been analyzed in the following section on prediction and evaluation of impacts.

BPRL’s primary purpose and need for the proposed activities is firstly to establish the availability of commercial quantity of the hydrocarbons by development drilling of wells, QPF and laying of pipeline within CB-ONN-2010/8 block.

The key potential environmental aspects associated with proposed Production and development drilling of wells, QPF and laying of pipeline include the following:

- Transportation of equipment;
- Fuel and HAZCHEM (explosives etc.) handling;
- Discharges of drilling cutting, slurries and wastewater;
- Atmospheric emissions from diesel engines and test flaring, if any (on discovery of petroleum products);
- Loss of crops and flora due to acquisition of land on temporary basis;
- Interface on the terrestrial environment viz. landuse, soil quality flora and fauna;
- Acoustic disturbance;
- Timing of activities (in areas of temporal significance);
- Interface to the surrounding villages communities, having bearing on socio-economic status of the human population, their health and amenities; and
- Rehabilitation of the well site areas in case commercial reserves of hydrocarbon is confirmed.
4.3 Prediction

This involves prediction of the nature, magnitude and significance of the impacts. It also includes analysis of the possibilities and/or probabilities of occurrences of the impacts. The matrix establishes ‘Cause-effect’ relationship between the activities and the environmental factors responsible for them as shown in Table 4.2 with respect to activities during Production and development drilling of wells, QPF and laying of pipeline within CB-ONN-2010/8 block.
Table 4.2: Impact Prediction Matrix for Development Drilling, QPF and laying of pipeline

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<td>Well site &amp; access road construction</td>
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<tr>
<td>Site preparation and cleaning</td>
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</tr>
<tr>
<td>Storage and handling of construction waste</td>
<td>✓</td>
</tr>
<tr>
<td>Transportation of drilling rig and ancillaries</td>
<td>✓</td>
</tr>
<tr>
<td>Generation of waste water &amp; discharge from construction activity &amp; labour camp</td>
<td>✓</td>
</tr>
<tr>
<td>Operation of DG sets and machinery</td>
<td>✓</td>
</tr>
<tr>
<td>Operation of drilling rig</td>
<td>✓</td>
</tr>
<tr>
<td>Storage and disposal of drill cuttings and mud</td>
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</tr>
<tr>
<td>Flaring during production testing and process upset</td>
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</tr>
<tr>
<td>Blow out</td>
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</tr>
<tr>
<td>Spillage of chemical &amp; oil</td>
<td>✓</td>
</tr>
<tr>
<td>Decommissioning and aftercare</td>
<td>✓</td>
</tr>
<tr>
<td>Removal of well site construction materials &amp; disposal</td>
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<tr>
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</tr>
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<tr>
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<tr>
<td>Generation of waste &amp; disposal</td>
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Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.

<table>
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<td>Trenching and Boring</td>
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</tr>
<tr>
<td>Sourcing &amp; transportation of pipes etc</td>
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</tr>
<tr>
<td>Generation of domestic solid waste &amp; disposal</td>
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</tr>
<tr>
<td>Surface run-off from construction site</td>
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</tr>
<tr>
<td>Blow out</td>
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<tr>
<td>Spillage of chemical &amp; oil</td>
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</table>

Source: ABC Techno Labs India Pvt. Ltd.
4.4 Evaluation

The significance of each impact is determined by assessing the impact severity against the likelihood of the impact occurring as summarized in the impact significance assessment matrix provided below in Table 4.3.

Table 4.3: Impact Rating Assessment Matrix

<table>
<thead>
<tr>
<th>Impact Severity</th>
<th>Impact Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unlikely (e.g. Not expected to occur during project lifetime)</td>
</tr>
<tr>
<td>Slight</td>
<td>Negligible Impact</td>
</tr>
<tr>
<td>Low</td>
<td>Negligible Impact</td>
</tr>
<tr>
<td>Medium</td>
<td>Negligible Impact</td>
</tr>
<tr>
<td>High</td>
<td>Minor Impact</td>
</tr>
</tbody>
</table>

Notes:
- Negligible Impact: Defined as magnitude of change comparable to natural variation
- Minor Impact: Defined as detectable but not significant
- Moderate Impact: Defined as insignificant; amenable to mitigation; should be mitigated where practicable
- Major Impact: Defined as significant; amenable to mitigation; must be mitigated

All the potentially significant environmental impacts are evaluated and a qualitative assessment is made. An impact level is rated as “Slight”, “Low”, “Medium” or “High”. The impact rating is based on two parameters i.e. the “severity of impact” and the “likelihood of occurrence of impact”.

- Severity of Impact: The severity of an impact is a function of a range of considerations including impact magnitude, impact duration, impact extent, compliance of prescribed legal framework and the characteristics of the receptors/resources; and
- Likelihood of Occurrence: How likely is the impact (this is particularly important consideration in the evaluation of unplanned/accidental events)

4.5 Impacts/Risks During Development Drilling of Well and Production

The assessment of impacts in this section is confined to Production and development drilling of wells, QPF and laying of pipeline with in CB-ONN-2010/8 block only.
The drilling sites will contain all equipment, storage, workshops, etc. using distances between various rig components in line with existing rules and regulations for the area of operation and the hazardous area drawing of the drilling/ work over rig.

Drilling operation basically involves two steps; first – drilling of development wells and second – testing of well. Drilling process is associated with various hazards such as well active situation (kicks), blowouts, H₂S situation (if any) etc., in addition to discharges of air emissions, waste water and solid wastes. BPRL is committed to minimize the impacts by using standard practice of operation. It is however important to remember that operations related to development well drilling, testing and completion activities also include positive socioeconomic impacts in terms of increase in local business opportunities and on a larger perspective, by providing potential energy security at a national level.

On completion of drilling and during production, the well site shall be manned and cordoned off adequately. Security guard shall be stationed to ensure restricted entry. Impacts on various aspects are described below:

4.6 IMPACT ON TOPOGRAPHY

4.6.1 TOPOGRAPHY AND DRAINAGE

Developmental Drilling and Testing

Potential impact on drainage and topography viz. alteration of drainage pattern and water logging are anticipated during well site preparation, widening/strengthening of access roads and restoration of development well facilities. There would be slight change in topography at the drill site as it will be elevated from ground level to avoid storm water accumulation. The study area has flat terrain and is almost devoid of approach roads with elevations vary from MSL 100m to140m. There would be minor changes in the natural drainage pattern at immediate vicinity of the well site. This impact would be substantially further reduced as the identification of wells sites would consider local drainage patterns in the area. Additionally the grading of the drilling site will be done keeping in mind that the existing aerial drainage flow pattern of the well site location. As drilling is a single point activity at each well location there will not be any change in sub-soil drainage patterns A stretch of land 50m x 150m surrounding the well head as center will be barricaded. The remaining land will be restored to its original state by laying topsoil.
Unplanned restoration may lead to the long term disruption in natural drainage pattern and water logging in neighbouring agricultural land abutting the site. The land has to be restored taking into consideration the originally existing contours and pre-dominant slope. The impact is considered to be of low significance as onsite drainage will be taken care of during site restoration.

**Mitigation Measure**

- Disruption/alteration of micro-watershed drainage pattern will be minimized to the extent possible.
- Leveling and grading operations will be undertaken with minimal disturbance to the existing contour, thereby maintaining the general slope of site;
- Loss of micro-watershed drainage, if any, is to be compensated through provision of alternate drainage.

Hence, the impact on the Topography & Drainage pattern of the Developmental Drilling activity is as per given below.

<table>
<thead>
<tr>
<th>Impact Rating</th>
<th>Topography &amp; Drainage pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significance and Nature of impact</td>
<td>Negligible and Adverse</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>Long term</td>
</tr>
<tr>
<td>Impacted Area</td>
<td>Localized</td>
</tr>
<tr>
<td>Likelihood of occurrence</td>
<td>Low</td>
</tr>
<tr>
<td>Severity of impact</td>
<td>Slight</td>
</tr>
</tbody>
</table>

**QPF and Pipeline**

The major impacts arising out of site preparation and construction of QPF is alteration of local topography. The raising of the height of the construction site above the surrounding land may lead to water logging of the adjacent land or disrupt the existing drainage pattern. A storm water drain will be built at the periphery of the QPF to contain the site drainage during excessive rain. The storm water drain will be led into the small ponds present at the proposed site after silt and oil and grease trapping. The alignment to the road to the QPF is not yet finalised but an approach of 200m will be required for accessing the QPF.

The construction of pipeline if required will be across a 1.5 km stretch of varying landuse and land cover. The pipeline will cross small streams that are not more than 5m in width. A suitable depth of land will be excavated beneath the water bodies to lay the pipeline.
The flow and course of the streams may be altered leading to flooding of adjacent land during laying of pipeline.

**Mitigation Measure**

✓ Proper engineering control must be employed as mitigation measures so that the flow and the course of the stream is not altered.

Hence, the impact on the Topography & Drainage pattern of the QPF & Laying of Pipeline is as per given below.

<table>
<thead>
<tr>
<th>Impact Rating</th>
<th>Topography &amp; Drainage pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significance and Nature of impact</td>
<td>Negligible and Adverse</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>Long term</td>
</tr>
<tr>
<td>Impacted Area</td>
<td>Localized</td>
</tr>
<tr>
<td>Likelihood of occurrence</td>
<td>Low</td>
</tr>
<tr>
<td>Severity of impact</td>
<td>Slight</td>
</tr>
</tbody>
</table>

**4.6.2 Land Use Pattern**

**Developmental Drilling and Testing**

Approximately 1.8 ha (including camp site) of land for development drilling of each well would be impacted within the CB-ONN-2010/8 Block. An approach road (with a width of 2.0 m) would need to be made from the road head to the drilling site. The land to be acquired for well site shall be on permanent basis while for camp site it will be on temporary basis for maximum one year.

Drilling rig activities will result in disturbance and compaction of soils within a 1.0 ha zone around the drilling rig due to equipment, vehicles. Access roads to the drilling sites will also impact top soils. The total loss of soils as a result of developmental drilling with probably will be in the order of 3-4 ha for each well, depending on the length of access road required to access each site.

**Mitigation Measures**

✓ BPRL will provide adequate compensation to landowners against loss of standing crops in accordance to regulatory requirements viz. Land Acquisition Act, 1894 (amended in 1984).

Hence, the impact on the land use pattern of the study area is as per given below:
Impact Rating | Land Use pattern
--- | ---
Significance and Nature of impact | Negligible and Adverse
Duration of impact | Long term
Impacted Area | Localized
Likelihood of occurrence | Low
Severity of impact | Slight

**QPF and Pipeline**

About 1.8 Ha of land will be required for installation of QPF facility and about 1.5 Km Pipeline will be laid from well site to QPF facility. The route of pipeline will not go through any forest land/ wildlife sanctuaries. Hence, there will be no impact on wildlife neither any major change in land use will occur and the impact will be negligible.

**4.7 Impact on Regional Climate**

Impact on the climatic conditions from the drilling activities and QPF facilities will not be significant. The maximum temperatures of the exit gas from the DG stack and flare stack will be around 300°C to 400°C. In terms of total emission of green house gases and consequent impact on global warming or on potential for local increase of ambient temperature, considering the quantum of exit gas and the total duration of flow, the impact on the local or global climate will be insignificant.

**4.8 Impact on Air Environment**

*Developmental Drilling and Testing*

During drilling, the potential sources of air emissions during the drilling operation would be as follows:

1. DG sets;
2. Test flaring; and

During the short period of site preparation mechanical shovels and earthmovers will be used for vegetation clearance, cut and fill and other site leveling activities. These activities could generate dust particles which will be mobilized by wind, and deteriorate the ambient air conditions. However, these activities will be only temporary and with the clay nature of the soil, the impact to ambient air quality would be within the close proximity of well site. All the anticipated air emissions other than dust arise from combustion of hydrocarbons. The pollutants of concerns are NOx, SO2, CO, Particulate Matter, and
unburnt hydrocarbons. However considering localized nature of impacts, temporary (short term for 4 months) nature of construction and drilling activities and during which DG set operation will only be for 45-60 days, which along with necessary mitigation measures that is likely to be adopted by the proponent, the impact is considered to be of low significance.

During construction phase it is estimated that approximately 100 tonnes of sand, stones and cement will be required per well site location for road construction/strengthening and site preparatory activities. Fugitive emission is therefore anticipated from transportation, storage and handling by contractor personnel. However, generation of such fugitive dust is likely to be governed by micro-meteorological conditions (windspeed and direction). The condition of transportation road has to be considered as the drilling activity will be carried out in dry season and majority of internal roads are kutchha or in degraded condition. Such impacts will be considered to be medium. However, the construction activity, rig mobilization and decommissioning activity is temporary and limited movement of project vehicles (5-6 nos./well)will take place after adopting mitigation measures, hence the impact is of low significance.

**1. Emissions from DG Sets & Flaring**

There will be four (04) DG sets of capacity 500 KVA each and 1 no. of DG set of capacity 250 KVA & 1 no. of 100 KVA installed at the rig. At a time, during drilling, maximum four (04) 500 KVA DG sets shall be in operation except during test flaring and one DG set shall be kept as stand by. During test flaring, only DG set of 250 KVA shall be in operation to meet the power requirement. The operation of DG sets will therefore result in the generation of air pollutants viz. PM, NO₂, and HC thereby affecting the ambient air quality. The dispersion of these air pollutants may affect the receptors viz. village settlements located in near vicinity of the well site only under exceptional combination of meteorological conditions. Emissions from DG Set will be continuous throughout the drilling operations.

Testing facilities will be available at drilling rig for separation of liquid phase and burning of all hydrocarbons during testing. The test flare boom will be located at a distance from the drilling rig. In production testing hydrocarbon are flared for 1 or 2 days in case it is required. The quantities involved in test flaring may be highly variable due to geological
un-certainties and reservoir potential. However, the maximum quantity expected in such well are 2500 m$^3$/hour (15000 m$^3$/day) (max.) of gas. Temporary flaring will be carried out at ground with elevated stack of 30 m high.

The test flaring will result in temporary emissions of CO$_2$, water vapours, NOx and other trace gases. It is assumed that the occurrence of SO$_2$ in the flare gas would be in traces or negligible as gas shall not have H$_2$S. The pollutants of concerns from DG Sets are NOx, SO$_2$, CO, CO$_2$, particulate, and un-burnt hydrocarbons. However pollutants such as PM, SO$_2$ and NOx have been considered for dispersion modeling.

Movement of traffic shall be very minimum as same shall be used only for mobilization of manpower and consumable materials on continuous basis.

- Prediction of the Ground level concentration (GLC) of emissions are made using software of Industrial Sources Complex Short Term model version 3 (ISCST3) approved by Environment Protection Agency (EPA) USA. ISCST3 which is a Gaussian Plume based model and is executed using stability classes developed by Pasquill and Gifford. Following are the assumptions made while using the model:
  - No dry and wet depletion of pollutants; and
  - Receptors are on flat terrain with no flagpole.

GLCs are calculated by using meteorological data collected from the meteorological station at site during the monitoring period i.e. from 20$^{th}$ April 2018 to 9$^{th}$ July 2018.

The emission characteristics and other details from DG Set and flaring assumed for the modeling are summarized below in Table 4.4.

### Table 4.4: Source and Emission Characteristics for Dispersion Modeling

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Particulars</th>
<th>Unit</th>
<th>Flare stack*</th>
<th>DG set (500 KVA)</th>
<th>DG set (250 KVA)</th>
<th>DG set (100 KVA)</th>
<th>QPS flare</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Number of Stack</td>
<td>-</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Fuel feed rate</td>
<td>m$^3$/hr</td>
<td>2500 (Natural gas)</td>
<td>0.2700 (HSD)</td>
<td>0.075 (HSD)</td>
<td>0.05 (HSD)</td>
<td>2500 (Natural gas)</td>
</tr>
<tr>
<td>3</td>
<td>Stack Diameter</td>
<td>m</td>
<td>0.21</td>
<td>0.42</td>
<td>0.28</td>
<td>0.25</td>
<td>0.21</td>
</tr>
<tr>
<td>4</td>
<td>Stack Height</td>
<td>m</td>
<td>30</td>
<td>12</td>
<td>12</td>
<td>9</td>
<td>30</td>
</tr>
<tr>
<td>5</td>
<td>Stack Exit Temperature</td>
<td>°K</td>
<td>1273</td>
<td>577</td>
<td>524</td>
<td>518</td>
<td>1273</td>
</tr>
<tr>
<td>6</td>
<td>Stack Exit Velocity</td>
<td>m/s</td>
<td>20</td>
<td>21</td>
<td>18</td>
<td>14</td>
<td>20</td>
</tr>
<tr>
<td>7</td>
<td>Normal Flow Rate**</td>
<td>Nm$^3$/hr</td>
<td>571</td>
<td>5293</td>
<td>2220.25</td>
<td>1399</td>
<td>571</td>
</tr>
<tr>
<td>8</td>
<td>Emission</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PM</td>
<td>g/s</td>
<td>0.012</td>
<td>0.110</td>
<td>0.046</td>
<td>0.029</td>
<td>0.012</td>
</tr>
<tr>
<td></td>
<td>SO2</td>
<td>g/s</td>
<td>0.0063</td>
<td>0.059</td>
<td>0.025</td>
<td>0.015</td>
<td>0.0063</td>
</tr>
</tbody>
</table>
Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Particulars</th>
<th>Unit</th>
<th>Flare stack*</th>
<th>DG set (500 KVA)</th>
<th>DG set (250 KVA)</th>
<th>DG set (100 KVA)</th>
<th>QPS flare</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOx</td>
<td>g/s</td>
<td>0.018</td>
<td>0.162</td>
<td>0.067</td>
<td>0.042</td>
<td>0.018</td>
<td></td>
</tr>
</tbody>
</table>


Ground Level Concentrations (GLCs) for pollutants as mentioned above have been calculated for following:

- An area of 5 km x 5 km with 200m x 200m grids;

Scenarios as per given hereunder:

**Scenario 1** - Continuous operation of 4 numbers 500 KVA DG sets during drilling operation.

**Scenario 2** – Test Flaring and operation of 250 KVA DG set,

**Scenario 3** - Operation of 100 KVA DG set; and

**Scenario 4** - Flaring at QPS Facility,

**Findings**

Isopleths for 24 hourly average increases in GLCs are depicted in Figure 4.1 to 4.9 for all four scenarios. Overall impact on existing ambient air quality shall be as per given hereunder in Table 4.5.

**Table 4.5: Overall Impact on Existing Ambient Air Quality**

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Predicted 24-Hour Average Maximum Concentration (µg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PM</td>
</tr>
<tr>
<td>Scenario 1 Maximum GLCs</td>
<td>0.028</td>
</tr>
<tr>
<td>Scenario 2 Maximum GLCs</td>
<td>0.317</td>
</tr>
<tr>
<td>Scenario 3 Maximum GLCs</td>
<td>0.098</td>
</tr>
<tr>
<td>Scenario 4 Maximum GLCs</td>
<td>0.218</td>
</tr>
<tr>
<td>Maximum Predicted GLC</td>
<td><strong>0.317</strong></td>
</tr>
<tr>
<td>Maximum Concentration Recorded in Ambient Air as Baseline</td>
<td>71.4</td>
</tr>
<tr>
<td>Maximum Projected Concentration in Ambient Air</td>
<td><strong>71.717</strong></td>
</tr>
</tbody>
</table>

*Source: ABC Techno Labs India Pvt. Ltd.*

Figure 4.1 describes the GLC increase isopleths of PM for Scenario 1, which are drawn at an interval of 0.028 µg/m³.
Figure 4.1: Maximum GLC Increase of PM for Scenario 1

GLC increase contours at an interval of 0.015 μg/m³ of SO₂ for Scenario 1 are depicted in Figure 4.2 below.
Figure 4.2: Maximum GLC Increase of SO$_2$ for Scenario 1

In Figure 4.3 GLC increase isopleths at an interval of 0.041 $\mu$g/m$^3$ of NOx for Scenario 1 are given.
Figure 4.3: Maximum GLC Increase of NOx for Scenario 1 (DG Set 4x500 KVA)

GLC increase contours at an interval of 0.317 μg/m³ of PM for Scenario 2 are depicted in Figure 4.4.
Figure 4.4: GLC Increase of PM for Scenario 2

Figure 4.5 explains the GLC increase isopleths of SO₂ for Scenario 2, drawn at 0.172 μg/m³ interval.
In Figure 4.5 GLC increase isopleths at an interval of 0.464 μg/m³ of NOx for Scenario 2 are shown.

Figure 4.5: GLC Increase of SO₂ for Scenario 2

Source: ABC Techno Labs India Pvt. Ltd.
In Figure 4.7 GLC increase isopleths at an interval of 0.098 μg/m³ of PM for Scenario 3 are shown.
Figure 4.7: GLC Increase of PM for Scenario 3

In Figure 4.8 GLC increase isopleths at an interval of 0.05 μg/m³ of SOx for Scenario 3 are shown.

Source: ABC Techno Labs India Pvt. Ltd.
In Figure 4.9 GLC increase isopleths at an interval of 0.141 μg/m³ of NOx for Scenario 3 are shown.
Figure 4.9: GLC Increase of NOx for Scenario 3

In Figure 4.10 GLC increase isopleths at an interval of 0.218 μg/m³ of PM for Scenario 4 are shown.
In Figure 4.11 GLC increase isopleths at an interval of 0.115 μg/m³ of SOx for Scenario 4 are shown.

Source: ABC Techno Labs India Pvt. Ltd.

**Figure 4.10: GLC Increase of NOx for Scenario 4**
Figure 4.11: GLC Increase of SO$_2$ for Scenario 4

In Figure 4.12 GLC increase isopleths at an interval of 0.327 μg/m$^3$ of NOx for Scenario 4 are shown.
Mitigation Measures

- Water spraying will be done on the access roads to control re-entrained dust during dry season;
- All vehicles used for transportation of loose and friable materials will not be loaded over the freeboard limit and will be covered.
- All the vehicles should be PUC certified
 Engines and exhaust systems of all vehicles and equipment used for the project will be maintained so that exhaust emissions are low and do not breach statutory limits set for that vehicle/equipment type.

 Equipment, machinery and vehicles having inbuilt pollution control devices will be considered as a measure for prevention of air pollution at source

 DG set with appropriate stack height will be utilized.

 Providing Personnel Protective Equipments (PPEs) like mask to workers at site.

2. Fugitive Emissions from Developmental Drilling Activities

Air pollution during construction would be primarily due to fugitive emissions from vehicular movement, site preparation activities and material handling. Weathering of soil would take place as a result of clearing of vegetation, excavation and movement of heavy vehicles. The weathered soil generates dust due to re-entrainment during vehicular movement and equipment mobilization. Such dust emissions as experienced in other similar construction activities are of larger than 10µ (more than respirable range) and propagates to short distances. These emissions only have nuisance factor affecting workers at site. Use of dust masks would be adequate to mitigate impacts on workers. Fugitive emissions of VOC may result from the vents from the venting of un-burnt methane from well testing. However, the testing phase will be short duration of 14 -21 days.

Fugitive emissions in the form of material dust is expected during drilling operations (loading, unloading, handling of drilling fluid, chemical additives, cement and cement additives). Some fugitive emissions are also anticipated from storages of volatile chemicals and fuel at the site if the storages are not properly capped or are handled without due care. However, such emissions will not disperse widely and can only affect workers and people at site. Fugitive emissions during drilling operations are however not as significant as during site preparation. Fugitive emissions during drilling are not expected to travel beyond project boundaries. Workers working near fugitive emission sources are only susceptible which would be mitigated through use of PPEs in these areas.

Also, out of total period of 45 days of development drilling at well locations with CB-ONN-2010/8 block, drilling days shall be limited (approximately maximum for 2 months).
3. Fugitive Emissions from GSC & Pipeline

Fugitive dust emission is evident during construction phase of QPF and pipeline. All the issues pertaining to air pollution that has been dealt in above section for development well also stand relevant for QPF. Activity related to air pollution during the operation phase is rare for pipeline and QPF.

**Mitigation Measures**

- The mitigation measures for fugitive dust emission and DG set operation have been outlined in the above section. The only measure will be erection of stack for flaring of gases in QPF.

Hence impact on ambient air quality is rated as shown below:

<table>
<thead>
<tr>
<th>Impact Rating</th>
<th>Ambient Air</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significance and Nature of impact</td>
<td>Negligible and Adverse</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>Short term</td>
</tr>
<tr>
<td>Impacted Area</td>
<td>Localized</td>
</tr>
<tr>
<td>Likelihood of occurrence</td>
<td>Low</td>
</tr>
<tr>
<td>Severity of impact</td>
<td>Slight</td>
</tr>
</tbody>
</table>

4.9 **IMPACT ON NOISE ENVIRONMENT**

**Developmental Drilling and Testing**

Potential impact on noise quality is anticipated from noise vehicular movement, operation of construction machinery during well site preparation and access road strengthening and operation of drilling rig.

Some noise will be generated due to operation of construction machines. However, these noise sources are temporary in nature and operated mostly during daytime and for short duration. Potential impact on noise quality are anticipated from noise vehicular movement, operation of construction machinery during well site preparation and access road strengthening and operation of drilling rig. Considering the construction phase activities to be of temporary (short and long term) nature with limited daily movement of project vehicles (5-6 nos. vehicle for transportation of personnel and 8-10 nos. for material transport) and adequate mitigation measures viz. equipment maintenance etc. to be implemented by the project proponent, impact is considered to be of medium significance.

During drilling, equipment/machinery, identified as important sources that may have adverse impact on the existing noise level within the block are: drilling machines,
compressor pumps, DG set etc. Operational phase noise impacts are anticipated from operation of drilling rig and ancillary equipment viz. shale shakers, mud pumps and diesel generators. Studies indicated that noise generated from operation of drilling rig generally varies in the range of 88-103 dB(A). Other contributors of high noise level at the development well site include shale shakers, mud pumps and diesel generators. The average equivalent noise levels of drilling rig and ancillary equipment is estimated to 96 dBA. General noise levels generated from them are as per given below in Table 4.6.

<table>
<thead>
<tr>
<th>Source of Noise/Equipment</th>
<th>Noise Level (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical Drilling Rig</td>
<td>103</td>
</tr>
<tr>
<td>DG Set (@500 KVA)</td>
<td>75</td>
</tr>
<tr>
<td>Compressor Pumps</td>
<td>103</td>
</tr>
</tbody>
</table>

Source: Hale hall Exploration site (Spectrum Acoustic)

The resultant noise level from above sources is 103 dB (A).
The general noise level due to other activities during development drilling of well such as preparation of site, commissioning of rig, cementing, surface test flaring, well logging etc may sometimes go upto 90 dB(A) at the work sites during day time.

Modeling for Noise Emissions Drilling Site

For dispersion modeling of noise, standard mathematical model for sound wave propagation have been used. The sound pressure level generated by noise sources decrease with increase in distance from the source due to wave divergence. An additional decrease in sound pressure level from the source is expected due to atmospheric effect or its interaction with objects in the transmission path.

For hemispherical sound wave propagation through homogeneous loss free medium, one can estimated noise levels at various locations due to different sources using model based on first principles, as per the following equation.

\[
\text{Noise (Receptor)} = \text{Noise (Source)} - 20 \log \left( \frac{\text{distance (Receptor)}}{\text{distance (Source)}} \right)
\]

The combined effect of all the sources then can be determined at various locations by the following equation:

\[
L_p (\text{total}) = 10 \log \left( 10(Lp_1/10) + 10(Lp_2/10) + 10(Lp_3/10) \right) \quad \ldots \ldots \ldots \ldots
\]

Where \(Lp_1\), \(Lp_2\), \(Lp_3\) are noise pressure levels at a point due to different sources.

For an approximate estimation of dispersion of noise in the ambient from the source point, a standard mathematical model for sound wave propagation is used. For the
modeling purposes, flat terrain is considered and environmental attenuation factors are not considered. Based on the model, calculations are made assuming maximum noise level to be generated during drilling phase as 95 dB (A) and the predicted attenuated noise levels from the drilling at different distances are as per given hereunder Table 4.7:

<table>
<thead>
<tr>
<th>Attenuated Noise Level (dB(A))</th>
<th>Distance from source (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>30</td>
</tr>
<tr>
<td>55</td>
<td>175</td>
</tr>
<tr>
<td>45</td>
<td>550</td>
</tr>
</tbody>
</table>

Source: ABC Techno Labs India Pvt. Ltd.

The above results show that the elevated noise levels will be limited to a short distance from source. The noise level so generated from the drilling operations will be mingled with the ambient noise level within short distance from the site as per details given below in Table 4.8.

<table>
<thead>
<tr>
<th>Background Ambient Noise Level (dB(A))</th>
<th>Distance from source (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>200</td>
</tr>
<tr>
<td>55</td>
<td>1000</td>
</tr>
<tr>
<td>45</td>
<td>3000</td>
</tr>
</tbody>
</table>

During Oil production, no additional noise level is anticipated except from DG sets. However, monitored noise level reveals that:

✔ In residential areas, the daytime equivalent Noise level (Leq\text{day}) varied between 47.9 to 54.5 dB (A) while equivalent noise level during night (Leq\text{night}) varied from 40.8 to 42 dB (A);

The above predicted noise levels are without mitigation measures. With the mitigation measures, the noise levels will be further restricted within very short distance from the sources. The operators/personnel working near the noise sources within drilling site will be provided with earmuffs and earplugs.

Since, the drilling operations last for only 2 months at each location, impact of the noise pollution due to the proposed developmental drilling will be insignificant on the community. It can be concluded that the impact due to elevated noise is confined only up to a distance of 100 m from the drilling point and in areas beyond this distance, the ambient noise levels are within the stipulated ambient noise quality norms. Also, out of
total period of 45-60 days (Max) of development drilling at CB-ONN-2010/8 block, drilling days shall be limited (approximately maximum for one month).

Noise pollution poses a major health risk to the workers near high noise source. If the magnitude of noise exceeds the tolerance limits, it is manifested in the form of discomfort leading to annoyance and in extreme cases to loss of hearing. Detrimental effects of noise pollution are not only related to sound pressure level and frequency, but also on the total duration of exposure and the age of the person.

For activities other than drilling, the workers in general are likely to be exposed to an equivalent noise level of 80-90 dB (A) in 8 hour shift for which all statutory precautions as per the law will be implemented. Use of proper Personal Protective Equipment (PPE) will further mitigate adverse impact of noise on the workers, if any. The impacts can be further minimized and made insignificant by using standard practice of development drilling of well.

**Mitigation Measures**

- Installation of sufficient engineering control on equipment and machinery (like mufflers & noise enclosures for DG sets and PC pumps) to reduce noise and vibration emission levels at source, carrying out proper maintenance and subjecting them to rigid noise and vibration control procedures.
- Re-locating noise sources to less sensitive areas to take advantage of distance and shielding
- Providing Personnel Protective Equipments (PPEs) like ear plugs/muffs to workers at site.
- Undertaking preventive maintenance of vehicles and machinery to reduce noise levels.

Hence the impact on the noise level during drilling is rated as per given below:

<table>
<thead>
<tr>
<th>Impact Rating</th>
<th>Noise Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significance and Nature of impact</td>
<td>Negligible and Adverse</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>Short term</td>
</tr>
<tr>
<td>Impacted Area</td>
<td>Localized</td>
</tr>
<tr>
<td>Likelihood of occurrence</td>
<td>Low</td>
</tr>
<tr>
<td>Severity of impact</td>
<td>Slight</td>
</tr>
</tbody>
</table>
QPF and Pipeline
The construction of QPF and the pipeline will involve noisy activities though the scale of noise will be far lower compared to the drilling activities. The major source of noise during construction of QPF would be during mechanical site clearance, top soil removal, site and access road construction and DG set operation. The movement of vehicles for transportation of construction materials, site equipments and transportation of waste materials will be another source of noise generation. For pipeline laying, apart from the manual trenching, the other major source of noise would be handling of pipelines. Hydrostatic pressure testing of pipeline will be conducted few days before operation phase that will create noise due to operation of pump sets. Noise pollution during the operation phase rarely occurs for pipeline. As mitigation measures in line with development drilling will be employed and the activities will be of short duration, hence the impact significance will be low.

Hence the impact on the noise level during QPF Facility & Pipeline laying activities is rated as per given below:

<table>
<thead>
<tr>
<th>Impact Rating</th>
<th>Noise Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significance and Nature of impact</td>
<td>Negligible and Adverse</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>Short term</td>
</tr>
<tr>
<td>Impacted Area</td>
<td>Localized</td>
</tr>
<tr>
<td>Likelihood of occurrence</td>
<td>Low</td>
</tr>
<tr>
<td>Severity of impact</td>
<td>Slight</td>
</tr>
</tbody>
</table>

4.10 IMPACT ON WATER ENVIRONMENT
4.10.1 WATER RESOURCE

Developmental Drilling and Testing

The study area is having small tributaries river system. The block area is drained by Meswa River. Location of well sites near to the rivers and major water bodies is however ruled out and thus any direct impact on water bodies is not anticipated. Therefore considering the water availability and abundant sources, there would be insignificant impacts on water resources due to usage in the project. Surface water quality in the region has been found to be of good quality and is being used by villagers for irrigation and other domestic purposes. Ground water in the region is potable in nature.

Typically, the water consumption including domestic for proposed development well will be 35 KLD for 45 days per well. The camp will normally operate with around 40
personnel and will consume water @ 5 KLD for domestic purpose only. However, the drilling and domestic water requirement would depend on the time required to drill the well, which is primarily dependent on the proposed depth. Water requirement for the operation will be met primarily from transporting the water from nearby sources with water tankers. Further, in case of more requirements during drilling and production activity, water bore well will be drilled and necessary prior permission will be obtained from authorities for borewell accordingly. Therefore considering the water availability and abundant sources, there would be insignificant impacts on water resources due to usage in the project.

During production, well site will be manned by 10-15 personnel during general shift and water requirement will be minimum. Hence, the impact on the water resources of the study area is as per given below.

<table>
<thead>
<tr>
<th>Impact Rating</th>
<th>Water Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significance and Nature of impact</td>
<td>Negligible and Adverse</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>Short term</td>
</tr>
<tr>
<td>Impacted Area</td>
<td>Localized</td>
</tr>
<tr>
<td>Likelihood of occurrence</td>
<td>Low</td>
</tr>
<tr>
<td>Severity of impact</td>
<td>Slight</td>
</tr>
</tbody>
</table>

**QPF and Pipeline**

It is estimated that during normal operation, 10 KLD of water will be required for process water, fire hydrant, floor washing, etc. Another 5 KLD will be required for domestic purposes. The treated water from the ETP can be used for fire hydrant and floor washing. Possibility of contamination of subsurface and unconfined aquifers may exist if the casing and cementing of the well is not carried out properly leading to infiltration or seeping of drilling chemicals or mud into porous aquifer region. The same is also valid for disposal of drilling waste and mud in an open/unpaved pit. However, the toxicity test of the drill cuttings of nearby wells of Cambay Basin has shown the absence of any hazardous chemicals. Moreover mitigation measures will be employed thus reducing the impact from medium to low significance.

**Mitigation Measures**

- Proper engineering controls will be used for drilling and cementing operations;
- Water based, non hazardous type of drilling mud will be utilized for drilling operation;
Drill cuttings & mud will be stored in HDPE lined pits as per GSR Rules 546.

4.10.2 WATER QUALITY

Developmental Drilling and Testing

Impact on surface water quality of natural drainage channels and community water bodies may arise from discharge of contaminated surface run-off, sewage and process waste water generated during various phases of the proposed project.

Potential wastewater discharges may arise from the following sources during drilling:

- Spent drilling muds, cuttings and completion fluids disposal;
- Treated domestic effluent (sewage and kitchen waste);
- Any produced water and liquid hydrocarbon fractions collected in the test separator during well testing.
- Potential contaminated storm water drainage from the derrick floor and other systems;

Process wastewater

Approximately 5 KLD of wastewater would be generated from the development drilling operation including minor quantities from washing and cleaning of rig floor and other equipments. The primary pollutants in the wastewater would thus be suspended solids, dissolved solids and traces of floating oil from washing of rig floor and other equipments. Drilling waste water including DC wash water should be collected in the disposal pit evaporated or treated in Mobile ETP. After compliance of notified standards for on-shore disposal liquid effluents will be disposed locally with intimation to GPCB or else sent to GPCB approved CETP for further treatment and disposal. Wastewater will be collected in lined pits and clarified wastewater will be treated in mobile ETP located at the well sites and the treated effluent is collected in a treated water collection tank, from which it is re-circulated for drilling equipment washing, plantation and dust suppression purposes.

BPRL proposes to use water based non-toxic biodegradable fluids with inhibitive and encapsulative characteristics as drilling mud. Additionally, the drilling mud collection and recirculation pond is lined with impervious layer to prevent seepage and loss of drilling fluid into the subsoil. Further, proper casing installation and cementing will ensure least groundwater contact.
Water based drilling mud is non-hazardous in nature. The primary pollutants in the wastewater would thus be suspended solids, dissolved solids and traces of floating oil from washing of rig floor and other equipments. Apart from the mud characteristics, the waste and spent mud would be disposed in polyethylene propylene lined pits for all the storage areas as per the EHS Management Plan – Civil works. The mud components during the storage form a bentonite (clay) lining along the pit wall preventing the seepage of water to the underground strata. Any hydrocarbons contamination will be skimmed off from site before proceeding to the next site so as to ensure that no leaching or subsurface contamination finally reaches the groundwater table. The waste oils and the skimmed oils collected from the drill site will be sent to the GPCB authorized recyclers.

- **Discharge of drilling mud and waste water**

It is estimated that nearly about 500 ton/well of drilling waste fluid and process waste water is likely to be generated during drilling operation. The drilling waste fluid so generated will be characterized by the presence of oil & grease, barites and heavy metal which on discharge to nearby natural drainage channels and little streams may lead to possible surface water contamination. Drill cutting will be separated from Water Based Mud (WBM) and unusable drilling fluid will be stored in HDPE lined pit for solar drying for temporary storage. The cuttings/mud residues so stored will then be treated and disposed in accordance with CPCB regulations specified for onshore oil & gas industry and guidelines provided by the MoEF&CC under the Hazardous & Other Wastes (Management & Transboundary Movement) Rules, 2016 the impact is not considered to be of significance.

- **Sewage**

It is estimated that approximately 4 KLD of sewage will be generated from each well site. The sewage will be disposed through septic tanks followed by soak pits. The subsoil in the area is found to be rich in organic content and micro-organisms. No impacts are thus envisaged from sewage disposal from site.

- **Surface Runoffs**

Due to Site clearance and stripping of top soil during site construction will result in an increase in soil erosion that might lead to an increased silt load when there is surface run-
off during rainfall. The surface run off over drilling waste (cuttings and drilling mud),
hazardous waste (waste oil, used oil, etc) and chemical storage areas on open soil is likely
to be contaminated. Further the surface run-off problem may be compounded by the
unquantified flow of formation water. To prevent these run-offs, waste pits, storm water
drains and tankers that will regularly carry the treated water will be provided during
drilling phase. Further, the boundaries of the pits will be raised to prevent any runoff.

As the area experiences high rainfall, the site will generate considerable volume of runoffs
during such rainy periods. The storm water generally contains high concentration of
suspended matter eroded from the soil by the runoff. There is also a potential for
contamination of the storm-water if the runoff picks up contaminants in the form of
chemicals, oil and lubricants, etc. that could have been spilled or if material is stored in
open areas (uncovered) in any particular area like the fuel storage or the non-hazardous
chemical storage areas. This may result in a potential impact to the receiving water body.

- **Ground water Pollution**

There is a probability that during excavations, especially if conducted immediately after
monsoon may lead to development of springs which may have to be dewatered.

The compaction of the working areas for setting up heavy machineries and equipments
like the rig may lead to increased runoff and reduced infiltration, thereby affecting
localised subsurface groundwater recharge. However, given that the occupation of the
area is temporary and the area experiences low rainfall and thereby low recharge
potential, the effect on the groundwater regime of the area will not affect water
availability in neighbouring wells and tube wells and any resulting conflict with other
users of groundwater in the area.

Overall, with the appropriate management practices in place impacts on groundwater
quality at the site is likely to be insignificant.

- **Mitigation Measures**
  - Water drainage outlet, to prevent discharge of contaminated run-off
  - Drainage and sediment control systems at the well site will be efficiently designed
  - Proper treatment of all wastewater will be made to ensure that they comply with
criteria set by the regulatory body (MoEF&CC and GPCB)
✓ All chemical and fuel storage areas, process areas will have proper bunds so that contaminated run-off cannot escape into the storm-water drainage system.

✓ Construction activities viz. stripping, excavation etc during monsoon season will be restricted to the extent possible.

Hence, the impact on the water quality of the Developmental Drilling is as per given below.

<table>
<thead>
<tr>
<th>Impact Rating</th>
<th>Water Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significance and Nature of impact</td>
<td>Negligible and Adverse</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>Short term</td>
</tr>
<tr>
<td>Impacted Area</td>
<td>Localized</td>
</tr>
<tr>
<td>Likelihood of occurrence</td>
<td>Low</td>
</tr>
<tr>
<td>Severity of impact</td>
<td>Slight</td>
</tr>
</tbody>
</table>

**QPF and Pipeline**

It is estimated that the concretization of the QPF site will be completed within a very short duration. This will reduce the probability of surface wash-out of silty material if there is no rain within the construction period. Further the surface run off from the site after it is concretized will be collected in a storm water drain that will have requisite silt trap and oil trap. The filtered water of the storm water drain will further be discharged to the nearest channel of river in compliance with the CPCB Inland Water Discharge Standards.

The QPF will generate produced water of approximately 5 KLD. An mobile ETP will be installed at the QPF to treat this produced water and discharge into the nearest stream after meeting the GSR 546 Rules. As the surface run off will hardly have any silt or oil and grease load that will impact the adjoining area or contaminate the natural drainage, the significance of impact will be low. The surface level of the pipeline is always well compacted after filling with the subsoil and topsoil and shrubs eventually grow within a normal time frame. Hence, surface run-off is not a problem in the case of pipelines.

Hence, the impact on the water quality of the QPF & pipeline laying activity is as per given below.

<table>
<thead>
<tr>
<th>Impact Rating</th>
<th>Water Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significance and Nature of impact</td>
<td>Negligible and Adverse</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>Short term</td>
</tr>
<tr>
<td>Impacted Area</td>
<td>Localized</td>
</tr>
<tr>
<td>Likelihood of occurrence</td>
<td>Low</td>
</tr>
</tbody>
</table>
Impact Rating | Water Quality
---|---
Severity of impact | Slight

### 4.11 Impact on Soil Environment

**Developmental Drilling and Testing**

Potential impact on soil quality is envisaged in the form of increase in soil erosion and loss of soil fertility resulting site clearance and top soil stripping due to well site preparation. Accidental spillage resulting from storage and handling of mud chemicals is potential soil abuser. Soil quality impacts so identified have been assessed and evaluated in the section below.

During construction the major impacts on soil would occur due to excavation, compaction due to movement of heavy equipment and leveling as well as pollution due to addition of moorum. Site preparation will entail stripping and removal of the topsoil which contains most of the nutrients and organisms that give soil a living character and productivity. This will in turn result in minor changes in soil hydrology and small changes in the topsoil structure. However, as the project design takes into account the preservation of the top soil and it’s subsequently use for topping up of the rehabilitated land. The impact on soil quality will be insignificant considering the mitigation measures implemented.

At the conclusion of well testing at proposed development drilling site, solar drying will dewater the waste pits. All residual solids and liner will be covered with thick column of native soil. The cutting mud is inert and with appropriate lining of the pit in place it does not pose any scope of environmental hazard. Grading will be done to ensure natural run-off. Any remaining topsoil that has been stocked during the site clearance will be re-spread over appropriate portions of the site. Plantation of saplings will be commenced during the next rainy seasons to restore the site and conduct afforestation in and around the site. BPRL has incorporated all these aspects in the development well site design and also has an elaborate waste management plan to ensure safe disposal practices and minimum chances of soil or sub surface contamination.

During production, fluid shall be in transported in closed loop hence no solid waste is anticipated. On consideration of the poor vegetation cover, the physical features of the proposed developmental block of CB-ONN-2010/8, the impact of drilling operations on soil quality will be insignificant. It is, however, important that mitigation measures are monitored to ensure that they are effective.
"Storage and disposal of drill cuttings and drilling mud"

The hazardous wastes generated from the developmental drilling operations include drill cuttings, drilling mud, spent lube oil and waste oil (Category 2.2, 2.3, 5.1 and 5.2). Apart from the above, packaging wastes, used containers and any contaminated soil arising out of any accidental oil spillages during the Drill Rig movements and operations etc. are also expected to be generated from proposed drilling activities.

During drilling, the chances of soil contamination shall be from the storage practices of chemicals and fuels surface runoff carrying contaminated substances. Drilling wastes are generated during drilling operation through various geological formations to reach the reservoir that might hold the hydrocarbons. The mud used brings the rock cuttings (generated from drilling) to the surface, along with the mud are called drilling wastes. Drilling operations are typically associated with a range of wastes such as drilling mud, used oils, hydraulic fluids and various discarded chemical products, empty drums and sacks, acids, surfactants, cement, biocides, solvents, and camp wastes. The drilling mud and the cuttings shall be inert in nature but could also add to the sub surface contamination if not handled appropriately. The extent of impact on surrounding soils from unconfined liquid chemical or fuel spills will depend upon the season and the nature of the spillage.

It is estimated that nearly about 1000 Tons/well of drill cuttings and 500 Tons/well of drilling mud will likely to be generated from each well during drilling operation. Improper storage and disposal of process waste on open soil or unlined areas may lead to the contamination of soil onsite and abutting land if not properly managed. Drill cutting will be separated from Water Based Mud (WBM) and unusable drilling fluid will be stored in HDPE lined pit for solar drying for temporary storage. The cuttings/mud residues so stored will then be treated and disposed in accordance with CPCB regulations specified for onshore oil & gas industry.

Hence, no significant impact in this regard is envisaged. Further with BPRL committing to the use of Water Based Mud, the drill cuttings and waste drilling mud generated are likely to be non-hazardous in nature and is not anticipated to pose any potential threat to the soil environment. Though as per regulations, the mitigation measures will comprise of the
waste cuttings to be tested and accordingly disposed by BPRL. The impact is therefore considered to be of low significance.

**Mitigation Measures**

- The top soil will be stored in mound form;
- The height of the mound should not be more than 2m;
- The slope angle should not be more than 30°
- A jute mat will be overlayed on the mound to contain the erosion of top soil;
- Restricted project and related activities during monsoon season;
- Carrying out restoration of soil to its earlier conditions, to the extent possible;
- Ensuring proper storage of fuels and chemicals to prevent any potential contamination from spillage;
- Implementing appropriate spill prevention and control measures;
- Implementing adequate sediment control measures to prevent discharge of untreated surface run-off characterized by increased sediment load to adjoining agricultural land.

Hence, the impact on the soil quality of the Developmental Drilling is as per given below.

<table>
<thead>
<tr>
<th>Impact Rating</th>
<th>Soil Quality &amp; Contamination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significance and Nature of impact</td>
<td>Negligible and Adverse</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>Short term</td>
</tr>
<tr>
<td>Impacted Area</td>
<td>Localized</td>
</tr>
<tr>
<td>Likelihood of occurrence</td>
<td>Low</td>
</tr>
<tr>
<td>Severity of impact</td>
<td>Slight</td>
</tr>
</tbody>
</table>

**QPF and Pipeline**

The construction of the QPF will result in long term diversion of land that is presently being used for rubber cultivation by village dwellers. Hence, instead of simply storing it in mound forms the top soil removed will be used at the periphery of the QPF for greenbelt development of 10 m width. The impact significance is medium as the top soil that was utilized for cultivation will be used for greenbelt plantation, an alteration of fertility.

The soil dug during trenching will be reused for concealing after laying the pipelines. Care will be taken to restore the location of the concealed pipelines to its earlier state. The process will be completed within a very short period of time.

Hence, the impact on the soil quality of the QPF & pipeline laying activity is as per given below.
4.12 **Biological Environment**

**Developmental Drilling and Testing, QPF and Pipeline**

Impact on the ecology will be mainly confined to drilling site and approach road and will vary with the proximity from the drilling locations. Beyond the drilling site and approach road, impacts may be during flaring to be carried out for testing. However, with the proper measures as defined in Chapter 9, the impact shall be minimized.

There are no significant impacts envisaged on the ecological environment of the region as the area is almost covered with fallow land devoid of any considerable ecological conditions. Efforts will be made to avoid areas of comparatively dense vegetation cover, unless absolutely essential. The impact due to air pollution on flora & fauna can be expected to be negligible, as the impact predictions based on the dispersion modelling do not indicate any significant release of the pollutants and ground level concentrations.

Implementation of erosion and sediment controls to direct construction runoff through silt fences, sediment traps, and vegetative berms to decrease sedimentation in streams.

The flora and faunal habitats in the study area may be affected by erosion, siltation and water stagnation arising from run-on and runoff at the well site, if suitable mitigative measures are not implemented. The mitigative measures pertain to surface run-off from well site, wastewater discharges, solid waste disposal, erosion abatement measures, etc;

- Land to be acquired is mainly agriculture in nature
- Further there would not be any considerable sources (noise, gaseous pollutants, effluent and hazardous waste) of impacts on ecology and thus, no significant impacts on ecological conditions due to operational activities are envisaged.
- Thus the overall impacts, considering the normal hazard free operation, appreciable beneficial impacts are anticipated on the ecological conditions of the region.
- During operation phase, no pollution except from DG sets shall be generated.
While impacts during developmental drilling shall be confined to air emission due to operation of DG sets & test flaring, noise & vibrations due to movement of heavy earth moving machines, rig etc, drilling and movement of vehicles etc for limited period as total time required to complete the developmental drilling of one well is about 45 days.

The project bears no impact on endangered/threatened flora and fauna as 8 development wells are proposed in open/ barren land.

No National Park/Wild life Sanctuary /Eco sensitive area exist in the area. There are no elephant corridors within 10 Km of the CB-ONN-2010/8 block.

As long as strict environmental management measures are put in place, including adequate measures for supervision of contractors and staff, negative effects on fauna will be minimized. There are however, likely to be some residual unavoidable, impacts, linked to the requirement of optimal clearing the vegetation to facilitate drilling activities. Hence, the impact on the ecology of the Developmental Drilling and Testing, QPF and Pipeline is as per given below.

<table>
<thead>
<tr>
<th>Impact Rating</th>
<th>Ecology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significance and Nature of impact</td>
<td>Negligible and Adverse</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>Long term</td>
</tr>
<tr>
<td>Impacted Area</td>
<td>Localized</td>
</tr>
<tr>
<td>Likelihood of occurrence</td>
<td>High</td>
</tr>
<tr>
<td>Severity of impact</td>
<td>Minor</td>
</tr>
</tbody>
</table>

4.13 Impact on Occupational Health and Safety

Developmental Drilling and Testing, QPF and Pipeline

Occupational injuries and ill-health have huge socio-economic implications on individuals, their families and communities. They also have economic impacts in form of direct and indirect costs for society as a whole. Major occupational health risks encountered in proposed drilling activity include noise from drilling activity, operation of heavy vehicles and machinery, handing of chemicals.

However, the BPRL will adopt necessary control measures through implementation of mitigation measures and provision of proper PPEs to workers operating in aforesaid area to prevent and/or mitigate adverse health related impacts. Hence any possible occupational health impact from exposure to such fugitive dust is not likely to be of major significance.
Community Health & Safety: Community health and safety of inhabitants residing close to the drilling site stands to get affected from frequent heavy vehicular movement along village access roads and due to noise from drilling rig operations. Health and safety impact arising from technological emergencies viz. well blow outs, explosions will be dealt separately in the Risk Assessment section. Although the aforesaid activities are temporary in nature it may not adversely affect community health and safety in the long term. Mitigation measures will be taken as outlined in Chapter 9 to reduce the impacts arising out of project activities and hence significance will reduce from medium to low significance.

QPF will ensure that all activities should be under proper fencing and proper hoardings in English and Gujarati language should be displayed during construction to prevent people from encroachment within the fenced area or to make them aware of the danger associated with the construction.

Mitigation Measures

✓ All activities should be under proper fencing;
✓ Proper hoardings in English and Gujarati language should be displayed during construction to prevent people from encroaching the fenced area or to make them aware of the danger associated with the construction;
✓ Pipes will be kept in level ground within proper barricade.

Hence the impact on the occupational Health & Safety level during drilling & testing, QPF & Pipeline laying is rated as per given below:

<table>
<thead>
<tr>
<th>Impact Rating</th>
<th>Occupational health &amp; safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significance and Nature of impact</td>
<td>Negligible and Adverse</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>Short term</td>
</tr>
<tr>
<td>Impacted Area</td>
<td>Localized</td>
</tr>
<tr>
<td>Likelihood of occurrence</td>
<td>Low</td>
</tr>
<tr>
<td>Severity of impact</td>
<td>Slight</td>
</tr>
</tbody>
</table>

4.14 Socio-economic Environment

Developmental Drilling and Testing, QPF and Pipeline

The components of the Development drilling of wells at CB-ONN-2010/8 block that could result in effects on the socio-economic environment include the following:
Visual Impacts & Aesthetics

Region has number of operating hydrocarbon fields, which has a number of producing wells. In these Fields, awareness about drilling activity for extraction of gas persists amongst local people. Approximately 1.8 Ha of land will be cleared for construction of proposed well location.

- During site construction, dust will be generated from transportation of construction material, machinery and personnel, irregular dumping of construction wastes, domestic wastes from labour camp. These may cause visual and aesthetic impacts. Such impacts are likely to be experienced by communities residing in the vicinity of development well. However taking into account of siting the well locations away from human habitation, use of existing infrastructure, temporary nature of site preparatory activities, adoption of mitigation measures like water sprinkling, the impact will be of low significance.

- The wells once drilled will be capped and connected with pipeline to the proposed QPF within block. The area will be cordoned with iron cage barricades. The visual impacts will be for a long term due to presence of the barricaded wells.

- The drilling waste and process waste water is likely to be temporarily stored in impervious pits, visual impact in this regard is not envisaged.

- Visual impact due to the operation of drilling rig and presence of base camp will not be considered significant given the temporary nature of short or long term development activities (about 45 days to few years). The DG sets will be housed in acoustic enclosure but the size of the DG set in the enclosure along with its stack that is continuously emitting is not aesthetically or visually pleasing in a rural setting where there is no other source of industrial pollution.

- The construction of drill pad, drilling of development wells and decommissioning will involve a continuous day and night process, hence the high power lighting (halogen) at night will be a source of visual discomfort to the residents of nearby settlements. Other than that light generated from flaring events might also be visually discomforting at night. However flaring is likely to be of intermittent in nature, to occur only during process upset and production testing.
Mitigation Measures

- All the construction activities will be restricted within the designated site;
- Dust nuisance from construction site will be suppressed through periodical water spraying at high dust laden area due to construction of wells;
- On completion of work all temporary structures, surplus materials and wastes will be completely removed from site and disposed at a designated area;
- Construction wastes and municipal solid waste temporarily stored at the sites will be transported to the designated disposal site/facility at regular intervals;
- Care will be taken to orient the halogens at the construction facility. Excess lighting should not be used.
- After decommissioning of rig and associated facilities, drill sites will be restored – drill platform will be removed, pits & garland drains will be filled up, construction material will be buried in the pit;
- Site will be restored through laying of top soil

Hence, the impacts may be as per given below.

<table>
<thead>
<tr>
<th>Impact Rating</th>
<th>Visual and Aesthetic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significance and Nature of impact</td>
<td>Negligible and adverse</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>Shortterm</td>
</tr>
<tr>
<td>Impacted Area</td>
<td>Localized</td>
</tr>
<tr>
<td>Likelihood of occurrence</td>
<td>Low</td>
</tr>
<tr>
<td>Severity of impact</td>
<td>Slight</td>
</tr>
</tbody>
</table>

Property Management

Partial Loss of the Land and Productivity of Land/crops

The proposed project would not require any displacement of villagers. The impact is considered to be of medium significance. As compensation will be provided, the significance of the impact will be reduced to low.

- Approximately 1.8 Ha land in total would be impacted for developmental drilling of one well. An approach road may need to be made from the road head to the drilling site. The width of the road is estimated to be around 2.0 m.
- The landowners would be adequately compensated for loss of standing crop as well as for inability to cultivate the land for that particular period. In case the crop has already been sown, the landowners would be compensated for loss of income from that crop. The loss of crop production for that particular cropping season as
well as partial loss of productivity of the soil in affected areas will be adequately compensated.

✓ The landowners would be adequately compensated for loss of standing crop as well as for inability to cultivate the land for that particular period. Compensation will be paid to the landowners at the rate of Gujarat Govt rate per acre of land.

✓ During the test flaring loss of any standing crops in the vicinity will be adequately compensated based on the loss of income from the crop.

**Loss of Physical Assets/ Common Property Rights**

✓ In the event that some dug wells, tube wells, private trees, cattle sheds and tool sheds etc are to be removed for the development drilling, BPRL will either shift these assets or compensate for the losses at the prevailing market price.

✓ No settlement land shall be acquired for development drilling.

Hence, the impact on the property management is as per given below.

<table>
<thead>
<tr>
<th>Impact Rating</th>
<th>Property Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significance and Nature of impact</td>
<td>Negligible and Beneficial</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>Long term</td>
</tr>
<tr>
<td>Impacted Area</td>
<td>Localized</td>
</tr>
<tr>
<td>Likelihood of occurrence</td>
<td>Low</td>
</tr>
<tr>
<td>Severity of impact</td>
<td>Slight</td>
</tr>
</tbody>
</table>

**Employment**

The labour strength engaged during development drilling will depend upon activities, since many activities are labour intensive. Most of the unskilled labour will be by and large available from the nearby villages and towns. Thus, impact on the physical and aesthetic resources will be minimal. In addition to direct employment, several opportunities for locals will be available in terms of supply of construction materials & machinery, vehicles and other essential commodities.

During operation, no permanent labour except guards shall be required. Hence, overall impact is rated as shown below:

<table>
<thead>
<tr>
<th>Impact Rating</th>
<th>Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significance and Nature of impact</td>
<td>Negligible and Beneficial</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>Short term</td>
</tr>
<tr>
<td>Impacted Area</td>
<td>Localized</td>
</tr>
<tr>
<td>Likelihood of occurrence</td>
<td>Low</td>
</tr>
<tr>
<td>Severity of impact</td>
<td>Low</td>
</tr>
</tbody>
</table>
Disturbance to Community Resources and Safety

Buildings and other infrastructure

Buildings, if any could be affected by proximity to the drilling site. BPRL would adhere to safe working practices, ensuring safe working distances for drilling operation.

Road crossings and traffic

There are safety risks related to crossing public roads near the drilling site and there may be a requirement to cordon off the road. Close consultation with local Police prior to placing any signage is intended.

During operation, no disturbance except during emergency to building & other infrastructure and road crossing & traffic is anticipated. Hence overall impact is rated as shown below:

<table>
<thead>
<tr>
<th>Impact Rating</th>
<th>Disturbance to Community Resources and Safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significance and Nature of impact</td>
<td>Negligible and Adverse</td>
</tr>
<tr>
<td>Duration of impact</td>
<td>Short term</td>
</tr>
<tr>
<td>Impacted Area</td>
<td>Localized</td>
</tr>
<tr>
<td>Likelihood of occurrence</td>
<td>Low</td>
</tr>
<tr>
<td>Severity of impact</td>
<td>Low</td>
</tr>
</tbody>
</table>

QPF and Pipeline

QPF and pipeline will be permanent structures compared to development wells. The visual impacts associated with the construction of development wells will also be relevant for the construction of QPF and Pipeline. Approximately 1.8 Ha of land will be required for the construction of QPF. Since this area is devoid of Industries, hence the construction of QPF will add a physical feature that will be an outlier in the majorly agrarian landscape. Construction of pipeline will require a narrow strip of land (10 m in width) and traverse through the landscape for approximately 1.5 Km. The pipes will be stored temporarily beside the trenches and will not be visibly pleasant or safe for the passerby especially in places where the pipeline is crossing a sloping region.

The impact significance will be low as the visual impact will be highest during the construction phase and reduce in the operation phase.

Mitigation Measures

- Water sprinkling should be done for dust suppression where the pipeline crosses human habitation
✓ The pipelines once laid will be covered with burrowed soil and leveled as per the surrounding land.
✓ The boundary wall of the QPF will be covered with creepers to blend with the surrounding.

4.15 Risk/Impact Mitigation Techniques

All API, Indian Petroleum Act and Indian Mines Act shall be strictly adhered to. Drilling Contractor’s safety guidelines shall be strictly adhered to along with all Personnel Safety Guidelines.

The well site supervisor shall carry out regular safety checks. All crew members would be reminded frequently of working safety aspects as part of work procedure. Should unsafe equipment or procedures be observed, operations would cease immediately and the hazard duly corrected. The well site supervisor would ensure that the Driller and above should have a valid “Well Control Certification”. Driller and above would have sound knowledge of the API specification relevant to Well Control Practices (API RP53 and those prescribed in it) and practice the same in all aspects of the job. The well site supervisor would maintain a separate mud material inventory and would ensure that accurate amounts of material used are entered in the Contractor’s daily drilling reports.

Contractor would ensure that a document is posted in the doghouse showing “maximum back pressure held on casing” vs. “various mud densities” and would supply daily and weekly rig inspections by the company representative and the tool pusher. A detailed inspection would be carried out prior to drilling out the surface casing it would be ensured that all inspections are recorded in the tour book.

In order to minimize environmental impacts, the following section conveniently classified the mitigation measures (in continuation to suggested DMP and EMP in chapters 7 & 9 respectively) based on the various activities performed during the development drilling operation:

☐ Mobilization of Drilling Equipment
  ✓ Existing road network shall be utilized up to maximum extent;
  ✓ Regular maintenance and check-up record shall be maintained of all vehicles used for the transportation of the men and machinery to the site; and
✓ Close consultation with the local police prior to transportation any equipment to
the site.

■ Drilling Site Preparation

✓ Minimize cleared area and size of site/maximize perimeter to area ratio to aid
natural re-vegetation;
✓ Use hand cutting to clear vegetation initially—where necessary be selective in
using machinery;
✓ Not removing top humus soil by stripping to a depth of 0.35 m;
✓ Conserve root stock and topsoil, store for later rehabilitation and/or further
usages;
✓ Limit leveling activity;
✓ Do not burn brush and uprooted materials;
✓ Natural drainage patterns of the area should be considered during commissioning
of equipment, pads, and pits so that storm water runoff does not create an
environmental hazard by erosion of base material, which could lead to equipment
instability, or by flooding of pits, which could cause a discharge of oil or other
fluids into the local surface waters;
✓ Construction designs should include installation of erosion and sedimentation
control systems;
✓ To prevent erosion of the soil on slopes, check banks and spur drains would be
constructed;
✓ Seal bund and ensure proper drainage of machinery areas, fuel and chemical
storage, and mud mixing areas;
✓ Protect water courses from contamination and siltation;
✓ Protect groundwater from drill stem penetration and shallow aquifers from
possible site contamination;
✓ Mud and burn pits, if used, must have adequate contingency capacity to account
for rainfall, and must be fully lined and bunded.
✓ Incorporate drainage and minimize disturbance to natural drainage patterns.
Engineer slopes and drainage to minimize erosion. Design for storm
conditions/ensure offsite natural runoff does not wash over site/use perimeter drainage ditches;

✓ Each location (except for the locations of the waste containment area and freshwater storage facility) within well site will be covered with up to 100 mm (4 inches) of suitable base. This would help to provide sufficient load-bearing capacity to enable all construction and drilling operations to be executed safely and with minimum impact on the environment;

✓ Provide base material compatible with local ground conditions. Hard core should be laid on geotextile membrane. Avoid concreting sites;

✓ Where water courses and aquifers are deemed sensitive, consider a fully sealed site, avoid use of mud pits, preferentially use steel tanks, but if used must be lined. Pits if used must be lined;

✓ Earth moving equipment, typically a bulldozer with a grader blade and ripper type and a bucket type bulldozer for excavation work, will be used;

✓ As the site is graded and leveled, site berms, culverts, drains and drainage treatment facilities will be provided to control run-off and enable the site to be operational throughout the dry season; and

Following types of erosion control should be provided: (whichever is feasible)

- Rip Raps
- Stone walls
- Rock berms
- Gabions

Drilling Operation

The approximate area of one well site would be about 1.8 Ha. As per the standard practice of operation, in practice, waste minimization and safety will be achieved through a number of measures:

✓ Employing industry standard technologies and practices;

✓ Extremities of flare lines will be located at least 90 m from roads, public works, processing units or tanks. They will be at least 50 m from a well, gas/oil separator, site drainage or other possible source of ignitable vapours. The flaring would be elevated type with a height of 30m;
Carefully designing the fluid handling system so as to maximize recycling of fluids and treatment of cuttings;
Maintain good housekeeping to avoid any accidental spill;
Loading & unloading of fuel and various materials should be properly handled and controlled;
Drip trays will be required to contain any leaks under stationary vehicles, items of rig and large vehicles carrying such fuels;
Provide spill kit near oil storage area i.e. sand bags, absorbing pad, shovels etc;
Any soil contaminated at the site will be removed and disposed off at the landfill, burn pit, as appropriate;
Bulk storage of lubricants and fuels will be permitted only within the designated places and fuel tanks must be properly marked by content and chemicals;
 provision of treatment facilities so as to maximize recycling of fluids and minimizing quantities of effluents;
Contracting and procurement of fittest equipment so as to minimize breakdowns;
Residue disposal ; after drilling completion, solids from de-watered drilling fluids (solids) and cuttings will be filled in solar drying beds and covered with soil;
Non-contaminated run-off from the majority of the drilling site will be routed, possibly via a silt trap, through a discharge pipeline to a suitable off-site location;
Potentially contaminated surface run-off from the drill pad will be routed via an oil trap system where oils will be skimmed off and put in drums for removal from site;
Equipment maintained in good working order. Workers near noise source provided with noise protection equipment (ear muffs);
Acoustic mufflers in large engines (where practicable);
Duration of well testing shall be minimized by careful planning;
High combustion efficiency, smokeless/burner will be used;
Any dry, dusty materials (chemicals, muds etc.) shall be sealed in containers;
Adequate and properly maintained firefighting equipment would be present at the site and all fires and ignition sources to be controlled to prevent fire; etc.
Demobilization

- All residual solids and liner shall be covered with thick column of native soil. The cutting mud is inert and with appropriate lining of the pit in place it does not pose any scope of environmental hazard;
- Grading shall take place to ensure natural run-off;
- Any remaining topsoil that has been stocked during the site clearance shall be re-spread over appropriate portions of the site;
- Mud pits, where used, should be de-watered and filled in with 1m cover of soil;
- Facility will be suspended with a wellhead in place, but all other equipment and materials will be removed from the site;
- All empty drums wastes, used and unused drilling fluids, fuel and lubricants shall be removed from the drilling site;
- The access road(s) would be reinstated; and
- Document and monitor site recovery;
- Coloured photographs would be taken, wherever possible, before and after the drilling operations. These photographs would be properly identified and catalogued.

Campsite and Access

- Ensure all requirements addressed in planning phase are fully met;
- Initiate consultation and liaison with local authorities;
- Use local expertise;
- Campsites would be located well away from major watercourses, springs, wells and pastoral property infrastructure;
- Disposal pits would be constructed above water table, away from watercourses, and water holes and shall be of an adequate size to contain all of the waste and to allow for deep burial;
- Kitchen and sanitary wastewater will be emptied into earthen drains that allow rapid infiltration, prevent discharge to surface waters and be of an adequate size to ensure that water is directed away from areas frequented by camp personnel and vehicles;
Adequate and properly maintained firefighting equipment would be present at the campsite and all fires and ignition sources to be controlled to prevent bush fire;

Litter, rubbish and other wastes that have not been buried must be removed from campsites within one week of abandonment and the sites put in such a condition as to encourage rapid rehabilitation;

Rubbish, dumps, sewerage drains, etc; shall be filled to ensure a minimum cover of 1 meter, in such a manner as to restore the land surface and to avoid surface contamination and disturbance by animals. During construction topsoil would be stockpiled and returned after filling to encourage regeneration;

There would be no burial in sensitive areas (wetlands, reserve forests, etc.). All rubbish would be removed and disposed of in a satisfactory manner;

Workforce should keep within defined boundary and to the agreed access routes;

Control workforce activities, e.g. hunting, interaction with local population. Purchase food from recognized local suppliers, not directly from local people without evaluating implications;

Consult local authorities and other stakeholders regarding preferred location;

Choose site to encourage natural rehabilitation by indigenous flora/ avoid removal of vegetation and topsoil/ preserve topsoil, and seed source for decommissioning;

Select site to minimize effects on environment and local communities/minimize clearing;

Use existing access if available;

Avoid or minimize road construction/ minimize clearing and disturbance/ minimize footprint, use existing infrastructure;

Use hand cutting techniques/ avoid use of heavy machinery e.g. bulldozers/ selectively use machinery;

Minimize size of camp/ facilities consistent with operational, health and safety requirements;

Take account of topography, natural drainage and site runoff;

Ensure adequate and proper drainage;

Ensure proper handling and storage of fuels and hazardous materials (e.g. explosives);
Minimize waste, control waste disposal (solids, sewerage);
Prepare contingency plans for spillages, fire risk;
Minimize extraneous noise and light sources; etc.

4.16 IMPACT EVALUATION
The evaluation of the impacts of the proposed development drilling activity on the environment, both in terms of quality & quantity have been made. For quantification of impacts, matrix system as modified to some extent has been used as per given below:

For quantifying impacts on the environment, the guidelines and standards prescribed by national and international agencies are being considered. 1000 numbers are distributed as per the weightage to each parameter considered based on its importance as per given below in Table 4.9.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Importance Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Quality</td>
<td>200</td>
</tr>
<tr>
<td>Water quality</td>
<td>100</td>
</tr>
<tr>
<td>Water resources</td>
<td>100</td>
</tr>
<tr>
<td>Noise and vibration</td>
<td>200</td>
</tr>
<tr>
<td>Soil &amp; Solid waste</td>
<td>200</td>
</tr>
<tr>
<td>Land Use Pattern</td>
<td>50</td>
</tr>
<tr>
<td>Forest &amp; Vegetation and wild life</td>
<td>50</td>
</tr>
<tr>
<td>Socio – economic</td>
<td>50</td>
</tr>
<tr>
<td>Employment</td>
<td>50</td>
</tr>
</tbody>
</table>

The severity has been divided in impact scores from 0-5 for calculating the severity of impacts on the environmental parameters due to various project activities as given below in Table 4.10.

<table>
<thead>
<tr>
<th>Severity criteria</th>
<th>Impact score</th>
</tr>
</thead>
<tbody>
<tr>
<td>No impact</td>
<td>0</td>
</tr>
<tr>
<td>Significant impact-slight and short term</td>
<td>1</td>
</tr>
<tr>
<td>Significant impact-slight and long term</td>
<td>2</td>
</tr>
<tr>
<td>Moderate impact- short term</td>
<td>3</td>
</tr>
<tr>
<td>Moderate impact- long term</td>
<td>4</td>
</tr>
<tr>
<td>Major Impact - Permanent</td>
<td>5</td>
</tr>
</tbody>
</table>

The impact score can be negative or positive depending on whether the impact is adverse or beneficial. Based on the above importance values and impact scores, the impact value
(impact score x importance value) for each environmental parameters is calculated. The impact value for individual parameter is added to arrive at the total impacts value. The criterion used to make conclusive statement is based on the total impacts value without control measures is defined as given below in Table 4.11.

**Table 4.11: Impact Assessment Criterion**

<table>
<thead>
<tr>
<th>Total impact value</th>
<th>Conclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upto (-)1000</td>
<td>No appreciable impact on environment</td>
</tr>
<tr>
<td>(-) 1000 to (-) 2000</td>
<td>Appreciable but reversible impact. Mitigation measures important.</td>
</tr>
<tr>
<td>(-) 2000 to (-) 3000</td>
<td>Significant impact which is mostly irreversible. Mitigation measures crucial.</td>
</tr>
<tr>
<td>(-) 3000 to (-) 4000</td>
<td>Major impact which is mostly Irreversible. Selection of process and raw material to be crucial.</td>
</tr>
<tr>
<td>Above (-) 4000</td>
<td>Permanent irreversible impact, alternative sites to be considered.</td>
</tr>
</tbody>
</table>

The environmental impact matrix based on the above principles has been attempted for the proposed development drilling and are given in Table 4.12.

**Table 4.12: Impact Evaluations – Development Drilling/Testing, QPF & Pipeline**

<table>
<thead>
<tr>
<th>Environmental parameters</th>
<th>Importance value</th>
<th>Impact Score</th>
<th>Overall Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Without EMP</td>
<td>With EMP</td>
<td>Without EMP</td>
</tr>
<tr>
<td>Air Quality</td>
<td>200</td>
<td>-1</td>
<td>-1</td>
</tr>
<tr>
<td>Water quality</td>
<td>100</td>
<td>-3</td>
<td>-1</td>
</tr>
<tr>
<td>Water resources</td>
<td>100</td>
<td>-1</td>
<td>-1</td>
</tr>
<tr>
<td>Noise and vibration</td>
<td>200</td>
<td>-1</td>
<td>-1</td>
</tr>
<tr>
<td>Soil Quality &amp; Solid waste</td>
<td>200</td>
<td>-4</td>
<td>-1</td>
</tr>
<tr>
<td>Land Use Pattern</td>
<td>50</td>
<td>-2</td>
<td>-1</td>
</tr>
<tr>
<td>Forest &amp; Vegetation and wild life</td>
<td>50</td>
<td>-2</td>
<td>-1</td>
</tr>
<tr>
<td>Socio – economic</td>
<td>50</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Employment</td>
<td>50</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>-1700</strong></td>
<td><strong>-800</strong></td>
<td></td>
</tr>
</tbody>
</table>

*Source: ABC Techno Labs India Pvt. Ltd.*

Thus, it can be evaluated that there will be No appreciable impact on environment is envisaged with proper mitigation measures.
CHAPTER 5

ANALYSIS OF ALTERNATIVES
CHAPTER 5: ANALYSIS OF ALTERNATIVES

5.1 ALTERNATIVE LOCATION FOR THE PROPOSED PROJECT
The proposed Drilling of development wells within CB-ONN-2010/8 block in Cambay Basin for production of hydrocarbons is located in Gandhinagar, Ahmedabad and Kheda, Gujarat. CB-ONN-2010/8 Block was awarded by Ministry of Petroleum and Natural Gas, Government of India. The total allocated area of the CB-ONN-2010/8 Block is 42 sq.km. CB-ONN-2010/8 block was explored by ONGC Ltd. during the period 1980-2007.

5.2 ALTERNATIVE DRILLING LOCATIONS
The identified locations for Developmental drilling have been selected based on data analysis and interpretation. However, all safe distances shall be kept as per relevant standards and guidelines.

5.3 ALTERNATIVE DRILLING TECHNOLOGIES
Standard practice shall be followed in which a standard mobile rig of 1000 HP with Rotary/Top drive System will be used (rotary drilling with WBM stabilization). Elevated flaring is considered for well testing. Therefore, alternative drilling technology is not necessary.

5.4 PIPELINE ROUTE
Initially the pipeline route from well site to QPF was planned along the State Highway-44, but the entire route was about 5 Km. To reduce the cost and the shortest route of 1.5 Km finalized. The present route is distant from any kind of human habitat, highways and also no schools, hospitals, markets etc. The length of proposed alternative alignment is 1.5 km and thus the footprint in ecosensitive zone will also reduce.

5.5 ALTERNATIVE RESOURCES
The entire water requirements will be met from water tankers to the drilling.

5.6 ALTERNATIVE TREATMENT OPTIONS
Following options are considered:
Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.

Environmental Management for Drilling Wastes

- Waste Minimization
  - Drilling Practices
    - Directional Drilling
    - Drilling by Coiled Tubing
    - Pneumatic Drilling
  - Drilling Muds
    - Water Based Muds
- Recycle/Reuse
  - Fixation
    - Pits
    - Landfills
    - Landfracing
  - Thermal Treatment
    - Incineration
    - Thermal description
  - DCRI
    - Annulus injection
    - Dedicated well injection
- Disposal
  - Bioremediation composting

Source: ABC Techno Labs India Pvt. Ltd.
**Selected option:**

Drill cutting will be separated from drilling mud and analyzed for Oil and Grease (O&G) content. If O&G content is found to be less than 10 g/kg, the cutting will be disposed off (in-situ) in an impervious lined pit and after drying it will be covered by an impervious liner and soil layer. If O&G content is found to be higher than the 10 g/kg, drill cuttings will be temporarily stored in HDPE lined pits /packed in bags and then disposed to secured landfill site (TSDF).

However, mobile ETP shall be provided to treat the waste water and the treated wastewater will be reused in various operations.

Elevated stack will be selected for test flaring.
CHAPTER 6

ENVIRONMENTAL MONITORING PROGRAMME
CHAPTER 6: ENVIRONMENTAL MONITORING PROGRAMME

6.1 INTRODUCTION
Regular monitoring program for the environmental parameters is essential to take account the changes in the environment due to Developmental Drilling activities of wells within CB-ONN-2010/8 block situated in Dehgam, Daskroi, Mehdavad, District-Gandhinagar, Ahmedabad and Kheda, State- Gujarat. To ensure the effective implementation of the mitigation measures and environmental management plan during operation phase of Developmental Drilling activities of wells within CB-ONN-2010/8 block, it is essential that an effective environmental monitoring plan be designed and followed during operation phases.

Normally, an Impact Assessment study is carried overshort period of time and the data cannot bring out all variations induced by the natural or human activities. Therefore, regular monitoring programme of the environmental parameters is essential to take into account the changes in the environmental quality.

6.2 OBJECTIVES OF MONITORING PROGRAMME
The objectives of environmental monitoring plan for Developmental Drilling activities of wells within CB-ONN-2010/8 block are:

✔ To verify the results of the impact assessment study in particular with regards to proposed development drilling of wells in CB-ONN-2010/8 block;
✔ To follow the trend of concentration values of the parameters which have been identified as critical;
✔ To check or assess the efficiency of the mitigation measures; and
✔ To ensure that new parameters, other than those identified in the impact assessment study, do not become critical at proposed Developmental Drilling activities of wells within CB-ONN-2010/8 block.

The environmental monitoring is the primary tool for assessing the prevailing quality of air, water, noise, land etc. The environmental monitoring helps in suggesting and taking corrective course corrections, monitored parameters are exceeding. The monitoring of various environmental parameters for ambient air quality, water quality, noise levels, soil quality will be carried out on a regular basis at and around the Developmental Drilling activities of wells within CB-ONN-2010/8 block area to ascertain the following:
✓ Pollution caused due to operations of proposed Developmental Drilling activities of wells within CB-ONN-2010/8 block.
✓ Change in environmental quality within and outside the proposed Developmental Drilling activities of wells within CB-ONN-2010/8 block
✓ To assess environmental impacts after set up of proposed Developmental Drilling activities of wells within CB-ONN-2010/8 block.
✓ Evaluate the efficiency of pollution control measures installed.

The environmental monitoring shall be periodic and comply with the promulgated standards. The frequency of monitoring of various environmental components and frequency to be monitored is given in Table 6.1.
Table 6.1: Environmental Monitoring Program for Developmental Drilling Activities

<table>
<thead>
<tr>
<th>Environmental Component</th>
<th>Project stage</th>
<th>Parameter</th>
<th>Standards</th>
<th>Location</th>
<th>Duration / Frequency</th>
<th>Implementation</th>
<th>Supervision</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ambient Air</strong></td>
<td>Construction Phase</td>
<td>PM2.5, PM10, SO2, NOx, CO</td>
<td>National Ambient Quality Standards</td>
<td>4 Locations within each block near wells</td>
<td>24-hourly measurement, once during the construction phase</td>
<td>Environmental Cell of BPRL or MoEF&amp;CC/GPCB/NABL approved monitoring agency</td>
<td>BPRL</td>
</tr>
<tr>
<td></td>
<td>Operation Phase</td>
<td>PM2.5, PM10, SO2, NOx, CO VOC &amp; HC (CH4)</td>
<td>National Ambient Quality Standards</td>
<td>4 Locations within each block near wells</td>
<td>Continuous 24-hourly once six monthly</td>
<td>Environmental Cell of BPRL or MoEF&amp;CC/GPCB/NABL approved monitoring agency</td>
<td>BPRL</td>
</tr>
<tr>
<td><strong>Water Quality</strong></td>
<td>Construction Phase</td>
<td>As per IS: 10500:2012 for relevant parameters</td>
<td>As Water quality standards (IS 10500:2012)</td>
<td>4 Locations within each block near wells</td>
<td>Six Monthly</td>
<td>Environmental Cell of BPRL or MoEF&amp;CC/GPCB/NABL approved monitoring agency</td>
<td>BPRL</td>
</tr>
<tr>
<td>Environmental Component</td>
<td>Project stage</td>
<td>Parameter</td>
<td>Standards</td>
<td>Location</td>
<td>Duration / Frequency</td>
<td>Implementation</td>
<td>Supervision</td>
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<td>Design</td>
<td>Location</td>
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<td>As Water quality standards (IS 10500:2012)</td>
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<tr>
<td>Developmental Drilling Activities</td>
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</tr>
<tr>
<td></td>
<td>Operation Phase</td>
<td>Noise Level in dB (A)</td>
<td>As per National Noise standards</td>
<td>Minimum 5 Locations within each block</td>
<td>24-hourly measurement, once during the construction phase</td>
<td>Environmental Cell of BPRL or MoEF&amp;CC/GPCB/NABL approved monitoring agency</td>
<td>BPRL</td>
</tr>
<tr>
<td>Noise Measurements</td>
<td>Construction Phase</td>
<td>Noise Level in dB (A)</td>
<td>As per National Noise standards</td>
<td>Minimum 5 Locations around developmental wells</td>
<td>24-hourly measurement, once six months</td>
<td>Environmental Cell of BPRL or MoEF&amp;CC/GPCB/NABL approved monitoring agency</td>
<td>BPRL</td>
</tr>
<tr>
<td>Soil Quality</td>
<td>Construction Phase</td>
<td>Texture, conductivity, organic carbon, P_2O_5, K_2O, pH, Cl, O &amp; G, Heavy metals viz. Cr, Ni, Cu, Zn, Cd, Hg and Pb</td>
<td>--</td>
<td>Minimum 8 Locations within each block</td>
<td>Six Monthly</td>
<td>Environmental Cell of BPRL or MoEF&amp;CC/GPCB/NABL approved monitoring agency</td>
<td>BPRL</td>
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</tbody>
</table>
### Environmental Component

<table>
<thead>
<tr>
<th>Project stage</th>
<th>Parameter</th>
<th>Standards</th>
<th>Location</th>
<th>Duration / Frequency</th>
<th>Implementation</th>
<th>Supervision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developmental Drilling Activities</td>
<td>Texture, conductivity, organic carbon, P₂O₅, K₂O, pH, Cl, O &amp; G, Heavy metals viz. Cr, Ni, Cu, Zn, Cd, Hg and Pb</td>
<td>Minimum 8 Locations within each block</td>
<td>Six Monthly</td>
<td>Environmental Cell of BPRL or MoEF&amp;CC/GPCB/NABL approved monitoring agency</td>
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<td></td>
</tr>
</tbody>
</table>

*Source: ABC Techno Labs India Pvt. Ltd.*

**Table 6.2: Environmental Monitoring Program for QPF Facility & Pipeline laying**

<table>
<thead>
<tr>
<th>Environmental Component</th>
<th>Project stage</th>
<th>Parameter</th>
<th>Standards</th>
<th>Location</th>
<th>Duration / Frequency</th>
<th>Implementation</th>
<th>Supervision</th>
</tr>
</thead>
<tbody>
<tr>
<td>QPF Facility &amp; Pipeline laying</td>
<td>Construction Phase</td>
<td>PM2.5, PM10, SO₂, NOₓ, CO</td>
<td>National Ambient Quality Standards</td>
<td>2 Locations near QPF facility</td>
<td>24-hourly measurement, once during the construction phase</td>
<td>Environmental Cell of BPRL or MoEF&amp;CC/GPCB/NABL approved monitoring agency</td>
<td>BPRL</td>
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</tbody>
</table>
### Environmental Component: QPF Facility & Pipeline laying

<table>
<thead>
<tr>
<th>Project stage</th>
<th>Parameter</th>
<th>Standards</th>
<th>Location</th>
<th>Duration / Frequency</th>
<th>Implementation</th>
<th>Supervision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation Phase</td>
<td>PM2.5, PM10, SO2, NOx, CO, VOC &amp; HC (CH4)</td>
<td>National Ambient Quality Standards</td>
<td>2 Locations near QPF facility</td>
<td>Continuous 24-hourly once six monthly</td>
<td>Environmental Cell of BPRL or MoEF&amp;CC/GPCB/NABL approved monitoring agency</td>
<td>BPRL</td>
</tr>
</tbody>
</table>

### Environmental Component: Stack Monitoring

| Operation Phase | Total CO, total hydrocarbon, NonMethane Hydrocarbons, NOx emission estimates based on emission factors | Continuous 24-hourly once six months | Environmental Cell of BPRL or MoEF&CC/GPCB/NABL approved monitoring agency | BPRL |

### Environmental Component: Water Quality

<p>| Construction Phase | As per IS: 10500:2012 for relevant parameters | As Water quality standards (IS 10500:2012) | 2 Locations near QPF facility | Six Monthly | Environmental Cell of BPRL or MoEF&amp;CC/GPCB/NABL approved monitoring agency | BPRL |
| Operation Phase | As per IS: 10500:2012 for relevant parameters | As Water quality standards (IS 10500:2012) | 2 Locations near QPF facility | Six Monthly | Environmental Cell of BPRL or MoEF&amp;CC/GPCB/NABL approved monitoring agency | BPRL |</p>
<table>
<thead>
<tr>
<th>Environmental Component</th>
<th>Project stage</th>
<th>Parameter</th>
<th>Standards</th>
<th>Location</th>
<th>Duration / Frequency</th>
<th>Implementation</th>
<th>Supervision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise Measurements</td>
<td>Construction Phase</td>
<td>Noise Level in dB (A)</td>
<td>As per National Noise standards</td>
<td>Minimum 4 Locations within 1m of QPF facility</td>
<td>24-hourly measurement, once quarterly during the construction phase</td>
<td>Environmental Cell of BPRL or MoEF&amp;CC/GPCB/NABL approved monitoring agency</td>
<td>BPRL</td>
</tr>
<tr>
<td></td>
<td>Operation Phase</td>
<td>Noise Level in dB (A)</td>
<td>As per National Noise standards</td>
<td>Minimum 4 Locations within 1m of QPF facility</td>
<td>24-hourly measurement, once six months</td>
<td>Environmental Cell of BPRL or MoEF&amp;CC/GPCB/NABL approved monitoring agency</td>
<td>BPRL</td>
</tr>
<tr>
<td>Soil Quality</td>
<td>Construction Phase</td>
<td>Texture, conductivity, organic carbon, P2O5, K2O, pH, Cl, SOG &amp;G, Heavy metals viz. Cr, Ni, Cu, Zn, Cd, Hg and Pb</td>
<td>--</td>
<td>Minimum 4 Locations near QPF facility</td>
<td>Six Monthly</td>
<td>Environmental Cell of BPRL or MoEF&amp;CC/GPCB/NABL approved monitoring agency</td>
<td>BPRL</td>
</tr>
</tbody>
</table>
### Environmental Impact Assessment Report

#### Proposed Onshore Oil and Gas Development and Production Activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.

<table>
<thead>
<tr>
<th>Environmental Component</th>
<th>Project stage</th>
<th>Parameter</th>
<th>Standards</th>
<th>Location</th>
<th>Duration / Frequency</th>
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</tr>
</thead>
<tbody>
<tr>
<td>QPF Facility &amp; Pipeline laying</td>
<td>Operation Phase</td>
<td>Texture, conductivity, organic carbon, P₂O₅, K₂O, pH, Cl, O &amp; G, Heavy metals viz. Cr, Ni, Cu, Zn, Cd, Hg and Pb</td>
<td>--</td>
<td>Minimum 4 Locations near QPF facility</td>
<td>Six Monthly</td>
<td>Environmental Cell of BPRL or MoEF&amp;CC/GPCB/NABL approved monitoring agency</td>
<td>BPRL</td>
</tr>
</tbody>
</table>

Source: ABC Techno Labs India Pvt. Ltd.
6.3 **Environmental Monitoring Schedules**

To check the efficacy of the adopted mitigation measures and environmental Management plan, post project monitoring is carried out for various environmental parameters. In case, the monitored results of environmental parameter are found to exceed the allowable/stipulated values, the Environmental Management Cell suggests remedial actions and gets these suggestions implemented through the concerned personnel.

In order to assess the extent and nature of impacts on environment due to drilling operations, the monitoring on various attributes of environment will be carried out during various phases of drilling as under:

A. **Pre-Drilling Phase:** Prior to the start of drilling activities, the environmental status around the proposed drilling locations shall be monitored. These results will represent the baseline environment status, against which the monitoring results from the other phases are compared.

B. **Drilling Phase:** Monitoring during drilling phase serves as a measure of the impact on the environment due to drilling operations. Besides, the analysis of drill cuttings and drilling mud at various depths shall be carried out as per MoEF&CC guidelines on disposal of drilling wastes.

C. **Testing Phase:** Well testing is a short term activity spread over a period of 2 to 3 days. Testing operations are carried out to determine the presence of hydrocarbons and to understand the reservoir characteristics. Monitoring during this phase will serves as a measure of the impact on the environment due to testing operations.

D. **Post-Drilling Phase:** Monitoring shall be carried out after completion of drilling and testing operations to determine if there has been any residual impact on the environment due to drilling and testing operations.

6.4 **Health, Safety & Environmental Management Cell**

Occupational health check up, especially for diseases of eye, ear, lung and chest for the workers and staff who work in the plant area shall be carried out annually. If any abnormalities found after occupational health check up, person shall be extended treatment at nearby hospital in Ahmedabad/ Gandhinagar depending upon on the type and severity of the health effect.
In order to implement the environmental management program efficiently within the organization, periodical monitoring as per statutory guidelines and mid course corrections/actions, if required based on the environmental monitoring results, management intends to establish environmental cell for successful implementation. The roles & responsibilities are clearly defined among the personnel within the environmental cell. A well-equipped laboratory with consumable items shall be provided for monitoring of environmental parameters in the site. Alternatively, monitoring can be outsourced to a recognized reputed laboratory.

Source: Bharat PetroResources Limited

**Figure 6.1: Environment Management Cell**

Basically, this department will undertake monitoring of the environmental pollution levels by measuring fugitive emissions, ambient air quality, water and effluent quality, noise level etc., either departmentally or by appointing external agencies wherever necessary. In case, the monitored results of environmental pollution are found to exceeding the allowable values, the EMC suggests remedial action and gets these suggestions implemented through the concerned head of activities. EMC will also coordinate all the related activities such as collection of statistics with respect to health of workers, restoration of site, losses to crops and ecology and compensation. BPRL’s environmental officer for investigation will have the following responsibilities in general:
• Will modify proposed EMP as described in chapter 9 and monitoring plan as mentioned in Table 6.1 in line with the conditions stipulated by MoEF&CC and GPCB.
• Thoroughly familiarize himself with the existing information about habitat, sensitivities and baseline environment scenario etc present in the study area, making use of the EIA report;
• If applicable, liaise with the contractor in order to develop a common understanding of the goals of the EMP during execution of various activities for completion of the proposed development drilling;
• In the event presence of ‘sensitive area’ but not described in the EIA report, then a brief account of the nature of the sensitivity, its physical dimensions and the area of the developmental drilling that would be affected by avoidance of sensitive area would be prepared. It would also be discussed with the contractor’s site manager as to how access to the site would be achieved without impacting on the sensitive area; etc.

Data will be recorded with respect to type of land covered by well drilling sites to establish specific termination points, if possible. It is also recommended to appoint a community-facilitation officer who will have the following responsibilities during planning and implementation phases;

• Identification of affected villages and individuals during planning and also making contact with village sarpanch and elder citizens and appraise them about the purpose and likely effect of their operation including Dos’ and Donts’ during the survey by the nearby habitants;
• Inspection and documentation of the conditions preceding the drilling in the area of operations to account for any permitting/operational damage which may occur through dialogue with the owners of the resources and Village Head;
• Negotiation and agreement concerning asset inventories and payment of compensation as per land revenue records of land yields;
• Monitoring of project impacts and verification of damage to resources; and
• Reporting so as to required.
6.4.1 **ROLE OF BPRL (OPERATOR)**

BPRL has the ultimate responsibility for implementing the provisions of the Environmental Monitoring Programme. The role includes ongoing management of environmental impacts and measuring environmental performance through inspections/audits and monitoring. The contractor performance as well as development of mechanism for dealing with EHS is an integral part of the environment management. It is recommended that EHS requirements will be made integral part of contract document and prior to tender for assigning any contract.

6.4.2 **ROLE OF CONTRACTOR**

BPRL’s management will be responsible for the performance of all it’s contractors/sub-contractors and ensuring that all commitments and policy requirement are translated into contractor’s requirements and implemented to the full intent and extent of BPRL’s commitment.

6.5 **AUDIT**

The audit program will include pre-commissioning audits of the activities focusing on the compliance of procedures to deliver the specified level of performance of equipment/machinery and to ensure that all environmental and safety requirements are met. This includes:

- Integrity and function of physical systems;
- Compliance with operating procedures and standards;
- Compliance with prescribed relevant environment standards;
- Testing and review of emergency procedures;
- Compliance with maintenance of procedures and records; and
- Competence and training of operatives and field management staff.

Audit results will be reported to management and field staff responsible for the process or equipment in question, where audits reveal non-compliance with requirements, corrective actions will be implemented. These will be prioritized according to the significance of the environmental risks arising. In-house Environment Management Cell (EMC) will conduct audit on fortnight basis during development drilling mainly on following aspects:

- Pollution and waste management;
- Safe working practices;
- Ecology;
- Habitat and other infrastructure;
- Employment;
- Losses/damage caused to surrounding areas;
- Compensation;
- Rehabilitation (when applicable); and
- Cultural heritage.

After completion of proposed development drilling of wells within CB-ONN-2010/8 block, an in-house audit will be carried out, focusing on following aspects:

- Restoration of site to the possible extent;
- Habitat and other infrastructure
- Losses to crops and ecology to the surrounding area;
- Compensation; etc.

6.5.1 PERFORMANCE MONITORING

- Environment & Safety Aspects

Safety features, ambient working environment and Occupational Health and Safety (OHS)-indicators are subjected to regular monitoring and review. The compiled information and any corrective measures taken will be applied in a continuous process to improve the OHS Management System (OHSMS) which will be responsible for management of environment, health and safety aspects related pertaining to proposed development drilling.

The OHSMS will include specifications for performance monitoring, evaluation, and improvement of the system including recording and reporting accidents.

- **OHSMS:** The performance and achievements of the OHSMS responsible for management of overall environment, Health & Safety aspects will be re-assessed on fortnightly basis.

- **Safety Inspection, Testing and Calibration:** BPRL will arrange for in-house and/or third party inspection and testing of all safety features including gas detectors and hazard control measures once during development drilling of each well. The inspection will focus on engineering and personal protective features,
work procedures, places of work, installations, equipment, and tools used. The inspection will ensure that issued personal protective equipment continues to provide adequate protection and is being worn as required. All instruments installed or used for monitoring and recording of working environment parameters will be regularly tested and calibrated. Records shall be kept of all inspections, tests, and calibrations.

- **Monitoring of the Working Environment:** Environment Monitoring will be carried out by using an appropriate combination of portable and stationary sampling and monitoring instruments for keeping healthy and hygienic environment to the possible extent. The monitoring as per details given hereunder Tables 6.1 (subjected to be modified as per conditions stipulated by MoEF&CC and GPCB) shall be carried out during development drilling:

- **Surveillance of Worker’s Health:** BPRL will provide appropriate and relevant health surveillance to workers with special emphasis to the dust and hydrocarbon prior to first exposure and at regular intervals thereafter.

- **Training:** Training activities for employees and visitors will be adequately monitored and documented (curriculum, duration, and participants). Emergency exercises including drills shall be adequately documented. Service providers and contractors are contractually required to submit the adequate training documentation before start of their assignment.

### Social Aspects

This will include:

- Interaction with direct affected families before, during and after the execution of proposed development drilling on the following aspects;
  - Pollution and waste management;
  - Safe working practices;
  - Ecology;
  - Habitat and other infrastructure;
  - Employment;
  - Losses/damage caused to surrounding areas;
  - Compensation;
6.5.2 Statutory Returns and Compliance Reports

The statutory returns and compliance reports here below are to be submitted to the Gujarat Pollution Control Board (GPCB).

- Submission of half yearly compliance report in respect of the stipulated prior environmental clearance terms and conditions in hard and soft copies to the regulatory authority concerned, on 1st June and 1st December of each calendar year to Regional Office of MoEF&CC, Bhopal.

- Submission of environmental statement for the financial year ending 31st March to the concerned Gujarat Pollution Control Board (GPCB) on or before 30th September every year.

- Submission of Water Cess returns in Form 1 as per Rule 4 (1) of Water (Prevention & Control of Pollution) Cess Rules 1978 on or before the 5th of every calendar month to Gujarat Pollution Control Board (GPCB).

6.6 Training

To achieve the objective of environment management, it is essential not only to provide best pollution control system but also to provide trained manpower resources to operate the same. Training facilities will be in place for environmental control. This training shall cover the items listed below:

- Awareness of pollution control and environmental protection;

- Operation and maintenance of pollution control equipment;

- Knowledge of norms, regulations and procedures; and

- Occupational health and safety.

BPRL will ensure that workers prior to commencement of new assignments receive adequate training and information enabling them to understand the hazards of work and to protect their health from hazardous ambient factors that may be present. The training will adequately cover:
1. Knowledge of materials, equipment, and tools;
2. Known hazards in the operations and how they are controlled;
3. Potential risks to health;
4. Precautions to prevent exposure;
5. Hygiene requirements;
6. Wearing and use of protective equipment and clothing;
7. Appropriate response to operation extremes, incidents and accidents; etc

A basic occupational training program and specialty courses will be provided as needed to ensure that workers are oriented to the specific hazards of individual work assignments. Training will generally be provided to management, supervisors, workers, and occasional visitors to areas of risks and hazards. Training will also be provided to account for new or changed risks whenever procedures are altered or new materials/equipment introduced. The salient features of the training program are as given hereunder:

- Employees will be trained on the hazards, precautions and procedures for the safe storage and handling of equipments/machinery, material etc relevant to each employee’s task and work area;
- Personnel will be trained in environmental, health and safety matters including accident prevention, safe lifting practices, the use of MSDSs, safe chemical handling practices, and proper control and maintenance of equipment and facilities;
- Training will also include emergency response, including the location and proper use of emergency equipment, use of personal protective equipment, procedures for raising the alarm and notifying emergency response teams, and proper response actions for each foreseeable emergency situation;
- Training will be repeated periodically and supported by feasible incentives;
- Workers with rescue and first-aid duties will receive dedicated training so as not to inadvertently aggravate exposures and health hazards to themselves or their co-workers;
- BPRL through appropriate contract specifications and monitoring will ensure that service providers, as well as contracted and subcontracted labor is appropriately trained before start of their assignments; etc
6.7 **Record Keeping**

Records of significant environmental matters, including monitoring data, accidents and occupational illnesses, and leaks/spills, fires and other emergencies will be maintained. Recorded information will be reviewed and evaluated to improve the effectiveness of the, health, safety and environmental program by BPRL.

6.8 **Waste Minimization, Recycling-reuse-recover Techniques and Natural Resource Conservation**

A. **Waste Minimization**: Process optimization by using latest and advance technology equipments.

B. **Recycle-Reuse-Recover**: The wastewater collected from Rig Wash will be recycled completely in the mud preparation. Other hazardous waste like spent oil etc. shall be given to GPCB approved recyclers and processors.

C. **Natural Resource conservation**: Rain harvesting will be carried out to store rain water for future use and thus minimizing the ground water consumption.
CHAPTER 7

RISK ASSESSMENT AND DISASTER MANAGEMENT PLAN
CHAPTER 7: RISK ASSESSMENT & DISASTER MANAGEMENT PLAN

7.1 INTRODUCTION

Environmental Risk Assessment is a scientific analysis for identification of credible risk and thereafter estimating the safe distances from any hazardous installations/processes in the eventuality of an accident. Estimation of near accurate safe distances is absolutely necessary to protect the public, property and environment.

Development drilling and testing operations of hydrocarbon, QPF & Pipeline within CB-ONN-2010/8 block situated in Dehgam, Daskroi, Mehdavad, District- Gandhinagar, Ahmedabad and Kheda, Gujarat are considered hazardous in nature, which can pose risk to life and property in an unlikely event of sudden and violent release of hydrocarbon fluid and hydrogen sulfide (H₂S) gas due to other unsafe acts/conditions and from fuel HSD storage. Therefore, detailed hazard identification, risk assessment have been carried out and disaster management plan has been prepared for prompt response in the event of an emergency.

7.1.1 OBJECTIVE

The objectives of the study are to provide:

- Preliminary identification of hazards and hazardous scenarios that could produce an undesirable consequence arising from the proposed developmental drilling of wells, QPF & Pipeline within CB-ONN-2010/8 block.
- Assessment of consequences of hazards from developmental drilling of wells, QPF & Pipeline within the facility in terms of ignition, thermal radiation, blowout etc.
- Determination of the magnitude of all major accidents arising due to the proposed developmental drilling of wells, QPF & Pipeline within CB-ONN-2010/8 block that have the potential to cause damage to life, property and environment including:
  - Effects are as where personnel may be located within the proposed developmental drilling of wells, QPF & Pipeline within CB-ONN-2010/8 block
  - Effects on are as external to the development drilling
- Estimation of frequency of occurrence of the hazards.
- Review of safety features (organizational systems & safety equipment)
- Recommendations for prevention, control and mitigation measures for any identified risk
The overall aim of the study is to provide a degree of predictability on the risk of the operation as a result of the proposed developmental drilling of wells, QPF & Pipeline within CB-ONN-2010/8 block.

7.1.2 Methodology & Approach Employed

Risk analysis consists of hazard identification studies to provide an effective means to identify different types of hazard during the operation of the facility. This is followed by an assessment of the impacts of these hazards. Hazard is present in any system, plant or unit that handles or stores flammable materials. The mere existence of hazards, however, does not automatically imply the existence of risk. Screening & ranking methodologies based on Preliminary Hazard Analysis (PHA) techniques have to be adopted for risk to be evaluated.

The approach and methodology by ABC Techno Labs followed for the Risk Assessment study are described hereunder:

- **Identification of Hazards Analysis**
  Various possible hazards will be identified during developmental drilling of wells, QPF & Pipeline within CB-ONN-2010/8 block. The release sources and potential accidents scenarios associated with each hazards will be listed. For each selected release sources, several scenarios may be possible depending upon the failure mode causing loss of containment. The criteria used for selection of scenarios for the consequence analysis will be the Maximum Credible Accidental (MCA) scenarios.

- **Effects & Consequence Estimation**
  Effects & consequence distance estimation performed to determine the potential for damage or injury from the selected scenarios. The incident outcomes analyzed using release rates, dispersion, combustion, thermal radiation from fire and spill. Damage distance computation based on jet fire, flash fire scenarios, as applicable.

- **Failure Frequency Analysis**
  Failure frequency analysis done for Blowout & well release, Structural failure etc. Standard international database referred for estimation of probabilities. Failure rate data is essentially derived from internationally well known generic databases. The generic failure data base selected for calculating the failure frequencies
and the values in the database are used to reflect the mechanical and process design of the development drilling operations, QPF & Pipeline.

- **Risk Summation**
  Risk quantification and summation is based on probabilities from standard international database. The risk to personnel will be expressed in terms of Individual Risk (IR) represented by Iso Risk Contours and Group Risk/Societal risk represented by F-N Curves based on risk tolerability criteria.

- **Risk Mitigation Measures**
  Based on consequence analysis and risk summation findings, risk mitigation measures will be suggested in view of applicable standards, guidelines and best practices to reduce risk and enhance safety at the proposed developmental drilling of wells, QPF & Pipeline within CB-ONN-2010/8 block.

### 7.2 Risk Assessment and Hazard Identification

Developmental operations and testing operations, QPF & Pipeline are generally hazardous in nature by virtue of intrinsic chemical properties of hydrocarbons or their temperature or pressure of operation or a combination of these factors. Fire, explosion due to hazardous release of crude oil, gas, \( \text{H}_2\text{S} \) or a combination of these are the hazards associated with hydrocarbon developmental and testing operations. These have resulted in the development of more comprehensive, systematic and sophisticated methods of safety engineering, such as, hazard identification and risk assessment to improve upon the integrity, reliability and safety of hydrocarbon operations.

The primary emphasis in safety engineering is to reduce risk to human life and environment. The broad tools attempt to minimize the chances of accidents occurring. Yet, there always exists, no matter how remote, that small probability of a major accident occurring. If the accident involves hydrocarbon in sufficient large quantities, the consequences may be serious to the project site, to surrounding area and the population therein.

Derrick floor is the center stage of all the development drilling operations and it is most susceptible to accidents. Safety precaution with utmost care is required to be taken during drilling as per the prevailing regulations and practices so that accidents can be avoided. Due to advancement in technology, numbers of equipment have been developed
over a period to cater the need of smooth operation on derrick floor. Various standards are required to be referred to cover the variety of equipments used for safe operation in drilling and it is desirable to use a properly prepared manual for occupational safety while working or drilling over rig.

The following are the main hazards envisaged during developmental drilling of well.

7.2.1 MINOR OIL SPILL

During development drilling and testing operations, details of classification of possible oil spill scenario(s) and respective activities are as follows:
### Table 7.1: Classification of Oil spill during Developmental Drilling, QPF & Pipeline

<table>
<thead>
<tr>
<th>Classification of spill</th>
<th>Extent of spill</th>
<th>Impact</th>
<th>Scenarios</th>
<th>Preventive Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tier 1</strong></td>
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</table>
| *Response can be adequately addressed using equipment and materials available at the site.* | Spill contained on site. | Minor equipment damage. Brief disruption to operations. | - Diesel fuel refueling (i.e. drill rig hose leaks, overfilling or connection/disconnection incidents).  
- Drilling fluid (i.e. leaks from tanks, pumps or other associated equipment within the closed loop circuit system).  
- Drilling fluid chemicals (i.e. chemicals used during drilling; note that the volumes are limited by the storage containers used i.e. 200 L drums etc.).  
- Hydraulic oil (i.e. leaks from a split hydraulic hose or failed connector; moderate pressure, low volume lines). | One of the following preventive systems or its equivalent shall be used as a minimum for onshore facilities:  
- Dykes, berms or retaining walls sufficiently impervious to contain spilled oil |
| **Tier 2**              |                 |        |           |                     |
| *Response requires additional oversight, equipment, and materials available* | Localized spill with potential for escaping the site or that has escaped the site but is of limited extent | Moderate to major equipment damage/loss. Partial or short-term shutdown of operations. | - Transportation incidents associated with the delivery of diesel fuel to the drill-site (i.e. third party supplier’s truck rollover or collision).  
- Complete failure of an on-site storage tank (e.g. diesel fuel for generators). | |
| **Tier 3**              |                 |        |           |                     |
| *Response requires oversight, expertise, equipment, and materials available* | Major incident or a spill that has extended beyond the site. | Extensive equipment damage/loss. Long-term shutdown of operations. | - Uncontrolled fluid flow (blowout) from a well during development drilling in case oil is part of fluid. | |

Source: ABC Techno Labs India Pvt. Ltd.
Spill response strategies for combating incidents include:

- **Prevent or reduce further spillage:** One of the first response actions, if safe to do so, is the isolation of the source and prevention of further discharge.

- **Monitoring and evaluation:** Monitoring and evaluation are used to: Determine the location and movement (if any) of the spill, its appearance, its size and quantity, changes in the appearance and distribution of the spill over time and potential threat to the environment and the resources required to combat the spill (i.e. a more effective and coordinated response).

- **Mechanical containment and recovery:** Restriction of spill movement through the use of physical barriers (e.g. bunds, booms, diversion swales). Containment would be followed by the physical removal of the spilled material. This may be accomplished using sorbent pads, vacuum trucks, skimmers or other mechanical means appropriate to the material spilled.

- **Protection of sensitive areas:** Bunds or booms will be used to prevent spills from migrating down a watercourse or stream.

- **Clean-up:** This involves earthmoving equipment used to recover the absorbed spill and affected soil. Such operations may involve the collection of significantly greater volumes of material than was originally released.

- **Combinations of the above strategies.**

Affected area due to oil spill will be isolated. Spilled oil will be recovered and stored. Contaminated earth will be collected and disposed in consultation with Gujarat Pollution Control Board.

### 7.2.2 Blowout

If the hydrostatic head exerted by the column of drilling fluid is allowed to drop below the formation pressure then formation fluids will enter the well bore (this is known as a kick) and a potential blowout situation has developed. Blowout means uncontrolled violent escape of hydrocarbon fluids from a well. Blowout followed by ignition, is a major hazard. Major contributors to blowout are:

**Primary**

- Failure to keep the hole full;
- Too low mud weight;
• Swabbing during trips;
• Lost circulation; and
• Failure of differential fill-up equipment.

Secondary
• Failure to detect and control a kick as quickly as possible;
• Mechanical failure of Blow Out Preventer (BOP);
• Failure to test BOP equipment properly;
• Damage to or failure of wellhead equipment;
• Failure of casing; and
• Failure of formation or cement bond around casing.
• Fast and efficient action by operating personnel in recognizing the above situations and taking precautionary measure can avert a blowout.

 Presence of Sour Gas (Hydrogen Sulphide-H₂S)
Presence of Sour Gas (H₂S) in hydrocarbon during blowout of well can pose immediate dangers to life and health at and around the rig area. On ignition, H₂S is converted to Sulfur dioxide (SO₂) which is also highly toxic. Therefore, a safety system should be in place to monitor H₂S.

Hydrogen Sulphide gas (H₂S) is extremely toxic and even very low concentrations can be lethal depending upon the duration of exposure. Additionally it is corrosive and can lead to failure of the drill string or other tubular components.

Important characteristics of H₂S gas are briefed below:
1. H₂S is a toxic colourless gas heavier than air.
2. In concentrations greater than 100 ppm, it causes loss of senses in 3 to 15 minutes and death within 48 hours.
3. The safe concentration for a normal working period without protection is 10 ppm.
4. It has an odour of rotten eggs.
5. In concentration greater than 10 ppm, the olfactory sense to smell the gas is lost, hence need for detectors is apparent.
6. It dissolves in the blood and attacks through the nervous system.
7. It is very irritating for the eyes as it forms sulphurous acid together with water.
8. It attacks the body through the respiratory organs.
9. The Occupational Safety and Health Act (OSHA) sets a 10 ppm ceiling for an (eight) hour continuous exposure (TWA limit), a limit of 15 ppm for short term exposure limit for 15 minutes (STEL) and a peak exposure concentration of 50 ppm for 10 minutes.

10. The best protection is breathing apparatus, with mask covering the whole face and a bottle containing breathing air.

11. H₂S burns with a blue flame to sulphur dioxide which is also dangerous

12. It forms an explosive mixture with air at concentrations from 4% to 46%.

13. Short exposure of high tensile steel to as little as 1 ppm in aqueous solution can cause failures.


15. When pH is above 9 and solubility is relatively high, it is readily soluble in mud and especially in oil mud.

16. A 30% hydrogen peroxide solution will neutralize H₂S gas in the mud or 20 gallons of H₂O₂ per 100 barrels of mud. It occurs together with natural gas in all oil provinces of the world.

17. Coughing, eye burning and pain, throat irritation, and sleepiness are observed from exposure to low concentrations of H₂S.

18. Exposure to high concentrations of H₂S results in panting, pallor, cramps, paralysis of the pupil and loss of speech. This is generally followed by immediate loss of consciousness. Death may occur quickly from respiratory and cardiac paralysis.

<table>
<thead>
<tr>
<th>Concentrations</th>
<th>Symptoms/ Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 ppm</td>
<td>Coughing, eye irritation, loss of smell after 2-15 minutes (olfactory fatigue). Altered breathing, drowsiness after 15-30 minutes. Throat irritation after 1 hour. Gradual increase in severity of symptoms over several hours. Death may occur after 48 hours.</td>
</tr>
<tr>
<td>Greater than 100 ppm</td>
<td>Loss of smell (olfactory fatigue or paralysis).</td>
</tr>
<tr>
<td>500-700 ppm</td>
<td>Staggering, collapse in 5 minutes. Serious damage to the eyes in 30 minutes. Death after 30-60 minutes.</td>
</tr>
<tr>
<td>700-1000 ppm</td>
<td>Rapid unconsciousness, &quot;knockdown&quot; or immediate collapse within 1 to 2 breaths, breathing stops, death within minutes.</td>
</tr>
<tr>
<td>1000-2000 ppm</td>
<td>Nearly Instant Death</td>
</tr>
</tbody>
</table>
As per available data, there is no chance of presence of H$_2$S in the hydrocarbon present within block, however, as a hypothetical case, scenario of presence of 3% H$_2$S has been considered for consequence analysis.

7.2.3 Other Hazards during Drilling Rig Operations

7.2.3.1 Hazards During Preparation for Setting Up the Substructure

Equipment(s) are unloaded and positioned at or near the exact location of drilling point. The substructure is assembled, pinned together, leveled, and made ready for other rig components on the floor. Equipping the cellar begins but can be done throughout the rigging up process. This includes welding on a drilling nipple to the conductor pipe and attaching a flow line.

Potential Hazards:

- Being struck by the crane, load, truck.
- Pinched fingers when assembling equipment.
- Burns from cutting and welding on the drilling nipple.
- Temporary eye irritation from welding light flash.
- Falling from heights.

7.2.3.2 Hazards during Setting Up the Rig Floor and Mast or Derrick

Once the substructure is set in place, the process of setting up the rig floor begins by installing stairways and guardrails to allow access to the rig floor. Then, the draw works is set in place and secured to the substructure. On mechanical rigs, the engines are set in place and the compound and associated equipment connected to the draw works. On electric rigs, the electric cables (lines) are strung to the draw works. The bottom of the mast is raised to the rig floor and pinned in place. The crown section is then raised into place on the derrick stand. The "A-legs" are raised and pinned into place. The monkey board is pinned in place on the mast and all lines and cables are laid out to prevent tangling when the mast is raised. A thorough inspection of the mast should be made before raising the mast/derrick. The mast is now ready to be raised. The engines are started, and the drilling line is spooled onto the draw works drum. Once the mast has been raised and pinned, the remaining floor equipment can be set into place. If the rig has safety guy lines, they must be attached to the anchors and properly tensioned prior to continuing the rigging up process. A derrick emergency escape device is installed on the mast.
**Potential Hazards:**

- Falling or tripping during rigging up;
- Falling from rig floor;
- Being struck by swinging equipment;
- Being struck by falling tools;
- Being crushed or struck by equipment due to failure or overloading of hoisting equipment;
- Getting entangled in lines during rising of the derrick or mast;
- Failure to properly install derrick emergency escape device; etc.

### 7.2.3.3 Hazard in Rigging Up the Circulating System

While one crew finishes preparing the rig floor, another crew might be rigging up the circulating system. The mud tanks and mud pumps are set into the predetermined location. The mud lines are then connected and electric cords are strung.

**Potential Hazards:**

- Being struck by or crushed by equipment being set into place;
- Getting caught in pinch points;
- Being struck by crane, load, truck or forklift tipping;
- Being struck by hammer when connecting mud line unions; etc.

### 7.2.3.4 Hazards during Installing the Auxiliary Equipment

All remaining drilling and auxiliary equipment must be set into place and installed where needed. The catwalk and pipe racks are positioned and the pipe and drill collars are set on the racks.

**Potential Hazards:**

- Getting struck or pinched by, or caught in between, tubulars being loaded onto racks.
- Having feet pinched or crushed when setting up the pipe racks and catwalk.

### 7.3 Consequence Analysis

The risk presented by a blowout (hydrocarbons release event) is determined by the frequency and consequence of its possible outcomes. The consequence of igniting a hydrocarbon release during blowout depends on the type of material released, the mass
release rate, the timing of the ignition, and the environment into which the hydrocarbon is released. Briefly, typical outcomes are:

- **Jet fires**: produced by an ignited jet of gas or liquid spray released under pressure;
- **Pool fires**: produced by ignition of a liquid release that accumulates on the surface and ignites;
- **Flash fires**: produced by igniting a gas cloud so that a fire propagates through the gas cloud (without generating a significant overpressure);
- **Explosions**: produced by igniting a gas cloud in conditions where the resultant accelerating flame front produces a significant overpressure.

Jet fire emanating from the release source may follow a flash fire or explosion.

1. **Early Ignition**

   In the consequence analysis, gas and two-phase events that ignite early are modeled as jet fires. Liquid releases that ignite early are modeled as pool fires.

   Briefly, jet fires are modeled as follows:

   - Mass release rate is determined (for each representative hole size) based on the operating temperature and pressure at the point of release.
   - From the mass release rate, the jet flame length and associated fatality area.

2. **Late Ignition**

   In the event of two-phase releases that ignite late are modeled as explosions.

   Delayed ignition is not assumed to occur for oil releases. The consequential effect of a hydrocarbon gas explosion on personnel is determined by a variety of factors, including:

   - Direct effects of blast overpressure;
   - Whole body translation due to the blast wave;
   - Thermal effects on personnel inside the burning gas cloud.

   It is assumed that all personnel caught inside the burning gas cloud are likely to be fatally injured due to thermal radiation effects and inhalation of burning gases. Outside the gas cloud, personnel may still suffer from the effects of flash fire.

   **Thermal Radiation**

   Thermal radiation from a hydrocarbon fire is a significant hazard to personnel. The degree of injury caused by thermal radiation is related to the intensity of the thermal radiation and the exposure time.
Thermal radiation effect modeling to estimate the likely injury or damage to people and objects due to thermal radiations resulting from incident outcomes is the straightest forward of the three types of physical exposure modeling referred to above. The consequence caused by exposure to heat radiation is a function of:

- The radiation energy onto the human body [kW/m²];
- The exposure duration [sec];
- The protection of the skin tissue (clothed or naked body).

The following damage distances for thermal radiation have been used for modeling:

<table>
<thead>
<tr>
<th>Radiation Energy [kW/m²]</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>37.5</td>
<td>Damage to process equipment. 100% fatality in 1min. 1% fatality in 10sec.</td>
</tr>
<tr>
<td>12.5</td>
<td>First degree burn for 10 sec exposure</td>
</tr>
<tr>
<td>4.0</td>
<td>First degree burn for 30 sec exposure</td>
</tr>
</tbody>
</table>

- **Ignition of Blowout**

Surprisingly, few surface blowouts ever ignite. Less than 10 blowouts per year ever catch on fire, worldwide. Typically, large formation water flows lifted by the hydrocarbon flow make ignition difficult if not impossible. Water comes into the blowout zone, drawn in by low flowing bottom hole pressure; or adjacent wet zones are exposed to the flow path. Highly flammable blowouts may never ignite if no ignition source is present and flow is quickly dispersed. Thus, knowledgeable and experienced blowout specialists always restrict blowout access and carefully inspect the area around blowouts for ignition sources, particularly areas within an explosive vapor cloud.

### 7.3.1 Model Used For Consequence Analysis

PHAST (Version 7.2) software of DNV has been used to perform the consequence calculations. PHAST is a consequence and risk assessment software for calculation of physical effects (fire, explosion, atmospheric dispersion) of the escape of hazardous materials. PHAST software allows detailed modeling and quantitative assessment of release of pure and mixtures of liquid and gaseous chemicals.

### 7.3.2 Scenarios Wise Findings of Consequence Analysis

Subsequent to the accidental release of hydrocarbon, the consequence depends on various factors e.g. type and quantity, presence and location of an ignition source, meteorological conditions, etc. The consequence analysis for the selected accident scenarios for
hydrocarbon releases have been carried out to estimate the impacted distances and outcomes of same have been described in subsequent sections.

- **Release of HSD due to pipeline rupture**
  
  **A. Jet Fire**
  
  In the event of rupture on HSD supply pipeline, computed thermal radiation distances resulting from jet fire are as per given hereunder:

<table>
<thead>
<tr>
<th>Radiation Level</th>
<th>Distances (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 kW/m²</td>
<td>231.8</td>
</tr>
<tr>
<td>12.5 kW/m²</td>
<td>172.5</td>
</tr>
<tr>
<td>37.5 kW/m²</td>
<td>137.2</td>
</tr>
</tbody>
</table>

- **B. Late Explosion Results**
  
  Computed over pressure radii resulting from HSD pipeline rupture are as per given hereunder:

<table>
<thead>
<tr>
<th>Pressure in bar</th>
<th>Max Diameter in m</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.02</td>
<td>213.4</td>
</tr>
<tr>
<td>0.13</td>
<td>194.5</td>
</tr>
<tr>
<td>0.02</td>
<td>193.4</td>
</tr>
</tbody>
</table>
Level Indicators, earthing, flame arrestor are the control equipments are proposed for the site.

- **Release of Crude due to pipeline leak**

  **A. Jet Fire**

  In the event of leakage on Crude pipeline, computed thermal radiation distances resulting from jet fire are as per given hereunder:

<table>
<thead>
<tr>
<th>Radiation Level</th>
<th>Distances(m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 kW/m²</td>
<td>25.69</td>
</tr>
<tr>
<td>12.5 kW/m²</td>
<td>18.53</td>
</tr>
<tr>
<td>37.5 kW/m²</td>
<td>14.35</td>
</tr>
</tbody>
</table>
B. Late Explosion Results
Computed over pressure radii resulting from crude pipeline leak are as per given hereunder:

<table>
<thead>
<tr>
<th>Pressure in bar</th>
<th>Max Diameter in m</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.5 m/s - F</td>
</tr>
<tr>
<td>0.02</td>
<td>105.5</td>
</tr>
<tr>
<td>0.13</td>
<td>60.79</td>
</tr>
<tr>
<td>0.02</td>
<td>58.09</td>
</tr>
</tbody>
</table>

C. Dispersion Results
The reported concentration due to dispersions is as per given hereunder:
UFL: 11.16 m
LFL: 42.94 m
Farthest Extent: 54.06 m
7.4 Failure Frequency Analysis

The failure frequency analysis aims at estimation of the “probability” of the incident. Failure frequencies may be classified as generic and synthesised for a particular situation, especially for more complex systems. Generic failure frequencies are preferred wherever available, as these reduce variances arising out of analyst judgement in the failure frequency estimation.

The standard method of calculating the failure rate of an isolated section of equipment or a chosen set of equipment items is to count the different items and associated line lengths. The failure rate for a certain item is then broken down into the correct proportions for required release rate bands.

7.4.1 Blowout and Well Release Frequencies

The study (Source: White Rose oilfield development on the Grand Banks, offshore New foundland by Husky Oil Operations Limited) estimates that there have been 51,000 development wells drilled in that period of 1955 to 1988 giving a frequency of 4/51,000 = 7.8E-05 blowouts per well drilled.

The frequency of well blowout and well release is discussed in The International Association of Oil & Gas Producers Risk Assessment Data Directory. Table 7.2 shows the expected frequency of such events based on historical data from recent years,

Table 7.2: OGP Blowout and Well Release Frequencies

<table>
<thead>
<tr>
<th>Operation</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>Average</td>
</tr>
<tr>
<td>Blowout</td>
<td>6.0E-05</td>
</tr>
<tr>
<td>Well Release</td>
<td>4.0E-04</td>
</tr>
</tbody>
</table>

Source: OGP - Oil & Gas Producers

Additional correction factors could also be considered based on the likelihood that the wind is blowing in the direction of populated areas. Also for smaller releases it is believed that the well release could be isolated by mechanical means reducing the event duration.

The above estimate is, however, still very conservative for a number of reasons. The data on which the above frequency is based cover several decades.

In past years, drilling technology has improved significantly since that time and the risk of a development drilling blowout will inevitably be lower than the above frequency suggests.
Finally, the drilling rig will operate in accordance with stringent operating procedures and these will be in line with the best practice of well drilling operation worldwide.

### 7.4.2 Structural Failure Frequencies

Det Norske Veritas (DNV 1997) states that the total structural failure frequency is comprised of:

- **Structural failure within design:** 2.4E-05 per year;
- **Structural failure due to extreme weather:** 1.2E-05 per year;
- **Structural failure due to ballast failures:** 1.2E-05 per year;

Therefore, the total structural failure frequency is 4.8E-05 per year, including failure in design, extreme weather and ballast failures.

### 7.4.2.1 Process Piping Failure Frequencies

Most data bases of pipe failure rates are not sufficiently detailed to allow a determination of the failure frequency as a function of the size of the release (i.e. size of the hole in the pipe). The data shows that well over 90% of all failure are less than a 1-inch (25 mm) diameter hole and 3% are greater than a 3 inch (75 mm) diameter hole. Since most full rupture of piping system are caused by outside forces, full rupture are expected to occur more frequently on small-diameter pipes.

### 7.5 Risk Reduction Measures

This section discusses the measures for risk reduction and enhancement of safety during development drilling operations.

#### 7.5.1 Risk Mitigation Measures to Control Hazards

Occurrence of blowout and sour gas (H₂S) are the two major hazards. Occurrence of H₂S along with oil and gas is the major anticipated hazard during development drilling and production testing (The past experience and historical information available for drilling, developmental and production of hydrocarbons in the area revel that H₂S gas shall not be found in hydrocarbon reserves of the region. However, in the event of occurrence of H₂S during drilling operations, associated hazards and risk are considered for completeness of the study). Control measures for occurrence of blowout and release of H₂S gas are discussed in following sub-sections:
7.5.1.1 Blowout

The risk mitigation measures used for blowout prevention are discussed below:

A. Blowout preventer assembly

- Blowout preventer assembly shall consist of:
  - One bag type of preventer for closing regardless whether drilling equipment is in the hole or not.
  - One blind ram preventer closing against an open hole.
  - One pipe ram preventer closing against drill pipe in use in the hole.

- In blow out preventer assembly, two seamless steel pipes at least 50 mm of diameter connected below each set of blow out preventer, (one for bleeding off pressure and the other for killing the well) shall be provided. These pipes shall be straight and lead directly into the well.

- Each pipeline shall consist of component having a working pressure equal to that of the blowout preventer.

- After the surface casing is set in a well, no drilling shall be carried out unless blowout preventor assembly is securely installed and maintained.

B. Blowout Preventer (BOP) Control Units: Location and Conditions

- BOP control units should be located at a distance of nearly 30 m from well center.

- Status of following should be checked and maintained in good condition:
  - Pressure gauges;
  - Pressure steel lines/fire resistant hoses;
  - Level of hydraulic oil;
  - Charging of unit; and
  - Availability of sufficient number of charged bottles.

C. Control System for Blowout Preventer

- All manual control for manually operated blowout preventer shall be located at least 0.60 meters outside the derrick substructures. Instructions for operating the controls shall be posted prominently near the control wheel;

- A control of power operated blowout preventer shall be located within easy reach of driller floor;
• A remote control panel for blowout preventer shall also be installed around floor level at a safe distance from the derrick floor;

• All control for blow out preventer shall be clearly identified with suitable markers; etc.

D. Other Preventive Measures
The following control equipments for drilling mud system should be installed and kept in use during drilling operations to prevent the blowout:

• A pit level indicator registering increase or reduction in the drilling mud volume and shall include a visual and audio –warning device near the driller stand;

• A device to accurately measure the volume of mud required to keep the well filled at all times;

• A gas detector or explosimeter at the primary shale shaker and connected to audible or visual alarm near the driller stand;

• A device to ensure filling of well with mud when the string is being pulled out;

• A control device near driller stand to close the mud pump when well kicks;

• Blowout prevention drill shall be carried out once every week near the well during drilling;

• Suitable control valves shall be kept available near the well which can be used in case of emergency to control the well;

• When running in or pulling out tubing, gate valve and tubing hanger shall be pre-assembled and kept readily available at the well; etc.

E. Measures after Blowout
During controlling a blowout, the following precautions shall be taken:

• On appearance of any sign indicating the blowout of well, all persons, other than those whose presence is deemed necessary for controlling blowout, shall be withdrawn from the well and a competent person shall be present on the spot throughout;

• An area within the 500 meters of the well on the down wind direction shall be demarcated as danger zone;
• All electrical installations shall be de-energized;
• Approved safety lamps or torches shall only be used within the danger zone;
• No naked light or vehicular traffic shall be permitted within the danger zone;
• A competent person shall ascertain the condition of ventilation and presence of gases with an approved instrument as far as safety of persons is concerned;
• Two approved type of self containing breathing apparatus or any other breathing apparatus of approved type for use in an emergency shall be available at or near the place. Adequate firefighting equipment shall be kept readily available for immediate use; etc.

7.5.1.2 CONTROL MEASURES FOR H₂S DURING DRILLING

A. H₂S Detection System

A four channels H₂S gas detection system should be provided. Sensors should be positioned at optimum points for detection, actual locations being decided on site but likely to be at or near to:

- Well Nipple
- Rig Floor
- Shaker header tank
- Substructure cellar

The detection system should be connected to an audio visual (siren and lights) alarm system. This system should be set to be activated at a concentration of 15 ppm H₂S.

The mud logging will have a completely independent detection system which is connected to an alarm in the cabin. This system will be adjusted to sound an alarm at a concentration level of 10 ppm H₂S as suggested in the Drilling and Production Safety Code for Onshore Operators issued by The Institute of Petroleum.

A stock of H₂S scavenger will be kept at drilling site for emergency use.

B. Small Levels of H₂S

Small levels of H₂S (less than 10 ppm) will not activate the well site alarms. Such levels do not create an immediate safety hazard but could be a first indication of high levels of H₂S to follow.
H₂S will cause a sudden drop of mud pH. The mud man will therefore organize and supervise continuous pH checks while drilling. Checks should be as frequent as required depending on ROP and always made following a formation change.

Following control measures will be taken in case of small level of detection:

- Add H₂S scavenger to mud.
- Check H₂S levels at regular intervals for possible increase.
- Inform all personnel of the rig about the presence of H₂S and current wind direction.
- Commence operations in pairs.
- Render sub base and cellar out-of-bounds without further checking levels in this area.

C. **High Levels of H₂S**

Higher levels of H₂S (greater than 10 ppm) do not necessarily cause an immediate safety hazard. However some risk does exist and, therefore, any levels greater than 10 ppm should be treated in the same manner. Occurrence of 10 ppm or greater H₂S concentration will sound an alarm in the mud logging unit.

If higher levels of H₂S greater than 10 ppm are found, following steps will be taken:

- Driller to shut down rotary and pumps, pick-up the string so that drill pipe is in the BOP and chain down the break;
- One pre-assigned roughneck will go to the doghouse and put on the breathing apparatus. All other rig personnel will evacuate the rig and move up wind to designated muster points;
- Driller and roughneck will return to the rig floor and commence circulating H2S scavenger slowly and reciprocating the pipe string;
- The level of H₂S will be checked in all work areas. H₂S scavenger will be added to the mud and circulated. If H₂S levels drop, drilling will be continued with scavenger in the mud. Approximately 30 % of hydrogen peroxide (H₂O₂) solution will neutralize H₂S gas in the mud at 20 gallon of H₂O₂ per 100 barrels of mud; etc.
D. Control Measures for H₂S During Testing

H₂S scavenging chemicals (caustic soda solution, calcium hydroxide or iron oxide slurry) will be continuously injected in the recovered gas/oil/formation water after pressure reduction through choke before sending the same to separator.

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Situations</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Monitoring of H₂S Levels at site</td>
<td>H₂S Engineer and HSE supervisor of contractor</td>
</tr>
<tr>
<td>2</td>
<td>When H₂S level more than 5ppm, inform shift in charge and Tool Pusher</td>
<td>H₂S Engineer and HSE supervisor</td>
</tr>
<tr>
<td>3</td>
<td>Tool Pusher to instruct crew to use protection equipment and inform Company man along with BPRL’s representative and Tool Pusher</td>
<td>Tool Pusher</td>
</tr>
<tr>
<td>4</td>
<td>Company man and SERT to look for any person affected by H₂S and taking him for first aid /medical attention</td>
<td>Company man along with BPRL’s representative and SERT</td>
</tr>
<tr>
<td>5</td>
<td>If concentration of H₂S is decreasing or in control, monitor the site closely. If it is increasing inform Project/Asset Manager about the situation</td>
<td>Company man along with BPRL’s representative and Tool Pusher</td>
</tr>
<tr>
<td>6</td>
<td>Project/Asset Manager and EMST to discuss among themselves and domain expert and instruct site whether to continue drilling operations or not</td>
<td>Project/Asset Manager and EMST</td>
</tr>
<tr>
<td>7</td>
<td>Mean while at site if the concentration of H₂S is increasing establish site emergency room and inform immediate neighbor about gas so as to ready for evacuation if required and local authorities</td>
<td>Company man along with BPRL’s representative, SERT and Tool Pusher</td>
</tr>
<tr>
<td>8</td>
<td>Project/Asset Manager to start emergency control room and after discussing with EMST and domain experts advice site for further operations.</td>
<td>Project/Asset Manager and EMST</td>
</tr>
<tr>
<td>9</td>
<td>Inform and liaise with local and statuary authorities. Mobilize any experts or services required for site</td>
<td>Project/Asset Manager and EMST</td>
</tr>
</tbody>
</table>

Source: Bharat PetroResources Limited

7.5.2 Safety System For Drilling Rigs

Operational Safety is the foremost concern while working on drilling rig. Derrick floor is the center stage of all the operations and it is most susceptible to accidents. Safety precaution with utmost care is required to be taken as per the prevailing regulation and practice so that accidents can be avoided. Due to advancement in technology, number of equipment has been developed over a period to cater the need of smooth operation on
derrick floor. Various standards are required to be referred to cover the variety of equipment used for safe operation in drilling and become cumbersome at times to refer standards for each equipment as per given hereunder;

- Twin stop safety device (crown-o-matic and floor-o-matic);
- Fall prevention device on mast ladder with safety belt;
- Emergency Escape device for top man;
- First aid box with Stretcher and Blanket;
- Fire bell /siren;
- Emergency vehicle;
- Fire extinguishers;
- Flame proof portable hand lamp /safety torch;
- Railling with toe board;
- Guards on all moving parts;
- Breathing apparatus (wherever required);
- Gas detector for hydrocarbon gas & H₂S gas (if required);
- Safety lines for power tongs;
- Rotary brake;
- Hoisting brake lever with safety chain;
- Emergency shutoff system for draw works;
- Safety chain for inclined ramp (to prevent fall of any person);
- Safety belt for top-man with lane yard;
- Railing on stair case at mud tank/walkways and derrick floor; etc.

### 7.5.3 Availability and Provisions Before Spudding of the Well

To enhance the safety at the drilling rig during drilling operation following should be ensured:

- Geo-technical Order (GTO)/drilling program with shift in-charge;
- PPE for crew;
- First aid box;
- Wash pipe should be greased after every 8 hours or as specified by the manufacturer;
- Kelly bushes to be greased after every 24 hours or as specified by the manufacturer;
Lower & upper kelly cock (its operating lever should be kept at designated place at derrick floor);
Kelly saver sub on Kelly;
Mud check valve /full opening safety valve;
BOP control panel on derrick floor;
Before lowering casing, inspect all the instruments such as, weight indicator, pressure gauges, rotary torque, SPM counter, RPM counter mud volume totaliser, flow meter & trip tank;
Required Number of drill collars and heavy weight D/Ps;
Ensure availability of two mud pumps in good working condition;
Rat hole and mouse hole be drilled;
Twin stop safety device should be made in working order; etc.

7.5.4 GENERAL SAFE PRACTICES DURING DRILLING OPERATION

Penetration rate shall be monitored. In case of any drilling break, stop rotary table, pull out the Kelly, stop mud pump and check for self flow;
Different type of drill pipes should not be mixed up during making up the string;
Protectors should be used on drill pipes while lifting and laying down the pipes on catwalk;
Drill pipe rubber protector should be installed on drill pipes body while being used inside the casing;
Before starting drilling, hole should be centered to avoid touching of kelly with casing / wellhead and ensure that no damage is done to well head and BOP;
Continuous monitoring of the gain/loss of mud during;
BOP mock drill should be carried during drilling / tripping and under mentioned operations;
Safe Working Conditions and Practices to be Adopted During Drilling Operations; etc

7.5.5 EMERGENCY PREPAREDNESS

BOP drills and trip drills should be done once a week;
Deficiency observed in BOP drill should be recorded and corrective measures should be taken; etc

7.5.6 FIRE FIGHTING FACILITY FOR DRILLING RIG

For the drilling rigs following fire fighting system/equipments should be provided:
Fire water system; and
First aid fire fighting system
7.5.7 Control of Hydrocarbon Release and Subsequently Fire & Explosion during Drilling and Testing

To detect the release of hydrocarbon during drilling and testing, hydrocarbon detectors should be placed, so that control measures may be taken to prevent fire and explosion. Emergency control measures should also be adopted as per Mines Act 1952, Oil Mines Regulation 1984 and Oil Industry Safety Directorate Standard 2000.

As per Oil Industry Safety Directorate (OISD) Standard, for the drilling rigs and well testing following fire fighting system/equipments should be provided:

- Fire water system; and
- First aid fire fighting system.

A temporary closed grid hydrant system with monitors, hydrant points and fire hose boxes may be installed to cover well location, and oil and diesel fuel storage tanks. Portable fire extinguishers of DCP, mechanical foam and CO\textsubscript{2} types of sufficient capacity and in sufficient numbers along with sand buckets should also be placed at strategic locations. Electrical and manual siren systems should be provided at the Security Gate of the experimental production facility. Electrically operated siren of 500 m range along with push buttons at appropriate locations to operate the siren should be installed.

Adequate personal protective equipments including sufficient number of breathing apparatus must also be kept ready in proper working condition.

- **Fire Water System**
  - One water tank/pit of minimum capacity of 40 Kl should be located at the approach of the drilling site.
  - For experimental production testing, one additional tank/pit of 40 Kl should be provided.
  - One diesel engine driven trailer fire pump of capacity 1800 lpm should be placed at the approach area of drilling site.
  - One fire water distribution single line with minimum 4 “ size pipe/casing should be installed at drilling site with a minimum distance of 15 m from the well.

- **First Aid Fire Fighting Equipments at Drilling Rig**
  Portable fire extinguisher on the drilling rig will be installed in line with IS: 2190 and minimum number requirement is as per details given below:
Table 7.3: Details of Fire fighting equipments

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Type of Area</th>
<th>Portable Fire Extinguisher</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Derrick floor</td>
<td>2 nos. 10 kg DCP type extinguisher</td>
</tr>
<tr>
<td>2.</td>
<td>Main Engine Area</td>
<td>1 no. 10 kg DCP type extinguisher for each engine</td>
</tr>
<tr>
<td>3.</td>
<td>Electrical motor/pumps for water circulation for mud pump</td>
<td>1 no. 10 kg DCP type extinguisher</td>
</tr>
<tr>
<td>4.</td>
<td>Mud gunning pump</td>
<td>1 no.10 kg DCP type extinguisher</td>
</tr>
<tr>
<td>5.</td>
<td>Electrical Control Room</td>
<td>1 no. 6.8 kg CO2 type extinguisher for each unit</td>
</tr>
<tr>
<td>6.</td>
<td>Mud mixing tank area</td>
<td>1 no. 10 kg DCP type extinguisher</td>
</tr>
<tr>
<td>7.</td>
<td>Diesel storage area</td>
<td>1 no. 50 lit mechanical foam</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 no. 50 kg DCP type extinguisher</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 nos. 10 kg DCP type extinguisher</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 nos. sand bucket or ½ sand drum with spade</td>
</tr>
<tr>
<td>8.</td>
<td>Lube Storage Area</td>
<td>1 no. 10 kg DCP type extinguisher</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 no. sand bucket</td>
</tr>
<tr>
<td>9.</td>
<td>Air Compressor area</td>
<td>1 no. 10 kg DCP type extinguisher</td>
</tr>
<tr>
<td>10.</td>
<td>Fire pump area</td>
<td>1 no. 10 kg DCP type extinguisher</td>
</tr>
<tr>
<td>11.</td>
<td>Near Dill In-charge Office</td>
<td>One fire extinguisher/shed with 3 nos. 10 kg DCP type extinguisher and 2 sand buckets</td>
</tr>
<tr>
<td>12.</td>
<td>Fire bell near bunk house</td>
<td>1 no. 10 kg DCP type extinguisher</td>
</tr>
</tbody>
</table>

Source: Bharat PetroResources Limited

### 7.5.8 Medical Facilities

First aid facilities should be made available at the core drilling site and a 24 hour standby vehicle (ambulance) should also be available at the well site for quick transfer of any injured personnel to the nearest hospital, in case an accident occurs and medical emergency arises. Prior arrangements should be made with the nearby hospitals to look after the injured persons in case of medical emergency during core hole drilling and experimental production testing operations.

### 7.6 Recommendations

#### Drilling Operations

A majority of accidents occur during drilling operation on the drill floor and may be associated with moving heavy tubular, which may strike or crush personnel. Being struck
by objects, falling and crushing usually make up maximum occupational risk of fatality. Mechanical pipe handling, minimizing the requirement of personnel on the drill floor exposed to high level of risk, may be an effective way of reducing injuries and deaths. Good safety management, strict adherence to safety management procedures and competency assurance will reduce the risk. Some of the areas in drilling operations where safety practices are needed to carry out jobs safely and without causing any injury to self, colleagues and system are given below:

**Maintenance of Mud Weight**

It is very crucial for the safety of drilling well. Drilling Mud Engineer should check the in-going & out-coming mud weight at the drilling well, at regular intervals. If mud weight is found to be less, barytes should be added to the circulating mud, to raise it to the desired level. Failure to detect this decrease in level may lead to well kick and furthermore, a well blow out, which can cause loss of equipments and injury to or death of the operating personnel.

**Monitoring of Active Mud Tank Level**

Increase in active tank level indicates partial or total loss of fluid to the well bore. This can lead to well kick. If any increase or decrease in tank level is detected, shift personnel should immediately inform the Shift Drilling Engineer and take necessary actions as directed by him.

**Monitoring of Hole Fill-up / return mud volume during tripping**

During swabbing or pulling out of string from the well bore, the hole is filled with mud for metallic displacement. When this string runs back, the mud returns back to the pit. Both these hole fill up & return mud volumes should be monitored, as they indicate any mud loss or inflow from well bore, which may lead to well kick.

**Monitoring of Inflow**

Any inflow from the well bore during tripping or connection time may lead to well kick. So, it is needed to keep watch on the flow nipple during tripping or connection time.

### 7.7 Disaster Management Plan

#### 7.7.1 Introduction

In view of the hazards associated with the Oil Exploration and Production industry, it is essential that a disaster control plan be evolved to effectively deal with the situation...
utilizing the available resources. There are many agencies involved in the activities associated with a disaster e.g. Government, Fire Service, Medical, Police, Army, Voluntary Organization etc. besides the various departments of the concerned organization itself which requires an organized multi-disciplinary approach to the problem.

The purpose of this DMP is to detail organizational responsibilities, actions, reporting requirements and support resources available to ensure effective and timely management of emergencies at, or affecting BPRL’s operations associated in the CB-ONN-2010/8 development block. The overall objectives of DMP are to:

- Ensure safety of people, protect the environment and safeguard commercial considerations
- Immediate response to emergency scene with effective communication network and organized procedures.
- Obtain early warning of emergency conditions so as to prevent impact on personnel, assets and environment;
- Safeguard personnel to prevent injuries or loss of life by protecting personnel from the hazard and evacuating personnel from an installation when necessary
- Minimise the impact of the event on the installation and the environment, by:
  - Minimizing the hazard as far as possible
  - Minimizing the potential for escalation
  - Containing any release.

### 7.7.2 Legal Requirements for Disaster Planning

Relevant statutory requirements, as given below and as amended from time to time, inter alia, are applicable for emergency response preparedness in E&P industry:

- *Oil Mines Regulation (OMR)*, 1984;
- *Central Electricity Authority Regulation*, 2010;
- *Explosives Rules*, 2008;
- *Atomic Energy (Radiation Protection) Rules*, 2004; etc
Additionally, all statutory requirements notified by the Central Government or States, from time to time, shall be complied with, as applicable. Clause-72 of Oil Mines Regulations (OMR), 1984 requires the Mines owner to formulate a contingency plan for fire and clause-64 requires development of an emergency plan for petroleum pipelines specifying actions to be taken in the event of fire, uncontrolled escape of petroleum from pipelines. Also, Clause -45(3) requires preparation of emergency plan for blow-out of oil and gas wells. The rules on “Chemical Accidents (Emergency Planning, Preparedness and Response) – 1996 compliments the set of rules on accident prevention and preparedness notified under the Environment (Protection) Act, 1986, in 1989 entitled “Manufacture, Storage and Import of Hazardous Chemicals Rules” and envisages a 4-tier crisis management system in the country.

BPRL will follows safety guidelines and emergency response procedures as per the detailed regulations given in the Oil Mines Regulation 1984 and Oil Industry Safety Directorate (OISD) Standard 2000.

7.7.3 Objectives of the Plan
The objectives of Disaster Management Plan (DMP) are to set out the appropriate course of action to mitigate the impact of an emergency event/incident. The plan provides procedures allowing all those involved to mobilize their resources in an orderly way and to react in time effectively. Disaster, in present context means an occurrence resulting in uncontrolled release of hydrocarbon and other associated developments. Most disasters have three common characteristic features i.e. loss of control, unwanted release of energy and failure to arrest chain of events. These may result in loss of life, damage to property, adverse effect on the environment and ecological imbalance.

This plan therefore aims at:

1. To visualize the possible emergency scenario that are likely to occur;
2. To evolve a pre-planned methodology of carrying out various emergency combating plans;
3. To prepare detailed responses for each type of emergencies;
4. To train operating personnel by means of mock drills, so as to make them well acquainted with the response action;
5. To minimize the damage to the environment during emergency; etc
The plan therefore, aims at immediate response to an emergency event to prevent escalation and also the response in the event of such escalation.

Generally, the following five phases are involved in an emergency:

1. **Discovery and Notification:** An event with an imminent threat of turning into an accident must first be discovered and the discoverer quickly notifies the same to the safety officer.

2. **Evaluation and Accident Control Initiation:** Based on the evaluation of available information, the safety officer makes a rapid assessment of the severity of the likely accident and initiates the best course of action.

3. **Containment and Counter Measures:** Action is first taken to contain and control the accident by eliminating the causes which may lead to the spread of accident. Measures are also taken to minimize the damage to personnel, property and environment.

4. **Clean-up and Disposal:** After the accident is effectively contained and controlled, the cleanup of the site of the accident and safe disposal of waste generated due to the accident are undertaken.

5. **Documentation:** All aspects of accidents, including the way it started and progressed as well as the steps taken to contain and the extent of the damage and injury, must be documented for subsequent analysis of accident/incident for prevention in future, damage estimation, insurance recovery and compensation payment. It may be noted that some aspects of documentation, such as, photographs of the site of accident and main objects involved in the accident, survey for damage estimation, etc. may have to be completed before the cleanup and disposal phase. However, the effort in all cases is to re-commence the operation as soon as possible.

BPRL will develop site specific on site and off site emergency plan which also includes linkages with local administration, local communities and other operators in the area to provide necessary support. However, salient features of proposed DMP are summarized below:
7.7.4 Emergency Classification

Severity of accident and its likely impact area will determine the level of emergency and the disaster management plan required for appropriate handling of an emergency. Emergency levels and the action needed for each level are indicated below:

7.7.4.1 Level 1 Emergency

Disaster would be one in which emergency response personnel within the installation would be able to contain and deal effectively with the disaster and its aftermath. In this level of emergency, the response is site specific where site personnel are involved and it takes into account the proposition that the situation is controllable with the help of resources available at site. An installation-specific Emergency Response Procedure (ERP) is available at each installation for this level.

- There is no immediate danger to public or environment
- Released hazard substance is contained to the working area
- Creates little or no media interest
- Low potential for it to escalate
- Handled by site personnel
- No immediate threat to workers

Action Plan:

- Notify Company man along with BPRL’s representative/ Tool Pusher.
- All well site personnel evaluate problem and initiate appropriate remedial measures.
- Unnecessary personnel to evacuate the site.
- Alert mobile emergency equipment to be in readiness.
- In case it is a thickly populated area, alert the nearby residents so that they are ready for evacuation in case the alert situation escalates.

7.7.4.2 Level 2 Emergency

Disaster would require efforts from BPRL resources at the work centers. Level II response is normally activated when the incident Coordinator reaches the site and after an assessment and taking initial actions decides that the situation requires still bigger response by higher authorities of the company, due to severity of the incident, lack of resources or adverse media publicity, community response etc. From this point, the steps of this DMP are applicable.
Action Plan

✓ Ensure all level 1 actions are taking place.
✓ Initiate evacuation of nearby residents. Restrict entry to the incident zone by roadblocks.
✓ Mobilize emergency control equipment.
✓ Establish communication links with Mumbai office about the incident and with local administration

7.7.4.3 Level 3 Emergency
Disaster would be of such a magnitude that it would be beyond the containing ability of work centres and would require mobilization of resources through local administration, mutual aid agencies and State / Central Govt. assistance. The CEC (Chief Emergency Coordinator) then activates the offsite DMP.

An accident involving very serious hazard and with likely impact area extending beyond 500 m from the operational area, that is, drilling area limits, such as, major fire, very large release of inflammable material. Major fires will usually have the triggering effect resulting in the propagation of explosion. In a level 3 emergency, evacuation of population in villages, if any, adjoining the operational area may sometime become necessary if threatened area extend to populated village area adjoining the site of the primary accident in a direction of maximum impact.

✓ There exists an immediate danger to the public or environment
✓ Control of situation has been lost
✓ Creates state or national media interest
✓ Emergency extends beyond drill site operations

Action Plan:

✓ Ensure all 1 and 2 level actions are taking place
✓ Mobile all emergency control equipment.
✓ Call for specialist team for control of the particular emergency.
✓ Inform local/state administration about the state of emergency.

7.7.4.4 Level 4 Emergency
Disaster response is initiated when the BPRL authorities after implementation and assessment of emergency procedures decides that the local resources are not capable to
cope-up with the emergency situation. There are adverse business implications and the situation is worsening and drawing more and more adverse reactions which would require the intervention of Corporate & National level. For such responses, Corporate DMP has been prepared and available at each installation.

Finally, since every emergency situation is unique in characteristics, the exact plan would be decided by the competent authorities. This plan would, at best, serve as guide for drawing the exact plan.

On-site Disaster Management Plan (DMP) will meet the hazards created due to all Level 1 emergencies and most of the Level 2 emergencies. In addition to on-site DMP, off-site DMP may also have to be put into operation for some Level 2 and all Level 3 emergencies.

Luckily the maximum vulnerable zone may not be extended much beyond development drilling and testing area due to blow out and fire around HSD storage area. Therefore, Level 3 Emergency requiring evacuation of surrounding village population is not applicable in case of drilling and testing area. Even the Level 2 emergency is likely to be confined within a limited distance from the drilling site and HSD storage area, the evacuation of personnel only from affected area will be required. Even under the worst accident scenario, evacuation of less than 30 persons may be involved and damage, if any, to nearby installations is expected to remain confined within the operational area.

7.7.5 GENERAL SAFETY

As part of BPRL Health, safety and Environment policy, BPRL is committed to the health and safety of its people and environment by providing a safe and healthy work place minimize impact on environment due to its activities.

BPRL is responsible for:

- Ensuring that operations are carried out in a safe working environment in accordance with good oil field practices as well as applicable regulations.
- Informing all personnel entering in operational area about the HSE requirements and the need for strict enforcement of these requirements.
- Improving competence and efficiency of people through training and emergency drills.

In general in the operational area appropriate Personal Protective Equipment (PPE) must be worn at all times including a minimum of hard hat, steel toed safety shoes and hand
gloves. Observe all safety signs such as “NO SMOKING” and “NO UNAUTHORSED ENTRY”. These are placed for the safety of all personnel. All visitors are to be made aware of safety regulations.

7.7.6 On-Site Disaster Management Plan
The On-site Disaster Management plan is activated in case the emergency requires mobilization of resources from the block manager. This plan is activated by the Chief Emergency Coordinator (CEC). Asset manager is the CEC at block level and will exercise control through the Block Emergency Control Room (ECR).

7.7.6.1 Emergency Organization
The existence of a well-defined emergency organization is the most vital part of an emergency preparedness plan drawn up to combat any emergency situation. On-site emergency organization chart will be appropriately activated and made functional while combating an emergency situation. The core action group of the emergency organization comprises of the various functionaries of the CB-ONN-2010/8 block.

Source: Bharat PetroResources Limited
7.7.6.2 Site Emergency Response Team (SERT)

SERT is the first responder in case of any emergency at site. Team will be responsible for:

- First aid and fire fighting.
- Search and rescue operations.
- Rig shut down if required.
- Respond as enumerated in procedures of different emergency scenarios.
- Estimate requirement of material, equipment and services for emergency control.
- Evacuation in case emergency is out of control.
- Coordinate with external emergency teams like fire fighting team, oil spill control team and blow out control team.
- Take active part in mock drills.
- Suggest revision of ERP based on threat vs. vulnerability analysis hazards, mock drills, actual incidents and emergencies.

Composition of SERT

- Company man: The Company man on the rig will be On Scene Coordinator & Head of SER. He shall supervise and monitor on-site emergency response along with BPRL’s representative and will also coordinate communications with BPRL’s resources / teams. Site Emergency Response Team will assist him.
- BPRL’s HSE Manager/Engineer: He shall be assisting company man along with BPRL’s representative in on-site emergency response and assist in coordinating with contractor’s supervisors as well as BPRL’s base support resources / team.
- Contractor’s Tool Pusher: The Contractor’s Tool Pusher will be nodal coordinator for coordination with company man on emergency response of the drilling unit including supervisors of the emergency teams made up of rig personnel. He will also be responsible for communications with drilling contractor’s base office and other contractual agencies involved. He will be assisted by the drilling rig team including HSE and operational personnel to deal with the emergency.
- Contractor’s personnel: To complete formation of SERT, rig crew (including services) shall be selected based on position and competency and will be directly responsible for execution of emergency plan.

List of SERT, shift-wise will be formulated and displayed.
SERT team will be formed from experienced rig crew knowledgeable about hazard identification, risk analysis and emergency management. All SERT team members will have basic knowledge of first aid and fire fighting. At least two members of SERT in each shift shall be trained first aider.

The Asset Manager, CB-ONN-2010/8 block is head of the On-site emergency organization and is designated as the Chief Emergency Coordinator (CEC). He will exercise control through the Emergency Control Room (ECR). The CEC is assisted by an expert team drawn from various disciplines forming Emergency Management Support Team (EMST).

The Chief Emergency Coordinator (CEC) will assume control through the EMST. The Chief Emergency Coordinator (CEC) may appoint.

The EMST will have the following expert representatives / services to function under his direct control and provide all the necessary assistance and inputs of men and material.

- **Chief Emergency Coordinator (CEC)**
- **Project Incharge, CB-ONN-2010/8 block**
- **Assistant Emergency Coordinator**
- **Head – Drilling Services / Well Services / Geophysical Services and Surface Area Manager**
- **On-Scene coordinator (OSC)**
- **Shift I/C in the initial phase & Installation Manager**
- **Logistics Coordinator**
- **Manager Logistics**
- **Safety Coordinator**
- **Head-HSE**
- **Material Coordinator**
- **Store Manager**
- **Medical Coordinator**
- **Medical Services**
- **Finance Coordinator**
- **Manager Finance**
- **Security Coordinator**
- **Head-Security**
- **Fire Safety Coordinator**
- **Manager Fire Services**
- **Communication Coordinator**
- **Manager-Personnel**
- **Public Relation Coordinator**
- **Manager-Personnel**
- **Welfare Coordinator**
- **Manager-Personnel**

### 7.7.6.3 Role of Co-Ordinators (Key Personnel)

1. **Chief Emergency Co-ordinator**
   - Overall command and control of the entire operations.
   - Establishing control room in case of emergency.
   - Activating Emergency Management Support Team (EMST).
   - Communication with Top Management.
- Liaison and coordination with other oil companies, domain experts like loss control/oil spill control/Blow out control teams as the case may be.
- Constant communication with company man along with BPRL’s representative at site through Emergency control room providing guidance, resource support and advice on emergency response.
- Liaison with statutory authorities for incidents requiring notification and / or external investigation.
- Liaison with appropriate local authorities and government agencies.
- Protecting the legal liability of the company.
- Arranging resources (material, equipment and services) to handle the emergency, including procurement and placing service contracts.
- Dealing with financial and insurance issues.
- Ensuring that the BPRL’s other day to day activities continue.

2. Emergency Management Support Team
- Prepare and Revise emergency plans and provide domain expertise in emergency management.
- Contact with crisis management team and arrange their visit to drill site.
- Establishing and manning Emergency Control Room. Constant communication with site control room to keep track of latest developments.
- Arrange necessary resource support including procurement.
- Assisting CEC in preparation of statements for press release.
- Liaison and coordination with external agencies as directed by CEC.

3. Administrative & Welfare Co-Ordinator
- Coordinates for security arrangements.
- Liaises with police and district civic authorities.
- Co-ordinates with Manager (block) for Rescue, Shelter and Medical relief operations.
- Informs the voluntary organizations to assist for rescue and relief operations.
- Public relations.

4. Medical Relief Co-Ordinator
- Organizes First Aid at the site of incidence.
- Arranges Ambulance Services.
- Medical relief camp in nearby Hospital and arranges extended services under.

5. Drilling & Workover Co-Ordinator
- Assesses damages to drilling/workover installations.
• Arranges salvaging of the affected installation.
• Act as chief co-ordinator till arrival of CEC of BPRL as the case may be.
• Guide fire Service, security, ambulance at site.

6. Employee Relations & Welfare Co-Ordinator
• To participate in rescue and relief operations.
• To contact relatives of affected persons and provide Food/ Beverage etc. at relief camp.
• Contacts Union Officials.

7. Safety & Environment Co-Ordinator
• To liaise between the main Co-ordinators.
• To liaise with statutory Safety & Environment authorities i.e. Mines Safety Directorate, Petroleum & Explosive Safety Organisation, State/ Central Pollution Control Board, OISD etc.

8. Finance Co-Ordinator
• To give finance support for all activities arranged by Main Co-ordinators.

9. Operation Group Co-Ordinator
• To co-ordinate activities of Well control measures in case of impending blow out or Blow out with or without fire.
• To liaise with Services Co-ordinator for fire control measures and emergency standby duty.

7.7.6.4 Site Control Room (SCR) at Rig
In case of emergency at site, Tool Pusher of Drilling Rig will set up a Site Control Room (SCR) at a safe distance near the site. The site control room will be managed on round the clock basis by defined Rig team of Drilling Contractor.

Emergency vehicle, communication facilities, light arrangements and food shall be provided at site control room in the minimum possible time.

Functions
✓ Communicate requirements for mobilization of equipment, resources etc.
✓ To keep records of all material received at site during emergency.
✓ To communicate with Emergency Control Room (ECR) on the latest position.
✓ To keep records of all decisions and messages sent/received.
7.7.6.5 **Emergency Control Room at Mumbai**

An Emergency Control Room (ECR) is the place, where the operations to be handled in emergency are directed and coordinated. The emergency control room should be equipped with good communication facilities like telephones, computers with internet, wall charts showing location of site, fire stations, copy of Emergency Response Plan (ERP) for the field, list of key personnel, their addresses and telephone/mobile numbers, note pads, telephone directories etc. Emergency control room will function from BPRL Mumbai office; Project/Asset Manager will depute suitable Duty Officers on round the clock basis in the emergency control room:

**Functions**

- Inform to all key personnel about incident and further happenings at site
- Maintain all records of events and actions taken.
- Round the clock monitoring and flow of information to and from emergency site.
- Coordinate with SCR on resource requirements.
- Coordinate with other oil companies and domain experts.
- Coordinate with key personnel for guidance and assistance required at drill site.
- Casualty list and information to next of kin.
- Preparation of management reports on the situation at every 12 hours interval.
- Coordination with local authorities such as police, civil administration, hospitals, fire department etc.
- Coordinate sanction & procurement of the items required during emergency.
- Arrangements for food, water, shelter medicines, logistics etc.

**7.7.6.6 Emergency Reporting**

- When witnessing or receiving notification of an emergency, as much information as possible should be taken and/or conveyed to the relevant emergency activation authority. Where ever possible, all information will be logged in written form with time and date included and provided to the Incident Controller.

- Personnel working on the field may, at any time, be exposed to an emergency, which could take many forms, for example (but not limited to):
Injuries and/or fatalities  Exposures
Aggressive releases  Fires and/or explosions
Equipment hazards  Impacts
Extreme weather  Adverse environments

✓ When an emergency occurs, an appropriate and prompt response is required, providing precise action to control, correct and return the site to a safe condition.

✓ Timely action is also required to protect people, the environment and property from harm.

✓ Reporting Forms for actions to be considered, when witnessing an emergency or receiving a report of an emergency.

✓ All near misses and unsafe acts will be written in logbooks / reported in the ‘Near miss, unsafe acts, hazards and sub-standard conditions report’ and verbally communicated to the concerned Supervisor / Superintendent / Installation Manager at an appropriate opportunity.

✓ All accidents and incidents will be immediately reported to the CEC (Chief Emergency Coordinator), and appropriate forms completed.

✓ All accidents and incidents occurring within the Field facilities will be reported to the Production Manager and Head-EHS as per CB-ONN-2010/8 block operator Incident Reporting and Investigation Procedure. This includes both situations where there is actual damage to health or equipment and also where there has been a threat of danger or a near miss.

7.7.6.7 INFORMATION SYSTEM

Please refer to communication chart for information flow on next page. Information flow to BPRL BOARD, Mumbai is for major emergency only. Other emergency cases are to be reported in daily/monthly reports. Reporting of incidence/emergency to regulatory authorities shall be immediately for major emergency and for others incidences, as per guidelines.
7.7.6.8 Safety Measures for Drilling Installations

Standing Order When Well Kicks and The Duties Of Person Employed On The Rig:

Shut-In Procedure

I. While Drilling
   1. Stop Rotary.
   2. Pick up Kelly to clear tool joint above Rotary table.
   3. Stop mud pump and check for inflow. If yes,
      - Raise Alarm
      - Close the Well by any the shut-in method.

II. While Tripping
   1. Raise Alarm
   2. Position tool joint above Rotary Table and set pipe on slip
3. Install Full Opening Safety Value (FOSV) in open position on drill pipe and close.
4. Shut-in Well by any of the method.

III. While Out of Hole

1. Raise Alarm
2. Close blind or Shear Ram.
3. Close Choke.
4. Open HCR/ Manual valve on Choke line.
5. Record SICP and Pit gain.

Positioning of Crew

Driller / Drilling Engineer/ SIC - at remote choke control panel
Asst. Drilling Engineer/ Jr. Engineer - on Floor to assist SIC
Derrick man / Top man-I - at Choke manifold
Derrick man/ Iop man-II - at Mud Pump
Floor men/ Rig men - at Stand pipe/ on Floor
Rig Mechanic/ In- Charge (TS) - at Rig Engines
Pump Fitter/ Technician - at Mud Pump
Electrician/ in- Charge (Elect) - at B.O.P Control Unit
Roustabouts/ Trade men - at Mud Tanks and Pumps
Mud Chemist/ Operator - at Shale Shaker tank
Geologist/ Mud logger - at flow line/ MLU

IV. To effectively kill a kick the end of the string shall be closed to the bottom of the well so that bottom hole pressure can be monitored and use of excess mud weight can be avoided. So if a kick is detected during tripping the D. E. should take the following steps:

The Tool Pusher will:

- Take immediate action to control the kick
- Coordinates well killing operations following well control procedures.
- Take all possible action to minimize damage to the rig, equipment and environment.
- Take immediate action to ensure the safety of all personnel.
- Coordinate medical emergency actions for any injuries.
✓ Make initial report and periodic updates to Company man along with BPRL’s representative.

**Case A - In case the kick is not severe i.e. rate of inflow is negligible:**

1. Run in the string to bottom as far as possible, carefully comparing the actual displacement volume against theoretical displacement volume, while running in care shall be bottom to fill up the string with mud.

2. After reaching bottom make up the Kelly cock.
3. Open choke line
4. Close annular B.O.P
5. Slowly close the choke line valve
6. Make up Kelly
7. Take steps to record shut in drill pipe and casing pressures

**Case B - If the kick is very severe the D.E. shall take the following steps:**

1. Open choke line
2. Close annular preventer
3. Slowly close choke line
4. Record annulus pressure
5. Arrange for stripping the string to bottom

The stripping procedure is briefly described as under:

1. Reduce closing pressure on the annular preventer.
2. Strip into the well bore with B.P.V. on the string. Bleed off required volume of fluid into the trip tank with hand adjustable choke. Drilling fluid volume bleed off shall include volume required for proper gas bubble expansion.

3. After reaching bottom, any standard well killing procedure may be adopted to circulate the kick out. It is to be noted that stripping operation shall always be done under proper guidance and supervision.

**V. Standing Order for Workover Well Blowout Shut- In Procedures**

When one or more of the warning signs are observed, immediate steps shall be taken to shut- in the well. If there be any doubt, it can always be checked up afterwards as even a small flow turn into big blowout in no time.
A. While Drilling

1. Raise Kelly until the tool joint is above the Rotary table or working platform.
2. Stop pump
3. Close B.O.P.
4. Inform IM
5. Read and record the shut-in tubing pressure, the shut-in casing pressure and the pit gain.

B. While Tripping

1. Set top tool joint on slip (If cut-off-hole run back.)
2. Install and make up shut-in valve in open position.
3. Close shut-in valve and B.O.P.
4. Pick-up and make circulation gear.
5. Open shut-in-valve.
7. Inform IM
8. Read and record the shut-in tubing pressure, the shut-in casing pressure and the pit gain.

Installing a full opening shut in valve instead of a drop in type valve is advisable as further operation such as running in of wire line tools if become necessary can be done through shut-in valve only.

VI. Responsibilities for Shut-In

Each member of the crew has different responsibilities during various shut-in/killing procedures.

A. While Drilling

- Drilling Crews
  1. JE-II - At Engine Kill
  2. TOPMAN-II - At pump
  3. TOPMAN-I - At kill manifold
  4. RIGMAN V - At well head
  5. RIGMAN I-IV - At Derrick floor/ working platform

- Engineering Crews
  1. Supervisor/ Fitter - Keep in touch with D.E.
  2. Remaining - 2 at pumps + 2 at outfit engine
3. Engine Driver - Electrical Switch Board
4. Chemical Deptt. Crews - At flow line
5. Production Crews - Near the well head

Drilling Engineer

1. Pick up Kelly to above Rotary Table/ Working platform
2. Stop pump
3. Close B.O.P
4. Inform Installation Manager / Higher Official.
5. Read & record shut in, tubing and casing pressures and pit gain.

B. While Tripping

Drilling Crews

1. JE II - Engine Kill
2. Topman II - Double board
3. Topman I - Kill manifold
4. Senior Grade - Well head
5. (I-V above) - Derrick floor/ working platform

Engineering Crews

1. Supervision/ Fitter - Keep-in with D.E.
2. Remaining Jugali - 2 at pump + at outfit engine
3. Engine Driver - Electrical switch board
4. Chemical Deptt. - At flow line
5. Production Crews - At well head

Drilling Engineer

1. Shut-in well immediately
2. If the string is out of hole run back as far as possible without any depth consideration set the top joint on slip. Direct crews to install shut-in value and close BOP.
3. If the string is already in hole set top too joint on slip and direct crews to install shut-in-valve, and close BOP.
4. Notify installation Manager / higher official.
5. Read & record shut-in tubing and casing pressures and pit gain.
Kill Procedures

The following variables are generally considered in killing a well:

1. Present following status
2. Magnitude of the formation pressure
3. Formation fracture pressure
4. Casing & Tubing burst pressure
5. Limitations of the working string such as packer leaks, tubing holes etc.
6. Limitations of surface Equipment
7. After studying all known & unknown variable the kill procedure can be evolved under a given situation.

VII. Precautions To Be Taken After A Blowout Has Occurred

1. An area within 500m of the well shall be demarcated as danger zone.
2. An electrical installation within the danger zone shall be de-energised and an alternative DG shall be commissioned for area lighting.
3. Only approved torches or safety lamps shall be used within the danger zone.
4. No naked light or Vehicular traffic are to be allowed within danger zone.
5. A portable gas detector shall be made available to indicate the presence of inflammable gas.
6. Person engaged in well control shall be equipped with gas makes. Adequate firefighting equipment shall be mobilized at the well site at the earliest. It may be necessary to provide additional sources of water for fire fighting.
7. An emergency medical unit shall be arranged outside the danger zone to render prompt medical help as and when required. This shall be equipped with minimum life saving drugs. One ambulance or any suitable vehicle shall also be kept standby near the site.
8. Temporary accommodation like tents with canteen facility shall be erected near the site.
9. Proper Radio or Telephone communication system shall be made available near the site. A Control room at CB-ONN-2010/8 block shall be established & shall be monitored round the clock by officers of Sr. level.
10. Civil authorities shall be notified to warn the local inhabitants about the possible fire hazard. The danger zone shall be preferably cordoned off by Security personnel.

11. Transport facility to place additional pumps and tank ages shall also be available at site.

**Contingency Plan to Prevent Blow-out**

The following actions shall be taken by the Shift – in charge to bring the situation under control.

**A. On experiencing Kick, following safety actions to be taken, if BOP fails to seal Well Mouth**

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Situations</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Alert crew to ensure escape if situation worsens</td>
<td>Shift I/C</td>
</tr>
<tr>
<td>2</td>
<td>Divert flow partially, intermittently or fully to waste pit (safe distance)</td>
<td>Drilling crew</td>
</tr>
<tr>
<td>3</td>
<td>Send SOS message to Base Office,</td>
<td>Shift I/C</td>
</tr>
<tr>
<td></td>
<td>(i) By EPABX (II) By Emergency Vehicles</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Switch off all engines/ generators</td>
<td>I/C Mech/ Elect</td>
</tr>
<tr>
<td>5</td>
<td>Remove all inflammable material away</td>
<td>Rig Crew (Drilling/ Mech./ Elect.)</td>
</tr>
<tr>
<td>6</td>
<td>Remove important Records to Safe place</td>
<td>Rig Crew (Drilling/ Mech./ Elect.)</td>
</tr>
<tr>
<td>7</td>
<td>Remove costly instruments/ equipments to safe place</td>
<td>Rig Crew (Drilling/ Mech./ Elect.)</td>
</tr>
</tbody>
</table>

*Source: Bharat PetroResources Limited*

**B. If the Blow out is sudden and massive while initial safety action could not be performed**

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Situations</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Carry out rescue operation for Top man and move other Rig crew to safe distance</td>
<td>Shift I/C</td>
</tr>
<tr>
<td>2</td>
<td>Send SOS message to Base Office,</td>
<td>Shift I/C</td>
</tr>
<tr>
<td></td>
<td>(i) By EPABX (II) By Emergency Vehicles</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Reorganize to try operations like BOP, Diversion of flow etc. as</td>
<td>Shift I/C</td>
</tr>
</tbody>
</table>
### 7.7.6.9 Fire or Explosions

The scenario anticipated is:

- Spillage/leak of oil/gas or presence of hydrocarbon vapors.
- Electrical short circuit.
- Fire in combustible material.

The events mentioned may lead to fire and explosion at the rig. With appropriate wind conditions, a fire within the site can spread and present a threat to the life and property not only at site, but also in the nearby areas. The key to containing an oil field fire is to isolate the problem area.

The Tool Pusher is to be informed immediately of any fire. Minor fire is to be dealt by using rig fire-fighting equipment. Any fire that threatens property/life must be notified to the nearest Fire Brigade Station.

### Sl. No. Situations Actions

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Situations</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>In case of fire, shout ‘fire” “fire” “fire” and sound the alarm.</td>
<td>Person who notices the fire.</td>
</tr>
<tr>
<td>2</td>
<td>Inform shift - in charge, Tool Pusher about fire/explosion.</td>
<td>Person who notices the fire.</td>
</tr>
<tr>
<td>3</td>
<td>Determine the type, location and extent of fire and inform Fire Station and Company man along with BPRL’s representative.</td>
<td>Tool Pusher.</td>
</tr>
<tr>
<td>4</td>
<td>The personnel not involved in fire control operation to evacuate the site.</td>
<td>All personnel at rig except SERT.</td>
</tr>
<tr>
<td>5</td>
<td>The Company man will assume charge of on scene coordinator. He along with BPRL’s representative will carry out head count of the personnel to ensure that every one has been safely evacuated and record response time. He will set up Site Control Room (SCR).</td>
<td>Company man along with BPRL’s representative and Drilling Contractor’s designated person (having POB list)</td>
</tr>
<tr>
<td>6</td>
<td>SERT under supervision of Company man along with BPRL’s representative will identify the source of leakage, isolate and attempt to extinguish the fire with portable fire extinguisher ad fire pumps.</td>
<td>Site Emergency Response Team(SERT)</td>
</tr>
<tr>
<td>Sl.No.</td>
<td>Situations</td>
<td>Actions</td>
</tr>
<tr>
<td>-------</td>
<td>---------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>7</td>
<td>If the emergency is out of control and could not be brought under control by in house resources, Emergency should be declared.</td>
<td>Company man along with BPRL’s representative in consultation with Project/Asset Manager.</td>
</tr>
<tr>
<td>8</td>
<td>Shutdown the rig under emergency condition. Keep concerned officials informed and seek help.</td>
<td>Tool Pusher and Company man along with BPRL’s representative</td>
</tr>
<tr>
<td>9</td>
<td>Cordon off the area, regulating the entry at entrance.</td>
<td>In charge security</td>
</tr>
<tr>
<td>10</td>
<td>If safe to do: Shut off or remove source of fuel. De-pressurize/remove any gas containing equipment located close to fire. Shift records/documents to safe location. Shift useful material/chemicals to safe location.</td>
<td>SERT</td>
</tr>
<tr>
<td>11</td>
<td>If spillage occurs, try to contain inside the boundary</td>
<td>SERT</td>
</tr>
<tr>
<td>12</td>
<td>Fire crew in charge after arriving at site will report to Tool Pusher/Company man along with BPRL’s representative, assess the situation and position the fire tender at appropriate place from where fire can be controlled effectively.</td>
<td>Fire crew in charge</td>
</tr>
<tr>
<td>13</td>
<td>The quantum of spillage/gas leakage along with brief actions taken shall be informed to in charge fire fighting.</td>
<td>Company man along with BPRL’s representative</td>
</tr>
<tr>
<td>14</td>
<td>Mobilize the Fire tenders from other fire stations if required and meanwhile place fire tender and take water for fire fighting.</td>
<td>BPRL’s representative, rig Tool Pusher, in charge fire crew</td>
</tr>
<tr>
<td>15</td>
<td>Cooling and quenching nearby tanks and equipments etc.</td>
<td>Fire crew and SERT</td>
</tr>
<tr>
<td>16</td>
<td>Assist the fire crew in fire fighting.</td>
<td>SERT</td>
</tr>
<tr>
<td>17</td>
<td>Regular monitoring of gas concentration.</td>
<td>Contractor’s HSE Supervisor</td>
</tr>
<tr>
<td>18</td>
<td>Direct visitors, contractor sand service personnel to appropriate area.</td>
<td>In charge Security</td>
</tr>
<tr>
<td>19</td>
<td>Determine need for additional services or further evacuation.</td>
<td>SERT</td>
</tr>
<tr>
<td>20</td>
<td>Pass the information and progress to Emergency Control Room</td>
<td>Site Control Room (SCR)</td>
</tr>
<tr>
<td>21</td>
<td>Coordinate and liaison with adjoining land owners/occupiers for emergency measures, assistance, evacuation compensation etc.</td>
<td>Company man along with BPRL’s representative and rig Tool Pusher</td>
</tr>
<tr>
<td>22</td>
<td>Liaison with local and appropriate govt. officials including notification, status reports and assistance.</td>
<td>Project/Asset Manager and EMST</td>
</tr>
<tr>
<td>23</td>
<td>Liaison with BPRL resources.</td>
<td>Project/Asset Manager and</td>
</tr>
<tr>
<td>Sl.No.</td>
<td>Situations</td>
<td>Actions</td>
</tr>
<tr>
<td>--------</td>
<td>---------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EMST</td>
</tr>
<tr>
<td>24</td>
<td>Draw the execution plan to combat emergency, ensuring stoppage of the spill/leak and arranging to clear the emergency site.</td>
<td>Project/Asset Manager in consultation with SERT and EMST</td>
</tr>
</tbody>
</table>

*Source: Bharat PetroResources Limited*

### 7.7.6.10 Flooding in the Field

Emergency Response in case of flooding is as follows:

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Situations</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Location to be constructed so as to prevent flooding of site.</td>
<td>Project/Asset Manager/ civil engineer</td>
</tr>
<tr>
<td>2</td>
<td>On discovery of flood/likely flood situation that threatens the well site, raise alarm.</td>
<td>Person who notices</td>
</tr>
<tr>
<td>3</td>
<td>Inform shift in charge, Tool Pusher and Company man and give location and extent of flood.</td>
<td>Person who notices</td>
</tr>
<tr>
<td>4</td>
<td>Determine details of flood situation and inform Emergency Control Room and further as per communication chart.</td>
<td>Company man along with BPRL’s representative</td>
</tr>
<tr>
<td>5</td>
<td>Secure the well if situation demands.</td>
<td>Tool Pusher</td>
</tr>
<tr>
<td>6</td>
<td>Company man will head count the personnel to ensure that every one has evacuated safely and set up Site Control Room.</td>
<td>Company man along with BPRL’s representative and Drilling Contractor’s designated person (having POB list)</td>
</tr>
<tr>
<td>7</td>
<td>Shutdown the installation under emergency condition. Keep concerned officials informed/seek help.</td>
<td>Tool Pusher, in consultation with Company man along with BPRL’s representative</td>
</tr>
<tr>
<td>8</td>
<td>Rescue any trapped personnel, provide first aid and send them for further medical assistance if required.</td>
<td>SERT and site Doctor</td>
</tr>
<tr>
<td>9</td>
<td>If safe to do:</td>
<td>SERT</td>
</tr>
<tr>
<td></td>
<td>Shut off source of fuel.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shift records/documents to safe location.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shift useful material/ chemicals to safe location.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Liaise with local and appropriate govt. officials including notification, status report and assistance.</td>
<td>Project/Asset Manager and EMST</td>
</tr>
<tr>
<td>Sl.No.</td>
<td>Situations</td>
<td>Actions</td>
</tr>
<tr>
<td>-------</td>
<td>-----------------------------------------------------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td>11</td>
<td>Liaise with BPRL resources.</td>
<td>Project/Asset Manager and EMST</td>
</tr>
<tr>
<td>12</td>
<td>Observe flood situation, if safe move inside of site and resume operations.</td>
<td>Project/Asset Manager in consultation with EMST &amp; SERT</td>
</tr>
</tbody>
</table>

Source: Bharat PetroResources Limited

7.7.6.11 Contingency Plan in the Event of Oil/Chemical Spill

Immediately extinguish any heater or fire that may ignite the spill.

- No smoking during spill control operations.
- Close valves if dealing with a fuel line rupture.
- Direct spillage to rig ditches or drains that will carry the oil to a safe holding sump or reserve pit.
- Distribute hulls, fibertext, gel, barite and any other absorptive material on hand as required to contain oil, which cannot be directed to ditch.
- Inspect area to ensure that all oil is contained in ditches, cellar, sumps, or reserve pit. Add ditches levees, dams, pits and sumps as required to contain spill.
- Start jets or sump pumps and transfer spilled oil from sumps to reserve pit or holding tank.
- After spill is stopped, collect all used hulls, fibered and similar materials for disposal as given prior inspection from the Tool Pusher. Ensure that no oil is left in ditches, cellar, pit, or sump, which might become a fire hazard.
- If the oil has escaped from rig site, use the chemicals and equipment provided to emulsify, blot up, and recover oil spilled.
- Notify Company man of the spill, which will in turn inform the Project/Asset Manager.
- After discussing with SERT, Company man along with BPRL’s representative and Tool Pusher will set up Site control room at a safe place.
- Company man along with BPRL’s representative will take guidance from Project/Asset Manager for hiring services of experts to control oil/chemical spill.
- After the special team has controlled the oil spill necessary cleaning operations are to be followed.
Tool Pusher will conduct an investigation of the spill and BPRL’s representative to determine the cause of the spill.

7.7.6.12 Casualty Evacuation

The site doctor in consultation with Tool Pusher, Company man and BPRLHSE Manager along with BPRL’s representative will decide about casualty evacuation. For evacuation ambulance will be available round the clock at drill site. After evacuation to local facilities as patience care and/or doctor and/or hospital personnel will make transfer. The respective service providers will be responsible to take care of the casualty after admission in hospital.

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Situations</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Inform shift supervisor Tool Pusher, In-charge of the service provider and give location and extent of incidence for evacuation</td>
<td>Person who notices</td>
</tr>
<tr>
<td>2</td>
<td>Administer immediate first aid</td>
<td>Doctor/ First aider</td>
</tr>
<tr>
<td>3</td>
<td>Determine need for medical assistance and/or evacuation</td>
<td>Doctor, Tool Pusher and Company man, BPRL’s representative</td>
</tr>
<tr>
<td>4</td>
<td>Liaise with ambulance personnel and local Doctor</td>
<td>Company man along with BPRL’s representative</td>
</tr>
<tr>
<td>5</td>
<td>Prepare patient for medical evacuation</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>If required accompany patient to hospital</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Ensure any necessary things to accompany patient like his personnel belongings, medicines and ID</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Inform and seek assistance from Project/Asset Manager</td>
<td>Company man along with BPRL’s representative</td>
</tr>
<tr>
<td>9</td>
<td>If necessary arrange for next of kin to be notified.</td>
<td>Respective In-charge of service company and BPRL Representative</td>
</tr>
<tr>
<td>10</td>
<td>Report incidence to appropriate authorities as necessary including management and statuary</td>
<td>Project/Asset Manager</td>
</tr>
</tbody>
</table>

Source: Bharat PetroResources Limited

7.7.6.13 Security Breach

The unauthorized presence of an individual on site is to be treated as Security Breach. Oil field operations, being hazardous, all field personnel are required to be very vigilant about unauthorized entry of persons in the field.
### Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Situations</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>On discovery of unauthorized personnel on site, question them on who they are and why they are at site.</td>
<td>All field personnel</td>
</tr>
<tr>
<td>2</td>
<td>Inform shift supervisor, Tool Pusher and if necessary and safe to do so, escort individual away from site</td>
<td>All field personnel</td>
</tr>
<tr>
<td>3</td>
<td>If any intruder is acting in a dangerous fashion, inform local police requesting assistance and notify Project/Asset Manager</td>
<td>In charge security, Tool Pusher and Company man along with BPRL’s representative</td>
</tr>
<tr>
<td>4</td>
<td>If intruder is threatening in a manner that may lead to a process incident, secure the process to minimize the risk of injury to personnel and damage to equipment. Stay calm and ensure security of personnel.</td>
<td>In charge security, Tool Pusher and Company man along with BPRL’s representative</td>
</tr>
<tr>
<td>5</td>
<td>Inform and seek assistance from Project/Asset Manager as deemed necessary</td>
<td>BPRL’s representative</td>
</tr>
<tr>
<td>6</td>
<td>Seek advice, assistance and liaise with appropriate govt. authorities</td>
<td>Project/Asset Manager</td>
</tr>
</tbody>
</table>

**Source: Bharat PetroResources Limited**

### 7.7.6.14 ACCIDENTS

In case of accidental emergency it is duty and responsibility of each individual to report the accident including near misses to shift in charge. Shift in charge in turn must report the same to Tool Pusher.

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Situations</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>On observing the accident/near miss inform shift in charge, Tool Pusher</td>
<td>The person who notices</td>
</tr>
<tr>
<td>2</td>
<td>Administer first aid in case of injury</td>
<td>Doctor/First aider</td>
</tr>
<tr>
<td>3</td>
<td>Tool Pusher to report the incident to Company man along with BPRL’s representative</td>
<td>Tool Pusher</td>
</tr>
<tr>
<td>4</td>
<td>In case of major accident the injured person to be sent to hospital</td>
<td>Doctor, Tool Pusher, HSE Manager and Company man along with BPRL’s representative</td>
</tr>
<tr>
<td>5</td>
<td>Minor accidents and near misses to be dealt as described in safety manual to be informed to Company Man</td>
<td>Tool Pusher, HSE Manager along with BPRL’s representative</td>
</tr>
<tr>
<td>Sl.No.</td>
<td>Situations</td>
<td>Actions</td>
</tr>
<tr>
<td>-------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>6</td>
<td>All accidents to be reported to Project/Asset Manager</td>
<td>BPRL’s representative, HSE Manager and Tool Pusher in consultation with Company man</td>
</tr>
<tr>
<td>7</td>
<td>Project/Asset Manager to immediately report accident to management and statutory authorities and constitute enquiry committee</td>
<td>Project/Asset Manager and EMST</td>
</tr>
<tr>
<td>8</td>
<td>After the enquiry is completed the findings to be conveyed to site for implementation if any changes are required</td>
<td>Project/Asset Manager and EMST</td>
</tr>
<tr>
<td>9</td>
<td>To implement the instructions received from Project/Asset Manager</td>
<td>Company man along with BPRL’s representative, HSE Manager and Tool Pusher</td>
</tr>
</tbody>
</table>

Source: Bharat PetroResources Limited

### 7.7.6.15 Essential Services

1. **Water Supply**

   On declaration of Emergency situation, Manager (Water Supply) and his team would organize availability of Water supply for Fire fighting and drinking water requirement. He would check up the feasibility of maintaining water from central water supply station, failing which he would commission the same from available Tube wells.

2. **Transport and Salvage Equipment**

   Manager (Transport) would check up the fleet and driver's availability or- all Rescue, Salvage, Transport operations and provide the services.

3. **Telephone Communication**

   On declaration of Emergency situation, Incharge- Control Room would check up the feasibility of operation the telephone exchange on mains supply. He would keep ready such alternate arrangements to operate the exchange with portable DG Sets. He would ensure that emergency telephones at declared control rooms are made available readily and available wireless sets at critical operational centers are in working condition.

4. **Electricity**

   One declaration of Emergency situation, Manager (Elect.) and his team would ensure that Power supply is cut off immediately where ever required so. He would try to maintain Power supply at critical locations like Medical relief centers, Water supply sources etc.
Manager (Elect.) and Manager (Water Supply) would organise to provide electricity at essential centers, in case Mains power supply from Power station could not be made available there.

5. **Civil Engineering Jobs**

One declaration of crisis situation, Manager (Civil) would organise gangs for debris removal, construction of temporary camps, etc.

During the critical phase of emergency, all out efforts would be made for meeting the needs of rescue, relief and fire fighting operation. During this phase maintenance of services like water and electricity for other purposes would receive lower priority. While restoring services, high priority would be given for maintenance of drinking water supply, then electricity.

<table>
<thead>
<tr>
<th><strong>DO’S AND DON’TS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Do’S</strong></td>
</tr>
<tr>
<td>✓ Release only authorised, verified written information</td>
</tr>
<tr>
<td>✓ Keep accurate records and logs of all enquiries and news coverage.</td>
</tr>
<tr>
<td>✓ Escort the Press and government agencies to the nearest safer place at the emergency site.</td>
</tr>
<tr>
<td>✓ Have a designated Spokesman.</td>
</tr>
<tr>
<td>✓ Know what information can and cannot be released.</td>
</tr>
<tr>
<td><strong>Don’ts</strong></td>
</tr>
<tr>
<td>✓ Speculate on the causes of an emergency.</td>
</tr>
<tr>
<td>✓ Speculate on the resumption of normal operations.</td>
</tr>
<tr>
<td>✓ Speculate on the outside effects of emergencies.</td>
</tr>
<tr>
<td>✓ Speculate on the value of losses and damages.</td>
</tr>
<tr>
<td>✓ Place blame of emergencies.</td>
</tr>
<tr>
<td>✓ Allow crowd in the affected area (Those who have no role assigned in the disaster plan should stick to their jobs).</td>
</tr>
<tr>
<td>✓ Spread rumours.</td>
</tr>
</tbody>
</table>

**SUPPLY BASE BPRL**

*Central Warehouse Karachi,*

*Central Warehousing Corporation, Near Flyover Bridge, IPCL Road,*

*Karachia P.O., Ranoli District, Vadodara-391350*
7.7.6.16 Conclusion

Even though the key contact personnel chart and role clarity are spelt out, experience has shown that in critical situation like a disaster, there is invariably some sort of panic at the beginning. Each Co-ordinator shall have a manual which will help him to train the personnel under him. This can be achieved if regular mock drills are undertaken. Each and everyone will become more conscious of the type of roles they will have to play to successfully combat the crisis situation.

7.7.7 Off-Site Disaster Management Plan

Offsite emergency preparedness is covered in the Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996. The following are the Block operator’s responsibilities towards generation of the Offsite Emergency Plan:

- To provide basic information on Risk and Environmental Impact Assessment to the Local/District Authority, Police, Fire Brigade, Doctors, surrounding industries and the public and to appraise them on the consequences and the protection/prevention measures and control plans and seek their help to manage the emergency.
- To assist the District Authorities in preparing the Off-site Emergency Plan.

An off-site emergency plan organization has essentially two parts:

A. Formation of the Local Crisis Group: This Group is headed by the Deputy Collector or the Magistrate of the Industrial area and is responsible for the management of any industrial emergency confined to the local area.

B. Formation of the District Crisis Group: This Group is headed by the District Collector of the District and is responsible for any major Industrial emergency affecting Local and beyond any industrial area of the District.

The composition of the Off-Site Crisis Group is covered in. Since, the actual offsite plan requires the participation of outside agencies; this report does not dwell further on the issue.
An efficient and reliable communication system is required for the success of the emergency plan. The efficient communication system is required to alert:

- **Emergency Authorities and Services**
- **Neighbouring area and public in the vulnerable zone**

The communication system requires the following:

- **Communication between Control Room to other units in the terminal**
- **Hotlines between Control Room to Emergency Services, Meteorological Station and the mutual aid members**
• Paging system and alarm for with the Control Room for alerting the employees
• P&T Telephone lines

A communication flow chart is to be prepared and kept in the Control Room. An up-to-date Telephone Directory of key personnel concerned with the emergency should be available at all times. These matters should be documented and kept within the Disaster Management Plan manual. The Disaster Management Plan Manual is required to maintain a record of police stations, hospitals and fire brigade stations in the area to seek assistance in dealing with emergency situations. The emergency team of Block operator should liaise with these agencies and with district officials and furnish them information on the possible hazards, extent of damage and actions to be taken by them during such emergencies.

7.7.7.2 Role of External Services

Police
The Police should assist in cordon off the accident site; organize evacuation and removing any seriously injured people to the hospitals. They shall divert traffic as and when necessary.

Fire Brigade
The fire brigade shall organise to fight fires other than gas fires and provide assistance as required.

Hospitals and Doctors
Hospitals and doctors should treat any injuries, which may primarily be burn injuries.

Mutual Aid from Neighboring Installations
Block operator may also depend on the local facilities handling emergencies. They will have to arrange with the local administration for providing services, such as fire fighting and medical needs during incident particularly in the nearby regions. Telephone links with neighboring industries and customer facility control rooms should be established.

7.7.7.3 Public Information System

During a crisis following an incident, the people of the area and a large number of media representatives would like to know about the situation from time to time and the response of the district authority to the crisis. It is important to give timely information to the public in order to prevent panic and rumors. The emergency public information could be carried out in three phases.
**Before the Crisis**

This will include the safety procedure to be followed during an emergency through posters, talks and mass media in different languages including local language. Leaflets containing do’s/don’ts should be circulated to educate the people in the vicinity.

**During the Crisis**

Dissemination of information about the nature of the incidents, actions taken and instructions to the public about protective measures to be taken, evacuation etc. are the important steps during this phase.

**After the Crisis**

Attention should be focused on information concerning restoration of essential services, travel restrictions, etc.

### 7.7.7.4 Warning System

In an off-site management plan, one of the most important prerequisites is a good 'Warning System'. Efficient warning system will save lives, prevent injuries and reduce losses. The Chief Emergency Co-ordinator - Onsite in consultation with Emergency Co-ordinator Offsite will decide the appropriate warning system and implement it. The warning systems are of the following types:

- Disaster Warning (Maximum Credible Loss Scenario) High pitched continuous wailing siren
- Fire/Toxic Release
- Long siren followed by short siren
- All Clear

Depending upon the nature of hazards and the area affected, other methods of warning may be used as follows:

- Out-door warning sirens
- Public address system with police
- ARP sirens
- Mass media
- Door to door visit by Civil/Defence Personnel
- Telephone contact with schools and other organisations/public institutions
✓ Information to be provided at common gathering places such as village canteens, shops, etc.

7.7.7.5 Services Support System
A major off-site incident may affect a number of units and the surrounding colonies. Hence in addition to the communication, warning, public information, fire fighting system, following additional service support will be required:

✓ Health and medical services
✓ Transportation services
✓ Security and police
✓ Media
✓ Mutual aid services

A telephone directory containing the contact numbers of all these support services should be documented and be part of the offsite disaster management plan.
CHAPTER 8
PROJECT BENEFITS


CHAPTER 8: PROJECT BENEFITS

8.1 INTRODUCTION
The proposed developmental drilling of wells within CB-ONN-2010/8 block situated in Dehgam, Daskroi, Mehmndavad, District- Gandhinagar, Ahmedabad and Kheda, Gujarat will enable to extract economical viable Oil. The development of the oil field will result in considerable growth of service sector and will also generate new industrial and business opportunities in the area. Small and medium scale industries may be developed as consequence. The major benefits of the project include in reduction of the hydrocarbon import bill of the nation as well as reduction of the imbalance in production and consumption. The commercial development will also lead to investment in Gujarat, bringing oil and gas revenues both to the State and to the Central Government. The presence of Private Oil companies in the region will substantially improve the socio-economic conditions of the region. Employment opportunity for local people as contract/daily wages in nearby areas.

8.2 INFRASTRUCTURE BENEFITS
The beneficial impact of hydrocarbon development on the civic amenities will be substantial after the commencement of project activities. The basic requirement of the community needs will be strengthened by extending health care, educational facilities to the community, building/strengthening of existing roads in the area. BPRL will initiate the above amenities either by providing or by improving the facilities in the area, which will help in uplifting the living standards of local communities. With improved transportation facilities there is always a scope for development.

8.3 BENEFITS FOR SOCIAL INFRASTRUCTURE
Improvement in social infrastructure such as:
- Increased revenue to the state by way of royalty, taxes and duties;
- Generation of employment: The project will create opportunities for direct and indirect employment;
- Establishment of small and medium scale industries may be developed as consequence;
- Regular Fund flow to local market;
• The basic amenities viz., roads, transportation, proper sanitation, educational institutions, medical facilities, entertainment, etc. will be developed as far as possible;
• Overall the proposed project will change living standards of the people and improve the socio-economic conditions of the area.
• Community Awareness programmed like Aids awareness, Polio camps, Eye camps and blood donation camps will be organized in vicinity from time to time for the benefit of people living in the surrounding area
• Need assessment study and its implementation: In line with the parent company CSR initiatives, the Operator (BPRL) will identify the requirements of the people/society in and around the project site after need assessment by CSR team. A detailed programme will be tailor made to resolve the issues and requirements of the villagers near the drill site, as per company policy.

In addition to above, due to increase in purchasing power of local habitants:
• There shall be significant change in the socio-economic scenario of the area;
• Recruitment for the unskilled and semiskilled workers for the proposed project will be from the nearby villages;
• The proposed project shall enhance the prospects of direct & indirect employment;

8.4 ENVIRONMENTAL BENEFITS
• Environmental awareness in school at nearby Villages and Programs for environmental education and public participation shall be developed with the help of audio visual aids to create awareness about the activities.
• Proper awareness campaign shall be organized for water conservation.
• In order to increase the aesthetic environment, plantation program shall be carried out in the nearby villages.
• Celebration of World Environment Day every year on 5th June will be marked by plantation of number of trees in order to develop awareness in them about protecting environment from pollution and to save earth.
• BPRL as part of corporation wide effort for “Swachh Bharat Abhiyan” will carry out the cleaning activity every Thursday Afternoon by dedicating for two hours during drilling of the wells at the project site.
CHAPTER 9

ENVIRONMENTAL MANAGEMENT PLAN
CHAPTER 9: ENVIRONMENTAL MANAGEMENT PLAN

9.1 INTRODUCTION

Environmental management is concerned with a planned, integrated programme aimed at ensuring that identified and unidentified impacts of a proposed project are contained and brought to an acceptable minimum. It provides confidence on the part of project planners that a reliable scheme will be put in place to deal with any contingency that may arise during all phases of development, from preliminary study to abandonment.

Environment Management Plan (EMP) for Production and development drilling of wells in CB-ONN-2010/8 block is required to ensure that mitigation of adverse impacts and strengthening of positive impact resulting from the proposed activities. EMP will be an overview document that will guide environment management of all aspects of development drilling activities within the CB-ONN-2010/8 block.

Environmental management activities of the proposed development drilling of wells in CB-ONN-2010/8 block will be governed by a series of regulations that impose standards and mitigation of environmental hazards. Thus, it is a planned and integrated programme aimed at ensuring that both identified and unidentified impacts that may arise during the various phases of the project are brought to an acceptable level.

This Environmental Management Plan has the following specific long-term objectives:

- Ensure compliance with legislation and Company policy;
- Achieve, enhance and demonstrate sound environmental performance built around the principle of continuous improvement;
- Integrate environment fully into the business;
- Rationalise and streamline existing environmental activities to add value in efficiency and effectiveness;
- Encourage and achieve the highest performance and response from individual employees and contractors;
- Provide standards for overall planning, operation, audit and review;
- Enable management to establish environmental priorities;
- Be applicable throughout the organisation;
- Hold early consultations with communities and regulating authorities to ensure hitch free operations.
9.2 PURPOSE OF ENVIRONMENTAL MANAGEMENT PLAN (EMP)

Various purposes of the Environmental Management Plan at the proposed development drilling of wells in CB-ONN-2010/8 block are:

- To treat and dispose of likely pollutants viz. liquid, gaseous and solid & hazardous wastes so as to meet statutory requirements with appropriate technology,
- To support and implement for proposed development drilling of wells in CB-ONN-2010/8 block to achieve environmental standards and to improve the methods of environmental management,
- To monitor the parameters to ensure effective implementation of the action;
- To promote green-belt development,
- To encourage good working conditions for employees,
- To implement best practices for environmental management,
- To reduce fire and accident hazards,
- Budgeting and allocation of funds for Environmental Management System,
- To adopt cleaner technology and waste minimization program.

With the availability of cost-effective advanced technology and innovative environment management practices, the EMP can act as an effective management tool to provide management solutions to all environmental pollution concerns including that of associated regulatory compliance.

9.3 ENVIRONMENT, HEALTH AND SAFETY (EHS) POLICY

BPRL will conduct its activities in a professional and responsible manner. The company, not only will comply with the laid down legislation requirements but when found inadequate will promote creative measures and internal standards for the protection of health, safety & the environment of the highest order for all who may directly or indirectly be affected by any of the activities. Personal safety and employee health will be the greatest responsibility, followed by the protection of the environment and company property.

The company will continue to take a proactive approach towards creating safe work environments for all employees and will be concerned for promoting continued safety education and training for all employees, assigning responsibility for all aspects of the program, continuously reviewing the program to identify potential areas of improvement,
and ensuring a thorough evaluation of all incidents. The company will continue to address the environmental and health impact of our operations by reducing waste, emissions, and discharges and by using energy efficiently. The company will maintain awareness of EHS matters, so as to be proactive in providing a value-added service to the clients. This awareness is achieved through education, communication and definition of the goals and standards appropriate to operation and those undertaken on the client’s behalf.

Figure 9.1: EHS Policy of BPRL
9.4 Organisational Structure & Responsibilities

BPRL has the ultimate responsibility for implementing the provisions of the EMP. The role includes ongoing management of environmental impacts and measuring environmental performance through inspections/audits and monitoring. The contractor performance as well as development of mechanism for dealing with EHS is an integral part of the environment management. It is recommended that EHS requirements shall be made integral part of contract document and prior to tender for assigning any contract.

Other essential features of the EMP are:

- **Block Operator** will appoint a Mine Manager to oversee EHS compliance throughout the duration of the drilling program. EHS Officer will assist him in implementation and monitoring;
- **Block Operator** will ensure that all contracts comply with the requirements given in the environmental management plan;
- **Block Operator** will cooperate with regulatory agencies (such as the Gujarat Pollution Control Board, CPCB, DGMS, OISD, MoEF&CC) who may want to send their own teams to monitor the activities during the drilling program.

The overall responsibility for compliance with the environmental management plan rests with the project proponents.

The contractors (civil, drilling, and other) will carry out field activities as part of the developmental drilling project. The contractors will be subject to certain liabilities under the environmental laws of the country, and under their contract with block operator.

A certain degree of redundancy is inevitable across all management levels, but this is in order to ensure that compliance with the environmental management plan is crosschecked.

9.4.1 Organisational Roles & Responsibilities

The salient features of the organisational responsibilities are described below:

- **Primary Responsibilities:**
  - The primary responsibilities for the environmental performance of the project proponents & the contractors will be assumed by their senior level officers during the project.
Block Operator’s Mine Manager will be responsible for the company’s compliance with the EIA and EMP throughout the project.

The contractor will assume the main responsibility for all environmental matters pertaining to their work.

Block Operator will coordinate with relevant government departments.

**Field Management and Quality Control:**

- Conducting drilling activities in an environmentally sound manner will be the responsibility of the drilling contractor/company.

- Block Operator’s Company Man (Drilling) will be responsible for the overall environmental soundness of all field operations.

**On-the-job Supervision and Monitoring:**

Block Operator has a safety officer, who is responsible for ensuring compliance with the EMP during the drilling operation. He will also be responsible for communicating with and training the drilling crews in all aspects of the EMP.

- Block Operator will have an EHS Coordinator who will be responsible for all environmental issues and for the implementation of the environmental management plan in the field.

- If any monitoring teams from government departments or from NGOs visit the field during the drilling operation, block operator’s EHS Coordinator and the Chief will be responsible for coordinating their visits.

**9.4.2 Environmental Management Cell**

Apart from having an Environmental Management Plan, it is also necessary to have a permanent organizational set up charged with the task of ensuring its effective implementation of environmental mitigation measures and to conduct environmental monitoring. BPRL will appoint an Environmental Management Cell to keep a close watch on the performance of the pollution control measures, emissions from the sources and the quality of surrounding environment in accordance with the monitoring program.

The Environmental Management Cell will also include the safety cell for observing, inspecting and regulating the safety measures inside the plant premise. The Environmental Management Cell will be responsible for maintaining records of all the
data, documents and information in line with the statutory requirements. The major duties and responsibilities of Environmental Management Cell shall be as given below:

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

This official will be responsible for day-to-day environmental affairs including implementing monitoring programme.

9.4.3 GOOD NEIGHBOUR PRACTICES

BPRL is dedicated to responsible development of oil and natural gas resources. Responsible development includes good relationships with neighbors and a commitment to environmental protection and compliance with all applicable federal, state, and local regulations.

To be a “good neighbor” in the areas, three objectives are to be followed:

- Protection of public safety;
- Protection of the environment; and
- Respect for the property rights of others.

These objectives shall be achieved through use of sound management processes as part of the responsibility to act as a “good neighbor.” This shall be achieved by designing and implementing EMP very effectively.
Listen to the land owner or surface user concerns and respond appropriately

- Respect rights-of-way;
- Take precautions to protect livestock;
- Take precautions not to harm ecology, wildlife habitation etc;
- Report damages to public or private property to the appropriate parties;
- Be willing to discuss issues with respect to surface use rights and compensation due to temporary loss of crops and others;
- Designate a company contact person who is responsible for responding to community questions;
- Listen to and discuss the concerns of the land owner or surface user affected by operations;
- Attempt to notify the landowner or surface user when commencing significant activity that will impact their land; and
- Train personnel on the rules and regulations applicable to operations.

Respect the property and the rights of others

- Minimize surface disturbances;
- Take precautions to protect livestock with appropriate measures;
- Practice good housekeeping;
- Remediate and restore the site in a timely manner in compliance with applicable regulations; and
- Drive responsibly on public and private roads.

Promote safety of the general public

- Train personnel in safe operating practices;
- Conduct emergency planning where applicable; and
- Post signage and warnings in accordance with regulations.

Protect the environment:

- Train personnel on environmental protection in compliance with applicable regulations;
- Maintain equipment and utilize good work practices;
- Seek to understand the land owner, and surface user concerns and possible questions regarding;
- Groundwater aquifers and surface water;
- Air quality;
- Ecology and livestock protection;
- Housekeeping;
- Noise;
- Surface disturbance;
- Noxious weeds and brush; etc

✓ Follow regulations for waste management and environmental protection.

9.5 Corporate Environment Policy
BPRL is committed to conduct its operation in such a manner as compatible with environment and economic development of the community. Its aim is to create an awareness and respect for the environment, stressing on every employee's involvement in environmental improvement by ensuring healthy operating practices, philosophy and training.

Objectives of this policy are to:

✓ Adopt environment sound operating systems, practices and procedures.
✓ Strive to progressively bring about an improvement in the environmental performance of our facilities by adopting Eco-friendly techniques/processes for optimal use of energy and to reduce hazardous emission and wastes.
✓ Create environment awareness amongst its employees and develop programs for environment protection.
✓ Comply with the relevant statutory Rules & Regulations and devise appropriate standards on other cases wherever required.
✓ Maintain highest standards of vigilance and preparedness to respond to emergencies supplemented with mutual aid of neighbouring facilities and Government agencies.
✓ Program reviews and evaluation to measure progress of compliance with the policy.

9.6 Environmental Management Plan
Environmental Management Plan (EMP) includes action to protect environment by using instruments, adoption of industrial best practices, surveillance and statutory norms. To
mitigate the adverse impacts, if any, caused due to proposed oil & gas development activities at CB-ONN-2010/8 block area, the EMP has been formulated. The EMP has prescribed environmental monitoring and implementation of environmental protection measures during all phases of the proposed development activities. The environmental and socio-economic aspects are dealt with likely environmental control measures are suggested as under:

- Land use Management
- Ecology Management Plan
- Water Resources Management Plan
- Air Quality Management Plan
- Noise & Vibration Management Plan
- Water Quality Management Plan (Surface & Ground water)
- Soil Quality Management Plan
- Disturbance to community resources & safety management plan
- Employment and Socio economic management plan
- Culture, Aesthetics and Archaeological sites management plan
- Occupational Health & Safety Management Plan

Also the following management plan will be followed strictly during the developmental drilling of wells within CB-ONN-2010/8 block:

- Spill Management Plan
- Waste Management Plan
- Site Closure Plan
- Flare and illumination Management Plan
- Greenbelt Plan
- Road Safety and Traffic Management Plan
- Management of Social Issues and Concerns

Details of proposed Environmental Management Measures (EMM) during development drilling of wells in CB-ONN-2010/8 block, are as per given in Table 9.1. This is subjected to be modified as per condition(s) stipulated by MoEF&CC and GPCB.
### Table 9.1: Environment Management Plan during Developmental Drilling of Well

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Component</th>
<th>Main Source of Risk</th>
<th>Mitigation Measures</th>
<th>Primary Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Topography</td>
<td>• Site preparation and elevation purposes, padding and fill materials usually will be&lt;br&gt;• brought to the site and lay over the site area</td>
<td>• The padding and fill material will have to be brought in from some nearby places and have to laid over the site area;&lt;br&gt;• During padding and fill operations, it will also be ensured that alteration of the natural drainage at the micro watershed level around the site is kept to a minimum;&lt;br&gt;• The slope of the padded area and the storm water drainage system will be maintained by providing garland drain along the site to channelize the storm water runoff and drains it into the nearby river;&lt;br&gt;• The slope of land will be maintained during designing of the drains for the purpose of waste water handlings at site;&lt;br&gt;• Excess compaction of the soil by vehicular movement during padding and filling will be preventing in some areas (like campsite) where it is not required;&lt;br&gt;• Sediment interception barriers will be provided for runoff occur during site preparation at those points, through which, runoff is expected to flow into the garland drain</td>
<td>BPRL/Contractor</td>
</tr>
<tr>
<td>2</td>
<td>Land Use</td>
<td>• Acquisition of land for development drilling, access road and camp site;&lt;br&gt;• Preparation of site and access road; and&lt;br&gt;• Decommissioning &amp; Restoration</td>
<td>• Consult local authorities and other stakeholders regarding preferred location for camps and access/maximize use of existing infrastructure.&lt;br&gt;• Mark out the site boundaries to ensure that land taken is restricted to pre-agreed area;&lt;br&gt;• Minimize the disturbance of vegetation present in and around area proposed to be used, if any;&lt;br&gt;• Where possible use existing road/water infrastructure.</td>
<td>BPRL/Contractor</td>
</tr>
<tr>
<td>Sl. No.</td>
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<td>------------------------------------------------------------------------------------</td>
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<td>-------------------------------</td>
</tr>
</tbody>
</table>
| 3       | Ecology       | • Preparation of site and access road  
• Mobilization and demobilization of drilling rig and others;  
• Test flaring;  
• Camp site;  
• Decommissioning & Restoration; etc. | • *In-house audit before and after development drilling:*  
• *Minimum utilization of land and clearing of site:*  
• *All necessary protocols shall be followed and legal requirements shall be implemented with respect to local regulation pertaining to use of land; etc.*  
• *Mark out site boundaries:*  
• *Choose site to encourage natural rehabilitation by indigenous flora/avoid removal of vegetation and topsoil/preserve topsoil, and seed source for further usages:*  
• *Siting to minimize impacts on ecology, water resources, and landscape. Consider using site that has been cleared/disturbed previously or of low ecological value, or which may be more easily restored, e.g., agricultural land:*  
• *Avoid uprooting vegetation to the possible extent:*  
• *Ensure proper handling and storage of fuels and hazardous materials:*  
• *Take account of topography, natural drainage and site runoff. Ensure adequate and proper drainage:*  
• *Minimize cleared area and size of site/maximize perimeter to area ratio to aid natural re-vegetation:*  
• *Use hand cutting to clear vegetation initially—where necessary be selective in using machinery:*  
• *Retain vegetation on edge of site to serve as seed bank for future site re-vegetation:*  
• *All bulldozer operators involved in site preparation shall be trained to observe the defined site boundaries:*  
• *Kerosene oil/LPG shall be used for domestic purpose:* | BPRL/Contractor                |
### Sl. No. Component Main Source of Risk Mitigation Measures Primary Responsibility

4 Water Resources Preparation of site and access road; Mobilization and demobilization of drilling rig and others; Drilling and completion of well Camp site; and Decommissioning & Restoration. • In-house audit before and after development drilling operation: • Distance in case of test flaring as suggested in Chapter-4 shall be maintained; etc

• Consider aquifer protection and proper plugging, if any; • Adequate water supply arrangement will be made at drilling site and camp site through local sources (Tankers); • Continuous attempt will be made to avoid wastage and leakage of water; • In case, water courses and aquifers are deemed sensitive, consider a fully sealed site, avoid use of mud pits, preferentially use steel tanks, but if used must be lined. Pits if used must be lined; • If an aquifer is breached, the drilling crew can cement the hole to prevent leakage; etc • Continuous attempt will be made to optimize/reduce the use of water; • Drilling will be avoided during monsoon season; • Toilets and bathrooms on temporary basis will be provided at drilling and camp site; and • In-house audit before and after development drilling: etc

BPRL/ Contractor

4 Air Emissions (Dust and gaseous emission) Preparation of site and access road; Mobilization and demobilization of drilling rig and others; Drilling and completion of well;

• Emission from flaring of petroleum hydrocarbons, DG sets and other machinery will confirm the standards as prescribed by MoEFCC/GPCB;
• Well testing (flaring) to be undertaken so as to minimize impacts of emissions by ensuring:
  o duration of testing minimized by careful planning; and
  o high combustion efficiency, smokeless flare/burner to be used.
• Detectors for CH₄ and H₂S will be placed at adequate locations;

BPRL/ Contractor
<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Noise and Vibration</td>
<td>Preparation of drilling site and access road; Mobilization and demobilization of drilling rig and others; Drilling and completion of well; Test flaring; Operation of DG sets; Traffic movement; Camp site; Decommissioning &amp; Restoration; etc</td>
<td>- Engineering specifications for machinery/equipment will be stipulated during tendering as a condition for contractor to maintain noise level not more than 85 dB(A) at 1 m from each source; - Selection of low noise generating machinery/equipment; - Provision of rubber padding/noise isolators/silencers to modulate the noise generated by machinery/equipment, wherever possible; - The high noise zones within ROW will be demarcated and temporary enclosures &amp; barriers, if required will be provided; - Use experienced and skilled personnel; - Train personnel of standard operating procedures for handling and shooting of explosives; - All employees will receive appropriate training and education as and when required; - Provision of protective devices like ear muff/plugs to the workers; - Preventive maintenance of machinery/equipment and vehicles; - All employees will be encouraged to cooperate in using agreed safe work practices;</td>
<td>BPRL/Contractor</td>
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</tbody>
</table>
### Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.

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<tr>
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<th>Mitigation Measures</th>
<th>Primary Responsibility</th>
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<tbody>
<tr>
<td>6</td>
<td>Water Quality</td>
<td>• Preparation of drilling site and access road;</td>
<td>• All the debris resulting from the site will be isolated from the waste water and disposed off separately;</td>
<td>BPRL/Contractor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Mobilization and demobilization of drilling rig and others;</td>
<td>• Incorporate drainage and minimize disturbance to natural drainage patterns. Engineer slopes and drainage to minimize erosion. Design for storm conditions/ensure offsite natural runoff does not wash over site/use perimeter drainage ditches.</td>
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<td></td>
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<td>• Drilling and completion of well;</td>
<td>• Seal bund and ensure proper drainage of machinery areas, fuel and chemical storage, and mud mixing areas;</td>
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<td></td>
<td></td>
<td>• Test flaring;</td>
<td>• In case, water courses and aquifers are deemed sensitive, consider a fully sealed site, avoid use of mud pits, preferentially use steel tanks, but if used must be lined. Pits if used must be lined;</td>
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<td></td>
<td></td>
<td>• Operation of DG sets;</td>
<td>• Provide base material compatible with local ground conditions. Hard core will be laid on geo-textile membrane. Avoid concreting sites;</td>
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<td></td>
<td></td>
<td>• Traffic movement;</td>
<td>• Protect water courses from contamination and siltation;</td>
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<td>• Camp site;</td>
<td>• Mud and burn pits, if used, must have adequate contingency capacity especially for rainfall, and must be fully lined and bunded.</td>
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<tr>
<td></td>
<td></td>
<td>• Decommissioning &amp; Restoration;</td>
<td>• Potable ETP will be used to treat the process waste water while domestic waste water will be discharged to soak pits.</td>
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<td></td>
<td></td>
<td></td>
<td>• Protect groundwater from drill stem penetration and shallow</td>
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</tbody>
</table>
Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.

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<td></td>
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<td><strong>aquifers from possible site contamination;</strong></td>
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<td>• At camp site, effective bunds capable of containing 110% of the volume of the largest container within and enclosing all potentially contaminating materials to be used for fuel lubricants and chemicals storage area;</td>
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<td></td>
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<td>• The storage areas will be inspected and cleaned at regular intervals;</td>
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<td>• Non-contaminated and potentially contaminated run-off will be kept separately. Non-contaminated run-off will be routed to off-site areas via silt traps. Potentially contaminated surface run-off shall be routed through oil traps;</td>
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<td>• Oil drip pans will be used wherever there is significant potential for leakage including, but not limited to;</td>
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<td>o Electric generator engine, DG sets, earth moving machinery/equipment etc;</td>
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<td></td>
<td>o Compressors, pumps or other motors;</td>
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<td></td>
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<td></td>
<td>o Maintenance areas;</td>
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<td>o Fuel transfer areas; etc</td>
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<td>• All spills/leaks to be contained, reported and cleaned up immediately;</td>
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<td>• Oil absorbent /spill containment material to be deployed to contain large spill, if any;</td>
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<td></td>
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<td>• Minimize suspended solids loads to watercourses by installing appropriate surface run-off drainage systems (e.g., silt traps);</td>
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<td>• Adequate sanitary facilities shall be provided;</td>
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<td>• No untreated discharge to be made to water course/land; and</td>
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<td></td>
<td>• Regular monitoring and In-house audit as per details given in this chapter or as stipulated by MoEFCC/GPCB.</td>
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<tr>
<td>Sl. No.</td>
<td>Component</td>
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<td>Mitigation Measures</td>
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<tr>
<td>7</td>
<td>Soil quality</td>
<td>• Preparation of access road and clearing of drilling site;&lt;br&gt;• Mobilization and demobilization of drilling rig and others;&lt;br&gt;• Drilling and completion of well;&lt;br&gt;• Camp site;&lt;br&gt;• Decommissioning &amp; Restoration; etc</td>
<td><strong>Soil Erosion</strong>&lt;br&gt;• Stockpile of topsoil wherever possible at the edge of site;&lt;br&gt;• Minimize area and extent of site clearance, by staying within defined boundaries;&lt;br&gt;• Limit erosion potential/avoid steep slope and drainage courses/avoid cut and fill techniques/incorporate proper drainage, culverting and bridging techniques;&lt;br&gt;• Avoid removing undergrowth where possible so as to retain land stability; etc&lt;br&gt;&lt;br&gt;<strong>Fuel, Lubricants and Chemical Management</strong>&lt;br&gt;• Storage and liquid impoundment areas for fuels, construction materials, solvents, chemicals and waste should be designed with secondary containment (e.g., dykes and berms) to prevent spills and the contamination of soil, groundwater, and surface waters;&lt;br&gt;• All fuels, lubricants, surface treatment materials, welding rods/gases, chemicals etc to be placed in controlled storage i.e. properly fenced area and in clearly marked vessels and containers;&lt;br&gt;• Effective bunds capable of containing 110% of the volume of the largest container within and enclosing all potentially contaminating materials to be used for fuel lubricants and chemicals storage area;&lt;br&gt;• Impervious liners will be in place for pits for storage of drill cutting and mud;&lt;br&gt;• Impervious liners will be in place for fuel, lubricants and chemicals storage area;&lt;br&gt;• Non-contaminated and potentially contaminated run-off will be kept separate. Non-contaminated run-off will be routed to off-site areas</td>
<td>BPRL/Contractor</td>
</tr>
<tr>
<td>Sl. No.</td>
<td>Component</td>
<td>Main Source of Risk</td>
<td>Mitigation Measures</td>
<td>Primary Responsibility</td>
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</tbody>
</table>
| 8      | Disturbance to community resources & safety | • Preparation of site and access road;  
• Mobilization and demobilization of drilling rig and others;  
• Drilling and completion of well;  
• Test flaring;  
• Traffic movement;  
• Camp site;  
• Decommissioning & Restoration; etc | • Advance notice to local administration about the activities;  
• Minimize use of roads by planning vehicle movements;  
• Proper cordon off the site with sign boards;  
• Adequate communication with locals which may be impacted during development drilling;  
• Diversion of traffic, if required;  
• Placing the warning board on the vehicles during transportation of machinery and materials;  
• Proper training to drivers about public safety.  
• Spray down dirt roads if too dusty;  
• In-house monitoring and audit; etc | BPRL/Contractor |
| 9      | Employment and Socio economic | • Loss to local habitants due to land acquisition on permanent and temporary basis;  
• Direct and indirect employment;  
• Loss due to test | • Close monitoring on the type of loss to local habitats, if any. In case of any loss to locals, adequate compensation shall be provided as per the law or on mutually agreed terms;  
• Preference will be given to locals for temporary direct and indirect employment;  
• Where ever local skilled labour is available, will be preferred to be hired for the respective job;  
• Local employment (unskilled) will be provided in a manner, giving | BPRL/Contractor |
<table>
<thead>
<tr>
<th>Sl. No.</th>
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<th>Main Source of Risk</th>
<th>Mitigation Measures</th>
<th>Primary Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.</td>
<td>Culture, Aesthetics and Archaeological sites</td>
<td>flaring; Utilization of local available resources; etc</td>
<td>fair representation to all section; Local suppliers for machineries and construction materials will be given preference; Local transporters will be preferred for transportation of machinery/materials. Third part audit after completion of activities; etc</td>
<td>BPRL/ Contractor</td>
</tr>
</tbody>
</table>

### Culture
- Discourage interaction of outsiders with locals, however if any issue arises, Senior officials of BPRL / Contractor should communicate with the elders/ sarpanch of village and settle down the issue;
- All workers should respect the local norms of communities.
- Control workforce activities, e.g. hunting, interaction with local population.
- Purchase food from recognized local suppliers, not directly from local people without evaluating implications;
- Monitoring and control of activities of work force that may affect women in the villages;
- No interruption to culturally important sites;
- Contractor should not utilize the local village's drinking water resources and must not damage the existing infrastructure;
- Community complaint registers must be placed at site and all complaints to be documented and strict compliance to be undertaken;
- Consultations with locals must be done by the contractor before making access roads; etc

### Aesthetics
- Strict compliance to Environment Management Plan (EMP);
<table>
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<tr>
<th>Sl. No.</th>
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<th>Main Source of Risk</th>
<th>Mitigation Measures</th>
<th>Primary Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Occupational Health &amp; Safety</td>
<td>• Preparation of site and access road; • Mobilization and demobilization of drilling rig and others; • Drilling and completion of well; • Test flaring; • Operation of DG sets; • Traffic movement; • Camp site; • Decommissioning &amp; Restoration; etc</td>
<td>• Camp should be constructed away from sensitive habitats; etc • Due care will be taken to maintain continuous water supply in the water spraying system and all efforts would be made to suppress the dust generated during drilling operation to the possible extent; • Any worker found to develop symptoms of dust related diseases will be changed over to other activities in cleaner areas; <strong>General Safety Measures:</strong> • Employees shall be provided with helmets, safety boots, eye and ear protection, and snug fitting gloves as appropriate; • Sensors shall be placed at adequate location for methan and hydrogen sulphide; • Masks and dust-proof clothing shall be provided to personnel; and • Procedures shall be strictly enforced for the drilling, storage, handling, and transport of explosives, flammable and hazardous materials. <strong>General Health Measures:</strong> • Sanitary facilities will be well equipped with supplies and employees shall be encouraged to wash frequently, particularly those exposed to dust, chemicals or pathogens; • Personnel required to work in areas with high humidity will be allowed to take frequent breaks away from these areas; • Pre-employment medical examinations of all personnel will be made mandatory for contractor; etc</td>
<td>BPRL/Contractor</td>
</tr>
<tr>
<td>13</td>
<td>Housekeeping</td>
<td>• Preparation of site and access road; • Mobilization and</td>
<td>• The facilities should be kept clean, maintained, and operated in a safe and environmentally sound manner; • Facilities will be cordoned off in a manner to prevent access to the</td>
<td>BPRL/Contractor</td>
</tr>
<tr>
<td>Sl. No.</td>
<td>Component</td>
<td>Main Source of Risk</td>
<td>Mitigation Measures</td>
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</table>
|        |           | demobilization of drilling rig and others;                                       | *facility by the general public, livestock, where appropriate;*  
|        |           | • Drilling and completion of well;                                                 | • All equipment will be painted and/or kept clean to present an acceptable appearance and to provide protection from external corrosion;  
|        |           | • Test flaring;                                                                   | • Signs will be posted in conspicuous locations to notify employees and the public of any dangerous situations such as, flammable conditions, high voltage, and toxic;  
|        |           | • Operation of DG sets;                                                           | • Waste receptacles will be provided at appropriate locations for collecting discarded paper, rags, etc. and emptied on a regular basis; etc                                                                 |
|        |           | • Traffic movement;                                                               |                                                                                                                                                                                                                  |
|        |           | • Camp site;                                                                      |                                                                                                                                                                                                                  |
|        |           | • Decommissioning & Restoration; etc                                               |                                                                                                                                                                                                                  |

*Source: ABC Techno Labs India Pvt. Ltd.*
9.6.1 Spill Management Plan

A number of chemicals and Oil (diesel) will be stored on site, improper handling or accidents are likely to result in spills which have a potential for contaminating the land and water. BPRL would develop and educate the Contractors/personnel working to prevent such spills and also develop a proper spill response and management plan. As best practices to avoid/contain any spill BPRL will ensure:

- All chemicals are stored within the designated area. To an extent possible all such areas would away from drainage channels;
- The flooring of the storage area should be impervious (paved or HDPE lining) and bunding to be provide on all sides of the chemical storage areas;
- The chemical storage area to be covered to ensure it has the minimum runoff;
- All transfers of chemicals to be done with proper care and under the supervision of the Store supervisor.
- Fuelling will take place in designated areas and no oil transfers will occur, unless adequate protection is in place
- BPRL’s spill management plan would aim to control the spill to a limited area and take necessary mitigative actions. The following additional measures will be implemented for spill management:
  - Spill management plan for each substance/chemical to be stored shall be in place based on its hazardous properties. MSDS for each substance/chemical to be stored shall be available;
  - Adequate PPE and resources shall be provided;
  - Adequate training shall be provided on spill management plan of each chemical to be stored;
- Spill response strategies for combating incidents include:
  - Prevent or reduce further spillage: One of the first response actions, if safe to do so, is the isolation of the source and prevention of further discharge.
  - Monitoring and evaluation: Monitoring and evaluation are used to Determine the location and movement (if any) of the spill, its appearance, its size and quantity, changes in the appearance and distribution of the spill over time and potential
threat to the environment and the resources required to combat the spill (i.e. a more effective and coordinated response).

- Mechanical containment and recovery: restriction of spill movement through the use of physical barriers (e.g. bunds, booms, diversion swales). Containment would be followed by the physical removal of the spilled material. This may be accomplished using sorbent pads, vacuum trucks, skimmers or other mechanical means appropriate to the material spilled.

- Protection of sensitive areas: Bunds or booms will be used to prevent spills from migrating down a watercourse or stream.

- Clean-up: This involves earthmoving equipment used to recover the absorbed spill and affected soil. Such operations may involve the collection of significantly greater volumes of material than was originally released.

- Combinations of the above strategies.

Affected area due to spill will be isolated. Spilled oil/chemical will be recovered and stored. Contaminated earth will be collected and disposed in consultation with Gujarat Pollution Control Board. Contaminated area will be reclaimed using suitable technique or other appropriate methods.

- Thereafter, the substance/chemical will be properly collected and stored in a separate labeled container marked “hazardous waste – do not burn”;
- Truck it away to the hazardous waste pit site and dispose it.

9.6.2 Waste Management Plan

Any development drilling of wells involving bush clearing and excavation is bound to encounter waste management problems that must be handled in compliance with required local, national and International regulations.

All activities shall be planned and executed in such a manner as to:

- Take all practical and cost effective measures to minimise the generation of wastes, by employing the four R’s (Reduce, Reuse, Recycle, Recover) through process optimisation or redesign, efficient procedures and good housekeeping.
- Minimise the hazards presented by all wastes and to ensure that all wastes are managed and disposed of in an environmentally acceptable manner.
Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.

- Waste management shall be carried out in full compliance with applicable local, State, and national legislation and guidelines of relevant regulatory agencies;
- Wastes generated by Developmental drilling activities shall be managed from “cradle to grave” to eliminate the potential liabilities that could result from improper disposal;
- The management of wastes shall be the responsibility of the company key/front-line staff.

To facilitate field level implementation, a draft waste management plan is proposed which will be subject to fine tuning before the start of the operations. This draft Waste management plan is presented below in Table 9.2:

Table 9.2: Waste Management measures

<table>
<thead>
<tr>
<th>Type of wastes</th>
<th>Amount</th>
<th>Mitigation measures</th>
</tr>
</thead>
</table>
| Waste Drilling mud generated from Water based Mud, not contaminated with oil | 500 ton/well (Approx.) | ☐ Use of water based mud or eco-friendly synthetic based mud as the drilling fluid;  
☐ Barite used in the preparation of drilling fluid shall not contain Hg>1mg/kg and Cd>3mg/kg;  
☐ The drilling fluid pit will be bunded to prevent water overflow during heavy monsoon;  
☐ Use of low toxicity chemicals for the preparation of drilling fluid;  
☐ Temporary storage of drilling fluid and wash waste water will be done in an impervious pit lined with HDPE;  
☐ Unusable drilling fluid will be stored in HDPE lined pit for solar drying for temporary storage. The cuttings/mud residues so stored will then be treated and disposed in accordance with CPCB regulations specified for onshore oil & gas industry |
| Drill Cuttings | 1000 ton/well (Approx.) | ☐ Drill cuttings separated from drilling fluid will be adequately washed and temporarily stored and disposed in an impervious pit lined by HDPE;  
☐ The drilling cuttings pit will be bunded and kept covered using tarpaulin sheets during monsoon;  
☐ The waste pit after it is filled up will be covered with impervious liner over which a thick layer of native top |
<table>
<thead>
<tr>
<th>Type of wastes</th>
<th>Amount</th>
<th>Mitigation measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil</td>
<td></td>
<td>- Periodic monitoring and analysis of drill cuttings will be undertaken to establish its nature and characteristics. Earlier test reports of drill cuttings from nearby wells have shown the absence of hazardous content; etc.</td>
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<tr>
<td>Chemical Sludge (generated as a result of wastewater treatment)</td>
<td>Small amount</td>
<td>- The treatment of the sludge so generated can be for pH correction, if any, followed by dewatering either in centrifuge and or solar evaporation.</td>
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<td>- The treatment is to be ensured in a pit properly lined with impervious HDPE liner</td>
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<td></td>
<td>- Disposal is dependent on establishing non-hazardous or hazardous nature after the end of operations.</td>
</tr>
<tr>
<td>Used/ spent oil</td>
<td>15 Litre per year per well</td>
<td>- The hazardous waste (waste and used oil) will be managed in accordance with Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 and amended thereof. Authorization for collection and storage shall be obtained from GPCB and disposed of by authorized vendors;</td>
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<td></td>
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<td>- The hazardous waste will be stored in properly labeled and covered bins located in paved and bunded area;</td>
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<td></td>
<td>- The hazardous waste so stored (not more than 90 days)to be periodically sent to GPCB registered waste oil recyclers/ facilities via authorized vendor(s)/transporter(s);</td>
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<td>- Necessary spill prevention measures viz. spill kit will be made available at the hazardous material storage area;</td>
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<td>- Adequate care will be taken during storage and handling of such waste viz. use of proper PPEs by personnel;</td>
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<td>- Storage details of onsite hazardous waste generated will be maintained and periodically updated;</td>
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<td></td>
<td>- Proper manifest as per Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 and amended thereof to be maintained during storage, transportation and disposal of hazardous waste; etc</td>
</tr>
<tr>
<td>Type of wastes</td>
<td>Amount</td>
<td>Mitigation measures</td>
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<tr>
<td>batteries</td>
<td>per drilling of well (max.)</td>
<td>acid batteries as required under the Batteries (Management &amp; Handling) Rules, 2010.</td>
</tr>
</tbody>
</table>
| Recyclables viz. paper, plastic, packaging waste etc. | Small amount | □ Proper segregation and storage of recyclable waste in designated bins onsite.  
 □ Recyclables will be periodically sold to local waste recyclers. |
| Drilling and rig wash wastewater | 5 KLD/Well | □ Drilling waste water including DC wash water should be collected in the disposal pit evaporated or treated in Mobile ETP. After compliance of notified standards for on-shore disposal liquid effluents will be disposed locally with intimation to GPCB or else sent to GPCB approved CETP for further treatment and disposal. |
| Domestic Sewage        | 4 KLD/Well       | □ The treatment proposed for the domestic waste water generated at site will be disposed through septic tanks followed by soak pits.  
 □ The septic tank will be constructed as per the Bureau of Indian Standard IS: 2470 (Part-1): 1985. |
| Food Waste             | 12-15 Kg/Well    | □ To be properly segregated (no plastics, metal, glass in it) and brought to the segregation pit.  
 □ Dig two small humus pits (each of 2m x 2m x 1.5 m) within the camp site area away from common use by rig crew members.  
 □ The humus pits are to be covered with soil on daily basis to avoid any odour nuisance due to putrification and check any contact with the flies or insects. |
| Bio-Medical Waste      | Small amount     | □ To ensure the availability of specified boxes, use of syringe cutters.  
 □ Waste to be properly separated and stored temporarily at site separately from other wastes.  
 □ Medical waste to be transported to the hospital capable of handling waste. |

Source: Bharat PetroResources Limited

The proposed drilling operations require to discharge treated wastewater only after achieving above standards and or as specifically imposed by the Gujarat Pollution Control Board in its permit to operate for drilling of proposed developmental wells.
In addition to the management measures specified for the major waste stream, BPRL will prepare and update periodically a waste inventory of all waste streams identified for the proposed project. Necessary measure will also be taken by BPRL to incorporate appropriate waste management and handling procedures in the contractor work document and conduct periodic training of personnel involved in waste handling onsite to ensure proper implementation of the Waste Management Plan. In this regard, necessary inspection, record keeping, training program and monitoring procedures will be established by BPRL and made operational to achieve proper management of all wastes generated on site. A typical layout of the waste management facilities on a well site is given in Figure 9.3. The salient features of measures taken to safeguard the environment are given below:

- The drill pad will be elevated and concretized;
- The Hazardous waste will be separated from Non-hazardous waste and stored separately in enclosed area;
- Recyclable and non-recyclable waste will be collected and stored separately;
- The Waste pits will be bunded to prevent the overflow of wastewater;
- Mobile Effluent Treatment Plant will be installed at each well site;
- Fluid and chemicals will be stored in enclosed area with restricted access;
- The top soils will be heaped and bounded by a retaining wall;
- Oil spill kits will be available near Drill pad and Oil storage area;
- A garland drain will be constructed within the external boundary of the site that will have a sedimentation tank with oil and water separator; and
- Sufficient lighting will be provided at rig.
9.6.3 Site Closure Plan

The site closure plan for will identify all the activities which would be performed during the restoration of a particular site after the extraction of hydrocarbons. Along with the well site the approach road connecting the wells, will be restored accordingly. Chronological inventory of activities which would be performed during the closure of the site are detailed in this section

Well sites

The following activities have been considered in the closure plan for well sites:

- Plugging & Abandonment of well: Close the well head properly to prevent any further leakage
- Decommissioning Phase: Removal of the materials form the site
- Waste/mud pit closure and reclamation
- Reinstatement Phase: regeneration of the land
- Handover Phase: Returning the land to the original owner

As and when the well will be declared as non productive, plugging of the well will be performed to close and abandon the well to prevent any leakage of oil or gas.

Decommissioning

The decommissioning phase includes activities dismantling and removal of surface facilities from the well site and storage in the Material Dumping Area. The activities which are envisaged during this phase are:

- Waste Management: clean up the site and remove all waste materials e.g. HDPE liners, any waste material etc. The waste will be dumped in the designated area as per the guidelines of local pollution control board
- Road Restoration: The fill materials should be removed and restore the site or it may be left for further local community use as per the agreement with community.

Waste and mud pit closure and reclamation

Following decommissioning and abandonment of the well site the waste and mud pits will be subject to closure through onsite burial of solids in accordance with lease and land owner obligations and with local, state and national regulations. Reclamation of closed pits or any other temporary retaining pits, including reserve pits, will be carried out...
within a period of one year from well closure/abandonment. All such reclamation activities will be carried out based on the climatic conditions and will be in accordance with reasonable landowner’s wishes, and/or resemble and contour of the adjoining lands.

**Reinstatement**

The reinstatement will be done as per reinstatement plan discussed in soil management section.

### 9.6.4 Flare and Illumination Management Plan

The glare from the flare and illumination not only cause visual impacts but also causes ecological impacts. These best practices can be adopted for reducing ecological impacts to animals especially when operating in the migratory bird habitat.

**Enclosed Ground Flaring- designing, planning & procurement**

The elevated flare can be replaced by an enclosed ground flare, such as the enclosed ground flare. This type of flare eliminates much of the visual impacts of burning produced gas in a processing facility. Also, the enclosed ground flare will decrease the amount of smoke and noise compared to the elevated flare.

**Work Zone Illumination- designing, planning & procurement**

Low height (less than 8 m), low-pressure sodium lamp or LED lights to be installed that are most energy efficient to reduce the ecological impacts. Further, illumination has been provided only in required locations and has placed UV filters on lamps. Such UV filtered lights have been found to less distractive to migrating birds.

### 9.6.5 Road Safety and Traffic Management Plan

The Road Safety & Traffic Management Plan is applicable to all operation pertaining to BPRL and contractor vehicular movement viz. vehicle involved in the transportation of raw materials, project and contractor personnel, drilling rig and other heavy equipment transportation to well site and decommissioning.

- Project vehicular movement involved in transportation of construction material, machineries and equipment for developmental drilling will be restricted to defined access routes to be identified in consultation with locals and concerned authorities
- The condition of roads and bridges identified for movement of vehicles and drilling rig will be assessed by BPRL/Contractors to ensure their safe movement
• Precautions will be taken by the contractor to avoid damage to the public access routes including highways during vehicular movement
• Provide safe and convenient passage for vehicles, pedestrians and livestock to and from side roads and property accesses along defined project routes
• Traffic flows will be scheduled wherever practicable during period of increased commuter movement
• Movement of vehicles during night time will be restricted. Speed limits will be maintained by vehicles involved in transportation of construction material and segregated waste.
• Proper signage will be displayed at important traffic junctions along the predefined access routes to be used by construction and operational phase traffic. The signage will serve to prevent any diversion from designated routes and ensure proper speed limits are maintained near village residential areas
• Clear signs, flagmen & signal will be set up at major traffic junctions and near sensitive receptors viz. schools, hospital, etc in discussion with Gram Panchayat and local villagers
• Adequate training on traffic and road safety operations will be imparted to the drivers of project vehicles. Road safety awareness programs will be organized in coordination with concerned authorities to sensitize target groups viz. school children, commuters on traffic safety rules and signage.
• Regular supervision will be carried out control vehicular traffic movement along defined traffic routes particularly near identified sensitive receptors

9.6.6 MANAGEMENT OF SOCIAL ISSUES AND CONCERNS
Mitigation measure have been outlined to address project related social issues and concerns in order for BPRL to take proactive steps and adopt best practices, which are sensitive to the socio-cultural setting of the region. The plans will include people residing in proximity to the proposed well sites, pipeline alignment and access routes.

Providing Job Opportunities
During site construction non technical jobs will be generated. Most of the people employed during this stage would be semi-skilled or unskilled. People from adjoining
areas especially given preference through local contractors according to the skill sets possessed.

**Ensuring Safety of local communities**

Since the project involves the movement of heavy vehicles and machinery in the area, the issue of public safety of the villagers, especially children, is an important concern. During the drilling phase and for the rest of the project activities proper safety measures will be undertaken both for transportation as well as the other operations. The drill sites would be fenced and gates would be constructed so that the local people are refrained from straying into the site. The movement of traffic is also likely to disrupt access conditions of the inhabitants residing close to the access road. The increase in traffic will have implications on their safety too, as well as create congestion, potential delays and inconvenience for pedestrians. The mitigative measures in this regard have been discussed in detail under the Road Safety & Traffic Management Plan.

**Corporate Social Responsibility**

From inception of its activities BPRL will take up various CSR initiatives in and around BPRL’s operational areas for the benefit of the residents as per the CSR Act and Rules, Govt. of India. BPRL’s CSR Vision Statement envisages 2% allocation of its net profit towards CSR. Based on the site specific assessments the CSR plan for this project would be framed. The broad areas to be focused under the CSR plan would include;

- **Health** - arranging mobile health camps including eye camps, School health programmes which includes free dental awareness examination camps and free checkups of the students; universal immunization programme etc.
- **Education** - Providing financial assistance to institutions towards purchasing of furniture and required amenities to school, libraries, auditoriums, teacher’s common room etc.
- **Funding for sports, cultural events etc.**

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>CER Activities</th>
<th>CER Budget (Lakhs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1st Yr 2nd Yr 3rd Yr 4th Yr 5th Yr</td>
</tr>
<tr>
<td>1</td>
<td>Construction Of Road</td>
<td>13 - - - -</td>
</tr>
<tr>
<td>2</td>
<td>Construction of Cross drains</td>
<td>2 - - - -</td>
</tr>
<tr>
<td>Sl.No</td>
<td>CER Activities</td>
<td>CER Budget (Lakhs)</td>
</tr>
<tr>
<td>-------</td>
<td>--------------------------------------------------------------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1st Yr</td>
</tr>
<tr>
<td>3</td>
<td>Arranging mobile health camps including eye camps, School health program which includes free dental awareness examination camps and free checkups of the students; universal immunization program etc</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Sanitation facility (Drinking water facility at school etc, Toilets etc)</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>Providing financial assistance to school towards purchasing of furniture and required amenities to school, libraries, auditoriums, teacher's common room etc.</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>Provision of Street lights</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>Grand Total</td>
<td></td>
<td>43</td>
</tr>
</tbody>
</table>

*Source: BPRL*

The above proposal is tentative and shall be finalize in consultation with District Collector(s)/Local Authorities.

**9.7 Cost of EMMP**

Cost of EMP during development drilling shall be **INR 43 lacs** for development drilling of each well which mainly includes rent of mobile ETP, waste management, environment monitoring, audit etc. Cost of civil construction & other facilities for waste management, compensation to be paid for land and other losses, PPE, site restoration, etc shall be additional.
CHAPTER 10

ADDITIONAL STUDIES
CHAPTER 10: ADDITIONAL STUDIES

Gandhinagar Public Hearing

M/s Bharat Petroresource Ltd. conducted public hearing through the Gujarat State Pollution Control Board (GSPCB) on 29th January 2019 at Pasunia, Survey No – 868, 878, 879, 880, 881, 882, 883 & 817, Village - Karoli, Ta – Dehgam, Gandhinagar, Gujarat, at 12.00 Hours.

The public hearing notice in English was published in Indian Express and in Gujarati in Navgujarat Samay dated 28th December 2018.

The public hearing was conducted in line with the new EIA notification dated 14th September 2006. The photos of the public hearing are given in the Figures below. MoM copy of the public hearing issued by GSPCB is attached as Annexure 7.

The Public Hearing was chaired by Mr. S.K.Langa, IAS, Collector & District Magistrate, Gandhinagar. Dist. Along with Regional Officer of GSPCB. About 55 public were present during the public hearing.

A copy of the action plan towards the issues raised during the public hearing is also given below:

Table 10.1: Issues raised during the Public Hearing, Gandhinagar

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Name of Participants</th>
<th>Question/ Comments by Participants</th>
<th>Response/clarification by RIPL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Shri Ashokbhai Gohilbhai Patel. Village – Karoli, Ta – Dehgam, Dist - Gandhinagar</td>
<td>He was telling that at present the quality of borewell water was bad which damaged the crop. Villagers wanted to know about the activities like explosions within the oil well.</td>
<td>DM suggested that the Borewell water will be checked by GPCB to assess the probable reason. 2.The Project Proponent assured that the explosions will be done 1500m below the earth surface to explore the oil. No impact will be</td>
</tr>
<tr>
<td>2</td>
<td>Shri.Gopal Thakar Principal Karoli High School. Village – Karoli, Ta – Dehgam, Dist - Gandhinagar</td>
<td>He requested the Project Proponent to convert the adjacent land into playground for school.</td>
<td>The District Magistrate informed to get the matter proposed in gram panchyat Meeting.</td>
</tr>
<tr>
<td>3</td>
<td>Shri. Bareyan Rajeshkumar Pikaji. Village - Kodrail Ta – Dehgam, Dist -</td>
<td>He requested the Project Proponent to build a two storied building and a playground for the Kodrail</td>
<td>The District Magistrate informed to take up the matter to sarpanch since the necessary funds are available</td>
</tr>
<tr>
<td>Sl.No.</td>
<td>Name of Participants</td>
<td>Question/ Comments by Participants</td>
<td>Response/clarification by RIPL</td>
</tr>
<tr>
<td>--------</td>
<td>----------------------</td>
<td>-------------------------------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>4.</td>
<td>Shri Vishnubhai Umarsibhai. Village – Karoli, Ta – Dehgam, Dist - Gandhinagar</td>
<td>He was asking that is there any solution for wild boars digging our fields.</td>
<td>Respected DM informed to take up the matter to forest department.</td>
</tr>
<tr>
<td>5.</td>
<td>Shri. Bharatbhai Patel. Village – Karoli, Dist - Gandhinagar</td>
<td>He asked for Guidance to change the Crop.</td>
<td>Respected DM informed to take up the matter to forest department.</td>
</tr>
<tr>
<td>6.</td>
<td>Shri. Mahendrabhai Rameshbhai Patel. Village – Karoli, Ta – Dehgam, Dist - Gandhinagar</td>
<td>He asked that when the land was allocated to the Project Proponent what was the criteria for compensated. Is it a fixed rate?</td>
<td>The Project Proponent Informed that initially the land was taken from the owner on short term lease to identify the availability of oil. If oil is found then a long term lease will be made on mutually agreed rate.</td>
</tr>
<tr>
<td>7</td>
<td>Shri. Kiran Kumar Thakor Village – Karoli, Ta – Dehgam, Dist - Gandhinagar</td>
<td>He requested the Project Proponent to kept the Mud generated during the activity within the Project Site.</td>
<td>Respected DM informed that GPCB will take the action accordingly.</td>
</tr>
</tbody>
</table>

Source: ABC Techno Labs India Pvt. Ltd.

Most of the participants welcome the project of Development drilling activities of M/s Bharat Petroresource Ltd as they believe it will help in development of the locality and economic wellbeing of the local people. Everybody gave their consent to the proposed activities of Bharat Petroresource Ltd.

**Ahmedabad Public Hearing**

M/s Bharat Petroresource Ltd. conducted public hearing through the Gujarat State Pollution Control Board (GPCB) on 2\textsuperscript{nd} February 2019 at Exploratory Well site of M/s Bharat PetroResource Pvt. Ltd. Survey No. 214, Village – Kuha, Taluka – Daskroi, Dist – Ahmadabad during 2.00 PM.
The public hearing notice in English was published in Indian Express and in Gujarati in Navgujarat Samay dated 28th December 2018.

The public hearing was conducted in line with the new EIA notification dated 14th September 2006. The photos of the public hearing are given in the table below. MoM copy of the public hearing issued by GSPCB is attached as Annexure 7.

The Public Hearing was chaired by Mr. C.M. Trivedi, Additional Collector & Additional District Magistrate, Ahmedabad Dist. Along with Regional Officer of GPCB. About 75 public were present during the public hearing.

A copy of the action plan towards the issues raised during the public hearing is also given below:

**Table 10.2: Issues raised during the Public Hearing, Ahmedabad**

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Name of Participants</th>
<th>Question/ Comments by Participants</th>
<th>Response/clarification by RIPL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mr. Bariya Ambalala Galabji. Village-Kuha, Ta-Daskroi, Dist-Ahmedabad</td>
<td>He requested to Build new road from Charanimuvadi to Khatwadi &amp; what will be the effect on ground water for agriculture and drinking purpose from upcoming well drilling process. They also made many representations regarding pollution of this area but no solution had come out. Regarding Concrete road the written representation was received from Sarpanch of Gram Panchyat.</td>
<td>1. Project Proponent had informed that for proposed well drilling approximately 2000 to 2200 mt drilling will be done by the metal pipe which will take out the underground crude directly to the surface and from there it will transfer to the respective tanks. So no underground water will be affected. The mud generated during the drilling process will store in a separate place and then send to the disposal site as directed by Gujarat State pollution control board. 2. The Project Proponent had assured that they will construct a new road before starting the drilling.</td>
</tr>
<tr>
<td>2.</td>
<td>Mr. Bholaji Mathurji Village-Kuha, Ta-Daskroi, Dist-Ahmedabad.</td>
<td>1. He was requesting the Project Proponent to increase the rent.</td>
<td>1. The Project Proponent had assured that a long term agreement will be fixed with mutually agreed rate. They will also discuss the matter with their company.</td>
</tr>
<tr>
<td>3.</td>
<td>Mr. Girish Bhai</td>
<td>1. He also requesting the</td>
<td>1. The Project Proponent had</td>
</tr>
<tr>
<td>Sl.No.</td>
<td>Name of Participants</td>
<td>Question/Comments by Participants</td>
<td>Response/clarification by RIPL</td>
</tr>
<tr>
<td>-------</td>
<td>----------------------</td>
<td>------------------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>4.</td>
<td>Mr. Kanaji Amraji Bariya.&lt;br&gt;Ambalal Patel.&lt;br&gt;Village-Kuha, Ta-Daskroi, Dist-Ahmedabad.</td>
<td>1. He was requesting the Project Proponent for a security job at this site.</td>
<td>1. The Project Proponent had assured that the first preference for the Employment will be given to the local villages based on the Skill Processed.</td>
</tr>
<tr>
<td>5.</td>
<td>Mr. Makaji Valaji Bariya.&lt;br&gt;Village - Charani Muvadi, Ta-Daskroi, Dist-Ahmedabad.</td>
<td>1. He requested the Project Proponent to arrange Rainwater Harvesting in the Proposed site.</td>
<td>1. Project Proponent had assured that they will inform the civil contractor about this.</td>
</tr>
</tbody>
</table>

Source: ABC Techno Labs India Pvt. Ltd.

Most of the participants welcome the project of Development drilling activities of M/s Bharat Petroresource Ltd as they believe it will help in development of the locality and economic wellbeing of the local people. Everybody gave their consent to the proposed activities of Bharat Petroresource Ltd.
CHAPTER 11

SUMMARY & CONCLUSIONS
CHAPTER 11: SUMMARY & CONCLUSIONS

11.1 BACKGROUND

Bharat Petroleum Corporation Ltd. (BPCL) entered the upstream sector in 2003 with an aim to provide partial supply security of crude and hedging of price risks and to become a vertically integrated oil company. A wholly owned subsidiary company of Bharat Petroleum Corporation Ltd. (BPCL), by the name Bharat PetroResources Limited (BPRL) was incorporated in October 2006.

An Environmental Impact Assessment (EIA) study report has been prepared for Proposed Onshore Oil and Gas development and production activities in the Block at Dehgam, Daskroi, Mehmdavad, District: Gandhinagar, Ahmedabad and Kheda, State- Gujarat based on Terms of Reference (TOR) prescribed by the MoEF&CC vide F. No. F. No. J-11011/324/2013-IA-II (I) Dated 2nd September 2018 and baseline environmental quality data collected in the study area during 20th April 2018 to 9th July 2018 by ABC Techno Labs India Pvt. Ltd. Identification and prediction of significant environmental impacts due to the proposed development drilling of wells project with an Environmental Impact Statement followed by a delineation of appropriate impact mitigation measures in an Environmental Management Plan (EMP) are included in the EIA report.

11.2 SALIENT FEATURES OF THE PROJECT

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Features</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Location Details</td>
<td>The identified block CB-ONN-2010/8 block in Cambay Basin of District- Gandhinagar, Ahmedabad and Kheda, State- Gujarat.</td>
</tr>
<tr>
<td>2</td>
<td>Number of development well to be drilled</td>
<td>10 no. of development wells within the 42 Km²</td>
</tr>
<tr>
<td>3</td>
<td>Depth of drilling</td>
<td>1300-1500 m</td>
</tr>
<tr>
<td>4</td>
<td>Activity involved</td>
<td>For well site during drilling will be 1.8 ha, including site facilities and for camp site</td>
</tr>
<tr>
<td>5</td>
<td>Area required</td>
<td>1.8 Ha</td>
</tr>
<tr>
<td>6</td>
<td>Cost of project</td>
<td>43 Crore INR</td>
</tr>
<tr>
<td>7</td>
<td>Drilling fluid</td>
<td>Water Based Mud (WBM)</td>
</tr>
<tr>
<td>8</td>
<td>Manpower requirement</td>
<td>Total Manpower: 40-50 (Construction Phase) and 10-15 (Operational Phase)</td>
</tr>
<tr>
<td>9</td>
<td>Water requirement</td>
<td>Approximately 35 KLD per well.</td>
</tr>
<tr>
<td>10</td>
<td>Waste water disposal</td>
<td>Concrete pads will be built to collect wastewater from kitchens, toilets, bathing and washing areas.</td>
</tr>
<tr>
<td>11</td>
<td>Domestic waste water</td>
<td>Wastewater from toilets shall be sent to soak pit after</td>
</tr>
</tbody>
</table>
Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Features</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Generation of drill cuttings and disposal</td>
<td>Around 1000 Ton/well (approx.) per well of drill cuttings and 500 Tons/Well (Approx) of waste mud will be generated as solid waste which will be separated from water based mud (WBM) and unusable drilling fluid will be stored in HDPE lined pit for solar drying for temporary storage. The cuttings/mud residues so stored will then be treated and disposed in accordance with CPCB regulations specified for onshore oil &amp; gas industry.</td>
</tr>
<tr>
<td>13</td>
<td>Generation of used oil and disposal</td>
<td>Spent oil shall be given to authorized vendor by GPCB for disposal. Un-used mud shall be disposed off in HDPE lined pit as secured land fill.</td>
</tr>
<tr>
<td>14</td>
<td>Power requirement</td>
<td>For Developmental Drilling 4 DG sets each of capacity 500 KVA for drilling operation. 1 DG set each of capacity 100 KVA &amp; 250 KVA shall be used at rig. About 6 KLD fuel (HSD) is required for the activity. HSD shall be stored in 2 no.s of 40 Kl at site</td>
</tr>
</tbody>
</table>

11.3 Salient Features of the Baseline Study

The reconnaissance survey of the area around the CB-ONN-2010/8 Block, Cambay basin of Gujarat was carried out from 20th April 2018 to 9th July 2018 and the field studies were carried out for one season during summer season for the EIA studies to collect baseline primary and secondary data for the present environmental scenario in the study area.

- **Micrometeorology:** Maximum and minimum temperature was observed 39.1°C and 27.5°C, relative humidity was recorded between 43% - 75%. The average wind speed varied from 0.8 to 2.3 Kmph and blow from the directions between SW and W during the period.

- **Ambient Air Quality:** Out of the 8 locations, maximum and minimum concentrations of PM10 were recorded as 71.4 µg/m³ at Ranodra (AAQ5) and 41.2 µg/m³ at Mirjapur (AAQ7). Oxide of Nitrogen (NOx) varies between 6.4 µg/m³ to 21.6 µg/m³ & Karoli (AAQ1) had maximum and Shiyapur (AAQ3) had minimum. Sulphur Dioxide (SO₂)
varies between 5.1 μg/m³ to 10.8 μg/m³ & Mirapur (AAQ7) have maximum. The VOCs of all the location are Below Detection Level.

- **Noise Level:** Out of 9 locations, during daytime highest values of noise level 54.5 dB (A) at near well no. DW#6 (N7) and lowest value 47.9 dB (A) was observed at near well no. PA#1 (N1).

- **Water Quality:** Out of 9 locations of Ground water, pH varied from 7.47 to 7.94. TDS varied between 217 to 1512 mg/l. Total Hardness varied from 140 mg/l to 620 mg/l. Chloride varied from 55 mg/l to 635 mg/l and Nitrate varied from BDL (1 mg/l) to 35 mg/l. Heavy metals like Arsenic, Manganese, Chromium, Lead, Mercury, Cadmium were found to be below detection limit at all locations. Total coliform found to be present in GW1, GW2, GW3, GW7, GW8, GW9 samples which doesn't meet the IS 10500:2012 standards for drinking water.

  Out of 5 locations of Surface Water, pH varied from 6.66 to 7.3. Turbidity varied between 4.1 to 14.1 NTU. TDS varied from 304 to 980mg/l. BOD found between 2.1 mg/l to 8.7 mg/l. Dissolved Oxygen varied from 3.5 mg/l to 6.3 mg/l. Heavy metals like Chromium, Mercury and Lead were found to be below detection limit at all locations. Total Coliform count varies between 17 to 2500 MPN/ 100ml.

- **Soil Quality:** Out of 5 locations, pH varied from 6.57 to 7.33. Electrical conductivity found within a range from 0.13 to 0.25 mS/cm. The texture of soil is predominantly Silty Clay Loam in most of the places. Available Nitrogen ranged from 165.5 to 192.5 kg/Ha, Potassium ranged from 1040 to 1892 kg/Ha, Available Phosphorus ranged from 66 to 125 kg/Ha. Soil organic content varied from 0.2 to 0.37 %, which indicates the very low level of organic matter.

- **Ecology & biodiversity:** Study conducted within 2 block area and some important tree species are *Acacia nilotica, Acacia auriculiformis, Azadirachta indica, Ficus religiosa* etc. Most dominant shrubs in the core zone and buffer zone were *Nerium indicum, Calotropis procera, Datura metel, Prosopis juliflora, Mimosa hamata*. Among the herb species observed are *Achyranthes aspera, Cassia tora, Commelina benghalensis, Cynodon dactylon, Typha angustata* etc. About 10 Mamalian species, 29 avifauna, 7 reptiles & amphibians were recorded within the study area.
Socio economic status: The study conducted within 10 km radius from centre of CB-ONN-2010/8 block. Total population in the study area is 141,564 and 28,152 Households. Male population is about 72,163 & female population is 69,401 with sex ratio of 961 females for every 1000 males and a literacy of 68.3%; Scheduled Castes and Scheduled Tribes accounted for 4,597 and 310 of the total population respectively. There were a total of 41,809 main workers, 13,453 marginal workers, 86,302 non-workers. About 29.5% employment rate found within the entire study area.

11.4 Salient Features of the Impact and Mitigation Measures

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Component</th>
<th>Mitigation Measures</th>
</tr>
</thead>
</table>
| 1       | Land Use  | • Consult local authorities and other stakeholders regarding preferred location for camps and access/maximize use of existing infrastructure.  
• Mark out the site boundaries to ensure that land taken is restricted to pre-agreed area;  
• Minimize the disturbance of vegetation present in and around area proposed to be used, if any;  
• Where possible use existing road/water infrastructure.  
• In-house audit before and after development drilling;  
• Minimum utilization of land and clearing of site;  
• All necessary protocols shall be followed and legal requirements shall be implemented with respect to local regulation pertaining to use of land; etc |
| 2       | Ecology   | • Mark out site boundaries;  
• Choose site to encourage natural rehabilitation by indigenous flora/avoid removal of vegetation and topsoil/preserve topsoil, and seed source for further usages.  
• Siting to minimize impacts on ecology, water resources, and landscape. Consider using site that has been cleared/disturbed previously or of low ecological value, or which may be more easily restored, e.g., agricultural land;  
• Avoid uprooting vegetation to the possible extent;  
• Ensure proper handling and storage of fuels and hazardous materials.  
• Take account of topography, natural drainage and site runoff. Ensure adequate and proper drainage.  
• Minimize cleared area and size of site/maximize perimeter to area ratio to aid natural re-vegetation.  
• Use hand cutting to clear vegetation initially—where necessary be selective in using machinery. |
### Mitigation Measures

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Component</th>
<th>Mitigation Measures</th>
</tr>
</thead>
</table>
| 3       | Water Resources | - Retain vegetation on edge of site to serve as seed bank for future site re-vegetation;  
- All bulldozer operators involved in site preparation shall be trained to observe the defined site boundaries;  
- Kerosene oil/LPG shall be used for domestic purpose;  
- In-house audit before and after development drilling operation;  
- Distance in case of test flaring as suggested in Chapter-4 shall be maintained; etc  
- Consider aquifer protection and proper plugging, if any;  
- Adequate water supply arrangement will be made at drilling site and camp site through local sources (Tankers);  
- Continuous attempt will be made to avoid wastage and leakage of water;  
- In case, water courses and aquifers are deemed sensitive, consider a fully sealed site, avoid use of mud pits, preferentially use steel tanks, but if used must be lined. Pits if used must be lined;  
- If an aquifer is breached, the drilling crew can cement the hole to prevent leakage; etc  
- Continuous attempt will be made to optimize/reduce the use of water;  
- Drilling will be avoided during monsoon season;  
- Toilets and bathrooms on temporary basis will be provided at drilling and camp site; and  
- In-house audit before and after development drilling; etc  
|
| 4       | Air Emissions (Dust and gaseous emission) | - Emission from flaring of petroleum hydrocarbons, DG sets and other machinery will confirm the standards as prescribed by MoEFCC/GPCB;  
- Well testing (flaring) to be undertaken so as to minimize impacts of emissions by ensuring:  
  o duration of testing minimized by careful planning; and  
  o high combustion efficiency, smokeless flare/burner to be used.  
- Detectors for CH₄ and H₂S will be placed at adequate locations;  
- Any dry, dusty materials (chemicals, construction materials etc) shall be stored in sealed containers and fenced storage yard;  
- Arrangement of water spray at drilling site and access road to the possible extent will be made;  
- Regular testing of the combustion efficiency of the vehicles/machinery; and  
- Preventive maintenance of vehicles and machinery;  
- Regular monitoring and In-house audit as per details given in this chapter or as stipulated by MoEFCC/GPCB.  
<p>|
| 5       | Noise and | - Engineering specifications for machinery/equipment will be |</p>
<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Component</th>
<th>Mitigation Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vibration</td>
<td>stipulated during tendering as a condition for contractor to maintain noise level not more than 85 dB(A) at 1 m from each source; Selection of low noise generating machinery/equipment; Provision of rubber padding/noise isolators/silencers to modulate the noise generated by machinery/equipment, wherever possible; The high noise zones within ROW will be demarcated and temporary enclosures &amp; barriers, if required will be provided; Use experienced and skilled personnel; Train personnel of standard operating procedures for handling and shooting of explosives; All employees will receive appropriate training and education as and when required; Provision of protective devices like ear muff/plugs to the workers; Preventive maintenance of machinery/equipment and vehicles; All employees will be encouraged to cooperate in using agreed safe work practices; Information on noise, the risks of exposure to noise and the appropriate control measures shall be disseminated in a manner appropriate to the workplace; In no case, workers will be exposed more than 85 dB (A) at 1m from source; Regular monitoring and In-house audit as per details given in this chapter; or as stipulated by MoEFCC/GPCB; etc.</td>
</tr>
<tr>
<td>6</td>
<td>Water Quality</td>
<td>All the debris resulting from the site will be isolated from the waste water and disposed off separately; Incorporate drainage and minimize disturbance to natural drainage patterns. Engineer slopes and drainage to minimize erosion. Design for storm conditions/ensure offsite natural runoff does not wash over site/use perimeter drainage ditches. Seal bund and ensure proper drainage of machinery areas, fuel and chemical storage, and mud mixing areas; In case, water courses and aquifers are deemed sensitive, consider a fully sealed site, avoid use of mud pits, preferentially use steel tanks, but if used must be lined. Pits if used must be lined; Provide base material compatible with local ground conditions. Hard core will be laid on geo-textile membrane. Avoid concreting sites; Protect water courses from contamination and siltation; Mud and burn pits, if used, must have adequate contingency capacity especially for rainfall, and must be fully lined and bunded. Potable ETP will be used to treat the process waste water while domestic waste water will be discharged to soak pits.</td>
</tr>
<tr>
<td>Sl. No.</td>
<td>Component</td>
<td>Mitigation Measures</td>
</tr>
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<td>--------</td>
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<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
|        | **Soil quality**               | **Soil Erosion**  
* Stockpile of topsoil wherever possible at the edge of site;  
* Minimize area and extent of site clearance, by staying within defined boundaries;  
* Limit erosion potential/avoid steep slope and drainage courses/avoid cut and fill techniques/incorporate proper drainage, culverting and bridging techniques;  
* Avoid removing undergrowth where possible so as to retain land stability; etc  

**Fuel, Lubricants and Chemical Management**  
* Storage and liquid impoundment areas for fuels, construction materials, solvents, chemicals and waste should be designed with secondary containment (e.g., dykes and berms) to prevent spills and the contamination of soil, groundwater, and surface waters; |
### Mitigation Measures

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Component</th>
<th>Mitigation Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All fuels, lubricants, surface treatment materials, welding rods/gases, chemicals etc to be placed in controlled storage i.e. properly fenced area and in clearly marked vessels and containers;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Effective bunds capable of containing 110% of the volume of the largest container within and enclosing all potentially contaminating materials to be used for fuel lubricants and chemicals storage area;</td>
<td></td>
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<tr>
<td></td>
<td>Impervious liners will be in place for pits for storage of drill cutting and mud;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Impervious liners will be in place for fuel, lubricants and chemicals storage area;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Non-contaminated and potentially contaminated run-off will be kept separate. Non-contaminated run-off will be routed to off-site areas via silt traps.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Potentially contaminated surface run-off will be routed through oil traps.</td>
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<tr>
<td></td>
<td>In-house audit will be carried out before and after development drilling operation.</td>
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<tr>
<td>8</td>
<td>Disturbance to community resources &amp; safety</td>
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<tr>
<td></td>
<td>Advance notice to local administration about the activities;</td>
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<td></td>
<td>Minimize use of roads by planning vehicle movements;</td>
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<td></td>
<td>Proper cordon off the site with sign boards;</td>
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<td></td>
<td>Adequate communication with locals which may be impacted during development drilling;</td>
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<td></td>
<td>Diversion of traffic, if required;</td>
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<td></td>
<td>Placing the warning board on the vehicles during transportation of machinery and materials;</td>
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<td></td>
<td>Proper training to drivers about public safety.</td>
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<td></td>
<td>Spray down dirt roads if too dusty;</td>
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<tr>
<td></td>
<td>In-house monitoring and audit; etc</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Employment and Socio economic</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Close monitoring on the type of loss to local habitats, if any. In case of any loss to locals, adequate compensation shall be provided as per the law or on mutually agreed terms;</td>
<td></td>
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<td></td>
<td>Preference will be given to locals for temporary direct and indirect employment;</td>
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<td></td>
<td>Where ever local skilled labour is available, will be preferred to be hired for the respective job;</td>
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<tr>
<td></td>
<td>Local employment (unskilled) will be provided in a manner, giving fair representation to all section;</td>
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<tr>
<td></td>
<td>Local suppliers for machineries and construction materials will be given preference;</td>
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<tr>
<td></td>
<td>Local transporters will be preferred for transportation of machinery/materials.</td>
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<td></td>
<td>Third part audit after completion of activities; etc</td>
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</tr>
<tr>
<td>Sl. No.</td>
<td>Component</td>
<td>Mitigation Measures</td>
</tr>
<tr>
<td>--------</td>
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<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| 10     | Culture, Aesthetics and Archaeological sites | **Culture**  
- Discourage interaction of outsiders with locals, however if any issue arises, Senior officials of BPRL / Contractor should communicate with the elders/sarpanch of village and settle down the issue;  
- All workers should respect the local norms of communities.  
- Control workforce activities, e.g. hunting, interaction with local population.  
- Purchase food from recognized local suppliers, not directly from local people without evaluating implications;  
- Monitoring and control of activities of work force that may affect women in the villages;  
- No interruption to culturally important sites;  
- Contractor should not utilize the local village’s drinking water resources and must not damage the existing infrastructure;  
- Community complaint registers must be placed at site and all complaints to be documented and strict compliance to be undertaken;  
- Consultations with locals must be done by the contractor before making access roads; etc  
**Aesthetics**  
- Strict compliance to Environment Management Plan (EMP);  
- Camp should be constructed away from sensitive habitats; etc |
| 11     | Occupational Health & Safety      | **Occupational Health & Safety**  
- Due care will be taken to maintain continuous water supply in the water spraying system and all efforts would be made to suppress the dust generated during drilling operation to the possible extent;  
- Any worker found to develop symptoms of dust related diseases will be changed over to other activities in cleaner areas;  
**General Safety Measures:**  
- Employees shall be provided with helmets, safety boots, eye and ear protection, and snug fitting gloves as appropriate;  
- Sensors shall be placed at adequate location for methan and hydrogen sulphide;  
- Masks and dust-proof clothing shall be provided to personnel; and  
- Procedures shall be strictly enforced for the drilling, storage, handling, and transport of explosives, flammable and hazardous materials.  
**General Health Measures:**  
- Sanitary facilities will be well equipped with supplies and employees shall be encouraged to wash frequently, particularly those exposed to dust, chemicals or pathogens;  
- Personnel required to work in areas with high humidity will be allowed to take frequent breaks away from these areas; |
### Sl. No. | Component | Mitigation Measures
--- | --- | ---
11 | Housekeeping | - Pre-employment medical examinations of all personnel will be made mandatory for contractor; etc

**Source:** ABC Techno Labs India Pvt. Ltd.

### 11.5 Cost of EMMP

Cost of EMP during development drilling shall be INR 43 lacs for development drilling of each well which mainly includes rent of mobile ETP, waste management, environment monitoring, audit etc. Cost of civil construction & other facilities for waste management, compensation to be paid for land and other losses, PPE, site restoration, etc shall be additional.
CHAPTER 12

DISCLOSURE OF CONSULTANT
CHAPTER 12: DISCLOSURE OF CONSULTANT

This chapter describes about the environmental consultant engaged in preparation of EIA report for Proposed Conversion of 2 exploratory wells to development well, Drilling of 8 development wells for production, construction of quick production facility within CB-ONN-2010/8 block situated in Dehgam, Daskroi, Mehmdavad, District- Gandhinagar, Ahmedabad and Kheda, State- Gujarat by M/s Bharat Petro Resources Ltd.

12.1 INTRODUCTION

ABC Techno Labs India Private Limited (formerly ABC Environ Solutions Pvt. Ltd.) is an ISO 9001, ISO 14001 & OHSAS 18001 Certified Company & leading Environmental Engineering & Consultancy Company constantly striving towards newer heights since its inception in 2006. Our Company is dedicated to providing strategic services in the areas of Environment, Infrastructure, Energy, Engineering and Multilab.

It is the first firm to be accredited by NABET (National Accreditation Board for Education and Training), Quality Council of India, as an EIA Consultant, approved for carrying out EIA studies and obtaining environmental clearance for various sectors such as Thermal Power Plants, Infrastructure, Industrial Estates / Complexes/ Areas, Mining, Township & area development and Building construction projects etc. ABC Techno Labs is equipped with in-house, spacious laboratory, accredited by NABL (National Accreditation Board for Testing & Calibration Laboratories), Department of Science & Technology, Government of India.

Since establishment ABC Techno Labs focus on sustainable development of Industry and Environment based on sound engineering practices, innovation, quality, R&D and most important is satisfying customers need. The company has successfully completed more than 100 projects of a variety of industries, in the field of pollution control and environmental management solutions. The company is also dealing in the projects of waste minimization and cleaner production technology.

The team of technocrats and scientist are well experienced to deal with the design, Manufacture, Fabrication, Installation, commissioning of Effluent/ Wastewater treatment plants, Sewage Treatment plants, and Combined Treatment plants.
The company is having well-experienced team of Scientists & Engineers who are looking after environmental projects & well-equipped analytical laboratory with a facility including analysis of physical, chemical and biological parameters as per the requirements of the State Pollution Control Board and our clients.

12.2 Services of ABC Techno Labs India Private Limited

12.2.1 Environmental Services
- Environmental Impact Assessment (EIA)
- Environmental Management Plan (EMP)
- Social Impact Assessment (SIA)
- Environmental Baseline data collection for Air, Meteorology, Noise, Water, Soil, Ecology, Socio-Economic and Demography etc;
- Environmental Monitoring
- Socio-Economic Studies
- Resettlement & Rehabilitation Plan
- Ecological & Human Health Risk Assessment Studies
- Ecological Impact Assessment
- Environmental Management Framework
- Solid Waste Management
- Hazardous Waste Management
- Internship & Training

12.2.2 Turnkey Projects
- Water Treatment Plants
- Sewage Treatment Plant
- Recycling & Water Conservation Systems
- Zero Discharge System

12.2.3 Other Services
- Operation & Maintenance of Water & Waste Water Plants
- Water & Waste Water Treatment Chemicals
- Pilot Plant studies
- Feasibility studies & preparation of budgetary estimates
12.2.4 **Laboratory Services**

- Chemical Testing
- Environmental Testing
- Microbiological Testing
- Food Testing
- Metallurgical Testing

12.3 **Sectors Accredited by NABET**

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Sector No.</th>
<th>Name of sectors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Mining of Minerals including Opencast &amp; Underground Mining</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td><strong>Offshore Oil and gas exploration, development &amp; productions</strong></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>Irrigation Projects</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>Thermal Power Plant</td>
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<tr>
<td>5</td>
<td>7</td>
<td>Mineral Beneficiation including palletisation</td>
</tr>
<tr>
<td>6</td>
<td>8</td>
<td>Metallurgical Industries – (Ferrous only) Secondary</td>
</tr>
<tr>
<td>7</td>
<td>9</td>
<td>Cement Plants</td>
</tr>
<tr>
<td>8</td>
<td>10</td>
<td>Petroleum Refining Industry</td>
</tr>
<tr>
<td>9</td>
<td>15</td>
<td>Leather/Skin/hide processing industry</td>
</tr>
<tr>
<td>10</td>
<td>16</td>
<td>Chemical Fertilizers</td>
</tr>
<tr>
<td>11</td>
<td>17</td>
<td>Pesticides industry and pesticide specific intermediates</td>
</tr>
<tr>
<td>12</td>
<td>18</td>
<td>Petro-chemical Complexes (industries based on processing of petroleum fractions &amp; natural gas and/or reforming to aromatics)</td>
</tr>
<tr>
<td>13</td>
<td>21</td>
<td>Synthetic organic chemicals industry (dyes &amp; dye intermediates; bulk drugs and intermediated excluding drug formulations; synthetic rubbers; basic organic chemicals, other synthetic organic chemicals and chemical intermediates)</td>
</tr>
<tr>
<td>14</td>
<td>22</td>
<td>Distilleries</td>
</tr>
<tr>
<td>15</td>
<td>25</td>
<td>Sugar Industry</td>
</tr>
<tr>
<td>16</td>
<td>27</td>
<td>Oil &amp; gas transportation pipe line (crude and refinery/ petrochemical products), passing through national parks / sanctuaries / coral reefs / ecologically sensitive areas including LNG Terminal</td>
</tr>
<tr>
<td>17</td>
<td>28</td>
<td>Isolated storage &amp; handling of hazardous chemicals (As per threshold planning quantity indicated in column 3 of schedule 2 &amp; 3 of MSIHC Rules 1989 amended 2000)</td>
</tr>
<tr>
<td>18</td>
<td>29</td>
<td>Airports</td>
</tr>
<tr>
<td>19</td>
<td>31</td>
<td>Industrial estates/ parks/ complexes/ areas, export processing Zones (EPZs), Special Economic Zones (SEZs), Biotech Parks, Leather Complexes</td>
</tr>
<tr>
<td>20</td>
<td>33</td>
<td>Ports, Harbours, Jetties, Marine terminals, break waters and dredging</td>
</tr>
<tr>
<td>21</td>
<td>34</td>
<td>Highways, Railways, Transport terminals, mass rapid transport system</td>
</tr>
<tr>
<td>22</td>
<td>36</td>
<td>Common Effluent Treatment Plants (CETPs)</td>
</tr>
</tbody>
</table>
Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.

<table>
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<th>Sector No.</th>
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</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>37</td>
<td>Common Municipal Solid Waste Management Facility (CMSWMF)</td>
</tr>
<tr>
<td>24</td>
<td>38</td>
<td>Building and large Construction projects including shopping malls, multiplexes, commercial complexes, housing estates, hospitals, institutions</td>
</tr>
<tr>
<td>25</td>
<td>39</td>
<td>Townships and Area development projects</td>
</tr>
</tbody>
</table>

Source: ABC Techno Labs India Pvt. Ltd.

12.4 Study Team

ABC Techno Labs India Private Limited has carried out this Environmental Impact Assessment (EIA) study. The multidisciplinary team included expertise in Environmental Impact Assessment, Air & Water pollution & Control measures, Noise Control measures, Ecology & bio-diversity, Land use, Geology, Environmental Chemistry and Socio-Economic planner. The team members involved in EIA study area:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mr. Abhik Saha</td>
<td>EIA coordinator – Offshore Oil and gas exploration, development &amp; productions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FAE – Air Pollution (AP)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FAE – Ecology &amp; Biodiversity (EB)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FAE – Water Pollution (WP)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FAE – Solid &amp; Hazardous Waste (SHW)</td>
</tr>
<tr>
<td>2</td>
<td>Dr. R.K. Jayaseelan</td>
<td>FAE – Land use, Prevention &amp; Control and Hydrogeology (Director –Technical)</td>
</tr>
<tr>
<td>3</td>
<td>Mrs. K. Vijayalakshmi</td>
<td>FAE – Risk Assessment, Air Quality Modelling &amp; Prediction</td>
</tr>
<tr>
<td>4</td>
<td>Dr. Thillai Govindarajan</td>
<td>FAE – Geology</td>
</tr>
<tr>
<td>5</td>
<td>Mr. R. Rajendran</td>
<td>FAE – Noise &amp; Vibration</td>
</tr>
<tr>
<td>6</td>
<td>Mrs. Geetha Shreeneevasakam</td>
<td>FAE – Socio-Economic Expert</td>
</tr>
<tr>
<td>7</td>
<td>Mr. Sameer Despande</td>
<td>FAE – Soil Conservation (SC)</td>
</tr>
</tbody>
</table>

Team Members

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>S. Sravanakumar</td>
<td>FAA- Air Pollution, Water Pollution Prevention and Control</td>
</tr>
<tr>
<td>9</td>
<td>Mr. Robson Chinnadurai</td>
<td>Senior Chemist</td>
</tr>
<tr>
<td>10</td>
<td>Mr. M. Muruganantham</td>
<td>Junior Chemist</td>
</tr>
<tr>
<td>11</td>
<td>Mr. Sathish</td>
<td>Field Technician</td>
</tr>
</tbody>
</table>
**Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.**

**DISCLOSURE AS PER NABET /QCI**
Details as per Schedule of EIA Notification 2006, as amended till date

*Name of Publication*  
Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.

*Schedule as per EIA notification 2006*  
1 (b)

*Category*  
A

*NABET Sector No.*  
2 - Offshore Oil and gas exploration, development & productions

**Declaration by experts contributing to the Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.**

I, hereby, certify that I was a part of the EIA team in the following capacity that developed the above EIA/EMP.

**EIA Coordinator**

<table>
<thead>
<tr>
<th>Name</th>
<th>Signature</th>
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</thead>
<tbody>
<tr>
<td>Mr. Abhik Saha</td>
<td>[Signature]</td>
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</tbody>
</table>

**Period of involvement**  
April 2018 – Till date

**Contact information**  
abc@abctechnolab.com

**FUNCTIONAL AREA EXPERTS:**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Functional Areas</th>
<th>Name of the Expert/s</th>
<th>Involvement (Period)</th>
<th>Signature &amp; Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>AP</td>
<td>Mr. Abhik Saha</td>
<td>April 2018 – Till date</td>
<td>[Signature]</td>
</tr>
<tr>
<td>2.</td>
<td>WP</td>
<td>Mr. Abhik Saha</td>
<td>April 2018 – Till date</td>
<td>[Signature]</td>
</tr>
<tr>
<td>3.</td>
<td>SHW</td>
<td>Mr. Abhik Saha</td>
<td>April 2018 – Till date</td>
<td>[Signature]</td>
</tr>
<tr>
<td>4.</td>
<td>EB</td>
<td>Mr. Abhik Saha</td>
<td>April 2018 – Till date</td>
<td>[Signature]</td>
</tr>
<tr>
<td>5.</td>
<td>SE</td>
<td>Dr. Geetha Shreeeneevasakam</td>
<td>April 2018 – Till date</td>
<td>[Signature]</td>
</tr>
<tr>
<td>No.</td>
<td>Initial</td>
<td>Name</td>
<td>Date</td>
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<tr>
<td>6.</td>
<td>HG</td>
<td>Dr. R.K. Jayaseelan</td>
<td>April 2018 – Till date</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>NV</td>
<td>Mrs. Vijayalakshmi</td>
<td>April 2018 – Till date</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>LU</td>
<td>Dr. R.K. Jayaseelan</td>
<td>April 2018 – Till date</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>RH</td>
<td>Mrs. Vijayalakshmi</td>
<td>April 2018 – Till date</td>
<td></td>
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<tr>
<td>10.</td>
<td>AQ</td>
<td>Mrs. Vijayalakshmi</td>
<td>April 2018 – Till date</td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>GEO</td>
<td>Dr. Thillai Govindarajan</td>
<td>April 2018 – Till date</td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>SC</td>
<td>Mr. Sameer Despande</td>
<td>April 2018 – Till date</td>
<td></td>
</tr>
</tbody>
</table>

**Declaration by the head of the Accredited Consultant Organization**

I, Mr. G. Murugesh, hereby confirm that the above mentioned experts prepared the EIA/EMP Report for the proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd. I also confirm that ABC Techno Labs India Pvt. Ltd. shall be fully accountable for any misleading information mentioned in this statement.

**Signature**: 

**Name**: Mr. G. Murugesh  
**Designation**: Chairman & Managing Director  
**Name of the EIA Consultant Organization**: ABC Techno Labs India Private Limited  
**NABET Certificate No. & Issue Date**: NABET/EIA/1619/RA0048 date 29th May 2017
ANNEXURE 1: DECLARATION REGARDING LITIGATION

This is to certify and declare that our company M/s Bharat PetroResources Limited (BPRL) does not have any direction / order passed by any Court of Law against the project and neither the unit received any notice under section 5 of Environment (Protection) Act, 1986 or relevant sections of Air and Water Acts.

However, one of the prospective bidder has filed a writ petition before the Honourable High Court of Gujarat pertaining waste management services tender. The Writ Petition filed in Gujarat High Court is currently pending, however no direction has been passed against the project.

From M/s Bharat PetroResources Limited.

[Signature]

Mr. Tushar Datta
Vice President (Assets)
ANNEXURE 2: LEASE AWARD LETTER

ORDER
In exercise of the powers conferred by Rule 511 (R) of the Petroleum and Natural Gas Rules, 1993, the Government of Gujarat is pleased to Grant a Petroleum Exploration License for the Block CB-ONN-2010/8 (NELP-X) in Ahmedabad, Gandhinagar and Ahmedabad Dist.

The grant of the license is subject to the terms and conditions mentioned below:
1. If any minerals are found during the exploration work, the BPR Ltd. shall bring them to the notice of State Government and all pertinent information available with them.
2. The BPR Ltd. has deposited security deposit prescribed in Rule 12 of the Petroleum & Natural Gas Rules, 1993. The BPR Ltd. has also paid the necessary amount as an application fee and preliminary expenses as detailed below:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Nature of Payment</th>
<th>Challan No. &amp; Date</th>
<th>Amount (Rs.)</th>
<th>Head of Account</th>
</tr>
</thead>
</table>

The BPR Ltd. shall immediately on demand submit to the State Government and the Director of Petroleum, confidentially a full report of the geological data of all the minerals found during the exploration of oil and gas and shall submit without fail every
Licences shall not employ any foreign national unlawfully in the area along the town.

No ground/surveys of the Defence VAPs are permitted. Air surveys, if any, would be governed by the provisions of Ministry of Defence letter No. GA/1(II) (323-03) dated 21 January 1989.

Air Force area falling within the zones earmarked for demarcation should be avoided.

For works in close vicinity of Indian Air Force units/instalments and visit to these instalments, if any, specific permission of Air Headquarters should be obtained.

Any work within 500m of the perimeter of Air Force Station should be intimated to Air Force Authority at least 10 days before commencement of the activities.

No obstruction shall be erected higher than 15 mts. Within 5 km. Radius of Air Force Air Fields and construction of any high mast/towers shall be carried out in consultation with the Air Force Authority.

Planned use of explosives on or below the surface shall be intimated to Air Force Authority at least 48 hours in advance.

No drilling work or installation of pipelines shall be carried out in and around village lake or residential areas.

If work has to be carried out in the land owned by Gram Panchayat permission of appropriate authority shall be taken before beginning the work.

If work has to be carried out in the land owned by Private Individuals permission of the same shall be taken before beginning the work.

No damages to the Major or Minor Minerals should be done.

All approach roads and natural drainage should be kept clear, open and intact.

No work shall be carried out as to damage public interest in any form.

No existing infrastructure public or private underground utility and human beings to be harmed.

The licencee have to submit the report of activities carried out in the said PEL area to the Director of Petroleum every month.

During the license period if any discovery is made, licencee has to immediately report it to the State Government and Director of Petroleum.

Licensee shall execute a separate lease deed in respect of such other covenants, terms and conditions as per the prescribed format.

Infringement of any one or more of the conditions enumerated above shall automatically render the PEL null and void ab-initio.

By order and in the name of the Governor of Gujarat:

Under Secretary to Government, Energy and Petroleum Department.

The District Collector, Gt. Ahmedabad, Gandhinagar and Chodod.
The Director of Petroleum, Gandhinagar.
The Accountant General, Ahmedabad.
The Accountant General, Rajkot.
The Secretary to the GOI, Ministry of Petroleum & Natural Gas, Shastri Bhawan.
New Delhi-110011.

Shri P.C.Srivastava, Vice President(Assets & Ops.), Bharat Petro Resources Ltd.
Malik Tower, E Wing, 18 Floor, Colaba, Mumbai-400005.
The Select file.
Annexure 3: TSDF Membership Certificate

This is to certify that M/s. Bharat Petro Resources Limited (Generator) having its Production Unit at Survey No. 879, Neelpur block-CB-ONN-2010/8, Vill. Karoli, Tal: Desgam, Dist: Gandhinagar has approached M/s. Saurashtra Enviro Projects Pvt. Ltd. (Operator) for obtaining membership of its Integrated Common Hazardous Waste Management Facility (I.C.H.W.M.F) for disposal of Industrial Hazardous Waste generated from their Production activities.

This Provisional Certificate with validity of 06 (six) months from date of issue has been issued for meeting and complying any immediate requirement of the Regulators.

Final Membership Certificate shall be awarded subject to successful completion of all essential membership formalities.

Note: Waste disposal activities shall commence post receipt of Final Membership Certificate by the Generator.

In event of any clarification/discussion, please feel free to contact us at info@seepindia.com for further assistance.

Thanks & Regards,

For, Saurashtra Enviro Projects Pvt. Ltd

(Chairman)
Annexure 4: NABL Certificate of ABC Techno Labs India Pvt. Ltd.
ANNEXURE 5: PREVIOUS ENVIRONMENTAL CLEARANCE

F. No. J-11011/324/2013/IA-II (c)
Government of India
Ministry of Environment, Forest and Climate Change
(I.A. Division)

Indira Paryavaran Bhawan
Aigar, Jorbagh Road,
New Delhi -110003

E-mail : lk.bokoliya@nic.in
Telefax : 011-24695353
Dated 22nd June, 2015

To,
Shri N. K. Jothiswaran
Senior Manager
Bharat Petro Resources Ltd.
Ranganathan Garden Office,
11th Main Road Post Box No.1212&1213,
Anna Nagar, Chennai 600040- India

E-mail: jothiswaran nk@bharatpetroresources.in; Phone: 044-26142127

Subject: Onshore Oil and Gas Exploration in Block CB-ONN-2010/8 at NELP, Cambay Basin, located in the common boundary of Ahmedabad, Kheda, and Gandhinagar Districts, Gujarat by M/s Bharat Petro Resources Ltd. - Environmental Clearance

Ref.: Your letter no. BPRL/CHI/2010/EIA dated 04.03.2015.

Sir,

This has reference to your letter dated 4th March, 2015 along with Form-1, Prefeasibility Report, EIA/EMP report, Public hearing report regarding above mentioned project.

2.0 The Ministry of Environment, Forest and Climate Change has examined the application. It is noted that proposal is for Onshore Oil and Gas Exploration (3 nos. Well) in Block CB-ONN-2010/8 in Gujarat. The NELP IX block CB-ONN-2010/8 is located in common boundary of 3 districts namely Ahmedabad, Kheda and Gandhinagar. The area covered under part A of the block is 14 sq. km and under part B is 28 sq. km. Mitha River is flowing within the block. It is reported that no protect area notified under Wildlife (Protection) Act, 1972 and Notified Eco-Sensitive Area is located within 10 km distance. Cost of project is US Dollar 26 Million. M/s BPRL intends to drill wells to depth ranging between 1800 m to 3500 m. Following are the coordinates of the blocks: Geographical coordinates of Block ‘A’

<table>
<thead>
<tr>
<th>Latitude</th>
<th>Longitude</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A 23</td>
<td>54</td>
<td>72</td>
</tr>
<tr>
<td>B 23</td>
<td>54</td>
<td>72</td>
</tr>
<tr>
<td>C 23</td>
<td>3</td>
<td>72</td>
</tr>
<tr>
<td>D 23</td>
<td>3</td>
<td>72</td>
</tr>
<tr>
<td>A 23</td>
<td>54</td>
<td>72</td>
</tr>
</tbody>
</table>
Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.

Geographical coordinates of Block ‘B’

<table>
<thead>
<tr>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>A 23 0 0</td>
<td>72 46 38</td>
</tr>
<tr>
<td>B 23 0 0</td>
<td>72 50 10</td>
</tr>
<tr>
<td>C 22 57 26</td>
<td>72 50 8</td>
</tr>
<tr>
<td>D 22 57 26</td>
<td>72 46 38</td>
</tr>
<tr>
<td>E 23 0 0</td>
<td>72 46 38</td>
</tr>
</tbody>
</table>

Details of each proposed exploratory wells are as given below:

<table>
<thead>
<tr>
<th>Well Locations</th>
<th>Village Distance</th>
<th>Distance of Road from Well Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well-1 Karoli</td>
<td>1.53 Km</td>
<td>0.12 Km (Village Road of Pasun-Karoli)</td>
</tr>
<tr>
<td>Well-2 Kodri</td>
<td>0.48 Km</td>
<td>1.76 Km (Village Road of Pasun-Karoli)</td>
</tr>
<tr>
<td>Well-3 Khara</td>
<td>2.12 Km</td>
<td>0.80 Km (Village road of Khara-Pasun)</td>
</tr>
<tr>
<td>Well-4 Demalaya</td>
<td>0.97 Km</td>
<td>1.05 Km (Village Road)</td>
</tr>
<tr>
<td>Well-5 Chandil</td>
<td>0.41 Km</td>
<td>900 meter (Ahmedabad Zalod Highway)</td>
</tr>
<tr>
<td>Well-6 Bhavda</td>
<td>1.79 Km</td>
<td>200 meters (Village Road) 1.85 Km (Ahmedabad-Zalod Road)</td>
</tr>
<tr>
<td>Well-7 Vadod</td>
<td>1 Km</td>
<td>1.85 Km (Village Road to Chandil)</td>
</tr>
<tr>
<td>Well-8 Ranadra</td>
<td>1.35 Km</td>
<td>0.14 Km (Village Road)</td>
</tr>
</tbody>
</table>

3.0 Air emissions from D.G. sets will be dispersed by providing adequate stack height. Flare stack of 30 m height will be provided. Water based mud will be used. Water requirement from tanker supply will be 35 m³/day. Wastewater generation will be 5 m³/day. Drilling cutting (DC) will be separated from water based mud (WBM) and washed properly and unusable drilling fluids (DF) will be disposed off in well designed lined pit with impervious liner for solar drying. Disposal of drill cuttings and drill mud will be carried out in accordance with the GSR 546 (E) dated 30th August, 2005. Used oil will be sent to authorized recyclers. D.G. sets (4x500 KVA + 1x100 KVA) will be installed to meet the emergency requirement of exploratory drilling operations. Blow out preventers (BOP) will be installed to control fluid from the formation gushing to the surface. In the event the well is unsuccessful, the well bore will be cement plugged.

4.0 All the projects related to offshore and onshore Oil and Gas exploration, development and production are listed in para 1(b) of schedule of EIA Notification, 2006 covered under category ‘A’ and appraised at central level.


6.0 The proposal was considered by the Expert Appraisal Committee (Industry) in its 9th meeting held during 28th - 30th January, 2014 and Expert Appraisal Committee (Industry-2) in its 38th meeting held during 20th-21st April, 2015 respectively. Project Proponent and the EIA Consultant namely M/s Detox Corporation Pvt. Ltd., have presented the EIA / EMP Report as per the TOR. EAC has found the EIA / EMP Report and additional information to be satisfactory and in full consonance with the presented TORs. The Committee recommended the proposal for environmental clearance.

7.0 Based on information submitted by you, the Ministry of Environment and Forest hereby accord environmental clearance to the above project under the provisions of EIA Notification dated 14th September, 2006 subject to strict compliance of the following specific and general conditions:
A. SPECIFIC CONDITIONS :

i. The present EC is for Exploratory Drilling only. In case Development drilling to be done in future, prior environmental clearance must be obtained from the Ministry.

ii. Ambient air quality shall be monitored near the closest human settlements as per the National Ambient Air Quality Emission Standards issued by the Ministry vide G.S.R. No. 626(E) dated 16th November, 2009 for PM10, PM2.5, SO2, NOx, CO; methane & Non-methane HC etc.

iii. Mercury shall also be analyzed in air, water and drill cuttings twice during drilling period.

iv. Approach road shall be made pucca to minimize generation of suspended dust.

v. The company shall make the arrangement for control of noise from the drilling activity. Acoustic enclosure shall be provided to DG sets and proper stack height shall be provided as per CPCB guidelines.

vi. Total water requirement shall not exceed 35 m³/day and prior permission shall be obtained from the concerned agency.

vii. The company shall construct the garrat drain all around the drilling site to prevent runoff of any oil containing waste into the nearby water bodies. Separate drainage system shall be created for oil contaminated and non-oil contaminated. Effluent shall be properly treated and treated wastewater shall conform to CPCB standards.

viii. 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. The membership of common TSDF shall be obtained for the disposal of drill cuttings and hazardous waste. Otherwise, secured land fill shall be created at the site as per the design approved by the CPCB and obtain authorization from the SPCB. Copy of authorization or membership of TSDF shall be submitted to Ministry's Regional Office at Bhopal.

ix. Good sanitation facility shall be provided at the drilling site. Domestic sewage shall be disposed off through septic tank/ soak pit.

x. Oil spillage prevention scheme shall be prepared. In case of oil spillage/environmental contamination, action plan shall be prepared to clean the site by adopting proven technology. The recyclable waste (oily sludge) and spent oil shall be disposed of to the authorized recyclers.

xi. 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 30th August, 2005.

xii. The Company shall take necessary measures to prevent fire hazards, containing oil spill and soil remediation as needed. Possibility of using ground flame shall be explored. At the place of ground flaring, the overhead flaring stack with knockout drums shall be installed to minimize gaseous emissions during operation.

xiii. The company shall develop a contingency plan for H2S release including all necessary aspects from evacuation to resumption of normal operations. The workers shall be provided with personal H2S detectors in locations of high risk of exposure along with self containing breathing apparatus.

xiv. On completion of drilling, the company have to plug the drilled wells safely and obtain certificate from environment safety angle from the concerned authority.
xv. Blow Out Preventer (BOP) system shall be installed to prevent well blowouts during drilling operations. BOP measures during drilling shall focus on maintaining well bore hydrostatic pressure by proper pre-well planning and drilling fluid logging etc.

xvi. Emergency Response Plan (ERP) shall be based on the guidelines prepared by OISO, DGMS and Govt. of India.

xvii. The company shall take measures after completion of drilling process by well plugging and secured enclosures, decommissioning of rig upon abandonment of the well and drilling site shall be restored to the original condition. In the event that no economic quantity of hydrocarbons is found a full abandonment plan shall be implemented for the drilling site in accordance with the applicable Indian Petroleum Regulations.

xviii. Abandoned well inventory and remediation plan shall be submitted within six months from the date of issue of letter.

xix. Occupational health surveillance of the workers shall be carried out as per the prevailing Acts and Rules.

xx. In case the commercial viability of the project is established, the Company shall prepare a detailed plan for development of oil and gas fields and obtain fresh environmental clearance from the Ministry.

xxi. Restoration of the project site shall be carried out satisfactorily and report shall be sent to the Ministry’s Regional Office at Bhopal.

xxii. Oil content in the drill cuttings shall be monitored by some Authorized agency and report shall be sent to the Ministry’s Regional Office at Bhopal.

xxiii. At least 5% of the total cost of the project shall be earmarked towards the Enterprise Social Commitment based on Public Hearing issues and item-wise details along with time bound action plan shall be prepared and submitted to the Ministry’s Regional Office. Implementation of such program shall be ensured accordingly in a time bound manner.

xxiv. An audit shall be done to ensure that the Environment Management Plan is implemented in totality and report shall be submitted to the Ministry’s Regional Office.

xxv. All personnel including those of contractors shall be trained and made fully aware of the hazards, risks and controls in place.

xxvi. Company shall have own Environment Management Cell having qualified persons with proper background.

xxvii. Company shall prepare operating manual in respect of all activities. It shall cover all safety & environment related issues and system. Measures to be taken for protection. One set of environmental manual shall be made available at the drilling site/project site. Awareness shall be created at each level of the management. All the schedules and results of environmental monitoring shall be available at the project site office.

B. GENERAL CONDITIONS:

i. The project authorities must strictly adhere to the stipulations made by the Gujarat Pollution Control Board (GPCB), State Government and any other statutory authority.
Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.

No further expansion or modification in the project shall be carried out without prior approval of the Ministry of Environment & Forest, in case of deviations or alterations in the project proposal from those submitted to this Ministry for clearance, a fresh reference shall be made to the Ministry to assess the adequacy of conditions imposed and to add additional environmental protection measures required, if any.

The project authorities must strictly comply with the rules and regulations under Manufacture, Storage and Import of Hazardous Chemicals Rules, 2000 as amended subsequently. Prior approvals from Chief Inspectorate of Factories, Chief Controller of Explosives, Fire Safety Inspectorate etc. must be obtained, wherever applicable.

The overall noise levels in and around the plant area shall be kept well within the standards by providing noise control measures including acoustic hoods, silencers, enclosures etc. on all sources of noise generation. The ambient noise levels shall conform to the standards prescribed under EPA Rules, 1989 viz. 75 dBA (day time) and 70 dBA (night time).

A separate Environmental Management Cell equipped with full fledged laboratory facilities must be set up to carry out the environmental management and monitoring functions.

A copy of clearance letter shall be sent by the proponent to concerned Panchayat, ZillaParishad / Municipal Corporation, Urban Local Body and the local NGO, if any, from whom suggestions / representations, if any, were received while processing the proposal. The clearance letter shall also be put on the web site of the company by the proponent.

The project proponent shall upload the status of compliance of the stipulated environment clearance conditions, including results of monitored data on their website and shall update the same periodically. It shall simultaneously be sent to the Regional Office of the MOEF, the respective Zonal Office of CPCB and the GPCB. The criteria pollutant levels namely, PM10, SO2, NOx, HC (Methane & Non-methane), VOCs (ambient levels as well as stack emissions) or critical sectoral parameters, indicated for the projects shall be monitored and displayed at a convenient location near the main gate of the company in the public domain.

The project proponent shall also submit six monthly reports on the status of the compliance of the stipulated environmental conditions including results of monitored data (both in hard copies as well as by e-mail) to the Regional Office of MOEF, the respective Zonal Office of CPCB and the GPCB. The Regional Office of this Ministry / CPCB / GPCB shall monitor the stipulated conditions. Environmental Clearance and six monthly compliance status reports shall be posted on the website of the company.

The environmental statement for each financial year ending 31st March in Form-V as is mandated to be submitted by the project proponent to the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently, shall also be put on the website of the company alongwith the status of compliance of environmental conditions and shall also be sent to the respective Regional Offices of the MOEF by e-mail.

The Project Proponent shall inform the public that the project has been accorded environmental clearance by the Ministry and copies of the clearance letter are available with the GPCB and may also be seen at Website of the Ministry of Environment and Forest at http://envfor.nic.in. This shall 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.
Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.

language of the locality concerned and a copy of the same shall be forwarded to the Regional office.

xi. Project authorities shall inform the Regional Office as well as the Ministry, the date of financial closure and final approval of the project by the concerned authorities and the date of commencing the land development work.

8.0 The Ministry may revoke or suspend the clearance, if implementation of any of the above conditions is not satisfactory.

9.0 The Ministry reserves the right to stipulate additional conditions if found necessary. The Company in a time bound manner shall implement these conditions.

10.0 The above conditions will be enforced, inter-alia under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, Air (Prevention & Control of Water Pollution) Act, 1981, the Environment (Protection) Act, 1986, Hazardous Waste (Management, Handling and Trans-boundary Movement) Rules, 2008 and the Public Liability Insurance Act, 1991 along with their amendments and rules.

11.0 Environmental Clearance is issued to M/s Bharat Petro Resources Ltd for onshore oil and gas exploration in Block CB-ONN-2010/8., in NELP, Cambay Basin, located in the common boundary of Ahmedabad, Kheda, and Gandhinagar Districts, Gujarat.

(Lalit Bokolia)
Additional Director

Copy to:
1. The Principal Secretary, Forest & Environment Department, Government of Gujarat, Sachivalaya, 8th Floor, Gandhinagar - 382 010, Gujarat.
2. The Chief Conservator of Forest (Western Zone), Ministry of Environment, Forest and Climate Change, Regional Office, E-6, Anara Colony, Link Road - 3, Bhopal - 462 016, M.P.
3. The Chairman, Central Pollution Control Board Parivesh Bhavan, CBD-cum-Office Complex, East Arjun Nagar, New Delhi - 110 032.
4. The Chairman, Gujarat State Pollution Control Board, Paryavaran Bhawan, Sector 10 A, Gandhi Nagar-382 043, Gujarat.
5. Monitoring Cell, Ministry of Environment, Forest and Climate Change, Indira Paryavaran Bhavan, Jor Bagh, New Delhi.

(Lalit Bokolia)
Additional Director
ANNEXURE 6: PREVIOUS CONSENT TO ESTABLISH

GUJARAT POLLUTION CONTROL BOARD
PARYAVARAN BHAVAN
Sector-10-A, Gandhinagar-382 010
Phone : (079) 23226295
Fax : (079) 23232156
Website: www.gpcb.gov.in

NOTICE:

TO:
Mr. S. Bharat Petro Resources Ltd.
Survey No. 879,
Nelp 2, block-ch-orn-2010/8,
VII-Karoli,
Tal-Delegam, Dist-Gandhinagar.

SUB: Consent to Establish (NOC) under Section 25 of Water Act 1974 and Section 21 of Air Act 1981.

REF: Your application No. 98774, dated 03/01/2015.

Sr. No. Well Location Latitude Longitude Tentative Location
1 Location-1 23° 02' 46.46" N 72° 48' 09.75" E VII-Karoli, Tal-Delegam, Dist-Gandhinagar

CONSIDERATION WATER PREVENTION AND CONTROL OF POLLUTION ACT- 1974:
1. The quantity of the industrial effluent to be generated from the manufacturing process and other auxiliary operations shall not exceed 1500 LMDay.
2. The quantity of the chemical and other auxiliary operations shall not exceed 1500 LMDay.
3. The safety of the domestic waste water (sewage) shall not exceed 11000 Liters/Day.
4. Sewage shall be disposed off by septic tank/tank pit system.

Clean Gujarat Green Gujarat
GENERAL CONDITION:

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

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

15. In case of change of ownership/managements the name and address of the new owners/partners/directors/proprietors should immediately be intimated to the Board.

16. The applicant shall however, not without the prior consent of the Board bring into use any new or altered outlet for the discharge of effluent or gaseous emissions or sewage waste from the proposed industrial plant. The applicant is required to make applications to this Board for this purpose in prescribed forms under the provisions of the Water (Prevention and Control of Pollution) Act-1974, the Air (Prevention and Control of Pollution) Act-1981 and the Environment (Protection) Act-1986.

17. The concentration of Noise in ambient air within the premises of industrial unit shall not exceed following levels:
   - Between 8 A.M. and 10 P.M.: 75 dBA
   - Between 10 P.M. and 6 A.M.: 70 dBA


19. If it is established by any competent authority that the damage is caused due to these industrial activities to any person or his property, in that case, they are obliged to pay the compensation as determined by the competent authority.

20. The applicant shall not carry out any activities or projects listed in schedule of the new EPA Notification dated 14/09/01 requiring prior Environment Clearance.

For and on behalf of
Gujarat Pollution Control Board

(Signed)
Senior Environment Engineer
ANNEXURE 7: PUBLIC HEARING PROCEEDINGS

Gujarat Pollution Control Board
Regional Office,
c/o Paryavaran Bhavan, Sector -10A, Gandhinagar – 382 010
Website: www.gpcb.gov.in

PUBLIC HEARING PROCEEDINGS

As per the provision of notification S.O. 1533 dated 14th September, 2006 and its subsequent amendments S.O. 3067(E) dated 1st December, 2009, Issued by the Ministry of Environment and Forests & Climate Change, Government of India, New Delhi, Public Hearing was conducted for the proposed Project of M/s Bharat PetroResources Limited for Conversion of one exploratory well to development well, drilling of 2 development wells for production & construction of quick production facility at Pasunia #01 (PA#01), Survey No.- 868, 876, 879, 880, 881,882, 883 and 817 P Village – Karoli, Ta: Dehgam, Gandhinagar, (Part of project located in Gandhinagar districts) which is covered under “Category A” of the schedule 1(b) of the above referred notification.

A copy of the draft Environment Impact Assessment Report and the Summary of Environment Impact Assessment Report were sent to the following authorities or offices to make available the draft EIA report for inspection to the public during normal office hours, till the Public Hearing is over.

1. The District Collector Office, Gandhinagar
2. District Development Office, Gandhinagar
3. District Industry Centre, Dist. Gandhinagar
5. The Chief Conservator of Forests, Ministry of Environment and Forest, GOI, Regional Office (West Zone), Kendriya Paryavaran Bhavan, E-5, Arera Colony, Link Road-3, Ravisankar Colony, Bhopal - 462016.

Other concerned persons having plausible stake in environmental aspects were requested to send their responses in writing to the concerned regulatory authorities.

The Public Hearing was scheduled on 29/01/2019 at 12:00 hrs. at M/s Bharat PetroResources Limited Pasunia #01 (PA#01), Survey No.- 868, 876, 879, 880, 881,882, 883 and 817 P Village – Karoli, Ta: Dehgam, Gandhinagar, (Gujarat).

An advertisement in English was published in “Indian Express” dated 28/12/2018 and in Gujarati language in “Nav Gujarat Samay” dated 28/12/2018.

Shri S.K. Langa, IAS, Collector and District Magistrate, Gandhinagar supervised and presided over the entire public hearing proceedings.

A statement showing participants present during the public hearing is enclosed as Annexure A.
A statement showing salient point highlighting issues raised by the participants and responded by the representative of the applicant during the public hearing in English Language is enclosed as Annexure-B and in Gujarati Language is enclosed herewith as Annexure B1.

The Copies of responses received in writing during public hearing environmental aspects is enclosed as Annexure C-Q-1 to C-Q-5 and the replies by the project proponent to the same are enclosed here with as and Annexure C-A-1 / (1 to 5) in English and C-A-2 / (1 to 5) in Gujarati.

Place: Karoli, Ta.: Dehgam, Dist.: Gandhinagar
Date: 29/01/2019

D. C. Vankani
Regional Officer,
GPCB, Gandhinagar as representative of the Member Secretary, GPCB

S. K. Langa, IAS
Collector and District Magistrate,
Gandhinagar

Encl: 1 Annexure A, B, B1, C-Q-1 to C-Q-5 and C-A-1 / (1 to 5), C-A-2 / (1 to 5) as above.
2 Video DVD of public hearing
Gujarat Pollution Control Board
Regional Office,
C/o. Paryavaran Bhavan, Sector -10A, Gandhinagar - 382 010
Website: www.gpoch.gov.in

ANNEXURE – A

A Statement Showing Present During the Public Hearing

As per the provision of notification S.O. 1533 dated 14th September, 2006 and its subsequent amendments S.O. 3067(E) dated 1st December, 2009, Issued by the Ministry of Environment and Forests & Climate Change, Government of India, New Delhi, Public Hearing Scheduled the proposed Project of M/s Bharat PetroResources Limited for Conversion of one exploratory well to development well, drilling of 2 development wells for production & construction of quick production facility at Pasunia #01 (PA#01), Survey No.- 868, 878, 879, 880, 881,882, 893 and 817 P Village – Karoli, Ta: Dehgam, Gandhinagar, (Part of project located in Gandhinagar districts) " which is covered under "Category A" of the schedule 1(b).

The statement showing Participants present during Public Hearing held on 29th January 2019, at at Pasunia #01 (PA#01), Survey No.- 868, 878, 879, 880, 881,882, 893 and 817 P Village – Karoli, Ta: Dehgam, Gandhinagar, at 12:00 Hrs. is as under:

Bharat PetroResources Limited, Ahmedabad, Gujarat, India

Participants:

1. M/s ABC Techno Labs India Pvt. Ltd.

Address: ABC Techno Labs India Pvt. Ltd.

联系方式: +91-9898989898

注意: 上述信息可能需要进一步确认，以确保其准确性和完整性。
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*Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd.*
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ANNEXURE – B (English)
A statement showing issues raised by the participants and responses by the representative of the applicant during the public hearing

As per the provision of notification S.O. 1533 dated 14th September, 2006 and its subsequent amendments S.O. 3067(E) dated 1st December, 2009, Issued by the Ministry of Environment and Forests & Climate Change, Government of India, New Delhi, Public Hearing was conducted for the proposed Project of Bharat PetroResources Limited for Conversion of one exploratory well to development well, drilling of 2 development wells for production & construction of quick production facility at Pasunia #01 (PA#01), Survey No. - 868, 878, 879, 880, 881,882, 883 and 817 P Village – Karoli, Ta: Dehgam, Gandhinagar, (Part of project located in Gandhinagar districts) * which is covered under "Category A" of the schedule 1(b) of the above referred notification.

Public Hearing has been conducted 29/01/2019 at 12:00 PM at M/s Bharat PetroResources Limited Pasunia #01 (PA#01), Survey No. - 868, 878, 879, 880, 881,882, 883 and 817 P Village – Karoli, Ta: Dehgam, Gandhinagar, (Gujarat).

Shri S. K. Langa, IAS, Collector and District Magistrate, Gandhinagar supervised and presided over the entire public hearing proceedings.

Shri D. C. Vankani, Regional Officer, GPCB, Gandhinagar and representative of the Member Secretary, GPCB welcomed all present in the Public Hearing. He outlined the various provisions of the Notification and briefed the procedural details for conducting this public hearing including the actions taken by GPCB for vide publicity of this public hearing including the advertisement given earlier in the local daily in English newspaper "Indian Express" dated 28/12/2018 and in Gujarati language in "Nav Gujarat Samay" dated 28/12/2018. He announced that as per the provision of Notification, only locally affected persons will be allowed to represent in the public hearing while others having plausible stake holders may give their representation in writing which would be included in the proceedings.

He then opened the Public Hearing forum after the due permission from Collector and District Magistrate. He invited the project proponent to give their introduction and to make the presentation of their project in local vernacular language i.e. Gujarati.

Mr. Sachin Kajrolkar representative of project proponent welcomed the gathering. Thereafter a power point presentation in local language i.e. Gujarati covering introduction of company, salient features of the project, technical details of proposed project, safety precautions, Environmental Management System, its impact on environment along with proposed mitigation measures and industry’s corporate environmental responsibilities was presented by Ms. Sneha Makwana from ABC Technolabs (Environmental consultant).
Gujarat Pollution Control Board
Regional Office,
C/o. Paryavaran Bhavan, Sector -10A, Gandhinagar - 382 010
Website: www.gpcb.gov.in

After the completion of presentation, Shri D.C. Vankani, Regional Officer, GPCB, Gandhinagar and Representative of member Secretary, GPCB with the due permission of the Collector and District Magistrate declared forum open for representations/ suggestions/ objections/questions from the participants present during the public hearing.

The statement showing issues/ suggestions/ objections/ opinions rose verbally by the participants and responded to by the representative of the Project Proponent during the Public Hearing are as under:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name and Address</th>
<th>Points Represented</th>
<th>Remarks</th>
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</table>
| 1       | Shri Ashokbhai Gohilbhai Patel, Village Karoli, Ta. Dehgam, Dist. Gandhinagar | • The bore well water seems reddish, at present the crop is damaged.  
• Villagers wanted to know about the explosion done inside the oil well and its effects? It was felt like earthquake. | • Respected District Magistrate suggested bore well water sample will be checked by Gujarat Pollution Control Board (GPCB) officer to assess the probable reason.  
• Project proponent replied that subject explosion is required to be done to make perforations inside well at around 1500 m below the ground level to take the subsurface oil out. BPRL confirmed that there are no adverse effects of the subject explosion done and the effect was momentarily. |
| 2       | Shri Gopal Thakar Principal, Karoli High school, Village Karoli, Ta. Dehgam, Dist. Gandhinagar | • The adjacent land to be converted in play ground for school. | • Respected District Magistrate informed to get the matter proposed in gram panchayat meeting. |
### Gujarat Pollution Control Board
Regional Office,
C/o. Paryavaran Bhavan, Sector -10A, Gandhinagar – 382 010
Website: [www.gpcb.gov.in](http://www.gpcb.gov.in)

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| 3.      | Shri Bareyan Rajeshkumar Pikaji, Village Kodrali, Ta. Dehgam, Dist. Gandhinagar | - There is no street light facility in village and no playground facility for Kodrali primary school. The school building is very old. It is requested to make school 2 storied and play ground to be provided.  
- Street lighting is also required at Chaturpura. | Respected District Magistrate informed to take up the matter to sarpanch since the necessary funds are made available to sarpanch as the grants of 13th and 14th commissions are made available to sarpanch. Also it was informed to give the applications to Dehgam TDO. |
| 4.      | Shri Vishnubhai Umarsibhai Village: Karoli, Ta. Dehgam, Dist. Gandhinagar | - Is there any solution for wild boars digging our fields? | Respected District Magistrate informed to take up the matter to forest department. |
- There are nearby 3000 nilgai, roz and 500-600 wild boars in karoli village staying in nearby Meshvo river. | Respected District Magistrate informed to take up the matter to forest department. |
<p>| 6.      | Shri Mahendrabhai Ramabhai Patel, | - When land is given for project how is it compensated? Is it at the beginning phase (drilling, exploration, testing period) of | BPRL informed that, |</p>
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<td>Shri Kirankumar</td>
<td>• It was informed that the mud generated during drilling activities is kept at site and the dust from the dried mud kept is flying into their houses.</td>
<td>• Respected District Magistrate informed that GPCB will take the action accordingly.</td>
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</table>

District Magistrate has asked Project Proponent and EIA consultant to brief about the Environment Impact Assessment of the proposed project to the villagers. EIA consultant briefed that during drilling there are minor waste generated however since, this nature of job generates less pollutants and the spread is confined within the well location only, the impact on sand, air and water in the vicinity is minuscule. Waste water generated during drilling activities will be treated in the mobile ETP at the site itself. Waste water will be discharged after confirming to its permissible limits of discharge contest and based on the permission granted by the GPCB. Project proponent has explained that only water based mud (WBM) is used for the drilling activities and no other chemical based mud has been used at well site, which is non-hazardous in nature. Drill cuttings and mud are stored in HDPE lined pits for solar evaporation and disposed off through waste management agencies as per govt. guidelines. It was also explained that during the previous exploration campaign, the liquid waste was disposed at Common Effluent treatment Plant at M/s ABC Techno Labs India Pvt. Ltd.
Gujarat Pollution Control Board
Regional Office,
C/o. Paryavaran Bhavan, Sector -10A, Gandhinagar - 382 010
Website: www.gpcb.gov.in

Odhav Enviro Project Limited and Solid wastes are disposed at M/s Saurashtra Enviro Project Pvt. Limited.

District Magistrate has asked from the project proponent that whether any (Group Gathering Station) GGS is planned in the project? Project proponent has explained that there is no GGS planned for the proposed project being small production prospects however it is planned as Quick Production Facility (QPF) for the production and produced oil will be transported through tank lorries to nearby ONGC Central Tank Facility at Navagam, Ahmedabad.

District Magistrate has suggested that CSR / CER activities to be conducted as per need basis of local people and activities may be taken up by project proponent as a part of CSR / CER initiatives by project proponent.

Regional officer, Gujarat Pollution Control Board, informed that there is no written intimation related to subject public hearing has been received from environmental bodies. All written queries received during the hearing have been taken up with the minutes.

The public hearing was ended with thanks to the chair.

Place: Karoli, Ta.: Dehgam, Dist.: Gandhinagar
Date: 29/01/2019

D. C. Vankani
Regional Officer,
GPCB, Gandhinagar as representative of the Member Secretary, GPCB

S. K. Langa, IAS
Collector and District Magistrate, Gandhinagar
PUBLIC HEARING PROCEEDING

As per Ministry of Environment, Forest and Climate Change, Government of India, New Delhi vide its Notification No. S.O. 1533 dated September 14, 2006 and subsequent amendment S.O. 3067 (E) dated 1st December 2009, Public hearing is conducted for proposal of M/s. Bharat Petro Resources Ltd. for Conversion of 1 exploratory wells to development wells, Drilling of 6 development wells for production and construction of Quick Production Facility (QPS), at PA#62-'214', '215A', '215B', '141/P', '139', Village – Kuha, Ta-Daskroi, Dist – Ahmedabad. Covered under Category "A" which is covered under category-A of the schedule 1(b) as mentioned in their request application.

A copy of the draft Environment Impact Assessment report and Summary of Environment impact Assessment Report were sent to the following authorities to make available the draft EIA Report for inspection to the public during normal office hours, till the public Hearing is over.

1. The District Collector Office, Ahmedabad.
3. District Industry Center, Ahmedabad.
5. The Chief Conservator Of Forest Ministry Of Environment & Forest Government of India Regional office( West zone), Kendriya Paryavaran Bhavan, E-5 Area Colony, Link Road-3, Ravishankar Colony, Bhopal 462 016.
6. Regional Office, Gujarat Pollution Control Board, Ahmedabad (East) Ground Floor, Shop No 1, Om Shanti Nagar 3+, Near Devimata Temple, Village Vatva, Tal: Daskroi, Dist. Ahmedabad.

Other concerned persons having plausible stake in the environment aspects were requested to send their response in writing to the concerned regulatory authorities.

The Public hearing was scheduled on 02/02/2019 at 14:00 Hrs at Exploratory Well site of M/s. Bharat Petro Resources Ltd Survey No. 214 Village – Kuha, Ta-Daskroi, Dist – Ahmedabad.

An advertisement in English was published in “Indian Express” and in Gujarati in “Navgujarat Samay” dated 28/12/2018.

C. M. Trivedi, Additional Collector & Additional District Magistrate, Ahmedabad as representative of District Collector and District Magistrate, Ahmedabad has Supervised and presided over the entire public hearing process.

A Statement showing participants present during the public hearing is enclosed as Annexure A.
Annexure-A

As per provision Notification Showing Participants Present during the Public Hearing


The Statement showing participants present during the Public Hearing held on 02/02/2019 at 14:00 Hrs. Well site of M/s. Bharat Petro Resource Ltd Survey No. 214 Village – Kuha, Ta:- Daskoi, Dist – Ahmedabad.

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*ABC Techno Labs India Pvt. Ltd.*  
*Page 412*
| Environmental Impact Assessment Report for proposed Onshore Oil and Gas development and production activities in the Block CB-ONN-2010/8, Cambay, Gujarat by M/s Bharat PetroResources Ltd. |
| ABC Techno Labs India Pvt. Ltd. | Page 413 |
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ABC Techno Labs India Pvt. Ltd.
ANNEXURE - B (English)

A statement showing issues raised by the Participants and responses by the representative of the applicant during the Public Hearing

As per the provision of Notification No.S.O.1533 dated 14th September, 2006 and its subsequent amendment S.O. 3067 (E) dated 1st December, 2009, issued by the Ministry of Environment and Forests & Climate Change, Government of India, New Delhi, Public Hearing was conducted by M/s. Bharat Petro Resource Ltd. for: Conversion of 1 exploratory wells to development wells, Drilling of 6 development wells for production and construction of Quick Production Facility (QPS), at PA#62-‘214’;’215A’;’215B’, ‘141/P’, ‘139’, Village – Kuha, Ta- Daskroi, Dist – Ahmedabad, covered under “Category A” of the schedule 1(b).

The Public hearing was scheduled on 02/02/2019 at 14:00 Hrs at Exploratory Well site of M/s. Bharat Petro Resource Ltd Survey No. 214 Village – Kuha, Ta- Daskroi, Dist – Ahmedabad.

Shri C. M. Trivedi, Additional District Magistrate, Ahmedabad supervised and presided over the entire public hearing proceedings.

Shri T. B. Shah, Regional officer, GPCB, Ahmedabad (East) and representative of the Member Secretary, GPCB; welcomed all present in the Public Hearing. He outlined the various provisions of the Notification and briefed the procedural details for conducting this public hearing including actions taken by GPCB vide publicity of this public hearing including the advertisement given earlier in the local daily English newspaper “Indian Express” dated 28/12/2018 and in Gujarati “Gujarat Samay” dated 28/12/2018. He announced that as per the provision of Notification, only locally affected persons will be allowed to represent in the public hearing while others having plausible stake holders may give their representation in writing which would be included in the proceedings.

He then opened the Public Hearing forum after due permission from Additional District Magistrate and Chairman. He invited the project proponent to give their introduction and to make the presentation of their project in local vernacular language i.e. Gujarati.

Mrs. Shneha Makwana – representative of project proponent welcomed the gathering and made power point presentation in local language i.e. in Gujarati covering technical information, detail of proposed project, safety precautions, Environmental Management System, its impact on environment along with proposed mitigation measures and industry’s corporate social responsibilities.

After the completion of presentation, Shri T. B. Shah, Regional Officer, GPCB, Gandhinagar and Representative of member Secretary, GPCB with the due permission of the Chairman declared forum open for representations/ suggestions/ objections/questions from the participants present during the public hearing.

The statement showing issues/ suggestions/ objections/ opinions rose verbally by the participants and responded to by the representative of the Project Proponent during the Public Hearing are as under:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name and Address</th>
<th>Point Represented</th>
<th>Replies from Project Proponent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Bariya Ambalal Galabji</td>
<td>• New Road to be Build from Chara ni muvadi to khatwadi and what will be the affect on ground water for</td>
<td>* Representative of project proponent having informed that for the proposed well drilling of the approximately 2000 to 2200 mt. drilling will be done by the metal pipe which will take out the</td>
</tr>
<tr>
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</tr>
<tr>
<td>--------</td>
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</tr>
<tr>
<td>2.</td>
<td>Bholaji Mathurji</td>
<td>Agriculture and</td>
<td>Underground crude directly on to the surface and from there it will be transfer to respective tanks. So that during the drilling work no any underground water will be affected. The mud generate during the drilling work will be stored in dig which is covered with plastic liners it will be ultimately send to the disposal site as decided by Gujarat Pollution Control Board.</td>
</tr>
</tbody>
</table>
• We have made many representation regarding pollution of this area but no any solution came out.  
• Regarding concrete road the written representation, also receive from sarpanch of kucha gram Panchayat. | |
<p>| 3.     | Girish Bhai Ambalal Patel, Vil. Kucha, Ta. Daskroi, Dis. Ahemdabad. | Bharat Petroresources Limited is Doing well drilling work in our agriculture land so we want a increase in rent. | Project proponent informed that for the exploratory work of drilling of wells up to next November and the agreement is done with the land owner. After the drilling will be started and long term agreement will be fixed with mutually agreed rate. Project proponent also informed that they would discuss the matter with the company. |
| 4.     | Kanaji Amraji Bariya, Vil. Kucha, Ta. Daskroi, Dis. Ahemdabad. | Earlier I was having 2 hectar land which I have given to Bharat PetroResources Limited for the drilling of wells so I don’t have | Project proponent informed that, from last 10 month there was no any activity on this proposed site. When the drilling and development of the proposed exploratory well will be started we will give first preference for the |</p>
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<td>5</td>
<td>Makaji Valaji Bariya Vil. Charani Mavadli, Ta. Daskroi, Dis. Ahmedabad.</td>
<td>any land so I am requesting Bharat Petroresources Limited give me a security job at this site.</td>
<td>employment to the village based on the skill possessed.</td>
</tr>
</tbody>
</table>

Regional Officer, Gujarat Pollution Control Board, informed the forum that no any written representation received before public hearing.

Additional District Collector has stated that environment impact due to the proposed project must be controlled & minimize as per the norms and employment of local public must be fulfilled. Project Proponent has given detailed description of project during public hearing. The project proponent will take care that no adverse environment impact will be occurred, if it is followed as proposed in the report.

The public hearing was ended with thanks to the chair.

Place: Kaha  
Tal: Daskroi  
Dist: Ahmedabad  
Date: 02/02/2019

(T.B. Shah)  
Regional Officer,  
Gujarat Pollution Control Board,  
Ahmedabad (East)  
As Representative of  
Member Secretary  
Gujarat Pollution Control Board

(C.M. Trivedi)  
Additional District Magistrate,  
Ahmedabad  
Representative of  
District Magistrate, Ahmedabad