**CHAPTER FIVE**

**POTENTIAL IMPACT ASSESSMENT AND MITIGATION MEASURES**

**5.1 General**

The key objective of an EIA is to predict changes (adverse or beneficial, whole or partial) in the ecological and socio-economic environment resulting from a proposed development project or activity as well as recommend mitigation measures to minimise, eliminate or offset those aspects that will adversely impact on the environment.

The assessment approach generally involves matching the various activities of the proposed project (as described in chapter 3 of this report) with the components of the existing environment. Consequently, the interaction may lead to changes in or impacts on the environment, hence mitigation measures are proffered in order to reduce, offset or ameliorate such changes. The assessment of the potential and associated impacts of the proposed Yoho Area Development Wells Drilling Project as well as the mitigation measures required for reducing the identified significant and residual impacts to as low as reasonably practicable is presented hereunder.

**5.2 Impact Assessment Methodology**

The pathway followed in the identification/assessment and evaluation of the potential and associated impacts of the proposed project is illustrated in the **Figure 5.1** below.

**Project activities**

**Checklist of impacts**

Environmental Aspects / Impacts Identification

**Baseline data**

**Characterise impacts as adverse, beneficial, short term, long term, residual, etc**

Impact Characterisation

**FMENV / DPR Guidelines**

**High, medium and low significant impacts**

**World Bank Guidelines**

Impact Significance Analysis

**Other International Standards**

Impact Mitigation Measure

**ExxonMobil SHE Policy**

Environmental Management Plan

**Figure 5.1: Impact Assessment Pathway**

Details of the process are discussed in **sections 5.2.1 – 5.3** while the results are presented thereafter in **Table 5.2**.

**5.2.1 Impact Identification**

The environmental aspects of the proposed project were teased out from the planned project activities description (**Chapter 3**). These aspects were then matched with the existing baseline description of the project environment (**Chapter 4**) and used to develop a checklist of potential and associated impacts of the proposed project (**see Table 5.1**). The development of the checklist was carried out using the FMENV EIA Sectoral Guidelines for Oil and Gas Industry Projects, the World Bank Environmental Assessment Source Book, Volume 111 (Guidelines for Environmental Assessment of Energy and Industrial Projects, 1991).

Other source references include ExxonMobil SHE Policy and other relevant international standard codes in oil and gas field development projects.

**5.2.2 Impact Characterisation**

The identified impacts of the proposed project were further characterised as explained in the bulleted items below. The characterisation was based on the nature, characteristics and duration of the various project activities on the ecological components of the marine environment as well as human health and safety as necessary.

*Impact Characterisation*

|  |  |
| --- | --- |
| **Impact Characterisation** | **Definition**  |
| Beneficial Impacts | Impacts that would produce an overall positive effect on the well-being of the people as well as the environment.  |
| Adverse Impacts | Impacts that may result in:* irreversible and undesirable change(s) in the biophysical environment;
* decrease in the quality of the biophysical environment;
* limitation, restriction or denial of access to or use of any component of the environment to others, including future generations; and
* sacrifice of long term environmental viability or integrity for short term economic goals
 |
| Direct Impacts | Impacts resulting directly (direct cause-effect consequence) from a project activity |
| Indirect Impacts | Impacts that are at least one step removed from a project activity. They do not follow directly from a project activity. |
| Normal Impacts | Impacts that will normally be expected to follow a particular project activity |
| Abnormal Impacts | An impact is considered to be abnormal when it follows a project activity as against sound predictions based on experience |
| Short-term Impacts | Impacts that will last only within the period of a specific project activity. |
| Long-term Impacts | Impacts whose effects remain even after a specific project activity. |
| Reversible Impacts | Impacts whose effects can be addressed on application of adequate mitigation measures |
| Irreversible Impacts | Impacts whose effects are such that the subject (impacted component) cannot be returned to its original state even after adequate mitigation measures are applied |
| Cumulative Impacts | Impacts resulting from interaction between ongoing project activities with other activities, taking place simultaneously |
| Incremental Impacts | Impacts that progress with time or as the project activity proceeds. |
| Residual Impacts | Impacts that would still remain after mitigation measures have been applied |

**5.2.3 Impact Evaluation**

At this stage, the potential and associated impacts identified and characterised in the previous stage of the assessment process (**sections 5.2.1 – 5.2.2**) were evaluated. The evaluation which was based on clearly defined criteria (legal / regulatory requirement, risk, frequency of occurrence, importance and public Interest / concern) was used to determine the significances or otherwise of the impacts. The criteria and weighing scale adopted for the evaluation are described below.

***Legal/Regulatory Requirements (L)***

Here, the proposed project activities that resulted in impacts were weighed against existing legal / regulatory provisions to determine the requirement or otherwise for permits prior to the execution of such activities. Such legal/regulatory requirements were identified from the laws/guidelines, which have been reviewed in opening chapter of this report as well as those guidelines in the source references relating to the proposed project activity as presented in **section 5.2** and **subsection 5.2.1**. The weighting scale used was as follows:

*Legal/Regulatory Requirements Criterion*

|  |  |
| --- | --- |
| **Condition** | **Rating** |
| No legal / regulatory requirement for carrying out project activity | **Low** |
| Legal / regulatory requirement exist for carrying out activity | **Medium** |
| A permit is required prior to carrying out project activity which may result in impact on the environment | **High** |

***Risk Posed by Impact (R)***

The health, safety and environmental risks associated with each impact were assessed and ranked as “low”, “medium” or “high”, using the Risk Assessment Matrix (RAM). Reference was also made to the source references listed in the previous sections. Three criteria (consequence, probability of occurrence and severity) were used as basis for ranking the risks of the impacts. These were determined using the RAM as shown in **Figure 5.2**.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | A | B | **C** | **D** | **E** |
| **I** |  |  |  |  |  |
| **II** |  |  |  |  |  |
| **III** |  |  |  |  |  |
| **IV** |  |  |  |  |  |

Probability

|  |  |
| --- | --- |
| **Probability****Consequences****Category** | **Definition** |
| A | Possibility of Repeated Incidents |
| **B** | Possibility of Isolated Incidents |
| **C** | Possibility of Occurring Sometime |
| **D** | Not Likely to Occur |
| **E** | Practically Impossible |

|  |  |
| --- | --- |
| **Consequence Category** | **Considerations** |
| **Safety / Health** | **Public Disruption** | **Environmental Aspects**  | **Financial Aspects** |
| **I** | Fatalities / Serious Impact on Public | Large Community | Major/Extended Duration/Full Scale Response | **High** |
| **II** | Serious Injury to Personnel / Limited Impact on Public | Small Community | Serious / Significant Resource Commitment | **Medium**  |
| **III** | Medical Treatment for Personnel / No Impact on Public | Minor | Moderate / Limited Response of Short Duration | **Low** |
| **IV** | Minor Impact on Personnel | Minimal to None | Minor / Little or No Response Needed | **None** |

**Figure 5.2: Risk Assessment Matrix**

The risks (measure of the likelihood and magnitude of an adverse effect) associated with offshore oil and gas exploration operations were evaluated in terms of:

* risk to human health;
* risk to asset (commercial and economic risk);
* risk to the biophysical environment; and
* risk to the ExxonMobil’s reputation.

Based on the matrix above, the weighting used was as follows:

*Risk Criterion*

|  |  |
| --- | --- |
| **Risk** | **Attribute – Environmental, Human Health, Safety and Reputation** |
| **Low** | * This means that no further mitigation may be required
 |
| **Medium** | * This means that the impact can be mitigated with additional controls and modifications
 |
| **High** | * This means that the impact require avoidance or major control/mitigation
 |

***Frequency of Impacts Occurrence (F)***

Evaluation of the frequency of occurrence of each impact was also carried out. Frequency of occurrence was rated as “high”, “medium” or “low” based on the historical records of accidents/incidents, consultation with experts and professional judgment. The frequency criterion is summarised below.

*Frequency Criterion*

|  |  |
| --- | --- |
| **Frequency** | **Attribute – Environmental, Human Health and Safety** |
| **High** | * Major degradation in quality in terms of scale (>1% of study area or habitat within the study area), appearance, duration (beyond duration of project)
* Irreversible or only slowly recoverable (change lasting more than 1 year) degradation of environmental ecosystem level (population, abundance, diversity, productivity)
* High frequency of impact (occur continuously and almost throughout the project execution period (< 4months)
* Geographic extent of impact (e.g. encompassing areas beyond Yoho field)
 |
| **Medium** | * Degradation in quality in terms of scale (>0.1% of study area, habitat), appearance, duration (a few months)
* Effect beyond naturally occurring impacts variability
* Slow reversibility (change lasting a few months before recovery), lasting residual impact
* Potential for cumulative impact
* Intermittent frequency of impact (occur in only a few occasions during the project execution period)
* Limited geographic extent of impact (large area within Yoho field)
 |
| **Low** | * Minor degradation in quality in terms of scale (<0.1% of study area, habitat, very localized), appearance, duration (a few days to a month)
* Effect within range of naturally occurring impacts, changes, dynamics
* Rapid reversibility (change lasting only a few weeks before recovery), no lasting residual impact of significance
* No potential for significant cumulative impact
* Low frequency of impact (occur in just about one occasion during the project execution period)
* Only very localized geographic extent of impact (e.g. not more than a few meters from impact source point)
 |

***Importance of Impact (I)***

The importance of target environmental component in respect of identified potential impact was also determined and rated as “high”, “medium” or “low”. The ratings were based on consensus of opinions among consulted experts including project engineers and other stakeholders in the proposed project. The importance criterion is summarised below.

*Importance Criterion*

|  |  |
| --- | --- |
| **Importance** | **Attribute – Environmental, Human Health and Safety** |
| **High** | * Highly undesirable outcome (e.g., impairment of endangered, protected habitat, species)
* Detrimental, extended flora and fauna behavioral change (breeding, spawning, molting)
* Major reduction or disruption in value, function or service of impacted resource
* Impact during environmentally sensitive period
* Continuous non-compliance with international best practices
 |
| **Medium** | * Negative outcome
* Measurable reduction or disruption in value, function or service of impacted resource
* Potential for non compliance with international best practices
 |
| **Low** | * Imperceptible outcome
* Insignificant alteration in value, function or service of impacted resource
* Within compliance, no controls required
 |

***Public Interest/Perception (P)***

Here, the interest / perception of the public on the proposed project and the identified potential / associated impacts were determined through consultation with proposed project stakeholders. The ratings of “high”, “medium” or “low” were assigned based on consensus of opinions among consulted known stakeholders. The public perception / interest criterion is summarised below.

*Public perception /interest criterion*

|  |  |
| --- | --- |
| **Public Perception** | **Attribute – Environmental and Human Health** |
| **High** | * Elevated incremental risk to human health, acute and / or chronic
* Possibility of life endangered for on-site personnel
* Continuous non-compliance with international best practices
* Any major public concern among population in the project region
 |
| **Medium** | * Limited incremental risk to human health, acute and / or chronic
* Unlikely life endangered for on-site personnel
* Possibility of adverse perception among population
* Potential for non-compliance
 |
| **Low** | * No risk to human health, acute and / or chronic
* No possibility of life endangered for on-site personnel
 |

**5.3 Result of Impact Assessment**

The results of the impact assessment exercise as discussed in the previous sections are presented in **Table 5.1**. The table presents the various project phases, planned project activities, the environmental aspects of the proposed project as well as the identified associated and potential impacts. Also included in the table are impact significance evaluation criteria:(legal/regulatory requirements (**L**), risk posed by impact (**R**), frequency of occurrence (**F**), importance of affected environmental component (**I**) and public perception (**P**). In addition, the overall ratings of impact significance (**High** or **Medium** or **Low**) of each impact considered have been included. The overall significance ratings were based on the following considerations:

* **High Significance** = >4 individual high ratings or 5 medium ratings.
* **Medium Significance** = 3 individual high ratings or 4 medium ratings.
* **Low Significance** = <2 individual high ratings.

**Table 5.1: Potential and Associated Impact Assessment of the Proposed Yoho Development Wells Drilling Project**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Project Activities** | **Associated and Potential Impact** | **Impact Categorisation** | **Impact Significance Evaluation** | **Significance Ranking** |
| **Legal Requirements (L)** | **Risk (R)** | **Frequency (F)** | **Importance (I)** | **Perception (P)** |
| **Logistics (Mobilisation/ Demobilisation** | Vessels to Site | Interference with marine transport and fishing activities within project area and along project route | Direct, adverse, reversible, short term | 0 | Med (3) | Med (3) | Med (3) | Med (3) | Medium (13) |
| Accidental collision of survey vessel with existing infrastructure (platform) leading to asset damage injury/death to/of personnel | Indirect, adverse, reversible, irreversible, short term | Med (3) | High (5) | Low (1) | Med (3) | Low (1) | Medium (13) |
| Collision with other vessels and smaller boats during adverse weather conditions resulting in injury/death of personnel and assets | Direct, adverse, reversible, short term | Low (1) | High (5) | Low (1) | High (5) | Med (3) | High (15) |
| Risk of pirate /militant attack/kidnap leading to trauma/injury or death of personnel and loss of revenue | Indirect, adverse, reversible, irreversible, short term |  (0) | High (5) | High (5) | High (5) | Med (3) | High (18) |
| Exhaust emissions from vessel engines contributing to greenhouse gas global warming agents | Direct, adverse, irreversible, cumulative, long term, short term | Low (1) | Low (1) | Med (3) | Med (3) | Low (1) | Low (9) |
| Loss of employment/disengagement of casual workers | Direct, adverse, irreversible, short term | Low (1) | Med (3) | Med (3) | High (5) | High (5) | High (17) |
| Rig Movement | Interference with vessels/boat traffic and fishing activities along mobilisation route | Direct, adverse, reversible, short term | 0 | Med (3) | Med (3) | Med (3) | Med (3) | Medium (13) |
| Disturbance of aquatic organisms along mobilisation route | Direct, adverse, reversible, short term | (0) | Low (1) | Low (1) | Med (3) | Med (3) | Low (8) |
| Collision and damage to existing offshore oil/ gas facilities | Direct, adverse, irreversible, short term | Med (3) | Low (1) | Med (3) | Med (3) | Med (3) | Medium (13) |

High significance =Impacts for which (L+R+F+I+P) is ≥15 or L=5, Medium significance = Impacts for which (L+R+F+I+P) is between 10 and 15,

Low significance = Impacts for which (L+R+F+I+P) is ≤9

**Table 5.1: Potential and Associated Impacts-cont’d**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Project Activities** | **Associated and Potential Impact** | **Impact Categorisation** | **Impact Significance Evaluation** | **Significance Ranking** |
| **Legal****Requirement (L)** | **Risk (R)** | **Frequency (F)** | **Importance (I)** | **Perception (P)** |
| **Exploratory Drilling** | Well Drilling and Installation of casings | Disturbance of bottom sediments and loss of benthic organisms during the drilling process | Direct, adverse, irreversible, residual, short term | 0 | Low (1) | Med (3) | Low (1) | Low (1) | Low (9) |
| Localised increase in ambient noise levels from rig operations. Leading to loss/ scare for fishes, seabirds and marine mammals | Direct, adverse, reversible, irreversible, cumulative, short term | 0 | Low (1) | Low (1) | Med (3) | Med (3) | Medium (11) |
| Well Completion and Development Prognosis | Liability to MPN and partners due to damage to subsea cables or pipelines | Direct, adverse, irreversible, short term | Med (3) | Low (1) | Med (3) | Med (3) | Med (3) | Medium (13) |
| Localised increase in the ambient concentration of air pollutants due to flaring from well testing | Direct, adverse, irreversible, short term | 0 | Low (1) | Med (3) | Low (1) | Low (1) | High (11) |
| Health, Safety and Environment (HSE) | Work place accidents/ incidents (trip and fall, man overboard, etc) during seismic and drilling sequence. Leading to injury/death of personnel | Direct, adverse, reversible, irreversible, short term  | Med (3) | Med (3) | Low (1) | High (5) | High (5) | High (17) |
| Sudden release of shallow hydrocarbon (gas or fluids) which may lead to environmental pollution, fire and injury/death to personnel as well as marine flora and fauna | Direct ,adverse, short term and irreversible | Med (3) | Med (3) | Low (1) | High (5) | High (5) | High (17) |
| Employment opportunities | Indirect, beneficial, cumulative, reversible, short term | - | - | - | - | - | Beneficial |
| Risk of communicable and other diseases such as Sexually Transimitted Infections (STIs), Human Immunodeficiency Virus (HIV), Malaria etc.  | Direct, adverse, reversible, irreversible, short term | 0 | Med (3) | Med (3) | High (5) | High (5) | High (17) |

High significance =Impacts for which (L+R+F+I+P) is ≥15 or L=5, Medium significance = Impacts for which (L+R+F+I+P) is between 10 and 15,

Low significance = Impacts for which (L+R+F+I+P) is ≤9

**Table 5.1: Potential and Associated Impacts-cont’d**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Project Activities** | **Associated and Potential Impact** | **Impact Categorisation** | **Impact Significance Evaluation** | **Significance Ranking** |
| **Legal****Requirement (L)** | **Risk (R)** | **Frequency (F)** | **Importance (I)** | **Perception (P)** |
| Waste Management | Degradation of water quality from discharge of untreated sanitary wastes, grey waters etc | Direct, adverse, reversible, cumulative, short term | 0 | Low (1) | Med (3) | Low (1) | Low (1) | Medium (12) |
| Degradation of water quality from accidental oil spills during fuelling/ handling activities | Direct, adverse, reversible, residual, short term | 0 | Med (3) | Med (3) | High (5) | Med (3) | Medium (14) |
| Reduction in diversity and abundance of marine flora and fauna resulting from oil spill due to pipeline rupture | Direct, adverse, irreversible, cumulative, short term | 0 | Med (3) | Med (3) | Med (3) | High (5) | Medium (14) |
| Alteration of seawater column baseline quality resulting from routine discharge of drilling wastes (deck drains, spent mud, cement, cuttings etc.) | Direct, adverse, reversible, irreversible, short term | 0 | Med (3) | Med (3) | High (5) | Med (3) | Medium (14) |
| Increased bioaccumulation in marine flora and fauna from discharge of chemicals, spent mud, cuttings, cement, oily waste waters, etc | Direct, adverse, irreversible, cumulative, short term | 0 | Med (3) | Med (3) | Med (3) | Med (5) | Medium (14) |
| Mortality /reduction in benthic species abundance and diversity through smothering resulting from drilling operations and discharge of mud, cement, cuttings, etc. to sea bottom | Direct, adverse, irreversible, residual short term | 0 | Med (3) | Med (3) | Med (3) | High (5) | Medium (14) |

High significance =Impacts for which (L+R+F+I+P) is ≥15 or L=5, Medium significance = Impacts for which (L+R+F+I+P) is between 10 and 15,

Low significance = Impacts for which (L+R+F+I+P) is ≤9

**5.4 Impact Discussion**

This section presents more detailed discussions on the environmental aspects as well as the associated and potential impacts of the proposed Yoho development wells drilling project. As already indicated in the previous section, these impacts have been assessed (characterised and evaluated) and the results presented in **Table 5.1**. The discussions presented in this section are intended to provide insight into the nature and magnitude as well as duration of identified impacts of the various project activities. It is also important to note that the proposed development wells drilling project will last up to three years. The drilling / workover activities would be performed from existing drilling platform.

**5.4.1 Drilling Operations**

The drilling rig serves as the central operation unit for the drilling operation. The proposed drilling campaign shall be executed utilising a Jack up rig, which will be positioned within designated well sites. Aspects of the rig and well engineering operations that may impact on the environment include:

* discharge of spent drilling fluid;
* discharge of formation cuttings;
* use of power generators for powering operations;
* well testing;
* discharge of brine water from the desalination unit of the rig;
* discharge of water from the cooling system;
* sanitary and domestic (including food) waste disposal; and
* use of chemicals and additives during drilling and completion operations.

***Discharge of Spent Drilling Fluids***

Both water-based mud (WBM) and Non-Aqueous Drilling Fluid (NADF) systems would be used for drilling operations in Yoho Field. Water based mud system are widely viewed by the industry as being sufficiently non-toxic as to have no special disposal requirements. According to UNEP (1985), water based mud discharges are not especially toxic being either biochemically inert or non-toxic derivatives of natural products. Furthermore, when water based mud is used in drilling:

* drilling discharges have no significant adverse effect on the water column due to their rapid settling and dilution;
* concentrations in plumes are in order of magnitude less than the 96hr LC50 values within meters of the discharge source;
* background levels are usually achieved within 1km or less of the source;
* drilling discharges can affect the benthic community near the drilling site, however the effect is temporary and is usually physical rather than toxic in nature;
* the only significant adverse effect is burial of sessile organisms within 200 - 300m of the well site; and
* recovery is usually observed to be quite rapid.

***Discharge of Formation Cuttings***

It is a standard practice for cuttings stained with WBM to be disposed of to sea. However, the system that will be employed in the Yoho development wells drilling project includes a closed loop re-circulation system minimising discharge of muds. The cuttings will be passed through efficient shale shakers prior to discharge to the seabed. Cuttings from the NADF system will be further dried to reduce base fluid on cuttings to a concentration not exceeding 5%.

The mangrove ecology is not likely to be affected due to dispersion and localised nature of the discharges. WBM will be recycled when economic but will eventually be discharged overboard. NADF will not be discharged to sea but will be stored for re-use or transported to shore and appropriately disposed.

The disposal of relatively small amounts of synthetic muds in cuttings to the seabed is not expected to cause any significant environmental impact, as the cuttings are not likely to be easily dispersed in the water column.

***Emissions from Power Generators***

Emissions from generators (typically gas and diesel driven) will include oxides of carbon, nitrogen, and sulphur, hydrocarbon gas and other volatile organic carbons. These emissions though emitted intermittently / continuous throughout the project life cycle will not significantly impact on the local ambient air quality of the project area. Under most offshore meteorological (winds, gales, etc.) conditions, concentration of air quality pollutants would be well below their maximum predicted values due to the effect of dispersion / dilution leading to very negligible effect.

***Well Testing***

During drilling and completion operations, air emissions will be generated from the generators that supply power to the rig and the drilling machines as well as gas flares and condensates during well tests. In addition, air emission is expected to come from the engine of the tugboat that shall act as an auxiliary vessel to the drilling rig. Exhaust gases will be readily dispersed given the wind conditions in the open sea. Impacts on the environment will tend to be localized.

Well clean-up is conducted to flush the well clean, thus removing any material, which may reduce the productivity of the well and to prevent debris damaging process equipment. Well testing involves the control of well test products to the drilling rig, where a number of reservoir and well characteristics are confirmed. During the test there is a requirement to dispose of the test products. Standard procedures will include flaring of hydrocarbons. Well test normally generate a number of atmospheric emissions that may include unburned hydrocarbons and combustion products. These emissions, will contribute to regional or global issues of atmospheric pollution. In addition, there may be a potential for small amount of fall out of hydrocarbons from the flare, which can result in oily sheens on the sea surface. The oil and gas, produced during well clean up and testing, will be channeled into existing production line as practicable.

The well clean-up process may involve the use of a series of chemicals, which must be selected used and disposed of in accordance with industry and international best practices. The environmental impacts due to well testing and clean up are associated with the amounts of hydrocarbons released or burned during testing, and the efficiency of the burning.

***Discharge of Brine Water***

The discharge of brine water into the sea will be within the range of the marine environment. The desalination unit is not expected to produce any adverse impact on the marine receiving waters, which typically have a salinity level of 33 – 35 ppm. This is especially so if the brine is discharged with the seawater cooling effluent which will enhance its dilution. Rapid dilution and dispersion will reduce the salinity level to ambient levels within a short distance from the outfall. This will minimize the potential for adverse effects on marine organisms.

***Discharge of Water from the Cooling System***

Heated water will be discharged from the rig’s cooling system directly to the sea. The key impact is that the temperature of the water is above ambient. The warm water will be discharged intermittently through an open pipe below the surface, this will allow for rapid dilution and dispersion to minimize potential effects on marine life.

***Sanitary and Domestic Waste Disposal***

Domestic waste water including kitchen waste will contain detergents and fats. Fats are among the more stable organic compounds and are not easily decomposed by bacteria. Discharge of domestic waste will increase the BOD level in the receiving environment. However, this is envisaged to be insignificant due to aeration / oxygenation and mixing from wave action in the upper water column thus minimizing its impact on dissolved oxygen (DO).

Although the envisaged volume of sanitary and domestic wastes that would be released from the rig is small, this may however slightly increase nutrient loading in the surface water, which would minimally enhance phytoplankton population. Residual disinfectant in the sanitary effluent will have the opposite effect since disinfectants are generally toxic to organisms. The net effect on plankton population therefore, is considered to be minimal.

Sanitary and domestic waste that cannot be treated or burnt will be stored for transport to land for appropriates disposal in line with MPN Waste Management Guidelines. In addition operational waste such as drums and packaging materials will also be stored and subsequently disposed in an appropriate manner.

Discharge of macerated food wastes will provide nutrients to marine organisms, which may lead to a slight increase in phytoplankton density around the site. A slight increase in phytoplankton population will lead to a slight increase in dissolved oxygen levels as a result of photosynthetic activity.

***Radioactive Sources***

The use of radioactive substances on the rig will be limited to very essential data gathering operations and only when the wellbore conditions are favourable for such operations. Only suitably qualified persons shall be allowed to handle radioactive sources. If a radioactive source is dropped to the seabed or lost downhole efforts shall be made to retrieve it.

***Use of Chemicals and Additives***

The use of lubricants, additives and other chemicals during drilling operations is of international concern due to the inherent health risks in living tissues. Overall handling will be carried out in liaison with and in compliance with MPN SHE policies, FMENV and DPR guidelines as well as international best practices. Accordingly, efforts shall be made to utilise the least toxic and hazardous chemicals (considering persistence and bioaccumulation) and to use low toxicity lubricant additives to reduce the overall toxicity of drilling fluids where possible.

***Impacts on Fishing Activities***

Impacts of the proposed development is considered potentially significant because fishermen may be temporarily excluded from preferred fishing sites and are likely to have a negative opinion during development operations. The disruption of fishing activities within this period would likely result to reduced fish catch and reduced income for fishermen especially if fishing area is within the prospect.

However, commercial fishing is presently not a prevalent feature in this region with water depths of about 300m. Carrying out the proposed operation in the area will have limited temporary interference with local fishing activities in the area. There may also be limited interference of fishing activities from periodic visits to the rig by supply and other support vessels.

***Seabed Disturbance***

A limited amount of seabed disturbance will be associated with rig activities due to shunting of wastes (cuttings, etc) to the seabed. Local transient increased turbidity may result from such operations. Potential impacts include local loss of benthic animals through smothering or burial. Also a temporary disruption of fish communities and short-term impact on sea mammals may result from such subsea operations.

***Non-Aqueous Drill Cuttings Release***

The non-aqueous drilling fluid system (NADF) will be used in drilling the sand section below the conductor. Accidental release of this mud system or the associated untreated cuttings could result from system failure during the drilling campaign aspect of the proposed project. The mud system is composed of Xanthan gum / PAC polymer mud treated with sized Calcium carbonate. However, the non aqueous fluid systems utilizing mineral oils will be used to true depth (TD) of the wells.

Studies have shown that with increasing environmental constraints on the use of mineral oil-base muds, attention has turned towards water-base systems. Recent studies have also revealed that polymer mud system gives excellent shale inhibition without sacrificing environmental acceptability.

***Hydrocarbon Release***

The possible release scenarios are well blowout and loss of diesel and lubricating oils as a result of storage or transfer failure.

MPN have developed safety/contingency procedures for the Yoho development wells drilling project. Generally, three tiers of oil spill are recognised viz: tier 1 {minor oil spill of 0 to 8 metric tonne per day (0-60 bbl)}; tier 2 {medium oil spill of up to 200 metric tonne per day (1,500 bbl)} and tier 3 {major oil spill resulting from a blow out and with a flow of more than 3,000 metric tonne per day (20,000 bbl)}. Logistic base is at FOT/FLT Onne, Rivers state. The capacity of the FPSO is 1.95 million barrels. The most likely spill is a tier 1 spill of diesel during transfer operations. These transfers include those between supply ships and the drilling rig. Once on board the diesel will be distributed to a number of end use sites including:

* power generation units;
* emergency generators;
* fire water pumps;
* fresh water makers; and
* life boats.

Diesel spills are the most commonly encountered form of spill in offshore operations. Typically the volumes to be handled will be small. Therefore spills, if they occur, will typically consist of small volumes that will not persist. Diesel spills may impact on bird populations and these could be protected by a limited amount of containment or chemical dispersion. The likelihood of spills of hydrocarbons from other sources is considered very low. Crude oil tends to be less toxic than diesel as it contains proportionally less light fractions than diesel; however it is typically more persistent. The potential environmental implications of a spill of crude oil in the offshore environment are:

* seabed impacts including smothering;
* surface impacts on birds, particularly moulting birds;
* surface impacts on marine mammals; and
* water column impacts on fauna and flora through toxic effects.

Birds at most risk includes those species that spend most time on the water surface or are moulting. There is little information available on the distribution of marine mammals offshore Nigeria. However, it is considered that they would avoid an oil spill area. Water column impacts including the effect of the dissolved toxic components of the oil will be felt by non-mobile planktonic species; mobile species such as fish will avoid the area of the spill.

*Onshore Impacts of an Oil Spill*

Depending on the nature of the recipient environment, significant impacts may arise from oil spill that makes landfall. The main shoreline types in the coastal areas of interest, based on geomorphic attributes are mangroves, fine sand beach and medium/coarse sand beach.

The dependence of coastal communities on fishing and farming makes the issue of oil spills in these areas a major one when considering related social impacts. While there may be a temporary effect on fishing (as oil spills in open waters dissipate quickly) if oil reaches the shoreline and indeed any farmlands or fish breeding areas, a serious social impact could occur. The main stay of the people’s economy will be affected, health issues may arise and long term effects may be felt in certain cases if spill response is not swift and properly focused.

MPN recognises this and has therefore put in place an oil spill contingency plan, which is a lay down plan to be adopted in order to address quickly any of such occurrences.

**5.4.2 Oil Spill Contingency Plan**

MPN is committed to the prevention of oil spills but realizes that accidents can and do happen. Therefore, MPN has developed a comprehensive, coordinated, and integrated Oil Spill Contingency Plan (OSCP) to be activated in the event of an oil spill. This plan is designed to cover the control and removal of an oil spill occurring at any MPN facility in the Federal Republic of Nigeria.

The OSCP highlights the roles and responsibilities of key MPN personnel and lists equipment and materials available to combat oil spills. The plan is reviewed and revised at least annually by the E&R Unit of the MPN SHE Department. It shall be revised as necessary to incorporate learnings from exercises and actual spill responses.

The main objectives of the MPN OSCP are to:

* identify and document task lists by position that shall be carried out in an oil spill
* incident;
* establish, prior to an actual spill, appropriate task assignments and delegation of authority; and
* provide contact lists and numbers to ensure efficient coordination of efforts in the management and control of an oil spill.
* provide a list and stock of equipment and materials available to combat oil spills

In general, response to spills shall be through a three-tiered system that allows an appropriate level of response to be brought to bear on a given spill situation. For spills occurring offshore, the following Tier definitions apply:

***Tier 1 Spill***

A Tier 1 spill is an oil discharge of less than 250 barrels to the offshore environment.

MPN resources can respond effectively to this spill category without outside assistance.

***Tier 2 Spill***

A Tier 2 spill is an oil discharge of between 250 and 2500 barrels to the offshore environment. For this size spill, assistance in handling containment, cleanup, and/or rehabilitation activities shall likely be required from sources outside MPN to avoid serious disruption of other MPN operations by diversion of MPN operational resources. Mutual aid resources that may be used include Clean Nigeria Associates (CNA), and/or the Mutual Assistance Plan (MAP) of the Oil Producers Trade Section (OPTS) provided from within Nigeria. Assistance may also be enlisted from Esso Exploration and Production Nigeria Limited (EEPNL) in line with the Mutual Assistance Agreement in place between MPN and EEPNL. For such spills, additional response capability is available from ExxonMobil’s Europe/Africa/Middle East Regional Response Team.

***Tier 3 Spill***

A Tier 3 spill is a discharge of more than 2500 barrels of oil to the offshore environment. For this size spill, resources beyond those available within Nigeria are likely to be required. As necessary, these shall be brought in rapidly from worldwide co-operative stockpiles such as Oil Spill Response Limited (OSRL). Response strategies employed shall vary according to the specific spill situation. However, in all cases aerial or other surveillance of the spill shall be maintained to the extent practical, appropriate response organizations shall be notified and deployed, and the Government Notification Reports shall be completed by MPN’s oil spill response team. If an attempt to contain the spill at or near the source fails and the probability of shoreline impact increases, back-up protection shall be placed at areas threatened by the spill. If warranted, and providing permission is secured to do so from the DPR, steps shall be taken to disperse the spill chemically. Special attention shall be directed toward protecting more sensitive areas, such as mangrove/swamp areas and river estuaries, with booms and other devices.

The MPN Oil Spill Contingency Plan shall be enhanced and strengthened by organizing training and refresher training for spill response personnel by the E&R Unit, and by holding periodic drills organized by MPN with active participation of DPR and NOSDRA.

**5.4.3 Abandonment and Decommissioning**

The environmental interactions arising from the abandonment of facilities may affect the physical and biological features of the natural environment and may influence other sea users. At the end of lifespan of the field, facilities/equipment/materials shall be decommissioned and either dismantled and removed, or abandoned. The decommissioning plan shall have as its main objective leaving the environment at the end of the operations in a safe and environmentally acceptable condition, suitable for future use. The main sources of potential environmental impacts during decommissioning and abandonment operations include:

* Air emission discharges from power generation, cutting tools, welding, transportation, lifting etc.
* Oil and chemical spills.
* Solid and other waste generation.
* Noise and vibration during cutting operations

Potential impacts such as temporary turbidity could arise due to dismantling of facilities. Also during the dismantling process, discharge of chemicals and other toxic wastes could be released constituting potential harm to aquatic organisms and fish populations.