4 PREDICTED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

4.1 INTRODUCTION

This chapter deals with the permanent and temporary impacts to the environment that may be produced during the construction and operational phase of the project together with their respective mitigation measures to avoid, reduce or remedy the impact.

4.2 RISK ASSESSMENT MATRIX

The level of risk tolerability is categorized on the matrix by four shading in areas namely:

- Low: The risk is tolerable. Continuous improvement needs to be applied.
- Medium: The risk requires control with a low priority
- High: The risk requires control with a high priority
- Very High: The risk requires immediate control in place

Figure 4-1 indicates the Risk Assessment Matrix used by EPML when evaluating risks from identified hazards against accepted screening criteria, taking into account the likelihood of occurrence and the severity of any consequences to employees, assets, the environment and the public.
EPML provides a Hazard and Effect Management Process (HEMP), which is used for the identification and management of HSEQ hazards in the workplace. Due to various number of processes safety incidents industry wide, the HEMP aims to focus on very high, high, and medium risks that exist within EPML to ensure adequate management of those risks are in place, thus preventing major incidents from occurring.

![Risk Matrix for Engen Petroleum Mauritius Ltd](image)

**Figure 4-1 Risk Matrix for Engen Petroleum Mauritius Ltd**
4.3 IMPACT DURING CONSTRUCTION STAGE

4.3.1 IMPACT ON NOISE LEVEL

During construction phase, it is expected to have a minimum increase in level of noise due to the use of heavy construction equipment such as excavators. However, the impact on noise level would be temporary in nature. Responsible persons of the surrounding undertakings would be duly informed of the construction work schedule and be made aware of inconveniences through appropriate signage. The ones mostly exposed to the noise are the construction workers and the personnel on adjacent property.

Mitigating measures:

- Construction workers provided with appropriate ear protection devices.
- Noisy operations restricted to daytime.

4.3.2 IMPACT ON AIR QUALITY

Temporary dust emissions are generated from site clearing and excavation activities, which has an impact on the construction workers, on the adjacent property and the nearest river. The installation of both piping system and foundation work for the storage tank will contribute to dust emissions. In addition, some impact on air quality is anticipated due to exhaust gases from diesel engine vehicles such as loaders and excavators, welding fumes and solvents from surface coating. However, the air pollution caused will be of short time duration.

Mitigating measures:

- Erection of a physical barrier to avoid causing dust nuisance to surrounding environment.
- Face masks to be provided to the construction workers during potentially dusty earth works operations.
- Damping of water, if needed, to control dust.
- Welding gas bag filter can be used for the welding gas emissions
4.4 IMPACT DURING OPERATIONAL STAGE

4.4.1 IMPACTS FROM WHITE OIL SPILLS

An Emergency Response Plan (ERP) is designed to provide guiding principles and standards to respond to any emergency and crisis that may occur within the EPML depot.

In the event of any spill, the level of response, the resources required and the organisations to be involved will depend on the size and nature of the incident. For planning purposes, spills have been categorized according to the guidelines in the National Oil Spill Contingency Plan, which are based on the volume of white oil released and the logistical resources available to handle the spills.

- Tier 1: Small Local Spills
  In this situation, there is no danger to life and risk of damage to property is minimal. It can be handled entirely by the EPML Emergency Response Team (ERT) using the onsite oil spill combat equipment and following the EPML Oil Spill Contingency Plan. These spills are normally associated with day-to-day operations and can be dealt with within 24 hours.

- Tier 2: Medium Spills
  In this situation, there is a danger to life and risk of damage to property. This event exceeds EPML on-site spill response equipment or work force capability and requires additional equipment and personnel. It is usually managed by the National Oil Spill Response Team and may require more than 24 hours for recovery and clean up.

- Tier 3: Large Spills
  In this situation, there is potential for multiple fatalities and severe damage to asset and involving sites and surrounding communities. It demands the activation of additional equipment and personnel through external emergency response resources or Engen’s worldwide response resources.
4.4.1.1 IMPACT FROM WHITE OIL SPILLS ON LAND

There is a potential risk of white oil spillage during the operation of the tank that can affect the environment. Through the assessment of the activities associated to the tank, the following have been identified as the potential points of spill:

- During filling of the tank with MOGAS
- Leakage through valves and pipe appurtenances
- Leakage from delivery of fuel to road tankers
- Overfill of product at the tank truck loading rack.
- Rupture of storage tanks
- Collapse of tank foundation
- Accidents during transportation
- Fire outburst
- Natural disaster

Mitigating Measures:

The procedure to handle any inland oil spill is specified in Engen Oil Spill Plan enclosed in ANNEX 12 of this document. The amount of product spilled is dependent on the response time, the management of the spill and the resources available. In short, some of the steps that are executed during the spill:

- Provision of bund walls has already been made, according to the design standards used for storage tanks, to contain the oil spills from storage tanks.
- Provision of an oil water separator is made to segregate the oil from the surface water run-off discharged from the bund area.
- Any oil spills within the petroleum storage depot shall be addressed by the promoter to prevent contamination of the soil.
- All activities and operations of the petroleum storage depot shall be discontinued followed by immediate clean up measures (using tools such as shovel, rake, scraper, etc.) of the oil spillage by the personnel and proper equipment. In addition, the workers involved in the clean-up measures are provided with proper Personal Protective Equipment (PPE).
- Ensuring safe driving and respecting Highway Code on road while transporting the petroleum product to avoid road accidents, which can lead to risk of spills and fire. In any such cases, necessary measures, such as notifying the relevant authorities, shall be made to deal with the situation.
4.4.1.2 IMPACT FROM WHITE OIL SPILLS ON NEARBY RIVER AND SEA

Since the depot is situated in the Port Area, which is under the jurisdictions of Mauritius Ports Authority (MPA), the Port Louis Harbour Oil Spill Response Plan shall be executed. Any oil spill that arises due to the implementation of the present project will be reported to the Port Master who is empowered by the virtue of the Ports Act to take command and control of any emergency in the harbour.

In Latanier River, there may be a possibility of an oil spill polluting it due to pipeline leakage or rupture.

Any potential white oil spill at sea may occur during:

- Bunkering process
- Marine receipt

At EPML, GASOIL is mainly used for bunkering purposes. These are carried out either through a vehicle PTO unit or pipelines. Spills may occur due to:

- Hose failure from truck or pipeline
- Valves damaged
- Bursting of pipes due to corrosion
- Human factor (lack of skills and training)
- Pump failure related to vehicle PTO (minor spill)

All the petroleum products stored in EPML are received via marine route. The products flow from the tanker along a common pipeline shared by the oil companies and then through a branch to EPML. In this process, oil spill may occur due to various scenarios namely:

- Bursting of the shared pipeline due to overload of pressure, leaks, or corrosion of the pipeline.
- In the terminal, due to damaged valves, leaks, bursting of pipes due to overload of pressure in pipes or corrosion of the pipes.
- Malfunctioning of the connection from tanker to the shared pipeline. In this case, the owner of the ship is responsible for the spill since he has strict liability for pollution damage caused by the escape or discharge of persistent oil from the ship.

**Mitigating Measures:**

The procedure to handle any oil spill at sea is specified in Engen Oil Spill Plan enclosed in ANNEX 12 of this document. In short, some of the steps that are executed during the spill:
• All activities and operations of the petroleum storage depot shall be discontinued.
• All possible sources of ignition are eliminated.
• The terminal manager is informed of the emergency.
• All the necessary resources and equipment to address the spill are made available. As listed below some of the equipment to be used during a spill:
  ✓ 36 mtDrizit oil absorbent boom
  ✓ 1 temporary 10000L fast tank
  ✓ 3x25 bags loose fibre (10x1kg)
  ✓ 2 x loose fiberdrizit oil absorbent loose fibre 5kg
  ✓ 4 x supersorb mini roll
  ✓ 50m length oil absorbent
  ✓ 2 drums of oil spill dispersant
  ✓ 15 shades and shovels
  ✓ 20 plastic gunny bags (small)

All these equipment are mentioned in the Engen oil Spill Plan enclosed in ANNEX 12.

• Appropriate PPE is essential during product spill and the nature of the exposure hazard associated.
• The spilled product is contained immediately to restrict the size and extent of the spill. Once the oil spill has been contained, skimmers and sorbents are commonly used for oil recovery from the water surface.
4.4.2 HAZARD RISK

As previously stated, EPML has the following petroleum products stored in its depot:

- White oils (MOGAS and GASOIL)
- Heavy Fuel Oil (HFO) 180 CST
- Jet A1

The characteristics of these products are found in "Engen oil spill plan ANNEX III", enclosed in ANNEX 12 of this document.

MOGAS, the petroleum product being stored in the new tank, is very volatile and produces large amounts of vapour at ordinary temperatures. It burns in a limited range of its vapour phase, coupled with its volatility, making leaks highly dangerous when sources of ignition are present. It has a lower explosion limit of 1.4% by volume and an upper explosion limit of 7.6%. Yet, the rapid mixing and spreading of MOGAS with air makes MOGAS quickly flammable.

All the petroleum products and any related equipment could create potentially fatal hazards. Whilst on site, the employees and the Contractor need to avoid the risks and activities associated with such hazards. Table 4-1 specifies the most serious hazards that may occur.

<table>
<thead>
<tr>
<th>HAZARD</th>
<th>TYPICAL CAUSE</th>
<th>REASON</th>
<th>PRECAUTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire/Explosion</td>
<td>Gasoline, Kerosene, LPG Diesel Oil</td>
<td>Products with low flash point cause explosive / flammable vapours</td>
<td>No smoking, open fires, machinery to cause sparks, except in demarcated areas</td>
</tr>
<tr>
<td>Dermatitis, Carcinoma, Liver, Lung &amp; Eye Problems</td>
<td>Gasoline</td>
<td>Lead, Benzene absorbed through the skin &amp; respiratory tract</td>
<td>Wear gloves, eye protection, avoid skin and eye contact, ingestion and inhalation of vapours</td>
</tr>
<tr>
<td>Slippery Surfaces</td>
<td>Slippery Walk Ways &amp; Stairways</td>
<td>Oil on slippery surfaces (Metal Walkways)</td>
<td>Wear safety shoes with correct soles</td>
</tr>
<tr>
<td>Soil, Pollution, Potential Fire Hazard</td>
<td>Damage to product lines, tanks: Spells</td>
<td>Accidental release of product from pipelines, tanks etc.</td>
<td>Extreme care when excavating/manoeuvring machinery close to lines or tanks. Disconnecting pipelines</td>
</tr>
<tr>
<td>Electrocution</td>
<td>Live High Voltage Cables/Switchgear</td>
<td>Accidental contact with live equipment causes serious burns or death</td>
<td>Extreme care when excavating; avoid unauthorised entry into substations; or tampering with cables; lock out systems</td>
</tr>
<tr>
<td>Poisoning</td>
<td>Toxic vapours in confined spaces</td>
<td>Inhalation of toxic vapours</td>
<td>Wear self-contained breathing apparatus; avoid unauthorised entry into confined spaces, ensure proper ventilation</td>
</tr>
<tr>
<td>Asphyxiation</td>
<td>Excess nitrogen or carbon dioxide</td>
<td>Lack of oxygen</td>
<td>Ventilate and refresh atmosphere (if oxygen level is below 19.5% wear breathing apparatus)</td>
</tr>
<tr>
<td>Vehicle Accidents</td>
<td>Collision</td>
<td>Vehicle driven without the necessary caution</td>
<td>Drive according to rules, taking into account site conditions, weather and visibility.</td>
</tr>
</tbody>
</table>
Table 4-1 Typical Hazards Associated with a Marketing Facility

**Mitigating Measures:**

- Proper fire control measures and sufficient setbacks have already been taken into consideration during the design of the tank. The fire-fighting system has been developed based upon the standard *PTS 20.158i - Fire Protection* as stated in **SECTION 3.5**.

- The depot is currently equipped with
  1. A roof drenching system for all its existing tanks.
  2. Two fire water storage tanks of 60m³ and 1000m³, which will be sufficient to provide a continuous flow in case of a fire outbreak until the intervention of the nearest fire brigade.
  3. Two fire pumps of 550m³/hr equipped with remote actuators, which are located outside the oil spill equipment storage shed.
  4. Fire hydrants installed onsite and located on the main firefighting pipeline going around the depot. This will ensure that all parts of the storage terminal will be provided with water for cooling purposes.
  5. Fire hose reels
  6. Portable fire extinguishers and foam type fire extinguisher for the tank are made available and used in accordance with the requirements of the Fire Government Services.
  7. A deluge fire sprinkler system providing full coverage to the white oil and black oil loading bays, the additization shed, and the transfer pump area. It is normally used
for special hazards where rapid fire spread is a concern, as they provide a simultaneous application of water over the entire hazard. The system is connected to a water supply through a deluge valve that is opened by the operation of an automatic means of detection through IR detectors.

8. 5500 L of foam concentrate a foam canon and fixed monitors (220 x 25 L pails foam FP70).

9. Centrally activated alarm system in the Head Office Building and Terminal that will be sounded to warn the personnel of an emergency.

- According to PTS 20.158i - Fire Protection Standard, a foam system, and cooling ring with sprinklers on tank shells need to be installed and properly integrated with the existing system.

- Appropriate training on the fire-fighting equipment is given to the personnel on site and a fire drill exercise is performed once a year. A flowchart highlighting the emergency procedures that are followed in EPML is shown in Figure 4-2.

- Engen has security risk management standards, procedures that need to be followed at all times by all the employees and even by the contractors. Besides, Engen does provide the necessary resources, systems, information, and awareness programmes to ensure that business operations are conducted in a safe and secure environment.

- EPML management takes all reasonable measures to promote safe working practice, safeguard the environment, and ensure that no one is unnecessarily exposed to the hazards. Prior to start of any work on Engen’s premises, there is a need of a valid work permit, which is issued by Engen. The Contractor in turn shall take all the necessary HSEQ precautions related to or arising out of the performance of the contract in order to protect the work, the personnel, and the property of Engen, Contractor, Subcontractor, all third parties and public from the hazards associated with the work.
Figure 4-2 Emergency Procedures in EPML.

Figure 4-3 gives a summary of the impacts during construction and operation stages.
## Summary of hazards with mitigating measures

<table>
<thead>
<tr>
<th>HAZARD</th>
<th>THREATS</th>
<th>TOP EVENT</th>
<th>CONSEQUENCES</th>
<th>RISK RATING</th>
<th>RESIDUAL RISK RATING</th>
<th>MEASURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrocarbons</td>
<td>Mogas stored at low pressure</td>
<td>Overfill of tank</td>
<td>Ground contamination</td>
<td>B3 B2 B3 B2</td>
<td>LOW</td>
<td>Proper maintenance plan in place</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mechanical defects</td>
<td>Fire/explosion/asset damage</td>
<td></td>
<td></td>
<td>Firefighting equipment located in tank farm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Human error</td>
<td>Hydrocarbon vapours</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tank overfill</td>
<td>Spill</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hazards associated with differences in height</td>
<td>Personnel at height &gt;2m (when working on tank roof)</td>
<td>Incorrect use of PPE</td>
<td>Trip/fall</td>
<td>B3 B2 B3 B2</td>
<td>LOW</td>
<td>Certified equipment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Human error</td>
<td>Fatality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamic situation hazards</td>
<td>Improper guard</td>
<td>Exposure to bodily parts</td>
<td>Injury</td>
<td>B3 B2 B3 B2</td>
<td>LOW</td>
<td>Trained personnel</td>
</tr>
<tr>
<td>Environmental Hazards</td>
<td>Use of hazardous hand tools</td>
<td>Human error</td>
<td>Loss of control</td>
<td>Asset damage</td>
<td>B3 B2 B3 B2</td>
<td>LOW</td>
</tr>
<tr>
<td>Toxic solid</td>
<td>Improper handling</td>
<td>Exposure</td>
<td>Injury</td>
<td>B2 B3 B2 B2</td>
<td>LOW</td>
<td>Proper waste handling and management plan in place</td>
</tr>
<tr>
<td>Ergonomic hazards</td>
<td>Manual materials handling</td>
<td>Incorrect lifting techniques</td>
<td>Loss of control</td>
<td>Asset damage</td>
<td>C2 C2 C1 C1</td>
<td>LOW</td>
</tr>
<tr>
<td></td>
<td>Noise</td>
<td>High noise levels</td>
<td>Exposure</td>
<td>Injury</td>
<td>C2 C2 C1 C1</td>
<td>LOW</td>
</tr>
<tr>
<td>Use of Natural Resources</td>
<td>Improper ventilation</td>
<td>Inhalation</td>
<td>Asphyxiation</td>
<td>C2 C2 C1 C1</td>
<td>LOW</td>
<td>Medical assistance, First aiders</td>
</tr>
<tr>
<td>Cement dust</td>
<td>Improper ventilation</td>
<td>Inhalation</td>
<td>Asphyxiation</td>
<td>C2 C2 C1 C1</td>
<td>LOW</td>
<td>Medical assistance, First aiders</td>
</tr>
</tbody>
</table>

*Figure 4-3 Summary of hazards with mitigating measures*
4.5 IMPACT ON LAND DURING CONSTRUCTION AND OPERATION STAGE

4.5.1 WASTE GENERATION

Waste is generally categorized as non-hazardous or hazardous waste. Hazardous wastes are disposed of at Mare Chicose landfill. Based on the Environmental Protection Regulations on hazardous wastes, authorized companies have to abide by specific rules and produce quarterly reports of good maintenance to the appropriate enforcing agency.

Solid wastes mainly comprise of excavated materials, general construction wastes such as plastic and metal packaging materials, metal cut-offs and paper, cardboard and timber packaging materials.

Furthermore, during the construction phase, there will be workers present on site, which need sanitary facilities. Besides, if not provided, there is a risk of land pollution and public health issues.

Mitigating measures:

- An adequate waste management plan is set up to handle the production of wastes. Table 4-2 illustrates the disposal of certain wastes.
- Figure 4-4 and Figure 4-5 display the waste disposal procedure applied for both non-hazardous and hazardous wastes respectively.
- The tank cleaning process is usually carried out based on API guidelines. This depends on the petroleum product that is being stored in the tank.
- Metal cut-offs, plastic and clean paper/cardboard shall be provided for recycling process.
- For any other types of wastes, the terminal management ensures that a waste disposal certificate is submitted by the waste contractor, irrespective of the quantity collected from the terminal.
- Sanitary facilities shall be provided for the workforce by the Contractor.
- A proper discharge system to be provided for the effluent.
## Table 4-2 Disposal of wastes

<table>
<thead>
<tr>
<th>Facility</th>
<th>Location</th>
<th>Wastes Handled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landfill</td>
<td></td>
<td>All domestics waste – paper, plastics, grass, glass, and rags are collected by licensed waste carrier and transported to the transfer station where it is mixed with domestic waste from other areas. This waste is compacted and sent to the landfill via trucks</td>
</tr>
<tr>
<td>Landfarm</td>
<td>On site or neighborhood depending on the volume of waste to be land farmed</td>
<td>Spill on the ground</td>
</tr>
<tr>
<td>Drum Handling Area</td>
<td>Port Louis terminal</td>
<td>When appropriate, drums will be cleaned and stored at the terminal and used for storage of water-draw off while waiting for the product to be collected by licensed contractor</td>
</tr>
<tr>
<td>Water draw off</td>
<td>From tanks</td>
<td>Waterdraw off is collected in drums. And then collected by licensed waste effluent carrier as and when required. The waste is then sent to the licensed waste management contractor – EcoFuel</td>
</tr>
<tr>
<td>Effluent</td>
<td>Oil water separator</td>
<td>Oil water separator is cleaned on a quarterly basis. The water content is collected by waste licensed contractor truck.</td>
</tr>
<tr>
<td>Sludge</td>
<td>Tank Bottom, Oil water Separator</td>
<td>See <strong>ANNEX 11</strong> on Sludge disposal guidelines</td>
</tr>
<tr>
<td>Septic Tank waste</td>
<td>Septic tank</td>
<td>Septic tanks have to be emptied when there are full – a licensed waste contractor is called for this purpose: D.Seeven Ltd.</td>
</tr>
</tbody>
</table>
Non Hazardous Waste

Domestic waste
Paper, plastics, kitchen waste, etc
Weekly or fortnightly collect by Municipality/district council
Regional Transfer Station
For compacting
Mare Chicose Landfill

Cumbersome Domestic waste
Construction, branches, etc
Pay private licensed waste contractor
Pay Municipality/district council
Regional Transfer Station
For compacting
Mare Chicose Landfill

Figure 4-4 Non-Hazardous Waste Disposal Flowchart
Figure 4-5 Hazardous Waste Disposal Flowchart