
8. Proposed Pollution Prevention and Mitigation Measures

8.1 Introduction

The potential significant impacts of the Project will have on the environment have been discussed in the previous Chapter. In order to prevent or minimize these environmental impacts, it is necessary to include P2M2 as an integral part of the Project in its implementation.

The P2M2 will be proposed accordingly for the construction and operation phases for the impacts identified. The Project Proponent (PP) and the facility operators will be responsible for the implementation and management of the proposed P2M2 during construction and operation phases respectively.

8.2 During Construction Phase

8.2.1 Land Disturbance Pollution Prevention and Mitigation Measures (LDP2M2)

The Project site is unlikely to have significant increase rate soil erosion and sedimentation outputs throughout the construction phase. Nevertheless, sedimentation is anticipated at any construction site especially during raining events. Therefore P2M2 should be implemented where practicable to reduce any erosion event due to exposed area.

An Erosion and Sediment Control Plan (Conceptual ESCP) for the Project has been prepared by M.E.I. Consultants Sdn Bhd (**Appendix 7.1**), in accordance with the principles and guidelines stipulated in *Manual Saliran Mesra Alam Malaysia* (MSMA) by the Department of Irrigation and Drainage (DID) Malaysia. The approved conceptual ESCP will be referred for the preparation of LDP2M2 during the Environmental Management Plan (EMP) preparation after this DEIA is approved by the Department of Environment (DOE).

Further to that, a further Erosion and Sediment Control Assessment has been conducted by certified professionals (CPESC) to assess the adequacy of the primary mitigation measure designed for the Phase 1 development, and subsequent future phase of the landfill cell development. The assessment outcome has been included in **Appendix 7.1A**.

The following method statements and requirements have been complied to minimize the soil erosion and sedimentation during the entire construction period:

(a) Site Planning

- Earthworks will be carried out in three stages. The total area to be cleared for the Stage-1 will be 116 ac [32 ac – Cell 1, 84 ac – Material Recovery Facility (MRF), Leachate treatment plant (LTP), and associated ancillary facilities]
- Cutting and filling are inevitable during earthworks and construction to prepare the platforms to build on. Although the terrain of the Project is relatively flat, the cut and fill activities are still needed to prepare the required platform levels for the construction of Project components (such as MRF, administration buildings, etc.).

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- The cut and fill volume involved in the Project is estimated at 140,501 m³ and 967,466 m³, respectively. The excavation of earth stripped from cut areas is proposed to be placed at low-lying areas within the site in order to balance the cut and fill volume as much as possible. The earth surcharge (red earth sources) will be imported from Kg Wellesley, Sg Jawi, Pulau Pinang.
 - The biomass/ mulch can be used as cover for exposed areas if they are suitable.
 - Segregate excavated materials into suitable and unsuitable stockpiles for future use or disposal. Segregate roots, stumps, and rocks larger than 150 mm, refuse and other deleterious materials from excavated material and dispose offsite in a legal manner. Place stockpiled materials no greater than 1.2 m in heights and do not obstruct proper drainage of area.
 - Any excess depth excavated below the required level specified shall be made good by backfilling with suitable material and compacted.
 - Earthwork, removal of excess materials and filling to stabilise the site will have to consider the rainfall pattern to reduce the environmental consequences. A logbook on the earthworks and the weather conditions shall be kept for checking by the DOE or other relevant authorities.
 - Construct fill or embankment using only approved suitable material. Compaction shall be undertaken by use of suitable compaction plants such as sheet-foot rollers, pneumatic-tyre or smooth-wheel rollers/ vibrating rollers/ or vibrators approved by the Engineer. Earth moving plant shall not be accepted as compaction equipment.
 - The slopes of cutting and embankments, roadsides, roadside tables, berms, benches, drainage channels and such other excavated and filled surfaces shall be turfed. The turf shall be from an approved source and shall be free from mimosa, leaves and any other plants.

(b) Surface Runoff Control

- A temporary drainage system should be provided during the earthworks phase to drain surface runoff and silts loads from the earthwork areas to proposed silt trap ponds before discharging into earth drains and eventually to the Sg Tengah. The permanent drainage system will be constructed as per engineering detailed designs and will be reported in the EMP.
- The temporary earth drains within the site and exiting JPS drain along the perimeter boundary of Project site shall be maintained during the construction phase to ensure the drainage design network works efficiently and can contain the generated storm-water to prevent erosion in the event of encountering a worst case scenario-under torrential rainfall.
- Check dams will be constructed whenever necessary to reduce flow velocity to check direct runoff.
- The soil sediment control structures (i.e. sediment basins) should be kept in good condition until all earthwork activities are completed and the site stabilized. Where necessary, measures to improve the damage structure shall be carried out.

(c) Erosion and Sediment Control

- Temporary perimeter earth drain, perimeter holding, sediment basin, wheel wash trough shall be installed immediately prior to the commencement of earthworks. Other measures such as earth banks, vehicle and equipment areas, and additional drains shall be constructed when required during construction stage.

- Sediment control measures, such as sediment basins will be installed based on the drainage pattern of the site.
- Construction of sedimentation basins shall be in accordance with the design specification as stipulated in the LDP2M2.
- Silt fences shall be installed where necessary to prevent migration of sediments and other soil piles into nearby drainage system, and public access road.
- A total of two silt trap ponds shall be constructed before earthworks to reduce eroded materials getting into the waterways directly. Sediment removed from trapping devices will be disposed at locations where further erosion will not occurred.
- Wheel wash trough will be constructed at the entrances into the Project site to ensure that the vehicles going out from the Project site will not introduce dirt onto the road and increase the sedimentation into nearby water bodies during raining event. And, it shall be maintained regularly to ensure that it is functional.
- The access road shall be paved with crusher run or hardcore. To ensure good traffic controls and prohibit unnecessary site disturbance.
- Work to be scheduled so that the time for land shaping to final stabilization is less than 2 weeks.

(d) Site Inspection, Maintenance and Monitoring

Regular site inspections of the Best Management Practices (BMPs) shall be conducted by the full time environmental officer with CESSWI certification throughout the construction phase to ensure their continued performance. The recommended frequencies for inspection are:

- Immediately or within 24 hours after rainfall event
- At least once a week

Appendix 7.1B has further elaborated the important elements of LDP2M2 which shall be referred when and where applicable for the design and construction development of this Project, including:

- 1) Erosion and Sediment Control Measures
- 2) Implementation of Erosion and Sediment Control Measures (BMPs)
- 3) Site Inspection and Maintenance

Performance monitoring and compliance monitoring program will be established as proposed in the EMP frameworks as shown in **Chapter 11**.

8.2.2 P2M2 for Water Pollution

The mitigation measure to control sediment load from surface runoff during construction phase are outlined below:

- Any exposed soil surface, especially slopes should be turfed immediately to prevent erosion
- Temporary earth drains and silt traps ponds should be constructed before construction starts. They should be regularly desilted to ensure their functional efficiency

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- All construction machinery and transport vehicles to be maintained regularly to prevent the leakage of oil/ lubricant
 - Located storage area away from nearby watercourses
 - Fuel storage tanks to be installed within a bund, and on a concrete platform to contain any oil spill and leakage. The barrier should be designed to contain 110% of the largest tank's content
 - Spent oil and grease to be stored in steel drums and sealed until disposal by a licensed contractor
 - Temporary sanitary facilities shall be provided and maintained according to specification of the Ministry of Health (MOH), and any sewage leak from them to be attended immediately to avoid pathogenic contamination of river system
 - Impact monitoring to be conducted periodically at the receiving water body to examine the condition of the water quality of the Project area

8.2.3 P2M2 for Hydrogeology and Groundwater

Earthworks and ground levelling should be performed in the appropriate manner to avoid unnecessary contamination. Precautionary measures shall take into consideration of Soil Investigation result on the Project site and the precautionary measures should be adopted in the design and construction method statement.

8.2.4 P2M2 for Air Pollution

Some of the common P2M2 to minimise air pollution during construction are outlined as below:

- Dampening the dry surface within the Project site by spray water or water browsing to prevent fugitive dust generation
- Vehicles existing to site to pass through a wash trough
- Traffic controls, such as speed limits and volume restriction, will also reduce dust generation
- Vehicles transporting earth or loose aggregates should be covered
- Turn off the machineries when it is not in used or in idle conditions
- Periodical inspection and maintenance to be carried out for the vehicle and machineries used on site to minimise undesired emission
- Any form of open burning is strictly prohibited
- Ambient air quality impact monitoring to be conducted on periodical basis to assess and monitor the ambient air quality at the Project area

8.2.5 P2M2 for Noise Pollution

Mitigating measures below are recommended to be carried out particularly during the Stage-1 construction phase should the settlement relocation program has yet to complete.

- Establish hoarding and maintain vegetation belt along the site boundary particularly at the central eastern boundary, where practical and applicable
- Construction vehicle speed limit control along Jalan Byram at the area near Kg Sg Byram

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- Working hour is limited to daytime for any works to be carried near the central eastern boundary
 - All vehicles and machinery will be properly serviced and maintained to ensure good working condition, thereby reducing the possible noise emission
 - Construction vehicles must comply with the noise control requirements of the *Environmental Quality (Motor Vehicle Noise) Regulations, 1987*. The maximum sound level permitted for trucks transporting goods or materials is 88 dB(A)
 - Any complaints on noise should be immediately attended to and action to be taken
 - Impact monitoring for noise will be included in the environmental monitoring programme to ensure that the construction noise levels are within the permissible limits

8.2.6 P2M2 for Waste

8.2.6.1 Biomass Wastes Management

Considering substantial biomass clearing are anticipated from the land clearing activity of the proposed development, biomass waste management plan need to be established before execution of land clearing activity. The following is proposed to minimise biomass waste disposal to the landfill:

Palm wood application for plies wood manufacturing has increasingly in demand in the market. The potential commercial values for the palm tree trunk should be explored and collected so that it can be sell for other application instead of disposed of as waste material.

Other best practices proposed includes:-

- Clearing operations to be carried out in stages in order to reduce the volume of biomass waste generated in short time so that it could be more easily managed
- Pulverizer could be used to reduce the size of the plant wastes into more uniform and smaller pieces. It could then be easily transported and stored in a controlled waste tip
- The residual biomass such as small branches and foliage could be chipped and used as mulching materials
- Open burning of biomass wastes is prohibited. Approval from the DOE is to be obtained should open burning is necessary

In case burning of biomass is required, the following procedure should be adopted for biomass management onsite:

Biomass will be left for drying on-site for approximately 1 to 2 weeks. Subsequently, air curtain incinerator will be deployed to incinerate the biomass. The air curtain incinerator is an environmental friendly burner designed specifically for wood and vegetative waste. Among the benefits are:

- 100% complete combustion with minimal escaped particulates.
- Virtual elimination of smoke
- Fast burning throughput

To engage the incinerator, prior written permission for open burning should be submitted to DOE for approval.

8.2.6.2 Solid Waste and Domestic Waste Management

During the construction phase, solid wastes will consist of food and kitchen wastes from the workers living in the base camps and domestic wastes from site office. Whilst construction wastes may include broken bricks, wood, cables, pipes, etc. Other solid wastes would comprise mainly packaging materials for construction materials. The following P2M2 and waste management practices are proposed:

- Establish a waste management plan which includes allocation of the dedicated construction wastes storage areas on site, frequency of waste collection and disposal and periodical inspection on site
- Wastes minimisation approach should be adopted in the work plan and to be integrated in the construction method. Solid waste generation could be minimized by sound planning of material usage, using reusable items and encourage 3Rs (Reuse, Reduce and Recycle)
- Sufficient waste storage facility should be provided and strategically located at the site office, worker camp and the works areas
- Segregation of waste should be encouraged where recyclable waste should be disposed of to the recycler. This will minimise amount of final waste to be landfilled
- All general refuse waste generated particularly from the site office, by the construction workers and construction wastes should be collected for disposal at the existing Phase 1 & 2 landfill

8.2.6.3 Scheduled Wastes Management

Generally, limited scheduled wastes generation is likely from the construction of the Project. The following should be adhered to in the management of scheduled wastes onsite:-

- Scheduled waste such as used paint and solvent, lubricants, used oil and contaminated soil, etc. generated shall be handled, stored and disposed of in accordance with the Environmental Quality (Scheduled Wastes) Regulations 2005
- Designated scheduled waste storage area should be provided with hard standing ground and shaded from rain water to store any scheduled waste generated
- Any scheduled wastes generated from the Project construction shall be disposed of by a DOE licensed scheduled waste contractor

8.2.7 P2M2 for Construction Traffic

The source of traffic impact on the road network that may justify mitigation consideration is when heavy earth moving equipment have to be transported, via road loaders, to and from the site at the commencement and completion of construction respectively. Owing to the size and length of the road loaders, their travel speed will be slow and turning circle wide. Their presence will slow down other traffic and cause annoying congestion. It is therefore recommended that slow moving heavy vehicles entering or exiting the Project site should be restricted during off peak hour so as not to affect other road users using existing main road of Jalan Byram. In addition, signs to indicate that slow moving heavy vehicles are travelling on the public roads to the constructions site should be mounted. The signs need to be approved and endorsed by the local authority and the Public Work Department (JKR) (i.e. Arahan Teknik (Jalan) 2C/85, Manual on Traffic Control Devices - Temporary Signs and Work Zones Control, published by Cawangan Jalan, JKR, Malaysia). Another recommendation is the flagmen with proper personal protective equipment and clothing should be stationed at the strategic locations along the main public road to warn road users of approaching heavy vehicles.

Working vehicle movements within the site do not contribute to traffic impact on the road network. However, to avoid unnecessary accident, it is desirable to plan, schedule and control the deployment and operation of working vehicles for smooth and unhindered traffic movements within the site. In addition, traffic management system shall be carried out to ensure:-

- Minimal inconvenience and delay to road users travelling to, from or through the areas affected by the construction;
- The safety of road users near and approaching the construction site area is maintained;
- Adequate access road to the work site so as to enable scheduled progress of construction activities to be maintained; and
- The safety of construction workers due to traffic flow at the construction site is maintained.

For the sake of environmental control, it is also necessary to direct all vehicles entering or exiting from the site to pass through a wash trough to clean their tires and to receive a water jet spray to remove dust particles on them. For vehicles transporting earth and other construction materials, covering with tarpaulin will be imposed.

8.2.8 P2M2 for Socio-economic Impact

In response to the perceived impacts as highlighted by the community surveyed, the following P2M2 is proposed to ensure the potential impacts in concern are mitigated and minimised during the construction of the Project:

- **Regular Briefing to the Community** – Regular briefings and dialogues between the PP and surrounding community and stakeholders should be established to provide better info on the function and operation of the Phase 3 Landfill to prevent misinterpretign of the impacts from the proposed Project
- **Traffic Management Plan** - The PP to provide an effective and efficient traffic management plan to be carried prior of the construction activities at the proposed Project site. The traffic management plan must include at least the following aspects:
 - Traffic control at the entrance of the Project site
 - Adequate parking spaces for heavy lorry in the Project site
 - All worker vehicles must be placed at a parking area free from external traffics
- **Guidelines and Environmental Standard Compliance** – The PP must ensure that all the activities comply with guidelines and environmental standard as stipulated by the DOE during the site and cell preparation phase.
- All operation must stop before 7 pm
- **Air Quality Level Monitoring** – PP also needs to monitor the level of air pollution i.e. dust generation that is caused by the transportation and construction activities.

8.2.9 P2M2 for Safety and Health

For the construction of the proposed Project, preliminary estimation indicated a maximum of 100 workers may be anticipated during the peak construction period. A temporary workers accommodation unit will be built within the Project site, therefore, some environmental management consideration need to be addressed and managed accordingly. Besides, the construction activities also will impact on safety and health of workers.

The P2M2 deemed necessary in association with construction workers management are generally in regards to workers camp management. The P2M2 on domestic waste and sanitation waste have been addressed in **Section 8.2.6.2**.

In terms of safety and health, the following are proposed:

- Workers' base camps should be equipped with proper toilets and drinking water supply to prevent the spread of waterborne and foodborne diseases
- Frequent housekeeping to be carried to ensure cleanliness of the construction site to prevent the creation of mosquito and pest breeding areas
- Foreign worker intake to work in the construction site to undertake foreign workers examination programme
- All workers to undergo Construction Industry Development Board (CIDB) and in-house training on safety procedures and precaution
- All workers shall wear personal protective equipment (PPE) i.e. earmuffs, helmets, gloves, etc. whenever in construction site.
- A trained supervisor to always be on-site
- Proper warning signs and signals shall be displayed near the construction areas to ensure safety of workers and also the public.

Migrant workers in Malaysia are known to import cases of malaria, filariasis and chikungunya. Makeshift workers' housing is known for notorious breeding grounds for Aedes mosquitoes which transmit dengue and chikungunya. Therefore, the following mitigating measures are proposed:

- Current Fomema's blood test for malarial parasite
- All foreign workers should be examined for signs and symptoms of filariasis, yellow fever, dengue and chikungunya
- Foreign workers from countries where yellow fever is endemic should have yellow fever vaccination certificates prior to entry into Malaysia

8.2.10 P2M2 for the Impact on Biological Environment

8.2.10.1 P2M2 for Terrestrial Ecology

While mitigating potential environmental pollution derived from the proposed development Project would require technological input, the following management steps can be taken during the development and commission phase to mitigate the other environmental impacts mentioned in **Section 7.3.10**.

- (a) The development plan must include the preservation of a buffer zone (minimum of 100 m wide) from the mangrove belt of Byram Forest Reserve that runs from the west to the north of the proposed area as well as the mangrove belt lining the Sg Kerian to the south. This buffer zone will be able to provide the following:
- shelter and refuge to the displaced birds and allow it time to adjust to changes in landscape and environment
 - buffer and absorb potential pollutants i.e. noise, air quality, water

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- (b) Regular ground checks to ensure that the habitat in the 100 m buffer belt is not encroached and/or used indiscriminately by irresponsible persons as dumping grounds, hideouts, rubbish burning, poaching etc.
 - (c) The buffer zone must be clearly marked on the ground with clear signage for notification at appropriate distances and locations around the development area.
 - (d) Any development around, near or on the mudflats and coast line to be strictly prohibited.
 - (e) Ensure that hazardous affluent, chemicals and/or discharge from the proposed Project is contained within the Project site and does not flow into the mudflat, coastal or river banks. Left unchecked, this could pollute the food resource of the bird community.
 - (f) Ensure that release of harmful gasses during the commission phase is contained and/or released at a safe level.
 - (g) Allocate a portion of the proposed land area for the creation of a fauna-friendly man-made pond and landscaping. This would provide birds, in particular, a refuge within familiar grounds to return to.
 - (h) Commit efforts to conserve and improve the adjacent Byram mangrove forest reserve and the Sg Kerian mangrove belt such as replanting degraded areas to ensure alternative habitats for birds are conserved.
 - (i) Major construction work where noise, vehicle movement and air pollutants is expected should be minimised especially those towards the coastal mangrove belt, during the migration season (September – April).
 - (j) Effective soil stabilisation and compacting techniques to avoid soil erosion and soil wash off into adjacent mangrove and marsh areas.
 - (k) Close collaboration with local authorities (i.e. DWNP Penang), NGOs and bird watchers/photographers to help monitor the bird population, particularly the migrant, and rare, endangered and threatened bird species around the coastline, mudflats, buffer belt and the surrounding mangrove forests.

8.2.10.2 P2M2 for Marine Ecology

- (a) Impact on Water Quality
 - High suspended solids generated from construction works can be reduced through adequate control measures that keep eroded sediments contained on-site. It is crucial that soil erosion control measures are fully implemented and their efficiency maintained. Control measures include minimization of exposed soil, the time it is exposed, terracing of exposed slopes and construction of anti-erosion berms (a level space, shelf, or raised barrier separating two areas) during the early stages of construction.
 - The detention ponds or sediment basins as well as appropriate traps and other infrastructure as proposed in the LDP2M2 must be provided for the purpose to prevent sediments and other debris from being washed into the adjacent water.
 - The PP also should provide appropriate waste and sewage collection as well as disposal procedures and facilities (rubbish bins and toilet facilities) during construction stage. The waste collection should also be scheduled prior to work commencement.

(b) Impact on Aquatic Productivity

- The detention ponds or sediment basins as well as appropriate traps and other infrastructure must be provided for the purpose to prevent sediments and other debris from being washed into the adjacent water.
- The PP also should provide appropriate waste and sewage collection as well as disposal procedures and facilities (rubbish bins and toilet facilities) during construction stage. The waste collection should also be scheduled prior to work commencement.

(c) Impact on Mangrove

- Similar P2M2 as in **section 8.2.10.2 (b)** should be provided by the PP.

(d) Impact on Aquaculture

- Similar P2M2 as in **section 8.2.10.2 (b)** should be implemented by the PP.

Table 8-1 Summary of Impact and P2M2 for Construction Phase

Impact	Sources of Impacts	Degree of Impact	Proposed Pollution Prevention and Mitigation Measures (P2M2)	Residual Impact
<p>1.0 Soil Erosion and Sedimentation</p>	<ul style="list-style-type: none"> • Land Clearing • Platforming • Sanitary landfill structure construction works 	<p>Minor (localised)</p>	<ul style="list-style-type: none"> • Land clearing and earthworks to be carried out at Cell 1, MRF, LTP and associated ancillary facilities areas during Stage 1 land disturbing phase. • LDP2M2 to be implemented, including provision of temporary drainage system with earth bund, silt traps pond and wash trough. • Sedimentation basins to be constructed before earthworks to reduce eroded materials getting into the waterways directly. • Temporary drainage system should be put in place to divert the surface runoff and silt loads from earthwork areas into the proposed silt traps ponds before discharging into nearby water body. • Regular site inspections of the Best Management Practices (BMPs) shall be conducted throughout the construction phase to ensure their continued performance. • Wheel wash trough for vehicles exiting site. 	<p>Minor (localised)</p>
<p>2.0 Water pollution</p>	<ul style="list-style-type: none"> • Soil erosion & sedimentation • Land clearing & earthworks • Improper disposal of wastes (i.e. sewage, solid waste, etc.) • Spill and leaks 	<p>Minor (localised)</p>	<ul style="list-style-type: none"> • Any exposed soil surface, especially slopes should be turfed immediately to prevent erosion. • Temporary earth drain and silt traps ponds should be constructed before construction starts. They should be regularly desilted to ensure their functional efficiency. • All construction machinery and transport vehicles to be maintained regularly to prevent the leakage of oil/ lubricant. • Fuel storage tanks to be installed within a bund, and on a concrete platform to contain any oil spill and leakage. The barrier should be designed to contain 110% of the largest tank's content. • Spent oil and grease to be stored in steel drums and sealed until disposal by a licensed contractor. • Temporary sanitary facilities shall be provided and maintained according to specification of the MOH, and any sewage leak from them to be attended to immediately to avoid pathogenic contamination of river system. • Conduct impact monitoring on periodical basis to examine the condition of the water quality of the Project area. • Locate storage area away from nearby waterways. 	<p>Insignificant</p>

Impact	Sources of Impacts	Degree of Impact	Proposed Pollution Prevention and Mitigation Measures (P2M2)	Residual Impact
3.0 Hydrogeology and Groundwater pollution	<ul style="list-style-type: none"> Earthwork and ground levelling works 	Insignificant to Minor	<ul style="list-style-type: none"> Earthworks and ground levelling and preparing of landfill base and cells, if any, needs to be performed in the appropriate manner. Earthwork and excavation works to more than 1 meter to be carried out with precaution to avoid potential contamination the groundwater. The design and work method for the excavation works to be proposed in reference to be detail soil investigation findings. 	Insignificant
4.0 Air pollution	<ul style="list-style-type: none"> Fugitive Dust from construction site Construction vehicles & machineries emission 	Minor	<ul style="list-style-type: none"> Reduce dust by regularly spraying water to wet the dusty surfaces when necessary. Vehicles existing to site to pass through a wash trough. Use heavy duty plastic cover for transportation vehicle transporting potential dust generating construction material. Turn off the machineries when it is not in used or in idle conditions. Traffic controls, such as speed limits and volume restriction, will also reduce dust generation. Regular inspection and maintenance of vehicle and machinery use at site Prohibition of open burning. Conduct impact monitoring for air quality. 	Minor (localised)
5.0 Noise pollution	<ul style="list-style-type: none"> Piling activities at the MRF area Construction machineries and vehicles Heavy vehicles movement 	Minor	<ul style="list-style-type: none"> Establish hoarding and maintain vegetation belt along the site boundary particularly at the central eastern boundary, where practical and applicable. Construction vehicle speed limit control along Jalan Byram at the area near Kg Sg Byram. Working hour is limited to daytime for any works to be carried near the central eastern boundary. All vehicles and machinery will be properly serviced and maintained to ensure good working condition, thereby reducing the possible noise emission. Construction vehicles must comply with the noise control requirements of the <i>Environmental Quality (Motor Vehicle Noise) Regulations, 1987</i>. Any complaints on noise should be immediately attended to and action to be taken. Conduct impact monitoring for noise quality. 	Minor (localised)

Impact	Sources of Impacts	Degree of Impact	Proposed Pollution Prevention and Mitigation Measures (P2M2)	Residual Impact
6.0 Waste	<ul style="list-style-type: none"> • Biomass wastes from land clearing • Inert waste and general solid waste construction activities • Scheduled Waste from leaks or spill or machinery emergency breakdown • Domestic waste from workers • Sewerage from worker toilet or workers camp 	Minor	<ul style="list-style-type: none"> • Land clearing operations to be carried out in stages. • Pulverizer could be used to reduce the size of the plant wastes into more uniform and smaller pieces. • The residual biomass such as small branches and foliage could be chipped and used as mulching materials. • Waste minimisation approach should be adopted in work plan and integrated in the construction method. • Provide sufficient waste storage facility and strategically located at the site office, worker camp and work areas. • Segregation of waste should be encouraged where recyclable waste should be disposed of to the recycler. • Promote re-use of construction materials to reduce construction wastes • Instil good housekeeping practice on site. • Strictly prohibit open burning of construction and domestic wastes. • Any scheduled waste generated to be handled as per the requirement of EQ (SW) 2005. • Provide designated scheduled waste storage area with hard standing ground and shaded from rain. • Any scheduled waste generated shall be disposal only via DOE licensed contractor. • Ensure construction of proper toilets with septic tank according to JPP and MOH specifications. • Periodic maintenance of septic tank. 	Insignificant
7.0 Construction Traffic	<ul style="list-style-type: none"> • Transportation of construction material • Traffic generated by Construction workers 	Minor	<ul style="list-style-type: none"> • Scheduling slow moving heavy vehicles entering or existing the Project site during off peak hours. • Provides approximate safety signages to warn road user of construction ingress/ egress. • Flagmen should be stationed at the strategic locations along the main public road to warn road users of approaching heavy vehicles. • Schedule and control the deployment and operation of working vehicles for smooth and unhindered traffic movements within the site. • Traffic management system to be established. • Proper maintenance of the construction transportation vehicles. 	Minor

Impact	Sources of Impacts	Degree of Impact	Proposed Pollution Prevention and Mitigation Measures (P2M2)	Residual Impact
			<ul style="list-style-type: none"> Cover the transportation materials and clean wheel to prevent spill of dirt or mud onto the public road and exit vehicles to be clean via wash through or water jet washing system. 	
8.0 Construction Safety and Health	<ul style="list-style-type: none"> Waste and sanitation waste generation Communicable disease Spread of vector Risks to worker within construction site 	Minor	<ul style="list-style-type: none"> Provision of appropriate sanitation facilities either temporary toilet or septic tank treatment with frequent maintenance. Establishment of waste management system with sufficient collection facilities and disposal services. Frequent housekeeping to keep the construction site clean and prevent vector breeding. Contractor to ensure living conditions of workers area adequate and clean. Ensure health screen and foreign workers examination programme as per requirement of MOH. All workers to undergo CIDB and in-house training on safety procedures and precaution. All workers shall wear PPE. A trained supervisor to always be-on-site. Put up proper warning signs and signals near construction areas. 	Insignificant
9.0 Health risk	<ul style="list-style-type: none"> Fugitive dust from construction activities 	Insignificant	<ul style="list-style-type: none"> Implementation of air, noise and water quality control as proposed in the respective sector study. 	Insignificant
10.0 Impact on Biological Environment	<u>Terrestrial ecology</u> <ul style="list-style-type: none"> Water and mudflat pollution from improper drainage and leachate management Air, noise & odour pollution 	Insignificant	<ul style="list-style-type: none"> The development plan must include the preservation of a buffer zone (minimum of 100 m wide) from the mangrove belt of Byram Forest Reserve that runs from the west to the north of the proposed area as well as the mangrove belt lining the Sg Kerian to the south. Regular ground checks to ensure that the habitat in the 100 m buffer belt is not encroached and/or used indiscriminately by irresponsible persons as dumping grounds, hideouts, rubbish burning, poaching etc. The buffer zone must be clearly marked on the ground with clear signage for notification at appropriate distances and locations around the development area. Any development around, near or on the mudflats and coast line to be strictly prohibited. 	Insignificant

Impact	Sources of Impacts	Degree of Impact	Proposed Pollution Prevention and Mitigation Measures (P2M2)	Residual Impact
			<ul style="list-style-type: none"> • Ensure that hazardous affluent, chemicals and/or discharge from the proposed Project is contained within the Project site and does not flow into the mudflat, coastal or river banks. • Ensure that release of harmful gasses during the commission phase is contained and/or released at a safe level. • Allocate a portion of the proposed land area for the creation of a fauna-friendly man-made pond and landscaping. • Commit efforts to conserve and improve the adjacent Byram mangrove forest reserve and the Sg Kerian mangrove belt such as replanting degraded areas to ensure alternative habitats for birds are conserved. • Major construction work where noise, vehicle movement and air pollutants is expected should be minimised especially those towards the coastal mangrove belt, during the migration season (September – April). • Effective soil stabilisation and compacting techniques to avoid soil erosion and soil wash off into adjacent mangrove and marsh areas. • Close collaboration with local authorities (i.e. DWNP Penang), NGOs and bird watchers/photographers to help monitor the bird population, particularly the migrant, and rare, endangered and threatened bird species around the coastline, mudflats, buffer belt and the surrounding mangrove forests. 	
	<u>Marine ecology</u> <ul style="list-style-type: none"> • Water quality deterioration 		<ul style="list-style-type: none"> • Fully implemented soil erosion control measures. • Provide appropriate waste and sewage collection as well as disposal procedures and facilities (rubbish bins and toilet facilities). 	Insignificant

8.3 During Operational Phase

Owing to the nature of the Project which involves material recovery process and final and safe disposal to landfill during the entire operation of the Project, more emphasis will be focuses on the operational associated environmental impacts. The impact assessment for this section is conducted based on the scope and approaches as defined in the TOR document.

8.3.1 Leachate Generation

As mentioned in previous sections, leachate generation is expected to be happened at both the proposed Phase 3 development and also the existing Phase 1 and Phase 2 landfill cells (closed and active operational cells). While the total quantity of leachate to be generated from Project (Phase 3 development) and existing Phase 1 & 2 shall be 2,000 m³/day.

Various P2M2 have been proposed to mitigate and reduce impacts from the identified impacts due to leachate generation and operational management. A wastewater treatment competent person IETS should be engaged and to be responsible to manage the LTP in accordance to the relevant requirements as stipulated in the Environmental Quality (Control of Pollution from Solid Waste Transfer Station and Landfill) Regulations 2009.

8.3.1.1 P2M2 for Leachate Generation

Under the mitigated scenario, an LTP shall be adequately designed, constructed, commissioned and operational at the Phase 3 Landfill site to ensure compliance of the discharge standards stipulated in the Second Schedule of the Environmental Quality (Control of Pollutant from Solid Waste Transfer Station and Landfill) Regulations 2009 which specify 29 parameters for compliance.

The design of the LTP mentioned in **Sections 5.3.2-5.3.5** has aimed to comply with the stipulated discharge standards, as various processing units have been allowed to be integrated into the treatment system, which emphasis and focus on key parameters, including biochemical oxygen demand (BOD), Chemical Oxygen Demand (COD), pH, Ammoniacal Nitrogen (AN), Colour, Total Suspended Solids (TSS), and Oil & Grease (O&G).

The LTP has taken into consideration removal and reduction of the pollutants from the final effluent, as well as managing and handling the sludge produced from the LTP operation. The excess filtrate generated from the sludge management process has also been fed back into the LTP incoming effluent line to make it a closed loop system without discharge of untreated effluent from the system.

However, a well-developed SOP, service and maintenance plan shall be planned and practiced at the LTP plant to ensure there shall be no operational failure from the plant, including incidents such as power failure, manpower shortage, major hiccup due to microbial population death, major mechanical failure, and other factors due to human errors and lack of supervision. The suggested additional mitigating actions, apart from having a good operational LTP shall include:-

- Competent and well trained operator(s).
- Periodic service and maintenance.
- Immediate repair and upkeeping to be carried out if any fault in operation is detected (early warning).
- Back-up power generator for LTP operation (partial).
- Fine tuning of operational controls on detection of inconsistency of raw leachate quality.

-
- Troubleshooting on detection of inconsistency of treated leachate quality.
 - Managing leachate release stoppage due to tidal occurrence at Sg Tengah.

8.3.1.2 P2M2 for Stoppage of Release of Treated Leachate

Under the mitigated scenario, a temporary storage of treated effluent shall be allowed, whereas the storage capacity shall be one month, or 60,000 m³.

Referring to **Figure 5.10**, a storage pond is designated to serve this purpose to store the treated leachate during the stoppage of release into Sg Tengah has been triggered due to tidal occurrence. The total storage capacity of the storage pond is adequate and shall be able to contain treated leachate from landfill cells up to a month period.

8.3.1.3 P2M2 to Prevent Untreated Leachate due to Failure of LTP Operation

Under the mitigated scenario, a temporary storage of untreated effluent shall be allowed, whereas the storage capacity shall be one month, or 60,000 m³. This one month period shall allow the LTP to be in functional condition, recovering from major plant hiccup, typically due to toxics entering the LTP system from leachate (potentially wiping out microbial population and causing fouling to the membrane system).

Referring to **Figure 5.3-5**, the primary location to store the untreated effluent shall be by recirculating the leachate back into the raw leachate pond, but in the event it is full, the same storage pond designated to serve for treated leachate during the stoppage of release into Sg Tengah during tidal occurrence can be utilised for this purpose. The stored untreated effluent shall be fed into LTP for treatment after the LTP plant is revived to operational and re-commissioning situation.

The total storage capacity of the storage pond is adequate and shall be able to contain untreated leachate from landfill cells up to a month period during the LTP recovery phase.

8.3.2 P2M2 for Water Pollution

Based on the water quality modelling results with consideration of local activities (especially fisheries and aquaculture) around the Project area, discharging the treated leachate into Sg Tengah via the existing JPS as borrow pit will not cause any adverse environmental impacts. However, it is recommended that the leachate not be released to Sg Tengah during low tide when the river experiences low flow. Daily tidal cycle in the Project area is semi-diurnal, therefore, low tide would generally occur every 12-hourly interval and last for a duration of approximately 6 hours (**Figure 8-1**). As such, it is recommended that the retention pond be design to be able to withhold the leachate during this period.

Based on historical rainfall data from Station 5205050 (**Figure 8-2**), low flow season is likely to occur during the month of January, February, June and July (**Figure 8-3**).

The following mitigation and management measures are recommended where practicable to further minimize any water quality impacts from the Project:-

- Ensure that the treated leachate from the Project site comply with Second Schedule (Regulation 13) of the *Environmental Quality (Control of Pollution from Solid Waste Transfer Station and Landfill) Regulation 2009*.
- Conduct a treated leachate discharge review to evaluate the potential of reducing the pollution loading to the drainage and river system during low flow periods.

- Conduct regular performance and compliance monitoring of treated leachate parameters as per the Second Schedule (Regulation 13) of the *Environmental Quality (Control of Pollution from Solid Waste Transfer Station and Landfill) Regulation 2009*.
- Conduct regular audits of the secondary leachate treatment system as a proactive approach to minimize breakdown or malfunction of equipment and machinery.
- Prepare a Spill Response Plan (SRP) to address emergency release or spill of secondary leachate events to enable rapid and effective mitigation of spills.
- Monthly impact monitoring should be carried out for water quality in Sg Tengah during the operational stage.

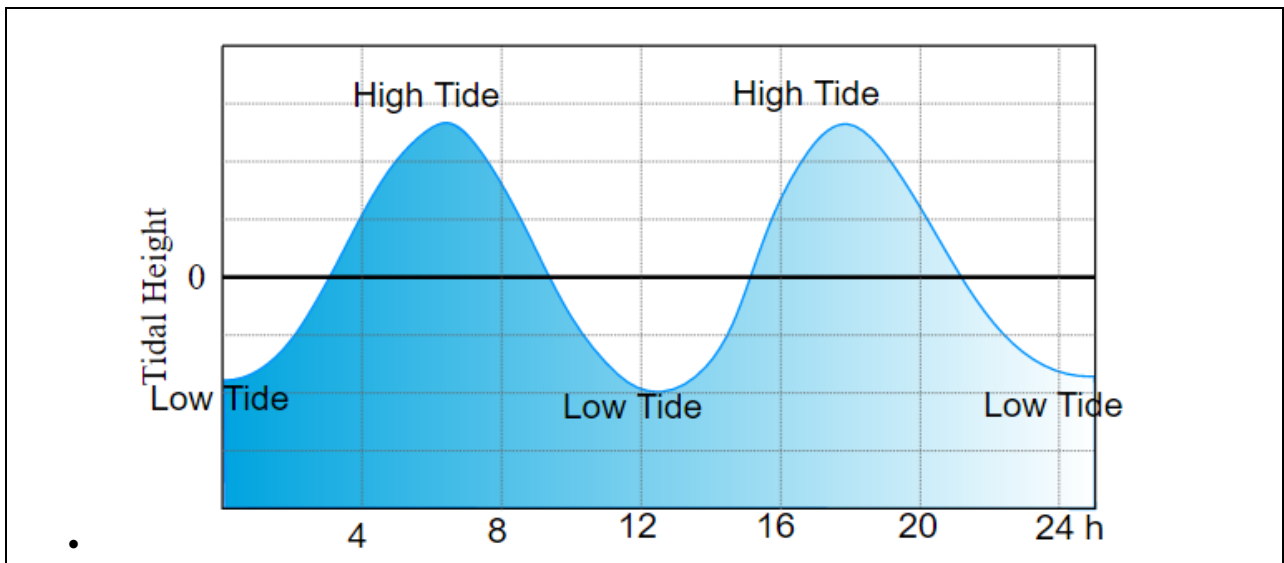


Figure 8-1 Example of Semi-diurnal Tide

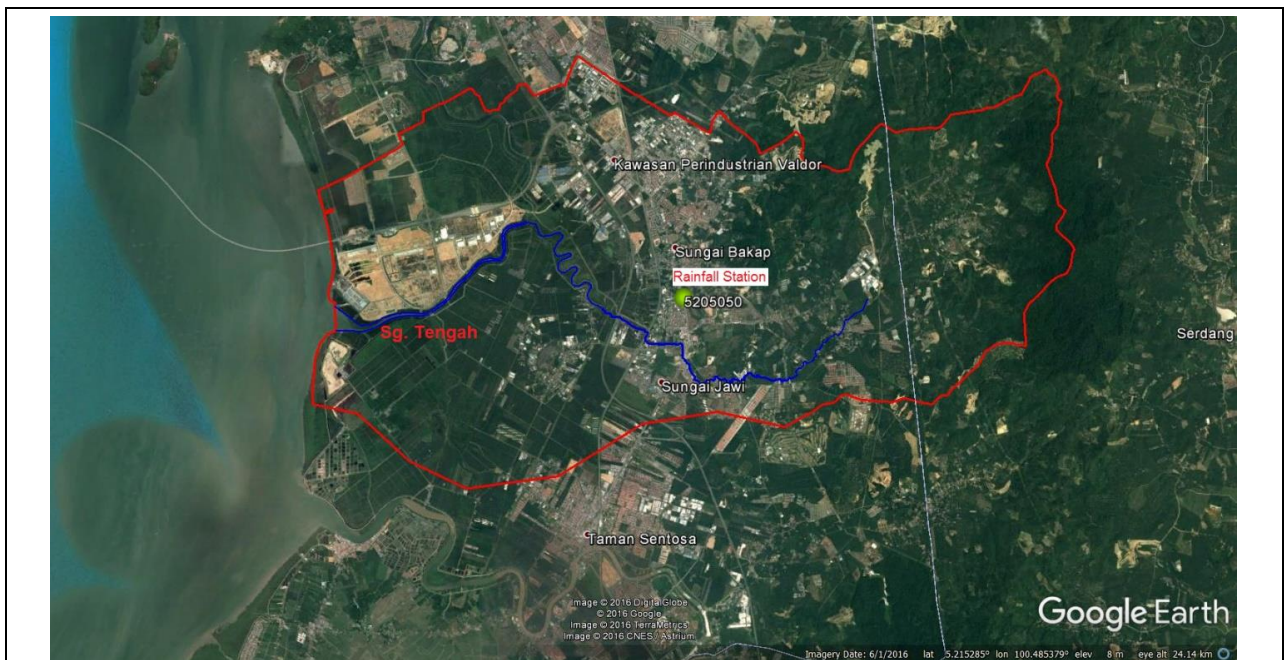


Figure 8-2 Location of Rainfall Station 5205050

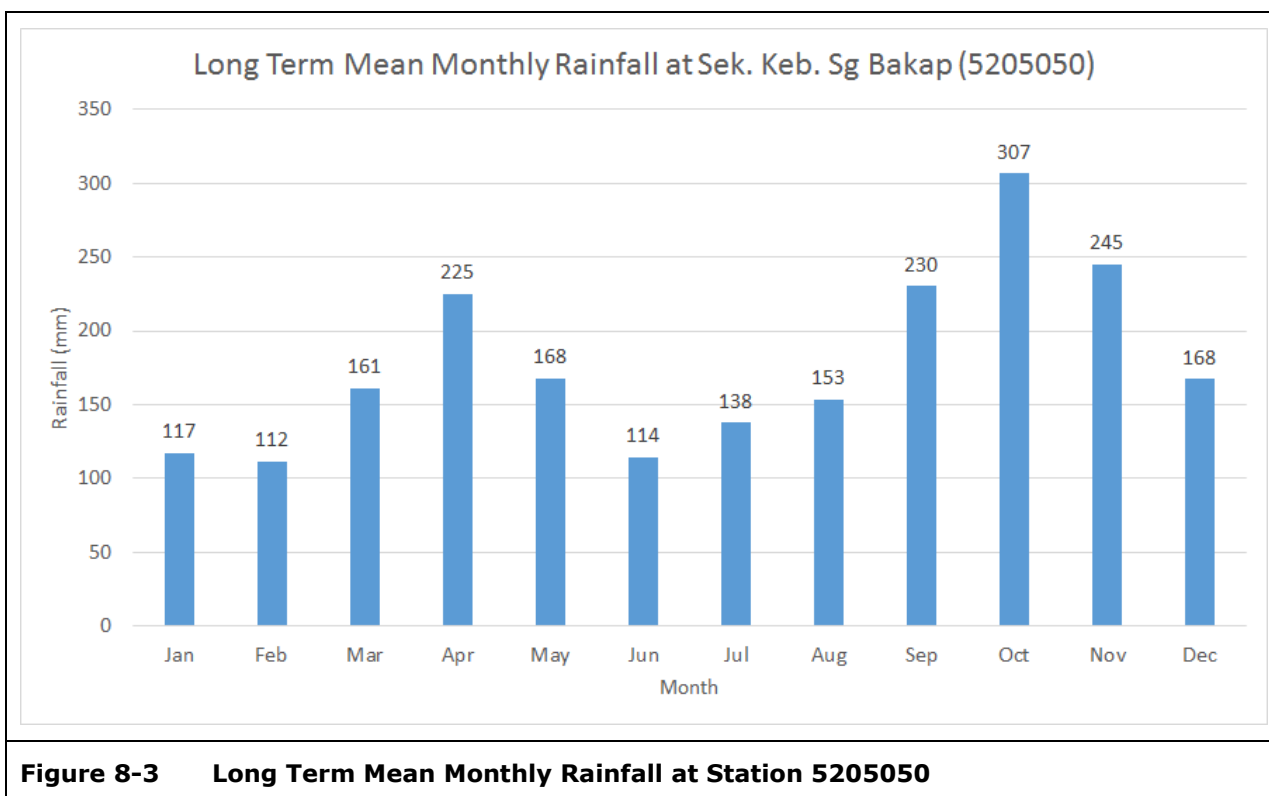


Figure 8-3 Long Term Mean Monthly Rainfall at Station 5205050

8.3.3 P2M2 for Air Pollution

During Phase 3 operation, the main gases generated are Methane (CH₄) and carbon dioxide (CO₂). non-methane organic compounds (NMOC), hydrogen sulphide (H₂S), benzene (C₆H₆) & toluene (C₇H₈) will be in considerably smaller amounts. As the landfill gases in Phase 3 will be collected and flared, therefore the issue of landfill gases is not expected to be significant. Suspended particulates will also be high from the traffic, but this is not a gas. The exhaust from vehicles/ machinery will also contain carbon monoxide, nitrogen oxides (NO₂) and sulphur oxides (SO₂), but in very much smaller amounts than CH₄ and CO₂. The P2M2 should include, but not limited to, the following:

(a) Mitigation of CH₄

- The unit of collecting and flaring the gas should be built to resist corrosive even in the long-term. The burner, made of special steel, should be fitted with a flame detector and an auto-relight mechanism, which will also manage the pumping installation. Any problem in the network (decreased/ increased pressure, %O₂, etc.) will stop further pumping of the gas to the flare and avoid any uncontrolled venting of the gas into the atmosphere.
- All work in places where gas is likely to accumulate (e.g., leachate inspection well) will have the area closed off (from incoming gas) and be done only under special conditions: qualified staff, reinforced safety measures, etc.
- All the inspection and adjustment as well as selective actions will be carried out by staff trained in this apparatus and annual maintenance and verification of all of them should be carried out by the installation company.

(b) Dust Generation

- Water tanker will be used to control the dust churned by vehicle movement.

-
- The machinery and equipment on site will emit pollutants in their exhaust. This will be minimised by maintaining them in good working condition.

8.3.4 P2M2 for Odour Impact

With the odour management by Phase 3, the level is 0.5 OU/m³ at station A3 (Aquaculture farm) for 1-hour averaging time from normal operation of the Project and during the worst atmospheric conditions (57.8 OU/m³) which is above the threshold of detection of 1 OU/m³. However, as such weather conditions are rare except during the monsoonal period where the wind is strong and if it blows in the direction of Aquaculture farm, it is unlikely that the surrounding area will be very much affected throughout the year. Therefore, from the environmental point of view, the odour from Phase 3 is acceptable with implementation of control measures.

The following P2M2 are recommended:

- Properly and frequently compact and cover the waste with adequate soil to reduce the escape of odour. If immediate soil cover is not possible, use woody materials alone or mixed with earth as mulch to cover the area.
- Good housekeeping of facilities like keeping the floors and ground of the MRF clean and any waste droppings removed immediately to prevent decay of the waste.
- Avoid parking waste trucks at Phase 3 overnight.

8.3.5 P2M2 for Soil and Groundwater Contamination

The assessment predicted that groundwater contamination is unlikely as the proposed Project will be developed as an engineered sanitary landfill (Level IV) equipped with liner, leachate collection and treatment facilities. However, groundwater contamination could happen if the liner is punctured or the liner membrane is not correctly installed, very low contaminant concentration and movement is anticipated.

However to minimise the potential groundwater pollution, the following is proposed:

- Liner installation works should be carried out in accordance to specific technical procedures to ensure it is adequately installed and efficient.
- Periodical groundwater monitoring to be carried out at the four (4) long term monitoring wells developed within Project to monitor potential changes to the groundwater quality over the Project life. The findings from the monitoring program will act as the first hand signal to any contamination.
- Remediation should be carried out particularly during Project closure if contamination is detected from the groundwater monitoring program.
- In case of liner failure, vertical liner will be proposed to mitigate the potential groundwater contamination

8.3.6 P2M2 for Noise Emission

Regular maintenance of machinery should be carried out. A maintenance programme/ schedule should be established to inspect and maintain the machinery periodically in particular the principle noise sources i.e. trommel screen, conveyor, magnet separator, etc.

If any workers expose to high noise, ear muff etc. will be provided to ensure no workers are being exposed to conditions that can induce health impairments such as hearing loss and olfactory damage, whereby:

- No employee shall be exposed to noise levels exceeding an equivalent continuous sound level of 90 dB(A) or exceeding the limits specified in the First Schedule of the Factories and Machinery (Noise Exposure) Regulations of 1989.
- No employee shall be exposed to noise levels exceeding 115 dB(A) at any one time.
- No employee shall be exposed to impulsive noise exceeding a peak sound level of 140 dB(A).

8.3.7 P2M2 for Traffic Management

By year 2019, when the Project is in operation, the traffic forecasts indicate the existing road facilities in the traffic influence area is still able to ensure smooth traffic flow at all times. Nevertheless, the following are some recommendations to be considered:

- During operation, the ingress road to the Project site is via Jalan Byram, therefore the geometric design of this ingress has to provide an adequate deceleration lane for vehicles entering the Project site. Similar for the egress road, it is necessary to design properly on this lane and the adjoining road to mitigate any potential adverse effects.
- The operating of the prime mover should be scheduled slightly away from the peak hours.

8.3.8 P2M2 for Waste Management

8.3.8.1 LTP Sludge Handling

The following P2M2 for the handling and management of LTP sludge are proposed:-

- For the LTP sludge generation, it is estimated about 438 kg or 0.4 m³ of the dry sludge will be produced daily. If toxic content (based on grab sample composition testing results) is detected in the produced sludge and it shall be disposed as special waste in the dedicated special cell in the landfill.
- Any plan for disposal of SW204 into the non-scheduled waste prescribed premises shall be carried out in accordance to Guidelines for Special Management of Scheduled Waste with approval from DOE to be obtained

8.3.8.2 Overall Scheduled Waste Management

The following P2M2 for the handling and management of scheduled waste are proposed:-

- Establishment of scheduled waste management system and integrate waste minimization and best management practices into the associated work procedures for the vehicle and machinery maintenance and repair SOP.
- Provision of appropriate temporary scheduled waste storage area onsite.
- Handling, storage and disposal of the scheduled waste in accordance to the requirements as per Environmental Quality (Scheduled Waste) Regulations, 2005.
- All personnel managing scheduled waste to be provided periodic training on safety measures. A competent person SWaM should be engaged to ensure proper handling of the scheduled wastes.
- PPE to be worn while handling scheduled wastes.
- In case of accidental oil and grease (O&G) spills, spill kits must be available on-site to facilitated immediate clean-up. Used spilled kits and contaminated soils to be disposed off as scheduled wastes.

8.3.9 P2M2 for Landuse Buffer Zone

8.3.9.1 Land Based Buffer Zone

The finding from various sectoral studies (air, noise and public health assessment) indicated that all potential impacts identified is confined within the 500 m radius hence a buffer of 500 m radius is deemed sufficient for the proposed Phase 3 landfill. The receptor identified at Kg Sg Byram will be relocated to ensure provision of the 500 m buffer zone requirements.

Based on the census conducted by Penang Development Corporation (PDC) and the Pejabat Daerah dan Tanah Seberang Perai Selatan (PDT SPS), a total of 93 households were recorded residing in the Kg Sg Byram located within the 500 m buffer zone of the landfill site. Besides the settlements units, a primary Tamil school namely SJK (T) Ldg Byram and a Hindu temple were also recorded within the area serving mainly the residents in Kg Sg Byram.

As per confirmation from Pejabat Setiausaha Kerajaan Negeri Pulau Pinang dated 28 April 2015 (Ref: PSUKPP/04/003/3Klt.20(7), these facilities located within the buffer zone of the Project site will be acquired by PDC by end of 2016. (Refer **Appendix 1.6** in **Chapter 1**).

Under the proposed relocation program, the affected receptor will be relocated to 8.75 acres of land located within part of Lot 7578 near Taman Bestari and Taman Cowin. The site is located approximately 3 km from the Kg Sg Byram (or approximately 7.5 km distance on the road). The location of Lot 7578 is shown in **Figure 8-4**.

The site is selected considering the location is considerably near to the origin and it is located nearer to the existing settlements area which is believed to provide better services to support better living standard to the affected residents.

The acquisition and relocation program will be conducted by PDC with close assistance from the PDT SPS in accordance to the appropriate acquisition and relocation procedure. Tentatively 3 month prior notice has been given to the affected households and land acquisition will take approximately 6

months duration and development of new houses at part of Lot 7578 is tentative scheduled to complete within 18 months. The acquisition and relocation is in progress during this DEIA process.

8.3.9.1 Sea Based Buffer Zone

Based on the findings from water quality modelling results and recommendation from the biological assessment study, it is proposed that the coastal water within 250 m radius from the river mouth of Sg Tengah to be reserved as buffer zone where no aquaculture activities should be carried out within this boundary especially at the mudflat on northern bank of Sg Tengah. Any cockle farming within this zone should be relocated. The proposed buffer zone for the coastal water is presented in **Figure 8-4**.

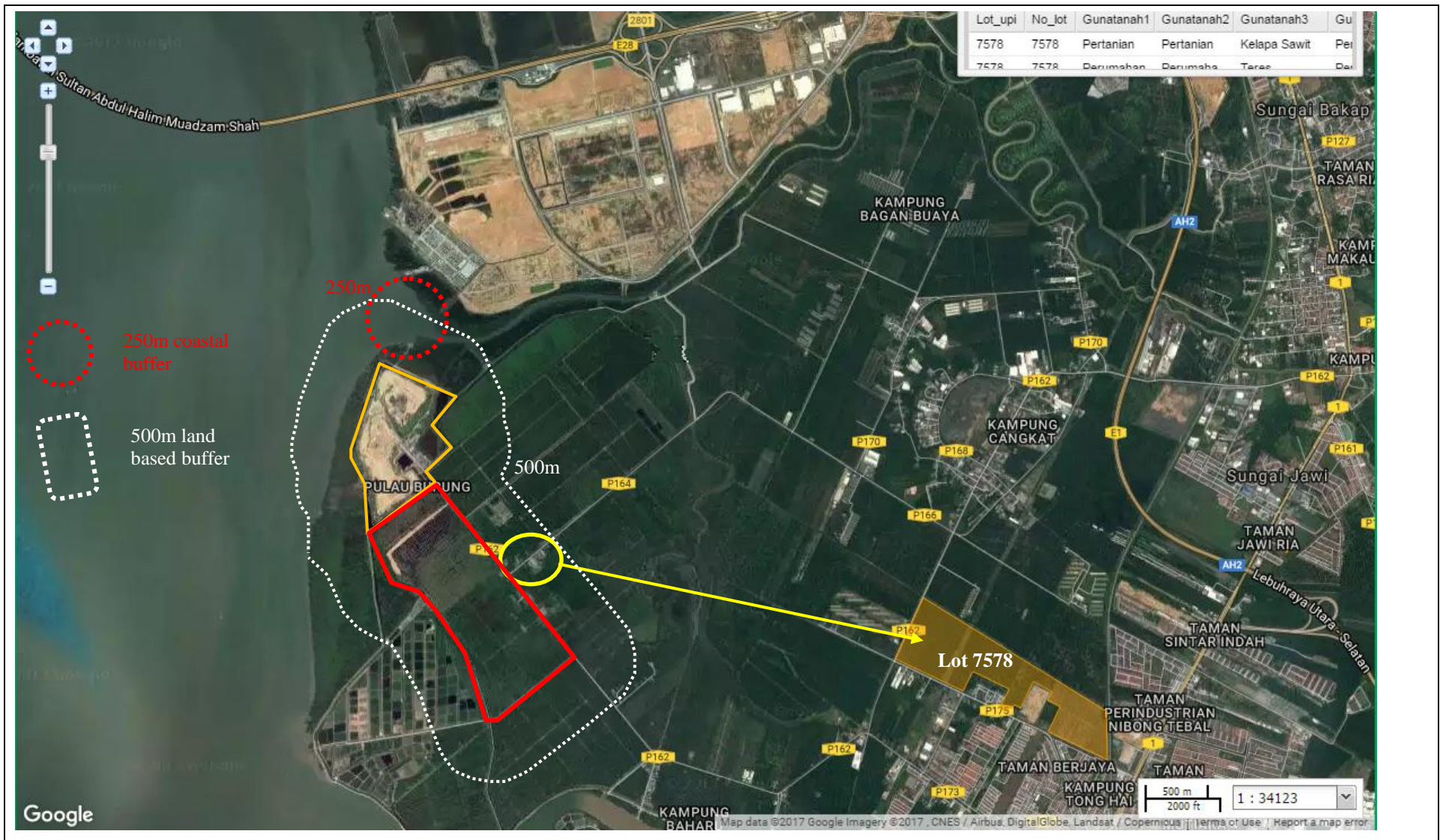


Figure 8-4 Proposed Site for the Relocation Program and Buffer Zone

Source: Geoportel Penang, JPBD Pulau Pinang

8.3.10 P2M2 for Socio-economic Perceived Impact

Based on the findings from the perceive impact assessment and the issue raised during the public dialogue session, the major social concern of the Project is the river and canal water pollution issues, followed by odour and air pollution.

The followings are the recommended P2M2 during Project operation:

(a) Control of Water Pollution into the Canal and River

Strict adherence to control of water pollution from the landfill into the canal and river is required the Project site is required.

(b) Control of Odour Pollution and Leachate Spill

Strict adherence to control of odor from waste collection truckss plying along the routes to the Project site is required upon the PP and management of the waste collection truck operation. This problem is overcome if the garbages are transported into the silo transfer trucks rather than in the municipal rubbish trucks.

8.3.11 P2M2 for Public Health Impact

One potential health impact from operation of this proposed sanitary landfill project is that from exposure to high PM₁₀ concentrations during the Project construction and operational phases when there is no control measure in place. Therefore, it is imperative that dust control during both the Project construction and operational phases be properly implemented.

To minimize the possibility of pest breeding and the spread of pest-related diseases, the following measures are recommended:

- Steps should be taken to minimize solid waste spillage during collection and transportation and disposal at the landfill site.
- All solid waste must be adequately covered with soil cover material at the end of each day's operation.
- Fogging of the perimeter of the sanitary landfill grounds whenever necessary to destroy adult mosquitoes.
- No human scavengers should be allowed within the sanitary landfill site.

8.3.12 P2M2 for Biological Environment

8.3.12.1 P2M2 for Marine Ecology

Riverine Outfall

(a) Impact on Water Quality

- The problem arising from the leachate discharge should be mitigated by equipping the landfill with leachate collection pipe, collection pond and leachate treatment plant facility (LTP). In addition, the LTP should consist of a biological treatment plant, chemical treatment plant and a final polishing system. The biological treatment plant can act as additional layer of protection in the event of treatment system failure. Quality work procedures/ quality inspection checks

should also be implemented to ensure the leachate lining (High-Density Polyethylene; HDPE or Geosynthetic Clay Liner; GCL), collection systems and also groundwater management system is installed with integrity. Continual monitoring of groundwater must be implemented also to ensure no leakage of the liners. Provision should be made to route any contaminated groundwater to the LTP.

(b) Impact on Aquatic Productivity

- Similar P2M2 as in **Section 8.3.12.1 (a)** must be employed by the PP.

(c) Impact on Aquaculture

- Similar P2M2 as in **Section 8.3.12.1 (a)** should be provided by the PP. In addition, it is also suggested that a buffer zone be established between the proposed site and the adjacent mudflats. The suggested buffer zone width would be 750 m from the existing landfill area (**Figure 8-5**). All fisheries and aquaculture activities should be prohibited within the buffer zone. This would mainly focus on cockle culture and shellfish collection activities that would be exposed to any inadvertent contamination and pollution from the current and proposed sanitary landfill. Any cockle farms located within the buffer zone should be relocated.



Figure 8-5 Proposed Buffer Zones between Cockle Culture and Project Area (Existing and Proposed Landfill)

Table 8-2 Summary of Operational Impact Assessment and P2M2

Sector Sources of Impacts	Potential Impact	Degree of Impact	Duration	Proposed Pollution Prevention and Mitigation Measures (P2M2)	Residual Impact
<p>1.0 Water pollution</p> <ul style="list-style-type: none"> Operational failure of LTP Leakage from the leachate collection and storage pond Spillage of leachate from waste collection and tipper truck 	<ul style="list-style-type: none"> Insignificant during normal operation with minimal incremental to the receiving water quality. All simulated parameters (DO, BOD, ammonia, arsenic, lead, mercury and cadmium) showed that the proposed Project (leachate after the treatment) would cause slight variation from the existing condition. These variations were mainly localised to Sg Tengah river mouth with dispersion of less than 3 km from proposed Project site. 	Minor increase of concentration	Long term	<ul style="list-style-type: none"> A storage pond with capacity of 60,000 m³ is designated to store the treated leachate from landfill cells up to a month period in case of stoppage of release of treated leachate or operational failure of LTP. Ensure leachate is collected and treated to Second Schedule (Regulation 13) of the <i>Environmental Quality (Control of Pollution from Solid Waste Transfer Station and Landfill Regulation 2009)</i>. Conduct review on the treated leachate effluent discharge to evaluate the potential of reducing pollution loading to the drain during low flow periods. Conduct periodical performance and compliance monitoring of treated leachate effluent and installation of online monitoring system for monitoring of AN concentration and the system to be linked to DOE. Conduct regular audits of the leachate collection system and leachate treatment system as a proactive approach to minimize breakdown or malfunction of equipment and machinery. Prepare Spill Response Plan to address emergency release of spill of secondary leachate event. Immediate repair and upkeeping to be carried out if any fault in operation is detected. Competent person, IETS and well trained operators to handle the operation of the LTP. Conduct monthly impact monitoring of water quality. 	Insignificant during normal operation due to dilution capacity of Sg Tengah drain near shore
<p>2.0 Air pollution</p> <ul style="list-style-type: none"> Dust (Particulate Matter) from landfill activities Landfill gases – Methane (CH₄), carbon dioxide (CO₂), non-methane organic compounds (NMOC), hydrogen sulphide (H₂S), benzene (C₆H₆) and toluene (C₇H₈) 	<ul style="list-style-type: none"> The maximum incremental GLCs for PM₁₀ were detected < 10 µg/m³ and <1.0 µg/m³ for 24 hours and 1 year time period respectively during normal operation. The cumulative GLCs are well below the recommended limits at all receptors identified. For landfill gases, currently, there are no ambient air guidelines for CH₄ and NMOC. H₂S, C₆H₆ and C₇H₈ which are release in trace to moderate amounts were assessed against the AAAQG and found to be below the guideline limits. 	Insignificant	Long term	<ul style="list-style-type: none"> Water tanker will be used to control the dust churned by vehicle movement. Regular maintenance of on-site machinery and equipment. Landfill gases in Phase 3 will be collected and flared, therefore the issues of landfill gases is not expected to be significant. The unit of collecting and flaring the gas should be built to resist corrosive even in the long-term. The burner, made of special steel, should be fitted with a flame detector and an auto-relight mechanism, which will also manage the pumping installation. Any problem in the network (decreased/ increased pressure, %O₂, etc.) will stop further pumping of the gas to the flare and avoid any uncontrolled venting of the gas into the atmosphere. All work in places where gas is likely to accumulate (e.g., leachate inspection well) will have the area closed off (from incoming gas) and be done only under special conditions: qualified staff, reinforced safety measures, etc. All the inspection and adjustment as well as selective actions will be carried out by staff trained in this apparatus and annual maintenance and verification of all of them should be carried out by the installation company. Conduct monthly impact monitoring of air quality. 	Insignificant
<p>3.0 Odour emission</p> <ul style="list-style-type: none"> Odour from landfill and MRF operation Odour from waste truck movement 	<ul style="list-style-type: none"> The predicted 1-hour and 24-hours average odour level were recorded to be less than 1.0 OU throughout the receptor grid, were well below recommended limit of 1.0 OU/m³. Objectionable odour was found near the Project site when no odour management measure. 	Insignificant	Long term	<ul style="list-style-type: none"> Properly and frequently compact and cover the waste with adequate soil to reduce the escape of odour. If immediate soil cover is not possible, use woody materials alone or mixed with earth as mulch to cover the area. Good housekeeping of facilities like keeping the floors and ground of the MRF clean and any waste droppings removed immediately to prevent decay of the waste. Waste transportation to the project site will be carried out by the waste transportation contractor appointed by the local authority. The transportation will be carried by the Prime mover with waste contained in the enclosed silo to prevent spill of leachate and odour. The waste transportation vehicle will be periodically maintained by the waste transportation contractor. 	Insignificant

Sector Sources of Impacts	Potential Impact	Degree of Impact	Duration	Proposed Pollution Prevention and Mitigation Measures (P2M2)	Residual Impact
4.0 Soil and groundwater contamination <ul style="list-style-type: none"> Potential leaks from leachate collection sump and retention pond constructed for the storage of raw and treated effluent from LTP 	<ul style="list-style-type: none"> Groundwater contamination could occur if the liner (or Geo-synthetic Clay Liner, GCL) is punctured or the liner membrane is not correctly installed. Contaminated water resources. 	Insignificant	Long term	<ul style="list-style-type: none"> Liner installation works should be carried out in accordance to specific technical procedures to ensure it is adequately installed and efficient. Periodical groundwater monitoring to be carried out at the four (4) long term monitoring wells. Remediation should be carried out particularly during Project closure if contamination is detected from the groundwater impact monitoring program. 	Insignificant
5.0 Noise <ul style="list-style-type: none"> Noise from waste transportation activities Noise from operation of machinery in the MRF facilities 	<ul style="list-style-type: none"> No assessment will be carried out for the potential noise from the waste transportation activities as it has been captured in the baseline noise level established in the presence of the existing landfill operation. The maximum incremental noise level at the boundary of MRF is predicted at 70dB(A). Ambient noise at other boundary of the Phase 3 project site was predicted below 70dB(A). Boundary noise during the operation of the Project was predicted below the 70dB(A) daytime noise level for industrial zone. No impact to the night time noise is predicted in view that the MRF and the landfill only operates during day time. 	Insignificant	Long term	<ul style="list-style-type: none"> Regular maintenance of the heavy vehicles and machinery to be carried out. A maintenance programme/ schedule should be established to inspect and maintain the machinery periodically in particular the principle noise sources i.e. trommel screen, conveyor, magnet separator, etc. Periodical boundary noise impact monitoring program to be carried out. Provide ear muff for workers expose to high noise working environment. No employee shall be exposed to noise levels exceeding an equivalent continuous sound level of 90 dB(A) or exceeding the limits specified in the First Schedule of the Factories and Machinery (Noise Exposure) Regulations of 1989. No employee shall be exposed to noise levels exceeding 115 dB(A) at any one time. No employee shall be exposed to impulsive noise exceeding a peak sound level of 140 dB(A). 	Insignificant
6.0 Traffic Impact Increase traffic volume from :- <ul style="list-style-type: none"> Approximately 60 trips is anticipated from the project workers The total trips for waste transportation activities will remained unchanged as per existing Phase 1&2 landfill operation 	<ul style="list-style-type: none"> Traffic performance at State Road 1 to Project site via P162, P164, P166 and Jalan Byram exhibited the same LOS level during all peak hour indicating traffic in future is about the same as current scenario. Findings indicate traffic conditions at the above road are still able to cater for increase traffic without deteriorate the LOS during operation stage. 	Minor increase in traffic volume	Long term	<ul style="list-style-type: none"> During operation, the ingress road to the Project site is via Jalan Byram, therefore the geometric design of this ingress has to provide an adequate deceleration lane for vehicles entering the Project site. Similar for the egress road, it is necessary to design properly on this lane and the adjoining road to mitigate any potential adverse effects. The operating of the prime mover should be scheduled slightly away from the peak hours. 	Insignificant as no effect to LOS level Minor increase of safety risk to the road user
7.0 Waste Management <ul style="list-style-type: none"> Domestic waste from administration building and workers sites Spent lubricating oil (SW305), Spent hydraulic oil (SW306) and used rags or filter (SW410) from ad-hoc machinery maintenance/ repair works Sludge (SW204) from LTP if toxic content was found 	<ul style="list-style-type: none"> Approximately 400 people during the full operation of Phase 3 landfill operation, an estimate of approximately 100 kg/day of domestic waste could be anticipated based on the conservative 0.25 kg waste generation rate per worker. A generation rates of 5 drums per month is anticipated from SW410, SW305 and SW306 The produced dry sludge is estimated at approximately 438 kg/day or about 0.4 m³/day. 	Minor	Long term	<ul style="list-style-type: none"> Instil good housekeeping practice on-site. Provide sufficient waste storage facility and strategically located within facility. Any scheduled waste generated onsite shall be handled, stored and disposed of in accordance to <i>Environmental Quality Scheduled Waste Regulations 2005</i> Establishment of scheduled waste management system and integrate waste minimization and best management practices into the associated work procedures for the vehicle and machinery maintenance and repair SOP. Provision of appropriate temporary scheduled waste storage area onsite. All scheduled waste shall be disposed of by DOE license scheduled waste contractor. Periodical inspection to be carried out at the scheduled waste storage area. All personnel managing scheduled wastes to be provided periodic training on safety measures. Competent person SWaM to be engaged. PPE to be worn while handling scheduled wastes In case of accidental O&G spills, spill kits must be available on-site to facilitated immediate clean-up. Used spilled kits and contaminated soils to be disposed off as scheduled wastes. 	Minor

Sector Sources of Impacts	Potential Impact	Degree of Impact	Duration	Proposed Pollution Prevention and Mitigation Measures (P2M2)	Residual Impact
<p>8.0 Landuse compatibility and buffer zone</p> <ul style="list-style-type: none"> Landuse compatibility to the existing and future development plan Buffer requirements accordance to <i>DOE Guidelines for Planning of Industrial and Residential Area</i> Environmental emission of the Project to the surrounding landuse receptor (air quality) 	<ul style="list-style-type: none"> The Project landuses is compatible to existing and future landuse in accordance to <i>Rancangan Struktur Pulau Pinang 2020</i>. No residential area within 500m radius surrounding the Project boundary as a primary Tamil school, a Hindu temple as well as a small estate settlement namely Kg Sg Byram will be relocated. 	None	None	<ul style="list-style-type: none"> A total of 93 households were recorded residing in the Kg Sg Byram located within the 500 m buffer zone of the landfill site will be relocated. Besides the settlements units, a primary Tamil school namely SJK (T) Ldg Byram and a Hindu temple were also recorded within the area serving mainly the residents in Kg Sg Byram. Implement P2M2 proposed in respective section for airse control to ensure optimum operation and minimum emission to the environment. Provision of 250 m buffer zone along the coastal water fronting the river mouth of Sg Tengah. Aquaculture activities is not recommended within this coastal water buffer zone area. 	None
<p>9.0 Socio-economic</p> <ul style="list-style-type: none"> Operation of the landfill and MRF Waste collection truck transportation activities 	<p>Findings from the perceived impact survey:</p> <p>Positive :</p> <ul style="list-style-type: none"> Improve state's waste management system and upgrading of local waste management system Potential improvement of local facilities and infrastructure to the local area <p>Negative :</p> <ul style="list-style-type: none"> Concern of stimulate more water pollution issues Concern of degrade the aesthetic value of the cleared land as well as the surrounding area Concern of spillages of leachate on the road and spread of unpleasant odour 	<p>Insignificant traffic impact as presented in item 6.0 above</p> <p>Minor to insignificant impact of treated leachate effluent discharge as presented in item 1.0 above</p>	Long term	<ul style="list-style-type: none"> Regular briefing public dialogues between the Project Proponent and other stakeholders including the community on the function and operation of the Phase 3 to prevent misinterpreting the impact that may occur. Strict adherence to control of water pollution from the landfill into canal and river. Cleanliness of waste collection truck to be maintained and fully covered waste collection truck to be employed to reduce odour emission. Traffic management system to be established particularly for waste collection truck. 	<p>Minor nuisances on traffic and odour from passing by waste truck</p> <p>Beneficial impact to the overall population in Penang Island with improved waste management system</p>
<p>10.0 Public Health Impact</p> <ul style="list-style-type: none"> Air pollutant (PM₁₀, CH₄, NMOC, H₂S, C₆H₆, C₇H₈) through inhalation Treated leachate discharge through human contact with water in Sg Tengah 	<ul style="list-style-type: none"> HQ for benzene (C₆H₆) and toluene (C₇H₈) at the aquaculture farm (A3) were below 1, signifying acceptable chronic, non-carcinogenic health risk. However the HQ for H₂S at Kg Sg Byram (A2) and the western Project Boundary, near aquaculture farm (A3) were greater than 1, signifying unacceptable chronic, non-carcinogenic health risk in the form of nasal lesion of the olfactory mucosa. Since landfill gases from Phase 3 will be collected and flared, therefore the issues of landfill gases is insignificant. In addition, relocation will be carried out for the Kg Sg Byram as well as SJK (T) Ldg Byram, therefore the exceedance of HQ at these locations is not expected to result in any health consequences. LCR for inhalation exposure to benzene (C₆H₆) estimated for its highest concentration at western Project boundary, near aquaculture farm (at receptors A3) of 1.46 µg/m³, fall within the acceptable cancer risk range at the receptor hence inhalation exposure is acceptable. 	Insignificant	Long term	<ul style="list-style-type: none"> Steps should be taken to minimize solid waste spillage during collection and transportation and disposal at the landfill site. All solid waste must be adequately covered with soil cover material at the end of each day's operation. Fogging of the perimeter of the sanitary landfill grounds whenever necessary to destroy adult mosquitoes. No human scavengers should be allowed within the sanitary landfill site. 	Insignificant

Sector Sources of Impacts	Potential Impact	Degree of Impact	Duration	Proposed Pollution Prevention and Mitigation Measures (P2M2)	Residual Impact
	<ul style="list-style-type: none"> HQ cannot be computed for lead as it does not have an RfD value. For ammonia, mercury, arsenic and cadmium, all their HQ were found to be well below 1, indicating acceptable chronic, non-carcinogenic health risk. Total estimated LRC for body contact exposure to both arsenic and cadmium through wading and swimming in Sg Tengah estimated within the acceptable LCR proposed for Malaysia. 				
<p>11.0 Impact on Biological Resources</p> <ul style="list-style-type: none"> Water quality deterioration due to the untreated landfill leachate discharges, leakage of leachate and the sewage discharges from the Project site 	<ul style="list-style-type: none"> Degradation of water quality can affect the aquatic environment and impact on the aquaculture activities adjacent to the Project site. Based on the finding on water modelling results for NH₃, the NH₃ level particularly at water intake for Sg Udang and Pulau Burung pond culture could potentially affected cultured species. However, the impact could insignificant as water source is generally treated before being used in the pond. 	Insignificant	Long term	<ul style="list-style-type: none"> Quality work procedures/ quality inspection checks should also be implemented to ensure the leachate lining (High-Density Polyethylene; HDPE or Geosynthetic Clay Liner; GCL), collection systems and also groundwater management system is installed with integrity. Continual monitoring of groundwater must be implemented also to ensure no leakage of the liners. Provision should be made to route any contaminated groundwater to the LTP. PP is committed with the effort to conserve and improve the adjacent Byram mangrove forest reserve and the Sg Kerian mangrove belt such as replanting degraded areas to ensure alternative habitats for birds are conserved. PP will be collaborate with local authorities (i.e. DWNP Penang), NGOs and bird watchers/photographers to help monitor the bird population, particularly the migrant, and rare, endangered and threatened bird species around the coastline, mudflats, buffer belt and the surrounding mangrove forests. 	Insignificant