

8.0 MITIGATION MEASURES

The adverse impacts on the environment arising from the development of the proposed project were discussed and highlighted in **Chapter 7**. The impacts generated during each phase of the development would create environmental issues if no proper mitigating measures are adopted to address these impacts, and in such event, it may lead to the deterioration of the environmental quality.

The generation of significant impacts on the environment is anticipated during the construction and operation phases where the impacts can be mitigated by sound agronomic and engineering practices and stringent control of development activities. However, the mitigating measures identified and implemented at the operating phase of the development would serve and provide guidance to the relevant authorities of the measures taken to control the impacts.

8.1 Adhere to DOE Guideline

The best management practices (BMP) is highly recommended for this proposed project. BMP is practical guidelines that can be used to lessen the environmental impact of coastal reclamation and water chalet construction activities. Moreover, it is designed to be low cost, practical and easily applicable to the operations.

The requirements and specifications stipulated in the following documents issued by the DOE shall be adhered to:

- Environmental Quality Act, 1974 (Act 127) & Subsidiary Regulations
- Environmental Impact Assessment Guidelines in Malaysia, Department of Environment, Ministry of Natural Resources and Environment
- Environment Impact Assessment Guidelines for Coastal and Land Reclamation, Department of Environment, Ministry of Natural Resources and Environment
- DOE Malaysia Marine Water Quality Criteria and Standard
- DOE Malaysia Air Quality Standard
- DOE Malaysia Guidelines for Environmental Noise Limits and Control
- Guidelines for Preparation of Coastal Engineering Hydraulic Study and Impact Evaluation

8.2 Proposed Mitigation Measures

This section discusses the key mitigating measures recommended to minimize or alleviate the adverse impacts discussed previously. It also includes, to some extent, recommendations for environmental management related topics. However, the undertaking of these measures by the Project Proponent will depend upon the overall assessment and through consultation with the Department of Environment (DOE).

The impacts generated were identified according to the development stages. Each stage generates and produces some form of adverse impacts. For the purpose of implementation of the mitigating measures to mitigate these impacts, the measures proposed were identified according to the stages at which these impacts were generated.

8.2.1 Mitigating Measures during Site Preparation Phase

8.2.1.1 Air Quality

- Provision should be made for water sprays to be available for use when dusts are being generated or at times of strong wind.
- Tyre washing facility is to be installed at all entrances to public roads or at points when the trucks leave the working site. Where possible, main road within the working site should be paved or overlain with aggregate prior to the start of construction works.
- Truck speed on unpaved roads or open spaces is to be limited to 20 km/h within the project area, unless sufficiently wetted to prevent dust generation.

8.2.1.2 Noise Level

- Machineries and equipment used during the site preparation should be fitted with effective exhaust silencers.
- Whenever possible, the level of noise should be minimized at all time so that it would not disturb the nearby people
- Regular maintenance for all machineries involved in the Project.

8.2.1.3 Waste Management

- All solid wastes generated must be disposed of at the local authority approved landfill, i.e. Sungai Udang Sanitary Landfill.
- Open burning of waste is prohibited.

8.2.2 Mitigating Measures during Sand Mining and Transportation

8.2.2.1 Hydrodynamic

- Minimising the reclamation period to the shortest period possible.
- Anchoring at only pre-determined locations and based on the approved anchor pattern.

8.2.2.2 Water Quality

- The increase in turbidity can be reduced significantly with proper dredging technology and a correct handling of machineries.
- Standard of Operation Procedure for the Transportation of fill material should be in place.
- Limit the speed of sand carrier during the transportation to avoid spills and the sand carrier should not be overloaded.
- Conduct regular maintenance of oil separator of the sand carrier in order to maintain its design treatment capability and also to prevent breakdown of the oil separator.
- Oily wastes shall be treated and disposed accordingly to avoid seawater pollution.
- The contractors shall ensure that their vessels are equipped with slop tanks (if applicable). The wastes collected shall be disposed at approved premises onshore.
- Non-biodegradable wastes shall not be flushed together with the sewage but should be compacted and stored before disposal onshore.
- Emergency response and contingency plans to be put in place for response in emergency cases.

8.2.2.3 Noise Level

- Restricting working hours to daytime only.
- Maintenance of all vehicles and machinery to ensure good working condition and reducing possible noise emission.
- Shut down engine/machinery when not in use.
- Machinery emitting high noise levels should be installed with suitable noise absorbent materials and shall be sited within an enclosure.
- Noise monitoring should be conducted to ensure the noise level does not exceed the limits stipulated by the DOE.

8.2.2.4 Navigational Safety

- The mobilization route must be planned to avoid fishing areas and shipping lanes where possible.
- All installation vessel and barge must have adequate navigational equipment to provide sufficient warning to approaching vessels.
- Vessel collisions, groundings and other accidents can be avoided through implementation of navigational safety practices which include the enforcement of safety zones, use of radar, routine surveillance, installation of navigation safety beacons.
- All vessel and barge should be sufficiently lighted up so that they are visible in poor weather condition and at night.
- Notify the Malacca Marine Department on the project's activities so that 'Notice to Mariners' could be issued to prohibit mariners including fishermen from encroaching into the project site.

8.2.2.5 Waste Management

- Direct discharge of any kind of wastes from the sand carrier and other supporting vehicles are not allowed.
- All wastes generated during the transportation of fill material should be transported back to nearshore.
- Wastes are to be disposed of by licensed contractors to municipal landfill (i.e. Sungai Udang Sanitary Landfill) approved by the local authority.
- All scheduled wastes generated are to be managed according to the Environmental Quality (Scheduled Wastes) Regulation, 2005.

8.2.3 Mitigating Measures during Reclamation Phase

8.2.3.1 Hydrodynamic

In general, the proposed reclamation at Melaka appears to have negligible impacts, except in the created small bays where the surface elevation shows slightly increased from proposed area. However, it is also evident from the morphological model results that there will be significant change in erosion and deposition if the reclamation work continues for a long duration for both the scenarios. It indicates that a continuous monitoring is needed at some specific locations nearby the project site.

8.2.3.2 Sediment Spill

Silt curtains are able to control the dispersion of turbid water by diverting the flow under the curtain, thereby minimizing turbidity in the upper layer of the water column outside the silt curtain. The spill rate and the total spill will be highly dependent upon work procedures, scheduling and reclaimed material characteristics. Each conveyor barge with a capacity of 1,250 m³ is assumed to operate for 12 hours (from 7 am to 6 pm) on a daily basis. Each barge has a pumping rate of 0.1 m³/s. The spill concentration is 4.2 kg/m³ for without silt curtain condition and 0.8 kg/m³ for with silt curtain condition. Results from the spill are presented in maximum and minimum suspended sediment concentrations showing the extent and concentration over the simulation period for spring and neap tide.

Figure 8-1 and **Figure 8-4** show the minimum and maximum sediment dispersion extent pattern without and with silt curtain respectively during neap and spring tide. The maximum plume extent approximately up to 0.85 km during neap tide and 1.0 km during spring without installing silt curtain. Whereas with silt curtain the maximum plume reaches approximately 0.4 km during neap tide and 0.55 km during spring tide.

The proposed work also involves dumping activities, which could attribute to the increase in suspended sediment. Considering the movement of the suspended sediment, it is important that appropriate mitigation measures be undertaken. The disposal of sediment should be contained as much as possible so as to limit the affected areas. This could be done by constructing proper containment structures prior to the disposal of material. The simulations also show the extent of the sediment together with silt curtain. By installing silt curtain, the sediment dispersion plume is restricted within the reclamation area.

If the silt curtains were found ineffective, it is recommended that rock bund shall be constructed in order to contain the spread of the sediment concentrations. It is also will act as the foundation/ basement for the propose revetment construction.

8.2.3.3 Sungai Lereh

Based on the simulation results, there is no significant impact on Sungai Lereh and very less formation of siltation around the project area. Mitigation measure proposed to be carried out is installation of single layer silt curtain at the location proposed in **Figure 5-5** to restrict the sediment dispersion plume within the reclamation area. It purposes that a continuous monitoring to be carried out at specific locations nearby the project site to ensure there is no changes in surrounding coastal environment due to the reclamation work.

8.2.3.4 Water Quality

Installation of silt curtains must be made mandatory so that the re-suspended bottom materials would be contained within the project area. Other proposed mitigation measures include:

- No direct discharge of untreated sewage and sullage into the waterways from the sand carrier and other vehicles.
- Regular checking and maintenance on the silt curtains.
- Reclamation is to be done within the approved area only and to be carried out in phases.
- Conduct periodic water quality during reclamation where water samples shall be collected as proposed in EMP report.
- Construct dykes, bunds, culverts to control the runoff from the reclaimed area.

8.2.3.5 Air Quality

- Equipment and machineries are in good repair and can operate efficiently to prevent carry through of elevated levels of hydrocarbons from engine operation.

The barges and workboats are contracted from third party. Incorporate clauses into the contract on the need to regularly maintain the engine to achieve high combustion efficiency and conform to the MARPOL 73/78 Annex V1 or other applicable standards to the vessel class requirements.

Figure 8-1 Minimum and Maximum Extent of Sediment Plume Dispersion Without Silt Curtain During Neap Tide

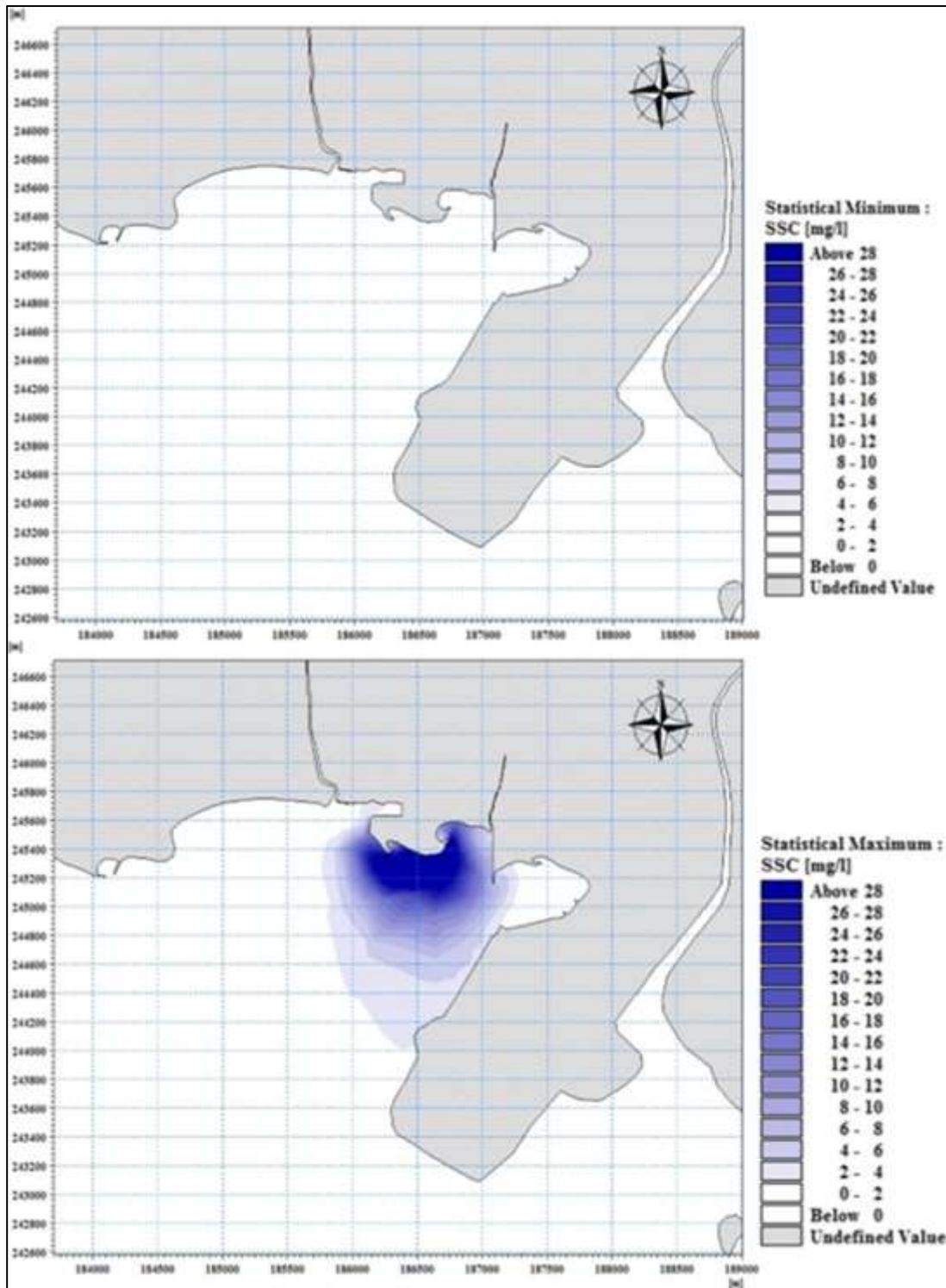


Figure 8-2 Minimum and Maximum Extent of Sediment Plume Dispersion with Silt Curtain During Neap Tide

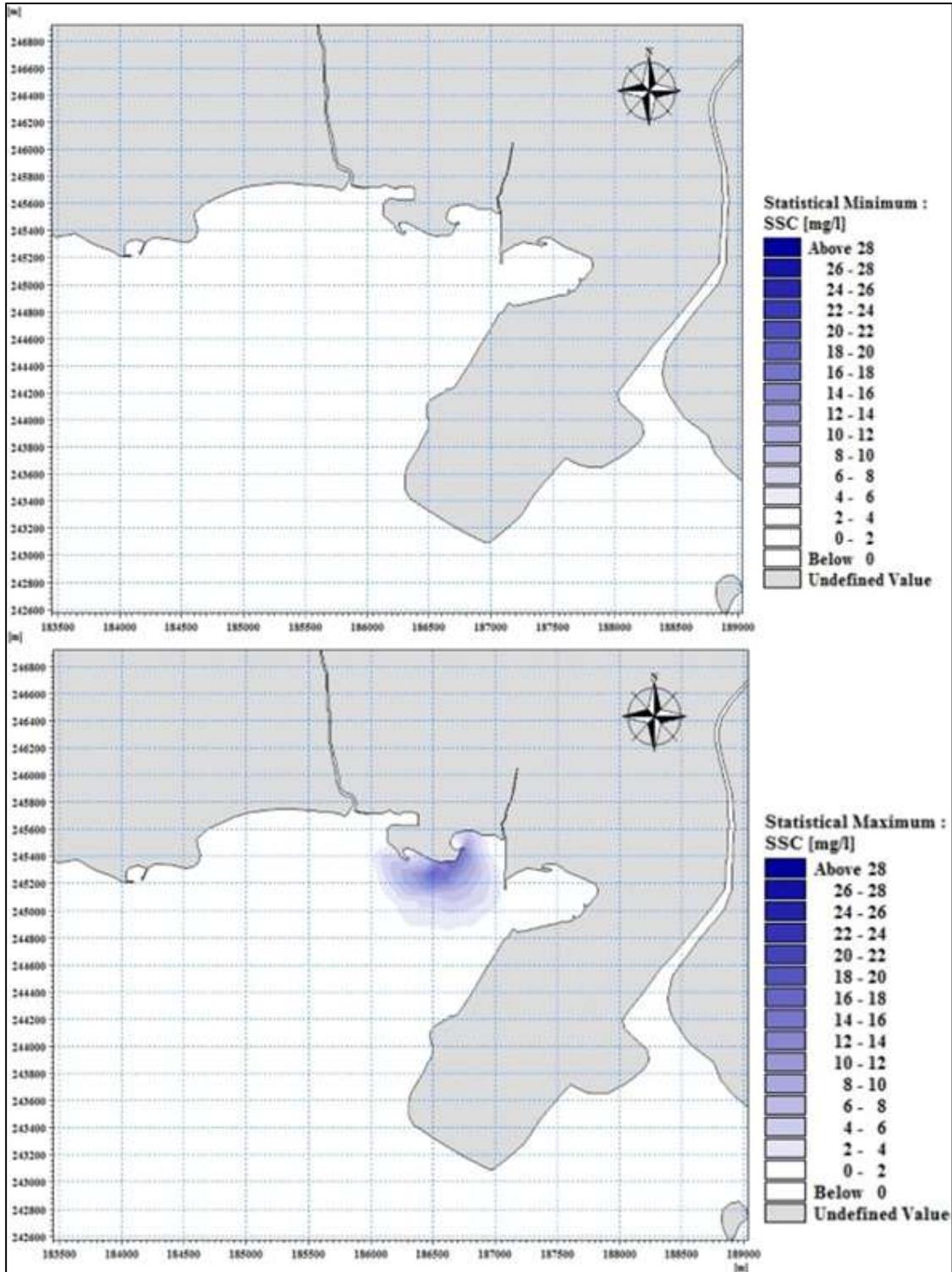


Figure 8-3 Minimum and Maximum Extent of Sediment Plume Dispersion without Silt Curtain during Spring Tide

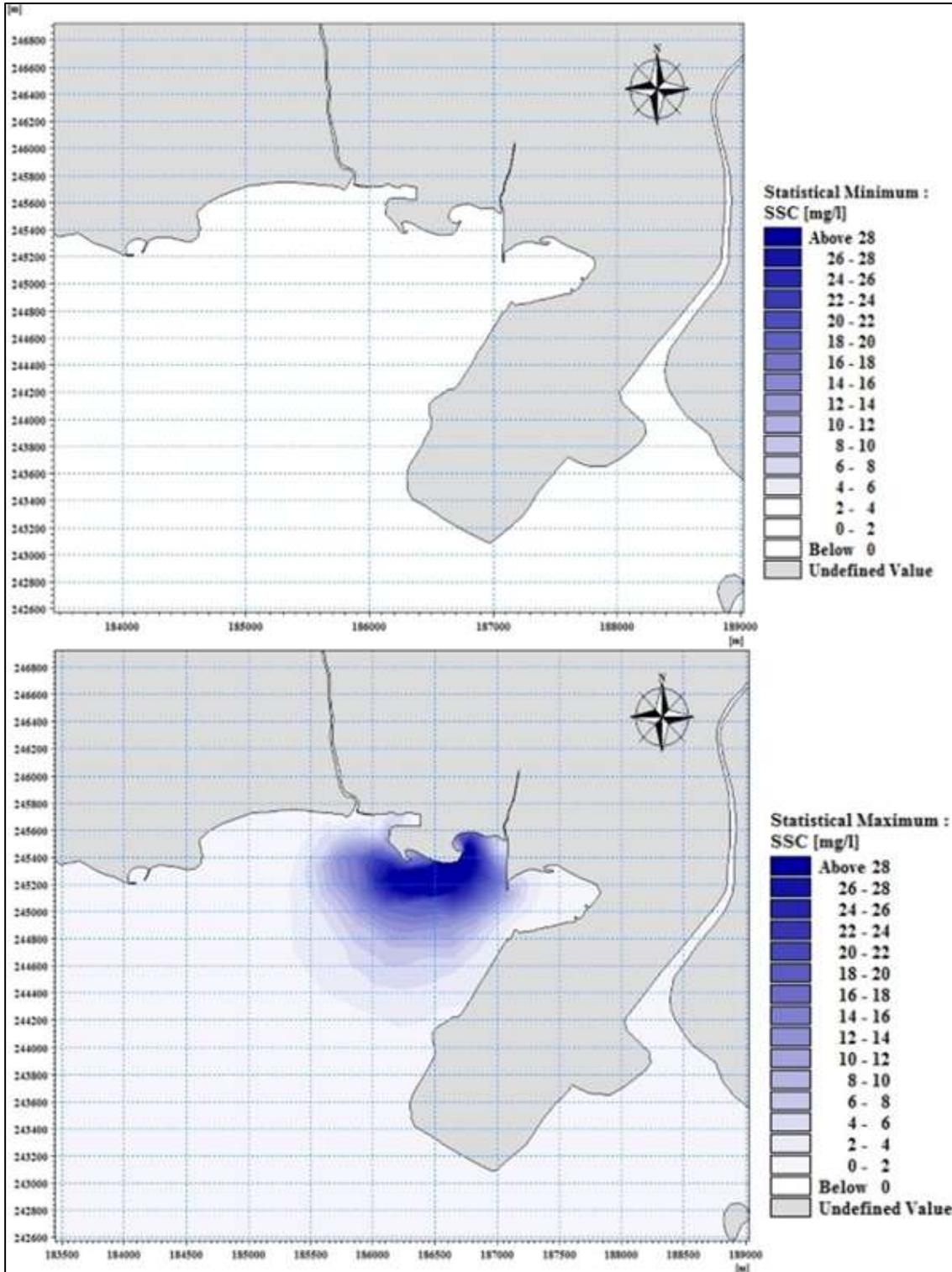
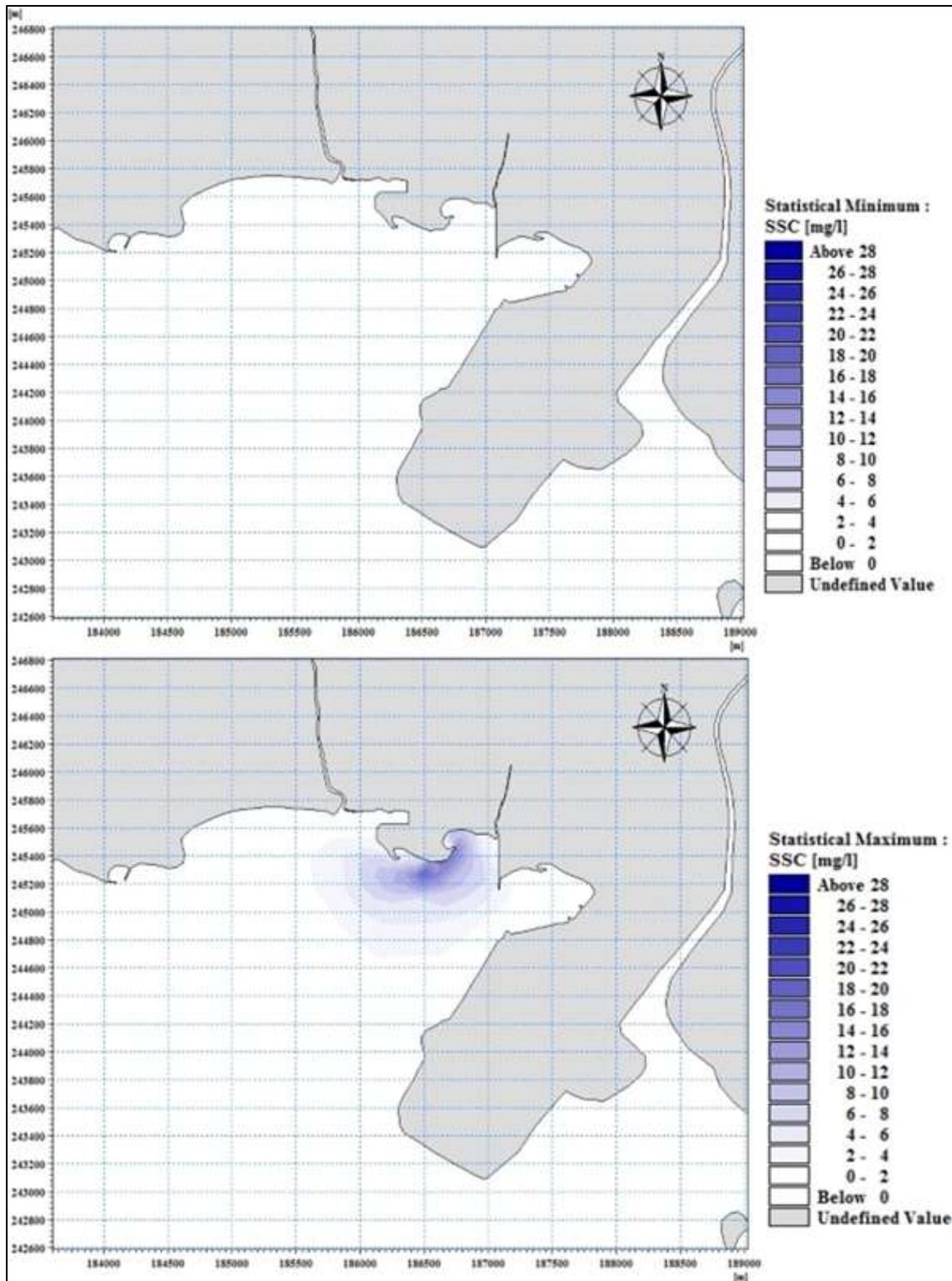


Figure 8-4 Minimum and Maximum Extent of Sediment Plume Dispersion with Silt Curtain during Spring Tide



8.2.3.6 Noise Level

- Machinery emitting high noise shall be sited within an enclosure to reduce noise pollution.
- Barges/workboats are contracted from third party. Incorporate clauses into the contract on the need to regularly maintain the engine to achieve low noise production.
- Restricting working hours to daytime.
- Shutdown machineries when not in use.

8.2.3.7 Marine Environment

- Ensure minimum seabed disruption and dispersion of sand.
- Phased reclamation to allow marine animals to move away from the proposed site.
- The reclamation period should be optimized to reduce the reclamation time; thus re-colonization or re-establishment of new communities will occur faster.
- Reduction of vessel speeds, implementation of marine navigation management plan to reduce impact of noise and vibration to marine animals.
- Workers to be educated and trained with regard to protected and threatened species.
- Restricted corridors of working. Works are prohibited from the designated boundaries.
- Anchors should be placed at pre-determined locations (anchor pattern plan) to minimize the risk of anchors dragging which could smother the benthic organisms.
- Strict adherence to safety standards should be enforced and provision of safe working conditions should be made at all times during reclamation activities.

8.2.3.8 Fisheries

A dialogue or meeting involving representatives from the affected fishermen and other related agencies (Fisheries Department, Lembaga Kemajuan Ikan Malaysia, Persatuan Nelayan) is recommended to assess the damage and to agree on the quantum of compensation.

8.2.3.9 Marine Traffic

- The mobilization route must be planned to avoid fishing areas and shipping lanes where possible.
- All installation vessel and barge must have adequate navigational equipment to provide sufficient warning to approaching vessels.
- Implementation of navigational safety practices which include the enforcement of safety zones, use of radar, routine surveillance, installation of navigation safety beacons.

- All vessel and barge should be sufficiently lighted up so that they are visible in poor weather condition and at night.
- Notify the Marine Department of the State of Melaka on the project's activities so that 'Notice to Mariners' could be issued to prohibit mariners including fishermen from approaching into the project site.

8.2.3.10 Waste Management

- Direct discharge of any kind of wastes from the sand carrier and other supporting vehicles are not allowed.
- All wastes generated during the transportation of fill material should be transported back to nearshore for disposal only.
- Regular training for staff on the safe handling of equipment, spill prevention and response procedures and proper clean-up for hazardous materials to ensure adequate level of awareness of the environmental sensitivity of the environmental components among contractors undertaking construction (as well as during maintenance and repair operations).
- Scheduled wastes and construction wastes generated during reclamation and construction of water chalet stages should be temporary stored at the designated zones as shown in **Figure 5-18**. The wastes stored within these designated zones will be segregated according to type.
- For construction wastes, they should be reused and recycled as much as practically possible prior being disposed of by licensed contractors to Dengkil Inert Waste Landfill.

8.2.4 Mitigating Measures during Construction of Revetment and Water Chalet

8.2.4.1 Water Quality

- Proper operating procedures should be established to reduce excessive re-suspension of bottom materials when placing rock materials.
- No direct discharge of untreated sewage and sullage into the waterways.
- To provide adequate temporary sanitary facilities, which are located away from watercourses.
- All waste water generated from the project site must be treated in the sewage treatment system before it is discharged into sea.
- Carry out regular preventive maintenance on the sewage treatment system to ensure its capability is always maintained.
- Construct dykes, bunds, culverts to control the surface runoff from the reclaimed area.
- Conduct periodic water quality during this phase where water samples shall be collected as proposed in EMP report.

8.2.4.2 Air Quality

- Provision should be made for water sprays to be available for use when dusts are being generated or at times of strong wind.
- Tyre washing facility is to be installed at all entrances to public roads or at points when the trucks leave the working site. Where possible, main road within the working site should be paved or overlain with aggregate prior to the start of construction works.
- Truck speed on unpaved roads or open spaces is to be limited to 20 km/h within the project area, unless sufficiently wetted to prevent dust generation.
- Truck loads such as sand, aggregate, cement, soil and other materials transported to the construction site should be covered.
- Open burning is prohibited; instead all vegetation and construction wastes are to be disposed of at the nearest municipal dumpsite.
- Construction equipment are to be kept in good repair and operate efficiently to prevent carry through of elevated levels of hydrocarbons from engine operation.

8.2.4.3 Noise Level

- Restricting working hours to daytime only and to shut down engine/machinery when not in use.
- Maintenance of all vehicles and machinery to ensure good working condition and reducing possible noise emission.
- Establish hoarding and maintain vegetation belt along the terminal boundary.
- Suitable noise absorbent materials should be installed on machinery that produces high noise levels. Machinery emitting high noise shall be sited within an enclosure to reduce the noise impact; and
- Speed limit for heavy vehicles is imposed on site.

8.2.4.4 Marine Environment

- To minimize the impacts on the benthos population, the revetment shall be positioned as proposed using the proposed engineering method to avoid the least damage possible.
- Restricted corridors of working. Works are prohibited from the designated boundaries.
- The works have to be scheduled in phases. The disturbances will be limited to certain areas at one time.
- The reclamation period should be optimized to reduce the reclamation time; thus re-colonization or re-establishment of new communities will occur faster.
- Strict adherence to safety standards should be enforced and provision of safe working conditions should be made at all times during reclamation activities.

8.2.4.5 Land Traffic

The traffic impact on the road network that may justify mitigation consideration is when heavy vehicles go to and from the site at the commencement and completion of reclamation activity respectively. Owing to the size and length of the transports, their travel speed will be slow and turning circle wide. Their presence will slow down other traffic and cause annoying congestion. It is therefore considerate to plan, schedule and control their trips, especially during the peak hours, so as to minimize the adverse traffic impact.

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.

For the sake of environmental control, it is 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.

8.2.4.6 Socio Economic

Wider impacts of the proposed project during the operational stage are anticipated to not only occur at the micro but macro level as well. The main socio-economic impacts during development of the newly-reclaimed land and operation would relate to employment, income, the wider economic and social effects.

8.2.4.6.1 Mitigation Measure for Job and Business Opportunities to Local Communities

- The boost in local economy would only be effective if a portion of the labour required is recruited from the local communities. For the project to be relevant to the local communities, it should have deployed the local community in the work force and have some ratio for the local community recruitment. The local community should at least be 30% of the work force recruitment. Local employment can be done through skills training programs for the local communities.
- To ensure that local content is included, contracting tenders would have to be included as one of the prerequisites for tender award. It should be similarly applied to employing local contractors and sub-contractors, and where possible from the local community which should be given priority in the selection process. Only then would it be most beneficial and relevant. Such an approach would not only fulfil the local community expectations but would portray and boost the image of the proponent as being socially responsible.
- It is proposed that a meeting between the local fishermen association units, the state fishermen's association, LKIM and other related agencies with the project proponent be held. This is necessary to work up a plan of monitoring of reclamation works, long term compensation scheme for loss of fishing areas, and job and business opportunities.

8.2.4.6.2 Mitigation Measure for Livelihood

- The community fear of losing their livelihood especially among the fishermen should not be overlooked or unheeded. Some forms of compensation, where applicable, should be considered and worked out with the affected parties through their representatives and should be settled accordingly and amicably.
- To facilitate grievance resolution particularly among the fishing communities, representatives each from the local Persatuan Nelayan Units within the zone of impacts (5 km) be employed by the Project Proponent during the reclamation duration to liaise between the fishing community with the developer directly.
- As a measure of Goodwill, the developer should consider the initial compensation to fishermen affected to not only licensed fishermen immediately off the coast of project site but also other fishermen from other Persatuan Nelayan Units nearby using the proposed reclamation area for their fishing activity. This initial compensation has to be done before conducting any reclamation work. Compensation must be direct to fishermen without going through a middleman whose integrity could be questioned.
- Whatever compensation decision should base on several considerations, such as genuinely, the type of inconveniences faced, frequency and the paying agency should also be considered.
- Concerted arrangement should be made to involve the local communities, otherwise the latter would stand to lose. Hence, ways and efforts should be found to make it happen. One such example is to include them or that their applications for undertaking business ventures such as operating worker's canteen or the general sales of local produce and prepared food in proper kiosks at strategic points nearby the construction area during expansion period are given priority.

8.2.4.6.3 Mitigation Measure for Safety

- "Safety First" should always be stressed upon. Hence, workers ought to be exposed to proper work ethics and trained to be always on the alert. They are required to wear personal protective equipment (PPE) including safety goggles and masks, overalls and safety shoes. The contractor need to observe this strictly to reduce industrial accident and the like.
- Transport operators should be more considerate and always observe safe driving at all time and the activities should be carried out during non-peak hours.
- Safety precautions should also consider effects upon local fishing communities. Hence, no reclamation work should be undertaken at night to avoid destruction of fishing nets and any risk to human lives.

8.2.4.6.4 Mitigation Measures on Tranquility and Aesthetics

- The activities that could cause nuisance to the public such as noise pollution emitted from dredging boats, heavy machinery and piling works should be avoided or minimized. Schedule of work time should be accommodative to the needs of the people.

8.2.4.7 Occupational Safety and Health

- All construction workers will be properly trained and informed with respect to potential hazards and risks associated with the works.
- All construction workers should be provided with proper personal protective and safety equipment such as hard hats, goggles, well-insulated safety boots, proper work gloves and safety belts, to prevent falls and hit by falling objects.
- Lifting equipment should be used to prevent ergonomic problems associated with manual handling. Training on proper techniques in manual handling including lifting, carrying, pushing and pulling will need to be given to workers to reduce musculo-skeletal disorders.
- To reduce exposure to noise during construction activities, quieter equipment should be used, and workers should be provided with hearing protection devices.
- Record all accidents, near misses, unsafe acts and bodily potential hazardous situation.
- Construction activities should only be carried out during daytime.
- All construction personnel must pass a medical examination prior to being engaged, both as a fitness for work assessment as well as a baseline for monitoring any deterioration or changes in health status.
- Ensure that all necessary first aid measures and fire prevention measures are provided on site.
- An Emergency Response Team along with supporting rescue services are on standby to respond to any safety incidents during the construction phase.

8.2.4.8 Waste Management

8.2.4.8.1 Scheduled Wastes

- Scheduled wastes should be managed according to the Environmental Quality (Scheduled Wastes) Regulation, 2005 and to be disposed of by DOE licensed contractor only.
- Maintenance of vehicles and machinery should only be undertaken at workshops and places where there are facilities for collection of such wastes.
- Regular training for staff on the safe handling of equipment, spill prevention and response procedures and proper clean-up for hazardous materials to ensure adequate level of awareness of the environmental sensitivity of the environmental components among contractors undertaking construction (as well as during maintenance and repair operations).

- Scheduled wastes and construction wastes generated during reclamation and construction of water chalet stages should be temporary stored at the designated zones. The wastes stored within these designated zones will be segregated according to type.

8.2.4.8.2 Construction Wastes

- For construction wastes, they should be reused and recycled as much as practically possible prior being disposed of by licensed contractors to Dengkil Inert Waste Lanfill.
- Construction waste should be temporary stockpiled within the designated storage area for the waste.
- Open burning of construction and solid waste is prohibited.

8.2.4.8.3 Solid Wastes

- Construction area and worker camp should be kept clean at all time. Maintain high quality of housekeeping and the requirements shall be included in the contract document for the contractors.
- Solid waste should be stored in containers of sufficient capacity (preferably covered) and be collected regularly by a licensed contractor. As Solid Waste and Public Cleansing Management Act 2007 (Act 672) is enforced in the State of Melaka, the Project Proponent/contractors should ensure that waste segregation at source is implemented on-site.
- Sufficient number of waste bins to be provided at the worker camp, site office and at strategic locations to minimize littering and encourage proper disposal.
- No open burning of solid wastes shall be carried out at any time.
- All solid wastes from the site must be regularly removed and disposed of to the municipal landfill (i.e. Sungai Udang Sanitary Landfill) approved by the local authority by licensed contractors.

8.2.5 Mitigating Measures during Operation Phase

8.2.5.1 Water Quality

The project proponent should ensure that all waste water generated from the operational of the water chalets will be channeled and treated by a centralized Sewage Treatment Plant from Majlis Bandaraya Melaka Bersejarah (MBMB) on Lot PT 1819, Mukim Tambak Laut Tengkeru in Melaka Tengah prior being discharged out to the nearby waterways. No direct discharge of untreated sewage and sillage into the waterways is allowable.

8.2.5.2 Land Traffic

By year 2021, when the proposed project is in operation, the traffic forecasts indicate the existing road facilities in the traffic influence area is still able to cater for the increase traffic. However, the following are recommendations to be considered:

- The proposed T-junction connecting the main road to project site shall be designed properly as it might have impact to accommodate the traffic flow in or out of project site as indicated by the higher v/c ratios and average delay due to increase traffic.
- Traffic management system to be implemented at the ingress / egress point of project site in order to manage the traffic accordingly

8.2.5.3 Socio Economic

During the operational stage, the mitigating measures to be taken are as follows:

- Foreign workers involved in construction works should be demobilized according to proper procedures and either re-located to other project sites or return to their country as per their work permits.
- All unused building materials should be cleared to prevent the area from becoming breeding grounds for mosquitoes and rodents to curb vector-borne diseases from recurring.
- Any significant increase in demand for social facilities should be matched with the corresponding equal amount of additional funding to improve and to expand the existing social facilities.
- In order to support the growth of the local economy, employment and business opportunities such as sub- contracting works and supply of essentials materials should be given, with greater priority, to the local residents or nearby residents especially in the surveyed villages. Participation of the locals will enhance the economy.

8.2.5.4 Waste Management

- All solid wastes generated from must be disposed of at the local authority approved landfill, i.e. Sungai Udang Sanitary Landfill. Disposal of solid wastes need to be regulated and coordinated with the relevant authorities. It will be the responsibility of the project proponent to ensure that proper collection and disposal of solid wastes is carried out.
- It will also be the responsibility of the project proponent to ensure the proper implementation of waste segregation at source during the operational phase.
- Regular collection to prevent the occupants from resorting to open burning of refuse.

- Recycling of waste material should be encouraged as solid waste generated would mainly consist of salvageable residential-households, bottles, tins, paper and plastic.
- Open burning of waste is prohibited.