

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 phase 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. 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.
- The sand carrier should be fitted with the equipments and discharge the sewage in accordance with MARPOL Annex IV whilst in Malaysia water.
- 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, which is from 7.00 am to 7.00 pm 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 insignificant 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, the development of the proposed breakwater and the reclamation project is not anticipated to contribute any backwater flow impact at the upstream of the Sg. Lereh and Sg. Udang. Hence, no mitigation measures are proposed to be carried out.

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:

- To provide approximate four (4) units of temporary sanitary facilities, which are located away from watercourses.
- The temporary sanitary facilities provided should be equipped with septic tank. No direct discharge of untreated sewage and sullage into the waterways and the septic tank will be de-sludged weekly by IWK licenced contractors.
- 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

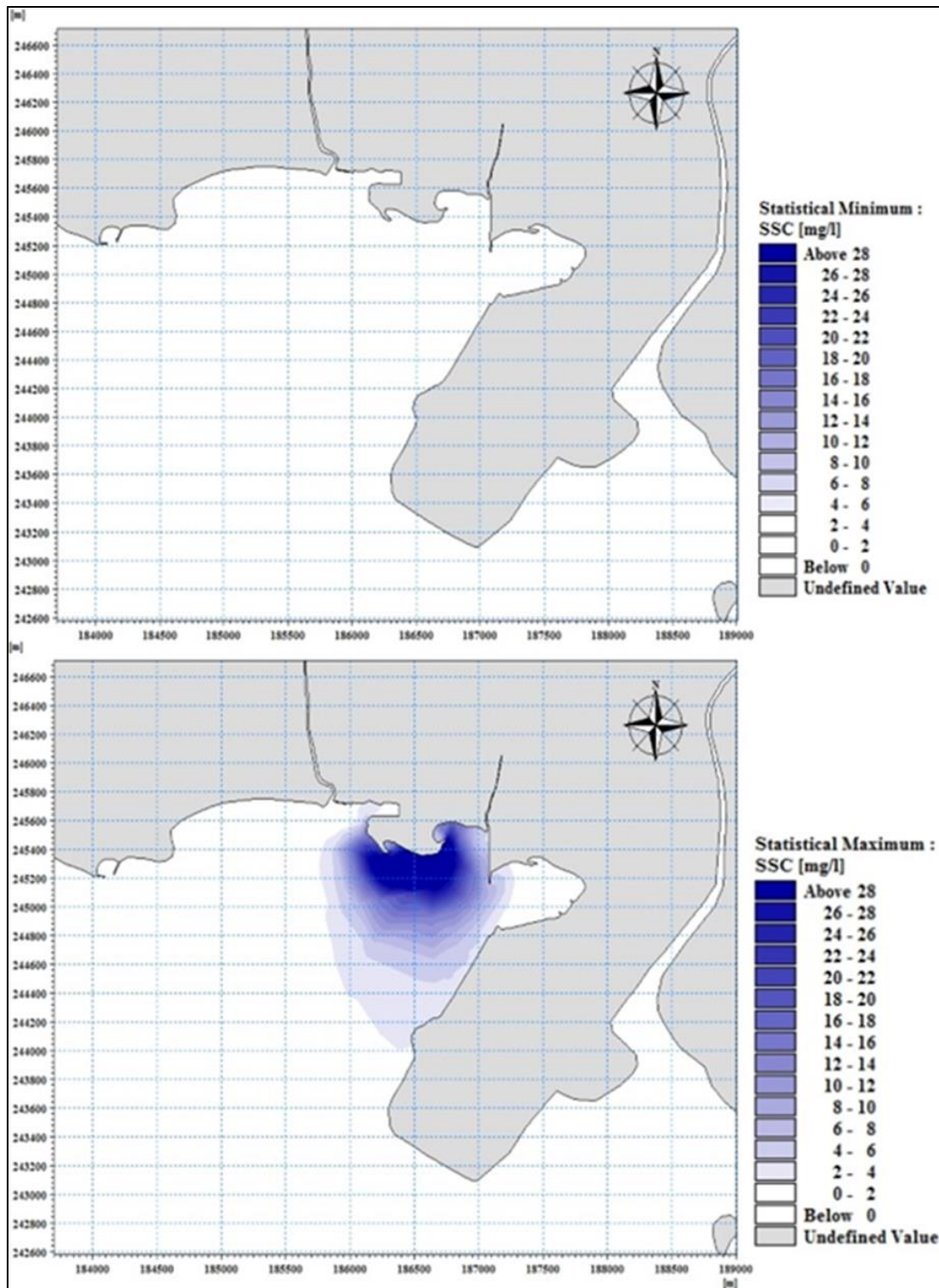


Figure 8-2 Minimum and Maximum Extent of Sediment Plume Dispersion with Silt Curtain During Neap Tide

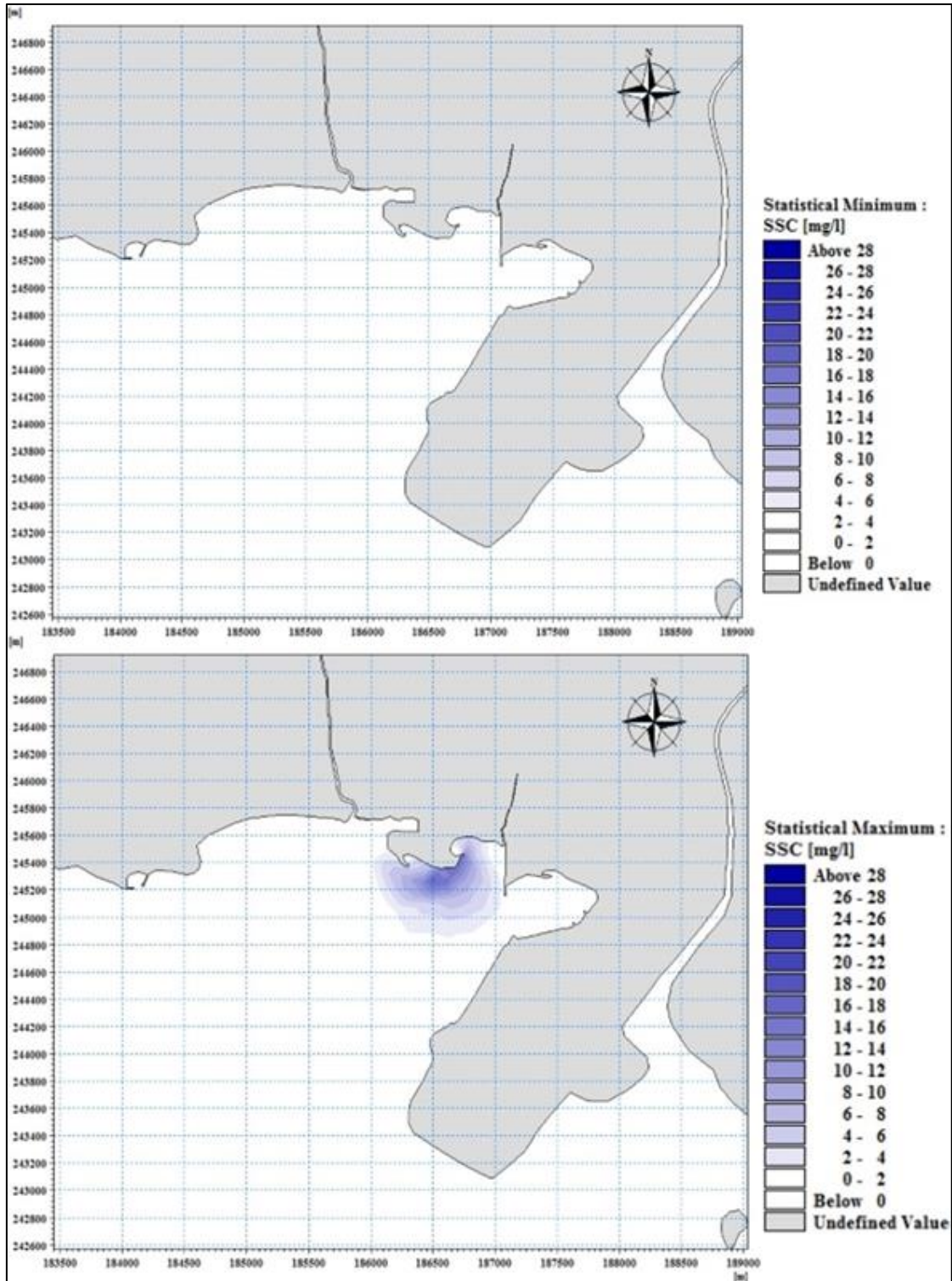


Figure 8-3 Minimum and Maximum Extent of Sediment Plume Dispersion without Silt Curtain during Spring Tide

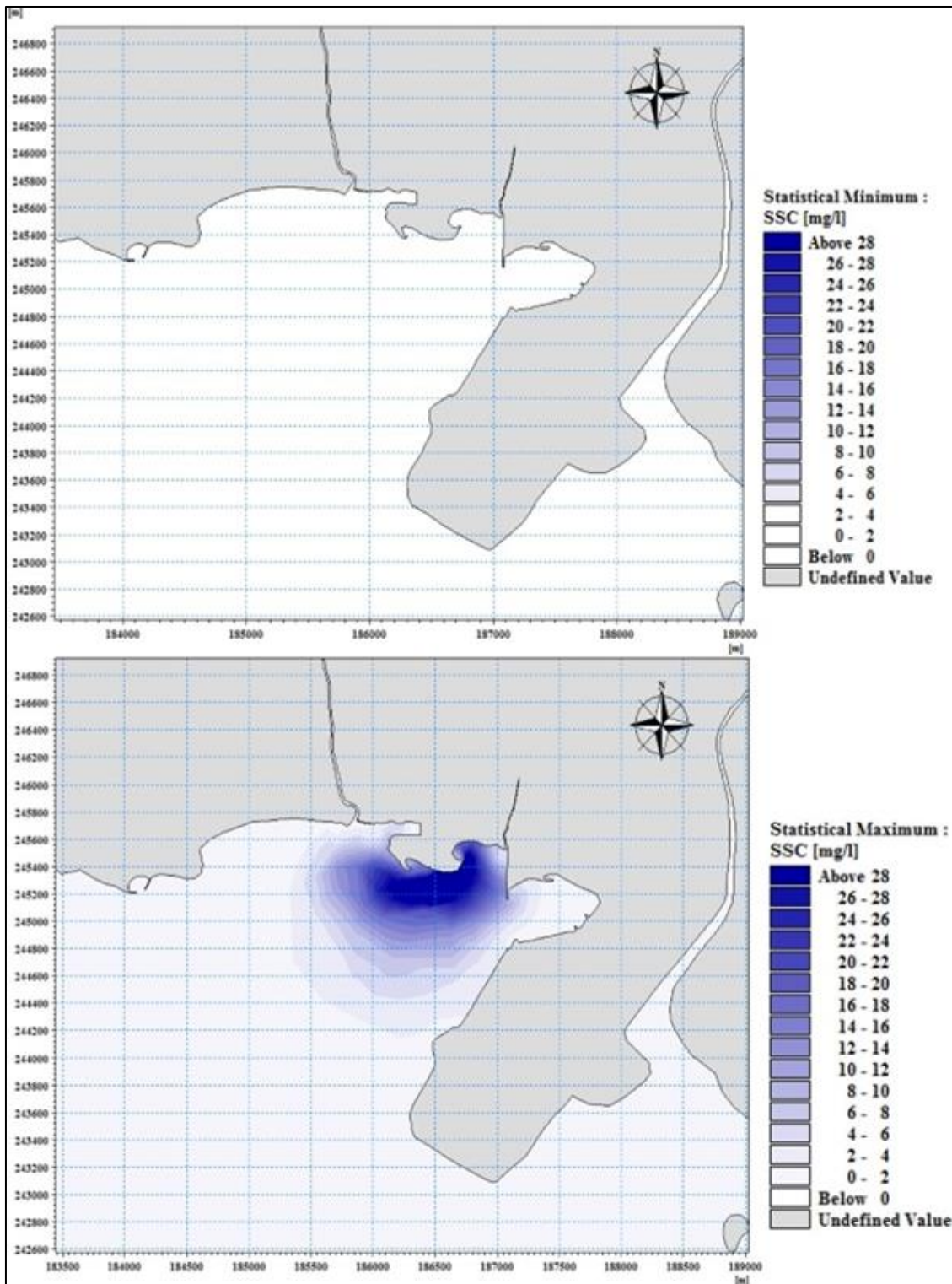
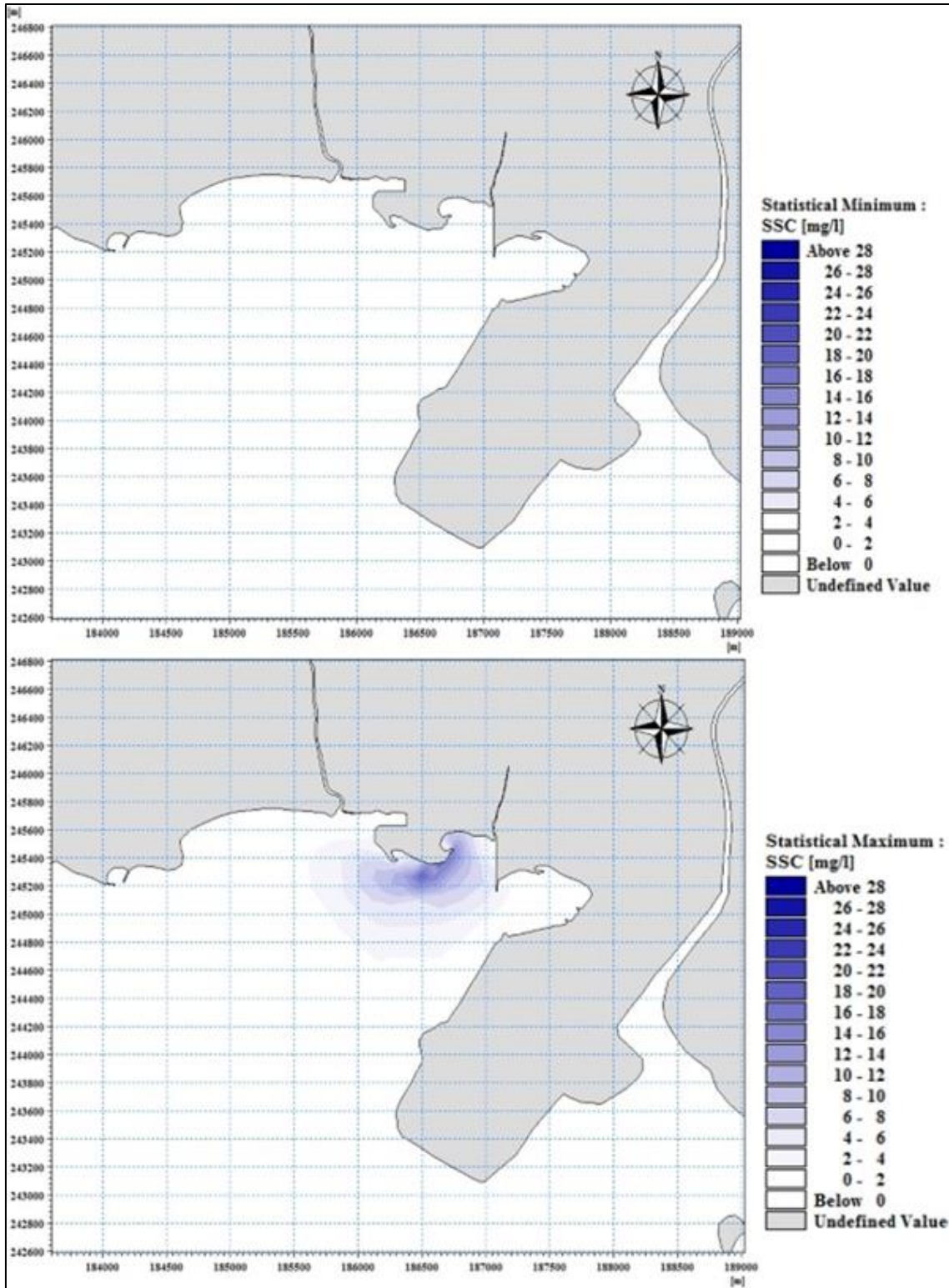


Figure 8-4 Minimum and Maximum Extent of Sediment Plume Dispersion with Silt Curtain during Spring Tide



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, which is from 7.00 am to 7.00 pm only.
- 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.

Environment Consultant had engaged with Pengarah Department of Fisheries in Melaka, En Johari Bin Tim to get advised and comments on the fisheries issues which have been discussed during the EIA-TRC Meeting on 15th December 2017. From the discussion, a list of proposed mitigation plan from Department of Fisheries (Melaka) is provided below:

- Specific provisions are provided for continuous research to study the long term impacts on fish stocks and resources due to mining / reclamation / coastal development. At present, research is done with provision from DOF.

- Specific provisions for upgrading fishery infrastructure facilities such as maintenance and repair of the nearby fishing jetties.
- Dredging of shallow river estuary near to the fishermen base, which is affected by the reclamation project.
- Contribution in the form of 'CSR' for the purpose of diversifying and providing alternative jobs for the affected fishermen. For example, implement aquaculture projects, processing and agro-tourism. Proponent projects can also provide job opportunities to members of fishermen's families affected by the project reclamation to supplement their side income.
- Impact of reclamation and sand dredging activities will affect the existing habitats that are breeding grounds. Therefore, mangrove tree planting program to rehabilitate fish breeding grounds are also recommended.
- Awarding compensation directly to fishermen who are adversely affected by the reclamation area with a compensation rate that agreed by the Department of Fisheries.
- Proposal from Melaka State Fishermen's Association to establish the building of Fishermen's Information Center (FIC), either the existing building or a new building for the fishing community doing business like selling fresh fish, opening store, selling downstream products, etc.
- The Melaka coast is the most important turtle landing area in Peninsular Malaysia. Impact of reclamation such as turbidity, barrier, habitat damage and human disturbance will affect the mating process or return to the habitat to lay eggs. Among the mitigation for conservation and preservation of turtles in Melaka are as follows:
 - Provision of turtle eggs collection by licensed Turtle Egg Collector for hatching in the Turtle Information & Conservation Hatchery Centre, Padang Kemunting.
 - Re-planting program for *merambong* and *ketapang* trees at turtle landing area.
 - Installation of suitable lighting along the coast of landing area so as not to interfere with turtles during laying.
 - Conservation programs for endangered species such as turtles, dolphins and sharks including the provision of satellite detector device and medical costs for treating injured turtles.

The project proponent has committed and contributed of RM 3,177,600.00 for fishermen compensation and 'Tabung Ekonomi Nelayan' (refer to **Appendix 1.3**). Hence, the proposed mitigation for fisheries issue is DOF to use the allocation money to implement the propose mitigation as per DOF suggestion.

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 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

8.2.4.1 Water Quality

- Proper operating procedures should be established to reduce excessive re-suspension of bottom materials when placing rock materials.
- To provide approximate four (4) units of temporary sanitary facilities, which are located away from watercourses.
- The temporary sanitary facilities provided should be equipped with septic tank. No direct discharge of untreated sewage and sullage into the waterways and the septic tank will be de-sludged weekly by IWK licenced contractors.
- 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 (from 7.00 am to 7.00 pm) 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

The main socio-economic impacts during development of the newly-reclaimed land 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 and heavy machinery 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 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 Landfill.
- 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.