Type of Development	Main Components
	Sewage Treatment Plant
Institution	Training Centre
	Quarters
Maritime Industrial Park	Industrial lots
Business and Residential Park	Shop lots
	Apartments
	Sewage Treatment Plant
Navigation channel and basin	Capital and maintenance dredging

This EIA will also study the reclamation of Phase 2 and Phase 3 which is planned for approximately 480 acres. However no assessment will be carried out on the land use of these phases as the development plan for these phases is not available at the time of this EIA study.

5.3 Project Activities

Phase 1 of the proposed Project will be developed in 3 sub phases, to be known as Phase 1a, 1b and 1c, over a period of about 9 years. Reclamation, dredging and construction works for Phase 1 is anticipated to begin in January 2018 and as soon as all necessary approvals are obtained from the approving authorities.

5.3.1 Construction Stage

5.3.1.1 Marine Works

5.3.1.1.1 Preparatory Works

Hydrographical and bathymetric surveys will be carried out by licensed surveyor to determine the existing seabed level prior to the commencement of reclamation and dredging works. Project and work boundaries will be indicated with floating markers or navigation markers.

Mobilisation of workers and machineries to the Project site and setting up of site office, temporary facilities and living quarters are among the preparatory works.

Arrangement and necessary approvals will be obtained for importing marine sand from an approved source and for disposal of unsuitable dredged materials at an approved disposal site. Tentatively the sand source (about 22 km from Project site) and dredged material disposal site (about 17.5 km from Project site) are indicated on **Figure 5.3.1**. These locations are currently being used by other Projects in Kuantan. This EIA study does not include the sand source and disposal site for dredged material.

Source: Google Earth 2017

ENVIRONMENTAL IMPACT ASSESSMENT

PROPOSED DEVELOPMENT OF KUANTAN MARITIME HUB AT GEBENG, MUKIM SUNGAI KARANG, PAHANG DARUL MAKMUR

LEGEND:
- PROJECT SITE
- DUMPING SITE
- SAND SOURCE

DUMPING SITE:

NO	EAST	NORTH
1	103° 35' 49.99"	3° 57' 5.00"
2	103° 34' 50.01"	3° 55' 9.98"
3	103° 36' 29.98"	3° 54' 10.00"
4	103° 37' 45.01"	3° 55' 50.01"

SAND SOURCE:

NO	EAST	NORTH
1	103° 38' 1.21"	3° 52' 2.0"
2	103° 35' 3.01"	3° 50' 3.01"
3	103° 40' 0.01"	3° 49' 0.01"
4	103° 37' 1.81"	3° 47' 4.2"

N

0 1 2 3 4 5KM

SCALE IN KILOMETERS (1:120,000) – A3 MEDIUM

POTENTIAL SAND SOURCE AND DUMPING SITE FOR DREDGED SPOIL

D:\ACAD\DRAWINGS\EV703\7021\FIG-000.DWG

5.3.1.1.2 Construction of Containment Bund

Prior to the construction of the sand containment bund and reclamation activity, floating silt curtains will be installed around the Project area to be reclaimed to contain potential sediment plume. The assembled silt curtains will be secured with anchor blocks to maintain their positioning (**Figure 5.3.2**). Regular checking and maintenance of silt curtains will be carried out throughout the reclamation to ensure that they in working conditions. Any tears or damaged will be repaired as soon as possible.

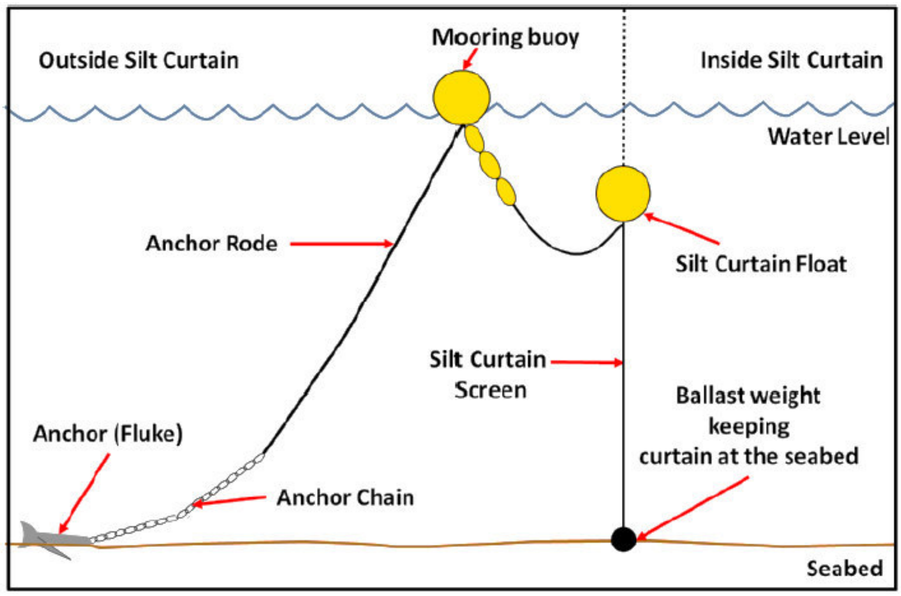


Figure 5.3.2: Typical Silt Curtain Layout

Some marine sand will be imported and used for the construction of the temporary containment bund. This containment bund will serve to contain the filling material from being washed to the sea during reclamation process. The proposed location of containment bund based on development phases is shown on **Figure 5.3.3** and a cross section of the containment bund is illustrated on **Figure 5.3.4**. Displaced water from the reclaimed area will be regulated with a weir box, where settlement of suspended sediment will take place prior to overflow to the sea via a double silt curtain.

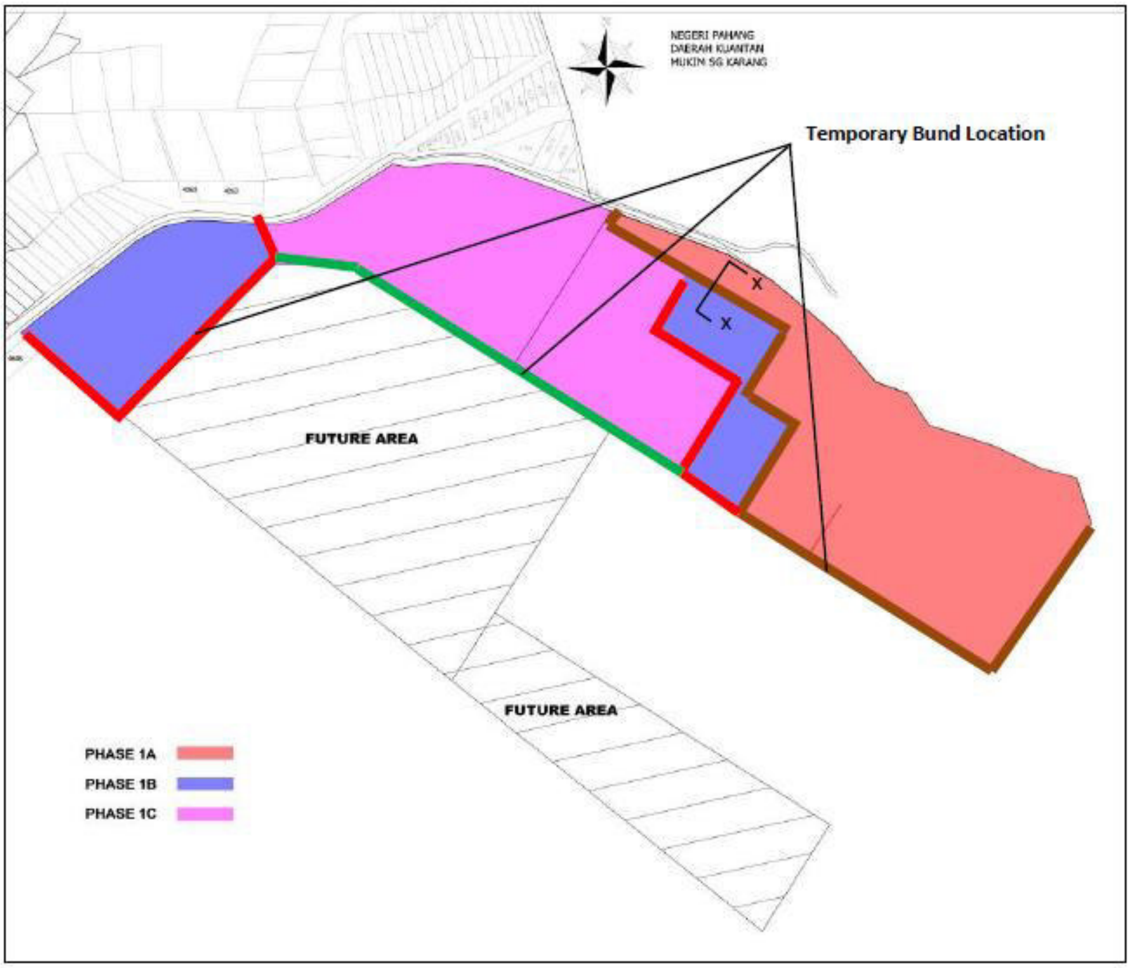


Figure 5.3.3: Proposed Location of Temporary Containment Bund

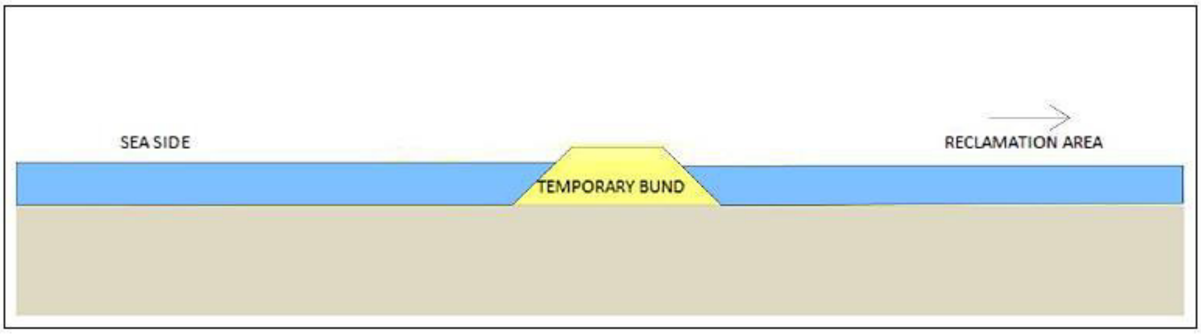


Figure 5.3.4: Cross Section of Proposed Temporary Containment Bund

5.3.1.1.3 Reclamation Work

The proposed filling material will be marine sand. Marine sand will be sourced from existing sand concessionaires (the sand sourcing activity is not covered in this EIA study). Tentatively, a potential existing marine sand source has been identified at approximately 22 km south east from the proposed Project site. The total volume of sand required for overall reclamation works is estimated to be approximately 22.5 million m^3, however this requirement will be in stages based on the development phases.

The reclamation works are expected to be carried out using 3 sand carriers with hopper barge capacity of 3,500 m^3 each. Each sand carrier is assumed to complete 4 trips per day with 3 hours of reclamation operation. Daily reclamation volumes is estimated between 12,500 m^3 and 37,500 m^3 (maximum daily reclamation volume where the 3 sand carriers are working simultaneously). The estimated volume and duration for each phase of the reclamation works is tabulated in **Table 5.3.1**.

Table 5.3.1: Summary of Estimated Volume and Duration of Each Reclamation Phase

Phases	Estimated Reclamation Volume (million m^3)	Estimated Reclamation Duration (months)	
		Min	Max
1a	4.0	4	12
1b	2.0	2	6
1c	3.2	3	10
2	8.2	8	25
3	5.1	5	16
Total	**22.5**	**22**	**69**

Marine sand will be discharged from the sand carrier using conveyor belt system to the area to be reclaimed. When the sand stockpile is raised above water level, bulldozers will be used to spread the sand until a platform is formed.

Plate 5.3.1: Conveyor belt system from sand carrier

At the shallow area where it may be difficult for the sand carrier to access, the sand will be transferred to the area to be reclaimed by a sand transfer pump barge. The sand transfer pump barge will be anchored at the vicinity of the area to be reclaimed with water depth of around -5m CD and this will ensure all time access of sand carrier to the sand pump barge for continuous reclamation operation. The sand will be hydraulic pumped to the reclamation site using discharge pipe of floating and / or landed pipeline. At the discharge point, bulldozers will be used to spread the sand until the required level.

Plate 5.3.2: Sand transfer pump barge

Plate 5.3.3: Discharge point of hydraulic pumped sand

Ground treatment and/or surcharging will be carried out after the completion of reclamation work if required. Compacted site will be trimmed and levelled to the required designed platform before it is handled over for land construction works.

5.3.1.1.4 Shoreline Protection

Once the reclaimed site is stabilised, permanent shoreline protection will be installed as per proposed plan on **Figure 5.3.5**. There will be two types of shoreline protection, namely designed slope with armour rock and retaining vertical wall along the seafront of shipyard and fabrication yard.

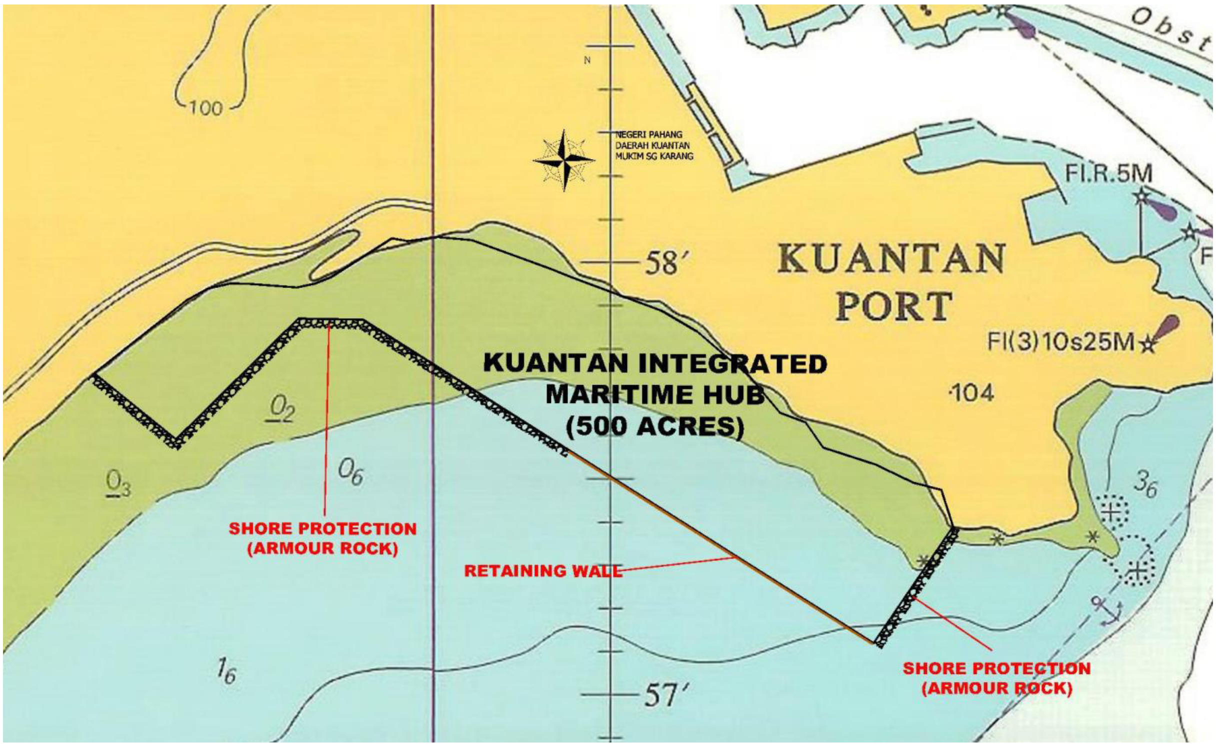


Figure 5.3.5: Proposed Type of Shoreline Protection

Typical approach to construct the armour rock type of shoreline protection are as follows.

Trim and compact the shoreline slope to designed gradient.

Install a layer of geotextile on the slope.

Add filter material on the geotextile.

Arrange and compact the amour rock to complete the installation of shoreline protection.

5.3.1.1.5 Dredging Works

The proposed Project requires capital dredging to form the required navigation channel and the harbour basin for marine vessels and transportation barges to traverse and dock. The proposed channel is about 3.5km long in south east direction from the proposed site. It is estimated that a total of about 17.7 million m^3 will be dredged to achieve the required depth of -12m CD.

The dredging works are to be carried out for Phase 1a, 1b, 1c and 2 only. There is no capital dredging for Phase 3. Dredging works are proposed to be carried out using 3 grab dredgers and 2 Trailer Suction Hopper Dredgers (TSHD). The unsuitable dredged materials will be transported for disposal at approved dumping ground which will be determined by the approving authorities at the time of project implementation. It is assumed that the dumping ground will be at least 17 km away from the proposed dredging area. The grab dredgers and TSHD are assumed to work on 24 hours basis. Daily dredging volumes is estimated between 12,500 m^3 and 32,800 m^3 (with maximum daily dredging volume where the 2 TSHDs and 3 grab dredgers are working simultaneously). The estimated volume and duration for each phase of the dredging works is tabulated in **Table 5.3.2**.

Table 5.3.2: Summary of Estimated Volume and Duration of Each Dredging Phase

Phases	Estimated Dredging Volume (million m^3)	Estimated Dredging Duration (months)	
		Min	Max
1a	5.8	6	13
1b	1.2	1	4
1c	5.5	5	13
2	5.2	5	14
Total	**17.7**	**17**	**44**

The dredging works will be carried out in two different methods i.e. by grab dredgers and TSHD. TSHD is preferred for this capital dredging work in view of the large dredging volume requirement. However, TSHD requires deeper water to be maneuvered, thus a combination of grab dredger and TSHD will be adopted whereby the shallow areas (up to about -5m CD) will be dredged using grab dredger and the remaining work will be completed by TSHD. Grab dredger will be used for profiling dredging at corners of the basin as well as near to the wharf face.

Plate 5.3.4: Grab dredger with hopper barge

Grab dredgers will load the dredged material onto hopper barge which will berth alongside the dredger. When the hopper is full, tug boat will be used to tow the fully loaded hopper barge to the approved dumping ground for the disposal of dredged material. It will be arranged in such a way that while the tug is towing the loaded hopper to the dumping ground for disposal, a second hopper barge will berth alongside the dredger for continuous dredging work to optimize dredger’s output.

Meanwhile TSHD will be used to dredge area deeper than -5m CD to the designed depths along the proposed navigation channel. TSHD trails its suction pipe when dredging and the pipe which is fitted with a dredge drag head will dredge and load the dredged material onto its hoppers in the same dredger vessel. When the hoppers are full, the TSHD will sail to the designated dumping area and dump the material through doors at the bottom of the hoppers. One dredging cycle (total of dredging and travel time) is estimated to take about 5.2 hours while the dredging time is estimated to be about 3.8 hours. It is calculated that a TSHD will have about 4.6 trips per day based on 24 hours continuous operation.

Plate 5.3.5: Typical view of a TSHD with dredger head

In order to control the position and depth of dredging, the site to be dredged will be divided into small grids. These grids will be shown on the computer screen in the operator room of the dredger. Dredging work will be guided by Differential Global Positioning Systems (DGPS) and the navigation software on board the dredgers. At the same time, the depth of dredging will also be monitored and controlled to ensure accuracy and efficiency of the dredging work.

Upon completion of the dredging work, a post dredging bathymetry survey will be carried out to record and verify the dredged levels against the designed depth for the navigation channel.

5.3.1.2 Land Works

The land construction works are expected to have the following activities which will apply standard construction methodologies.

5.3.1.2.1 Mobilisation of Workers and Machineries

Initial activities will include setting up of site office, workers' accommodations, sanitary facilities and other temporary facilities required for the construction works.

It is estimated during the peak construction period, about 2,800 workers including professional, skilled and semi-skilled workers will be engaged. Workers' accommodation will mostly be on-site and daily transportation of the workers to work site is not anticipated to be significant. Material transportation shall include pick-up trucks, multi-axle vehicles for heavy haul deliveries and large sized equipment deliveries as well as from transport barges from the sea.

5.3.1.2.2 Foundation Works

After the completion of the land reclamation, soil improvement maybe initiated to enhance settlement of the reclaimed land. Some soil and foundation improvement works are anticipated especially at areas to be loaded with heavy components. Typical foundation work includes piling.

5.3.1.2.3 Civil and Structure Works

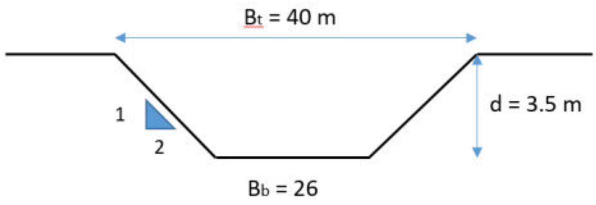
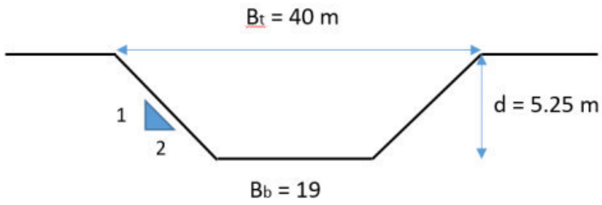
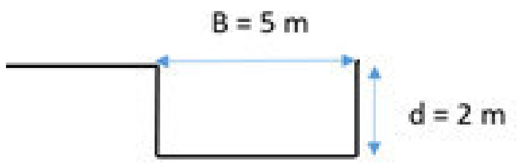
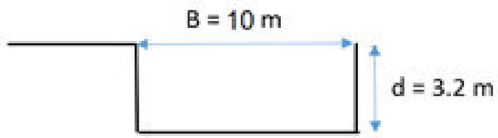
Civil and structural works involve frame work, casting, and building components of the proposed Project. These works will include, but not be limited to the upgrading of the existing access road to the site, and the establishment of internal access roads for the movement of materials, equipment, and for maintenance works. Storm water drainage system will be installed throughout the site to collect runoff water and for proper conveying to discharge point. Structural steel work may include fabrication, erection, painting, sheeting and cladding works.

5.3.1.2.4 Drainage Works

There are one stream (Sg. Pengorak) and two discharge points along the existing shoreline near the proposed Project site. In order to ensure that the proposed Project does not impact these discharge points, an extension of these discharges is required to allow good flushing capability. At the same time, the extension of channel shall be as such that it does not cause a significant increase of water level upstream of the discharge points which could increase the risk of flooding upstream.

The initial proposed drainage design for the extension of channel is presented in **Table 5.3.3**. Effectiveness of these proposed drainage will be verified via the hydraulic study and further refined where necessary to ensure minimal impact to the performance of the existing discharge points.

Table 5.3.3: Design details of the proposed artificial river and drainage

Cross Section	Channel Dimensions
S1 – Extended channel for Sg. Pengorak The channel will be constructed as an earth drain with constant side slopes down to existing seabed. The outlet will be close to the existing shoreline.	
S2 – Extended channel for Sg. Pengorak during Phase 2 The channel will be constructed as an earth drain with constant side slopes down to existing seabed. The exit of the channel will be located on the south-western side of the reclamation near the existing 0 m CD depth contour.	
S3 – Extended channel for culvert outlet (from Rumah Pangsa LPK) The channel will be constructed as a concrete drain with minimum width of 5m. The channel links to the extended channel for Sg. Pengorak.	
S4 – Extended channel from Kuantan Port outlet The channel will be constructed as a concrete drain (minimum width of 10m) with an outlet near the headland.	

5.3.1.2.5 Mechanical and Electrical Works

Mechanical works, equipment installations and electrical works are necessary to ensure functionality of the proposed Project's components. These will include the necessary piping, electricity, material and water supply connection with external sources. The environmental impacts from these activities are not significant although it may be necessary to assess the occupational related hazards.

5.3.1.2.6 Testing and Commissioning

Some components of the proposed Project such as the sewage treatment plant and utility services, will need to be tested and commissioned as they are completed. Various load tests and performance tests will be conducted once all the associated plant's components are commissioned. During this testing and commissioning period, the operation mode will be fine-tuned and optimized where necessary.

5.3.1.2.7 Demobilisation of workers and temporary facilities

On completion of the construction stage of the proposed facilities, all temporary facilities will be removed from site and these shall also include any excess of construction materials and wastes.

5.3.2 Operation Stage

5.3.2.1 Shipyard

Shipbuilding activities will involve designing work, cutting and welding work, blasting and painting works, outfitting, testing and ship launching. Shipbuilding requires skilled workers.

Cutting and Welding Works

Gases are used to melt and cut or to weld the steel. It also requires operations at high places (working at height) and cranes are used to transport and assemble each steel sheets into the shape of a ship.

Blasting and Painting Works

Blasting and painting are performed to protect the ship against aggressive corrosion and to enhance the aesthetic outlook of the ship. The nature of shipbuilding and repair may require several types of paints to be used for various applications (e.g., rust prevention, anti-fouling and alkaline resistance). Paint types range from water-based coatings to high-performance epoxy coatings. The type of paint needed for a certain application depends on the environment to which the coating will be exposed. Paint application equipment ranges from simple brushes and rollers to compressed-air and airless sprayers. Compressed-air systems spray both air and paint, which causes some paint to atomize (dry) quickly prior to reaching the intended surface. The transfer efficiency of air-assisted spray systems can vary from 65 to 80%. This low transfer efficiency is due mainly to overspray, drift and the air sprayer's inefficiencies; these sprayers are becoming obsolete because of their low transfer ability. The airless sprayer is most common in shipbuilding and it is a system which simply compresses paint in a hydraulic line and has a spray nozzle at the end; hydrostatic pressure, instead of air pressure, conveys the paint. Airless sprayers are much cleaner to operate and have fewer leaking problems as compared to compressed-air sprayers. Airless sprayers have close to 90% transfer efficiency, depending on the operating conditions.

Plate 5.3.6: Typical Sand Blasting Workshop

Plate 5.3.7: Before and after sand blasting products.

<u>Outfitting</u>

Outfitting is the process of installing parts and various subassemblies (e.g., piping systems, ventilation equipment, electrical components) on the block prior to joining the blocks together at erections. The outfitting of blocks throughout the shipyard lends itself to forming an assembly line approach to shipbuilding. For simplicity, outfitting can be divided into three main stages of construction once the steel structure of the block has been assembled, namely unit outfitting, on-block outfitting and on-board outfitting.

Unit outfitting is the stage where fittings, parts, foundations, machinery and other outfitting materials are assembled independent of the hull block (i.e., units are assembled separate from steel structural blocks). Unit outfitting allows workers to assemble shipboard components and systems on the ground, where they have easy access to the machinery and workshops. Units are installed at either the on-board or the on-block stage of construction. Units come in varying sizes, shapes and complexities. In some cases, units are as simple as a fan motor connected to a plenum and coil. Large, complex units are mainly composed of components in machinery spaces, boilers, pump rooms and other complex areas of the ship. Unit outfitting involves assembling piping spools and other components together, then connecting the components into units. Machinery spaces are areas on the ship where machinery is located (e.g., engine rooms, pump stations and generators) and outfitting there is intensive. Outfitting units on the ground increases safety and efficiency by reducing the work hours that would otherwise be allocated to on-block or on-board work in more confined spaces where conditions are more difficult.

On-block outfitting is the stage of construction where most of the outfitting material is installed onto the blocks. Outfitting materials installed on block consist of ventilation systems, piping systems, doors, lights, ladders, railings, electrical assemblies and so on. Many units are also installed at the on-block stage. Throughout the on-block outfitting stage, the block can be lifted, rotated and moved to efficiently facilitate installing outfitting materials on the ceilings, walls and floors. All of the shops and services in the shipyard must be in communication at the on-block stage to ensure that materials are installed at the right time and place.

On-board outfitting is performed after the blocks are lifted onto the ship under construction (i.e., after erection). At this time, the ship is either at a building position (building ways or building dock), or the ship could be berthed at pier side. The blocks are already outfitted to a large extent, although much more work is still needed before the ship is ready to operate. On-board outfitting involves the process of installing large units and blocks on board the ship. Installation includes lifting the large blocks and units on board the new ship and welding or bolting them into place. On-board outfitting also involves connecting the shipboard systems together (i.e., piping system, ventilation system and electrical system). All of the wiring systems are pulled throughout the ship at the on-board stage.

Testing

The operation and test stage of construction assesses the functionality of installed components and systems. At this stage, systems are operated, inspected and tested. If the systems fail the tests for any reason, the system must be repaired and retested until it is fully operational. All piping systems on board the ship are pressurized to locate leaks that may exist in the system. Tanks also need structural testing, which is accomplished by filling the tanks with fluids (i.e., salt water or fresh water) and inspecting for structural stability. Ventilation, electrical and many other systems are tested. Most system testing and operations occur while the ship is docked at pier side. However, there is an increasing trend to perform testing at earlier stages of construction (e.g., preliminary testing in the production shops). Performing tests at earlier stages of construction makes it easier to fix failures because of the increased accessibility to the systems, although complete systems tests will always need be done on board. Once all preliminary pier side testing is performed, the ship is sent to sea for a series of fully operational tests and sea trials before the ship is delivered to its owner.

Repair and Maintenance Works

The shipyard will have the capability to provide ship repair and maintenance works. These works are largely done at dry dock and the activities include mechanical and electrical repairs, hot works, cleaning, blasting and painting works. Ship owners may engage his own work team, including waste handling contractors.

Plate 5.3.8: Ship Drydock

Plate 5.3.9: Ship assembling at the shipyard

5.3.2.2 Fabrication Yard

A steel fabrication yard would generally accommodate activities such as workshops covering cutting, welding and grinding works, blasting work, painting work, packing and shipping of products to customer.

Most of these activities are generally similar to those elaborated under Section 5.3.2.1 of this EIA report. Products to be fabricated are dependent on customers' requirement and design.

Plate 5.3.10: An example of product (offshore topside module) being fabricated and build at fabrication yard.

5.3.2.3 Sewage Treatment Plant

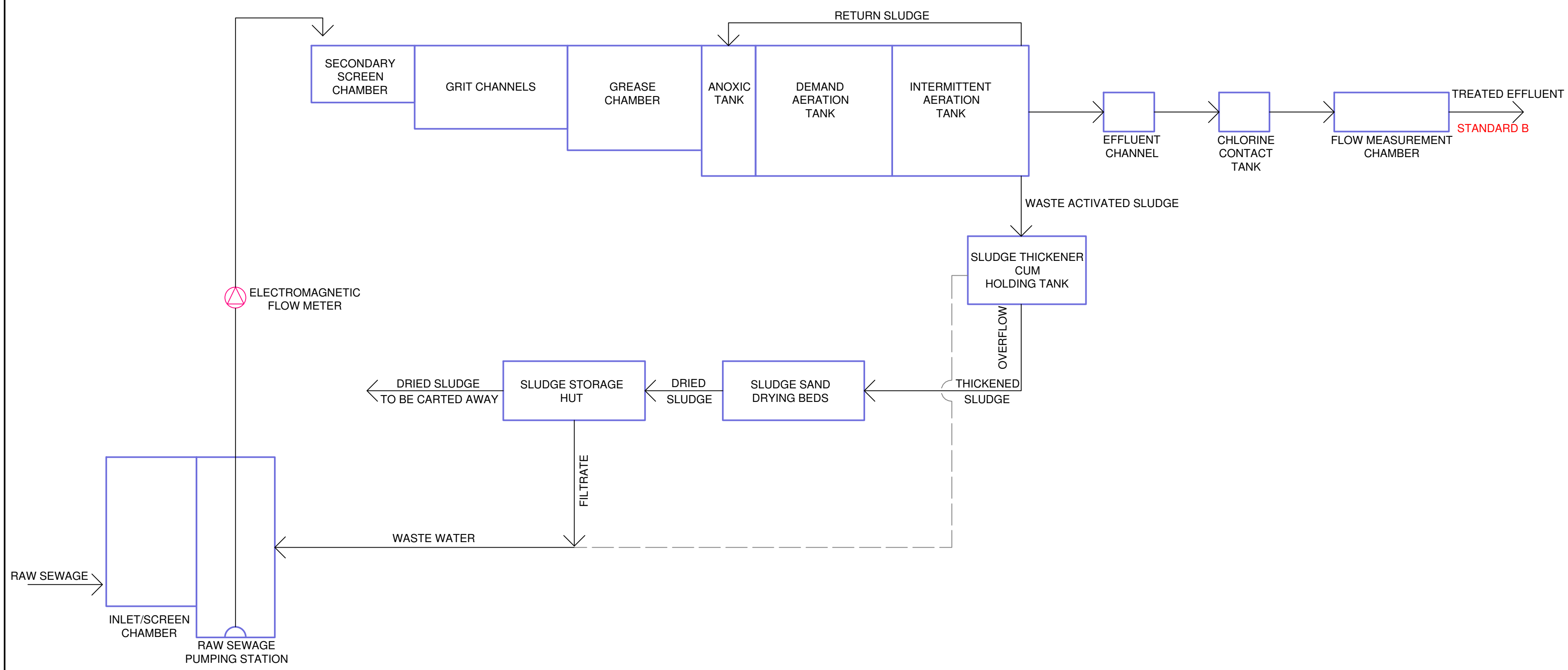
The proposed Project is required to be self-sufficient with provision for sewage treatment. The estimation of PE is presented in **Table 5.3.4** and 4 units of sewage treatment plants (STP) are planned.

Table 5.3.4: Estimation of Population Equivalent (PE) for STP

STP	Phase	Establishment	Population	Population Equivalent	PE	Total PE
1	1a	Shipyard				
		Staff	40	0.3 per staff	12	1012
		Workers	1000	1 per person	1000	
2	1b	Fabrication Yard				
		Staff	400	0.3 per staff	120	1720
		Workers	1600	1 per person	1600	
3	1c	Institution	800	1 per person	800	8061.3
		Business	89,710 m^2	3 per 100m^2	2691.3	
		Residential	914	5 per house	4570	
4	1c	Maritime Industrial Park	8224	0.3 per staff	2467.2	2467.2

The proposed STP shall apply the Intermittently Decanted Extended Aeration (IDEA) Activated Sludge treatment system. Schematic flow diagram and proposed STP layout plant are presented in **Figure 5.3.6** and **Figure 5.3.7** respectively.

These STP shall be designed to meet at least Standard B of the Environmental Quality (Sewage) Regulations 2009. The final discharge of treated sewage effluent is to the sea via discharge points identified on **Figure 5.2.1**.



SCHEMATIC FLOW DIAGRAM INTERMITTENTLY DECANTED EXTENDED AERATION (IDEA) ACTIVATED SLUDGE SEWAGE TREATMENT PLANT

FIGURE: 5.3.6

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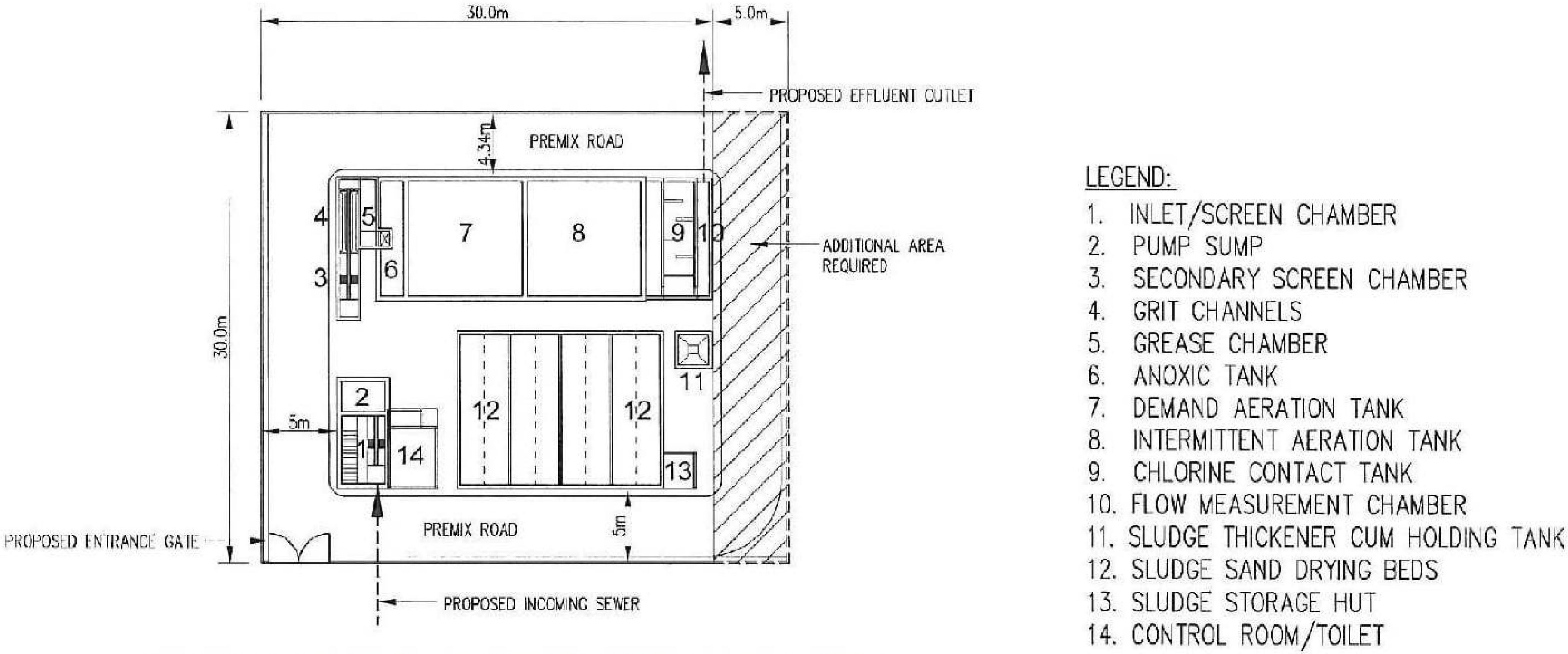

LAYOUT PLAN OF INTERMITTENTLY DECANTED EXTENDED AERATION (IDEA) ACTIVATED SLUDGE SEWAGE TREATMENT PLANT

FIGURE: 5.3.7

5.3.2.4 Waste Management

The proposed Project is expected to generate some wastes during both the construction and operation stages. **Table 5.3.5** presents the summarised list of anticipated wastes and its associated sources. As the generation of wastes are subjected to the type of projects / contracted activities, an estimation of wastes generation is not possible.

Table 5.3.5: Type of Anticipated Wastes

Stage	Category	Type of Waste	Possible Source
Construction	Scheduled Waste	Ballast water-oil mixture (SW309)	Working barge, dredger
		Diesel and Oil spills (SW307)	Working barge, dredger
		Equipment with mineral oil (SW409)	Working barge, dredger, workers
		Rags or filters contaminated with scheduled waste (SW410)	Workshops/stockpile on site
	Solid Waste	Metal Scrap	Workshops/stockpile on site
		Domestic	Temporary sanitary facility on site
Operation	Scheduled Waste	Spent garnet sand (SW104)	Fabrication yard
		Spent lubricating oil (SW305)	Barges, docks, workshops
		Spent hydraulic oil (SW306)	Barges, docks, workshops
		Diesel and oil spills/ Spent coolant (SW307)	Barges, docks, workshops
		Ballast water-oil mixture (SW309)	Barges, docks
		Clinical Waste (SW404)	Office
		Empty paint container (SW409)	Docks, workshops
		Rags and gloves contaminated with scheduled waste (SW410)	Workshops
		Waste of inks and paints (SW417)	Painting room, workshops
	Solid Waste	Metal Scrap	Workshops
		Domestic	Sanitary facility on site, sewage treatment plant

Sources: Muhibbah Steel Industries Sdn Bhd and Muhibbah Marine Engineering Sdn Bhd

5.4 Workforce

It is estimated during the peak construction period, about 2,800 workers including professional, skilled and semi-skilled workers will be engaged. Workers' accommodation will mostly be on-site and daily transportation of the workers to work site is not anticipated to be significant.

Meanwhile the forecasted population based on Phase 1 development plan and including number of workers to be employed at the proposed shipyard and fabrication yard are presented in **Table 5.4.1**. It is anticipated that the proposed KMH will contribute to the generation of significant numbers of job and business opportunities.

Table 5.4.1: Type of Development and Estimated Population for Phase 1

Phase	Type of Development	Estimated Population
1a	Shipyard	
	Staff	40
	Workers	1,000
1b	Fabrication Yard	
	Staff	400
	Workers	1,600
1c	Institution	800
	Residential	4,570
1c	Maritime Industrial Park	8,224

5.5 Project Implementation Schedule

The proposed timeline for Phase 1 development is enclosed in **Appendix 5.1**. Phase 1 development will be developed in phases over 9 years. Reclamation and construction works for Phase 1 is expected to begin in January 2018 and as soon as all necessary approvals are obtained from the approving authorities.

5.6 Project Management

MEB intends to oversee to the implementation of the overall project. At the time of this EIA report preparation, MEB has yet to appoint the Project contractor.

5.7 Project Abandonment

Project abandonment in major Projects can occurs for a number of reasons. However unlikely such event is, it is necessary for this EIA to discuss and outline the requirement should the proposed Project be abandoned during the Construction and Installation Stage or closed during Operation Stage. The Project Proponent, as well as the local authorities and DOE are expected to be involved in the process of handling the Project abandonment should such an event occur.