

# EXECUTIVE SUMMARY

## **1.0 Introduction**

The Penang State Government (hereafter referred to as the “Project Proponent”) intends to undertake land reclamation activities to create three man-made islands at the south coast of Penang Island. SRS Consortium will be the Penang State Government’s “Project Delivery Partner” (PDP). Its role is to ensure smooth implementation of the entire project delivery success. The three man-made islands are intended to be developed as a part of the expansion of Bayan Lepas Free Industrial Zone (FIZ) and Penang International Airport; as well as mixed development comprising residential and commercial areas.

The project for which this Environmental Impact Assessment (EIA) (Second Schedule) report is prepared is titled “The Proposed Reclamation and Dredging Works for the Penang South Reclamation (PSR), Penang” (hereafter referred to as “the Project”).

## **2.0 Legal Requirement**

As stipulated under the Environmental Quality Act 1974 (Amendment 2012) and the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015, any activity which may have significant environmental impact is categorised as “Prescribed Activity” with an Environmental Impact Assessment (EIA) as the prerequisite component for an approval.

T.1 tabulates the multi-prescribed activities of the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015 pertaining to the proposed development. The proposed Project consists of multi-prescribed activities, but this EIA study shall only address land reclamation and dredging.

## **3.0 EIA Study Approach**

The EIA study involves the collection and analyses of primary and secondary data related to the Project site and its surroundings. The scope of work of this EIA study follows the requirements of relevant framework, policies, conditions and guidelines. The following planning policies have been referred to in order to analyse the proposed Project’s compliance as summarised in T.2.

**T.1** Multi-prescribed activities of the proposed Project

Prescribed Activity	Term	Details
<b>Land Reclamation (Second Schedule)</b>	Item 7	b) Reclamation for man-made island
<b>Dredging (First Schedule)</b>	Item 15	a) Capital dredging
Industrial Estate Development (First Schedule)	Item 17	Development of industrial estate covering an area of 20 hectares or more
Housing (First Schedule)	Item 16	Housing development covering an area of 50 hectares or more
New Township (First Schedule)	Item 18	Construction of new township consisting of 2,000 housing accommodation units or more or covering an area of 100 hectares or more
Waste Treatment and Disposal	Item 14	c) Sewage i. Construction of sewage treatment plant with 20,000 population equivalent or more.

Note:  Reclamation and Dredging  Topside development (will be conducted later)

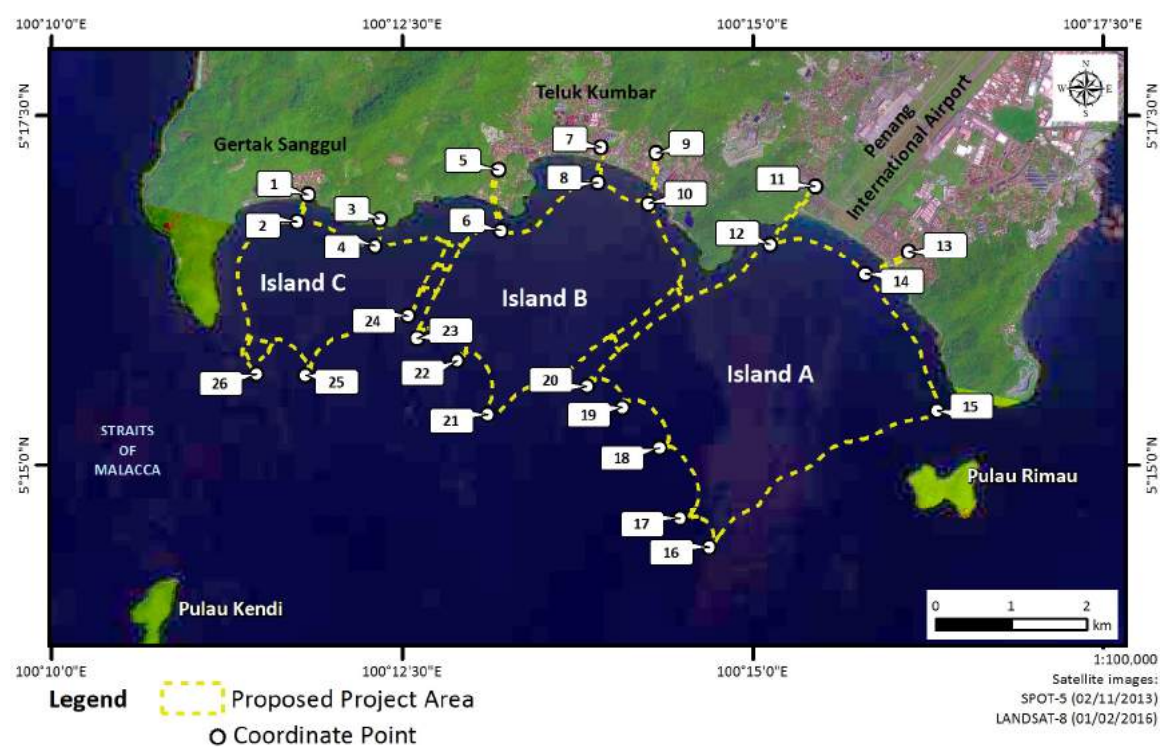
**T.2** Policies compliance of the Project

Policies	Remarks
Third National Physical Plan (NPP-3)	<p>The proposed PSR development is congruent with the objectives of NPP-3 which provide focus towards achieving a Resilient and Liveable Nation which ensures continued development after year 2020. PSR is planned in stages in order to achieve this aim.</p> <p>PSR also supports three main pillars of NPP-3 which are:</p> <ul style="list-style-type: none"> <li>i) Dynamic urban and rural growth;</li> <li>ii) Spatial sustainability and climate resilience; and</li> <li>iii) Building and inclusive and liveable communities.</li> </ul>
Penang Structure Plan (RSNPP)	The proposed Project site is partially gazetted in the RSNPP 2020. However, the three reclaimed islands have been included in the draft RSNPP 2030. The draft RSNPP 2030 was displayed to public from 19 <sup>th</sup> September to 19 <sup>th</sup> November 2018.
Northern Corridor Economic Region (NCER)	The proposed Project supports the government's effort in reaching NCER's vision in the growth of the Electrical and Electronics (E&E) sector (expansion of Bayan Lepas FIZ).
Integrated Shoreline Management Plan (ISMP) Pulau Pinang	The proposed Project is in line with the ISMP as it includes the development of a Smart City and providing new beaches for recreational and tourism activities on the reclaimed islands.

## 4.0 Project Background and Location

The Project consists of the reclamation of three man-made islands and is commonly known as the Penang South Reclamation (PSR). It covers a total area of 4,500 acres with the islands being fully owned by the Penang State Government. The proposed project is projected to help keep the economic growth engines humming and for Penang and Malaysia to keep moving up the value chain. The islands shall be part of the expansion of the Bayan Lepas Industrial Zone as well as in providing land for the development of a Smart City.

The proposed three PSR islands will be at the coastline of southern Penang Island (F.1). It is situated about 22 km away from Georgetown via the Tun Dr. Lim Chong Eu (LCE) Expressway and about 352 km away from Kuala Lumpur via the North-South Expressway. The coordinates of the Project location boundary are tabulated in T.3.



**F.1** Location and coordinate points of the Project boundary

### T.3 Coordinates of the Project area

Point	Latitude	Longitude	Point	Latitude	Longitude
1	5°16'56.3"N	100°11'49.8"E	14	5°16'22"N	100°15'48.1"E
2	5°16'44.7"N	100°11'45.1"E	15	5°15'23.4"N	100°16'19"E
3	5°16'45.7"N	100°12'20.5"E	16	5°14'24.8"N	100°14'41.6"E
4	5°16'34.2"N	100°12'18.6"E	17	5°14'36.9"N	100°14'29"E
5	5°17'6.8"N	100°13'11.1"E	18	5°15'7.6"N	100°14'20"E
6	5°16'40.7"N	100°13'12.3"E	19	5°15'24.8"N	100°14'4"E
7	5°17'16.4"N	100°13'55.1"E	20	5°15'33.8"N	100°13'49.2"E
8	5°17'1.3"N	100°13'53.7"E	21	5°15'21.8"N	100°13'6.6"E
9	5°17'13.9"N	100°14'18.7"E	22	5°15'44.8"N	100°12'53.7"E
10	5°16'52.3"N	100°14'15.3"E	23	5°15'54.5"N	100°12'36.4"E
11	5°16'59.8"N	100°15'26.7"E	24	5°16'4.2"N	100°12'32.6"E
12	5°16'34.7"N	100°15'7.6"E	25	5°15'38.5"N	100°11'48.7"E
13	5°16'31.7"N	100°16'6.8"E	26	5°15'39"N	100°11'27.6"E

## 5.0 Project Initiators

The Project Proponent is the Penang State Government with its Project Delivery Partner (PDP), SRS Consortium. SRS Consortium is a joint venture of Gamuda Berhad, Loh Phoy Yen Holdings Sdn. Bhd. and Ideal Property Development Sdn. Bhd.

This EIA (Second Schedule) has been conducted by Dr. Nik & Associates Sdn. Bhd. There are also other studies conducted separately to support the EIA study. They are:

- Hydraulic Study Report;
- Fisheries Impact Assessment Report;
- Social Impact Assessment Report;
- Traffic Impact Assessment Report;
- Water Quality Study for the Proposed Reclamation and Dredging Works for the PSR Scheme, Penang;
- Penang Reclamation Preliminary Assessment: Sea Turtle Nesting Status on Beaches of Southern Penang Island; and
- Penang Reclamation Hydraulic Study Independent Review: Tsunami Impact Assessment.

## 6.0 Statement of Need

### 6.1 Planning for Penang's Future Generations

In line with the realisation of the national aspiration (under 11<sup>th</sup> Malaysian Plan), the Penang State has corresponded its development vision to unlock economic opportunities while safeguarding the continued wellbeing of its *Rakyat*, encapsulated under the Penang Paradigm.

Whilst moving up the value chain and developing new economic drivers to attract investments, Penang needs to create new land to execute this transformative development plan to:

- a) nurture valuable human capital to fuel sustainable growth; and
- b) address the challenges faced by Penang:
  - i) lack of quality jobs leading to talent outflow (e.g. brain drain);
  - ii) economic growth constrained by inadequate infrastructure (e.g. traffic congestion and inadequate infrastructure to support growing population);
  - iii) northern-centric growth on Penang Island (e.g. widening socio-economic disparity between northern and southern regions); and
  - iv) need substantial developable land to facilitate transformation (e.g. fast escalation of property prices, ad-hoc developments that threaten liveability and preservation of Penang's heritage).

## **6.2 The Transformation of Penang – Smart City**

To transform Penang, a holistic transformation masterplan is much needed. For the overall PSR masterplan, the “Smart City” concept that would integrate the three aspects of Penang Paradigm into a single coherent agenda has been adopted.

## **6.3 Human Capital to Drive Penang's Transformation**

With the investments attracted by PSR into high-tech and R&D sectors, the skills level of workforce in Penang will subsequently be upgraded. The investments will also create new high-income jobs. These job opportunities coupled with good liveability help to attract and retain human talent in Penang.

## **6.4 Economic Transformation of Penang**

The economic transformation of Penang shall consist of the following:

- a) Expansion of the Bayan Lepas Free Industrial Zone;
- b) Diversifying the E&E sector;
- c) A new hub to charge up the services sector; and
- d) Tourism.

## **6.5 Relief Development Pressures on Georgetown**

PSR will open up a new holistic township on the southern island, an ideal location to absorb the spill-over effects of the incompatible developments on Penang Island and thus assisting the State to achieve a more inclusive and harmonised development throughout the whole Island.

## **6.6 Addressing New Land Scarcity and Preserving Penang's Hills**

With sufficient land mass, the State Government will be able to control the haphazard developments that is now threatening both the heritage charm and well-loved green hills of Penang. The State Government will also be able to moderate the escalation of land prices by controlling the supply of new PSR land into the market in an orderly and controlled manner.

## **6.7 Homes for All Income Levels Served by Well-planned Amenities**

Being the land owner of PSR land, the State Government will have the ability to carry out more housing projects that supplement its current effort to build sufficient quality housing for all income levels of its *Rakyat*.

## **6.8 Economic and Employment Benefit**

PSR will deliver an output multiplier of 2.5 times during the construction phase and by 2050, the new investments attracted by PSR will create more than 300,000 job opportunities.

## **6.9 New Beginnings for Fishermen**

In line with the spirit of the 11<sup>th</sup> Malaysia Plan (RMKe-11), PSR will deliver new opportunities to the fishermen community as follows:

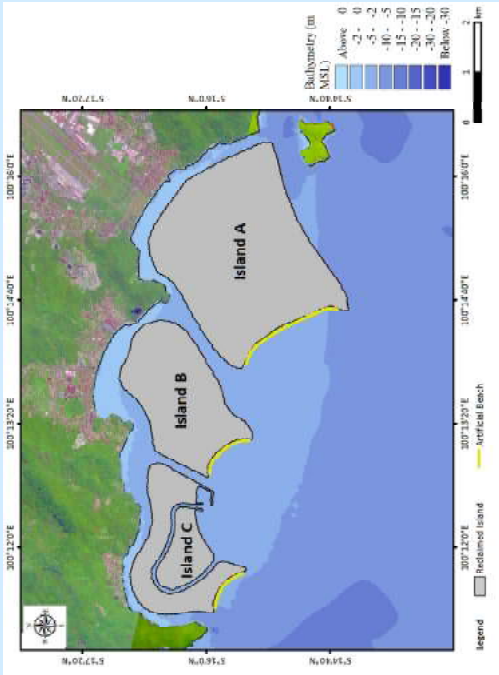
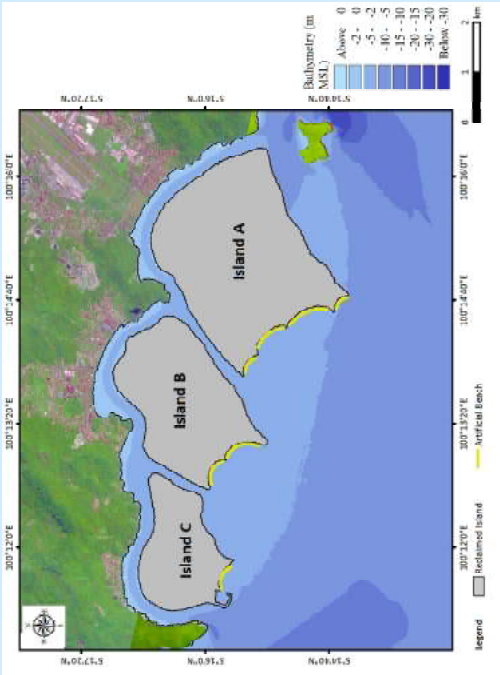
- a) Better fishing infrastructure in the south coast;
- b) Improvements to local infrastructure such as flood mitigation, shoreline enhancement, rural development and roadworks for better living conditions;
- c) Accessibility to future amenities such as parks and recreational facilities, education, health care and government services on PSR Islands;
- d) Increase income through the "Alternative Livelihood Options" scheme carried out by the State Government in collaboration with relevant Federal agencies i.e. deep-sea fishing, aquaculture, water taxi, fish tourism and recreational fishing, home-stay programmes, alternative employment in other sectors, etc.; and
- e) Eligibility for public housing that is in close proximity to their existing residence.

T.4 Summary of Project options

Option	Layout	Remark
<b>Option 1:</b> Reclaimed islands with foreshore reclamation for airport extension		Option 1 allows a minimum of 200 m width of access channel for fishermen at the eastern part of Island A (2,451 acres) and Penang Island. This option provides a foreshore reclamation area for airport extension. Erosion might occur at the sharp edge of Island A close to Tanjung Chut and Permatang Damar Laut due to the increase of current speed at the area, making this option unworkable.
<b>Option 2:</b> Streamlined edges of Island A with foreshore reclamation for airport extension		Option 2 proposed to streamline the edges at the southern and eastern coastlines of Island A (2,124 acres) to make the shape less resistant to hydrodynamics. High rate of erosion is expected to occur at the southeastern tip of Island A. At Tanjung Teluk Tempoyak, the current speed decreases, making the area susceptible to sedimentation. Thus, this option is not viable.



T.4 Summary of Project options (cont'd)

Option	Layout	Remark
<p><b>Option 3:</b> Reduction of size of Island A with no foreshore reclamation</p>		<p>Option 3 has the area of Island A being 2,432 acres. The shape of Island A is now streamlined with the bay between Tanjung Teluk Tempoyak and Tanjung Chut. The sharp edge at the tip of Island A is minimised to reduce the water current speed. Decrease of current speed in the access channel particularly at Tanjung Teluk Tempoyak and Tanjung Gertak Sanggul is observed. The marina breakwater at Island C is however too far to be accessed from deep water. Some refinements are still needed. Therefore, this option is not considered.</p>
<p><b>Option 4:</b> Increased number of embayed beaches at the south coastlines of reclaimed islands</p>		<p>The size of Island A in Option 4 is 2,300 acres. This option consists of the reconfiguration of the southwest-facing coastlines of all islands to increase the number of embayed beaches. The marina breakwater on Island C is relocated to the southwestern corner. The channel in Island C is also removed.</p> <p>There will be higher current speed in the access channel between Island A and Penang Island.</p> <p>This option is established as the chosen layout with consideration to the hydraulic modelling results and discussions with the PDP and master-planner.</p>



## 7.0 Project Options

There are four options considered in the design of the three islands. They are:

- a) Option 1: Reclaimed islands with foreshore reclamation for airport extension;
- b) Option 2: Streamlined edges of Island A with foreshore reclamation for airport extension;
- c) Option 3: Reduction of size of Island A with no foreshore reclamation; and
- d) Option 4: Increased number of embayed beaches at the south coastlines of reclaimed islands.

A summary of the Project options is tabulated in T.4.

## 8.0 Project Descriptions

This section covers the details of the proposed Project which include the following:

- a) Project site description;
- b) Project concept;
- c) Project components;
- d) Project activities and phasing;
- e) Topside development land use; and
- f) Project implementation schedule.

### 8.1 Project Site Description

The site description of the Penang south coast is addressed according to the headlands from east to west namely Tanjung Teluk Tempoyak, Tanjung Chut, Tanjung Bongkok and Tanjung Gertak Sanggul.

#### 8.1.1 Batu Maung to Tanjung Teluk Tempoyak

The distance from Batu Maung to Tanjung Teluk Tempoyak along the coastline is about 3.6 km. Pulau Rimau is located approximately 830 m away from the tip of Tanjung Teluk Tempoyak. The coastal erosion of the coastline from Batu Maung to Tanjung Teluk Tempoyak falls under Category 3 ("Acceptable") based on the National Coastal Erosion Study (NCES) (DID, 2015). The coastline nearer to Tanjung Teluk Tempoyak is generally shallow with mudflats visible during low water. Two rivers are located within the area: Sungai Tiram and Sungai Nipah. The Bayan Lepas FIZ is located at the north of Batu Maung.

### **8.1.2 Tanjung Teluk Tempoyak to Tanjung Chut**

Tanjung Chut is located approximately 6.5 km away to the west of Tanjung Teluk Tempoyak. The western side of Tanjung Teluk Tempoyak is mostly covered by forests and fronted by rocky outcrops and sandy beaches. The land use between the two headlands is already well-developed, particularly at Bayan Lepas with the Penang International Airport. The coastline erosion conditions along Permatang Damar Laut are categorised as Category 3 (“Acceptable”), except for a small bay at the west of Tanjung Teluk Tempoyak near Sungai Ikan Mati which is categorised as Category 2 (“Significant”). Three rivers or drainages are present within the headlands which are the Bayan Lepas Main Drain, Sungai Bayan Lepas and Sungai Ikan Mati.

### **8.1.3 Tanjung Chut to Tanjung Bongkok**

The coastline is about 4.3 km in length between the rocky headlands of Tanjung Chut and Tanjung Bongkok. A 600 m-long beach at Teluk Pak Pajuh, located beside small rock outcrops. Teluk Kumbar which is located within the two headlands is a developed district, with many residential areas. There is a 2.2 km-long embayed beach along Teluk Kumbar’s coastline. The coastline erosion condition along the bay is listed as Category 2 (“Significant”). Two main rivers are found here which are Sungai Batu and Sungai Teluk Kumbar.

### **8.1.4 Tanjung Bongkok to Tanjung Gertak Sanggul**

The length of the coastline from Tanjung Bongkok to Tanjung Gertak Sanggul is about 7.5 km. The coastline’s stretch is characterized by two large bays with Tanjung Gemuruh at the centre. The erosion condition at Pantai Tanjung Asam is listed as Category 2 (“Significant”) while at the coastline of Gertak Sanggul, it is as Category 3 (“Acceptable”). There are two rivers found between the headlands namely Sungai Gemuruh and Sungai Gertak Sanggul.

### **8.1.5 Proposed Location for Workers’ Quarters**

Prior to the beginning of dredging and reclamation works, workers’ quarters will be constructed first to cater for the incoming employees and labourers hired for the dredging and reclamation works. The quarters will be built on a land located near Tanjung Chut. It is accessible via Jalan Permatang Damar Laut which connects to an existing earth road leading to the site. The earth road will become the access road into the construction site. Presently, the quarters’ footprint is covered with vegetations and shrubs.

## 8.2 Project Concept

The reclamation Project offers an opportunity to address the issue of land scarcity on Penang Island, and at the same time facilitates the emergence of significant economic and social development opportunities through the green field reclamation Project.

The Penang State Government is proposing a new approach to the management of land where ownership of the newly created land lies with the State Government. The subsequent use of the land will, in turn, be determined by the State as it responds to the ongoing development needs of the State.

The plans for the islands, in responding to the trend experienced in world-class cities, also seek to encourage the use of public transport, in line with the Penang Transport Master Plan's ethos of "Moving people, not cars". The actual use of the land will, however, be the subject of subsequent submissions for consent to develop where each application would be subject to usual assessment.

The "Smart City" development concept of PSR will facilitate a sustainable urban ecosystem to yield high quality of life for the *Rakyat*, and ultimately a "City for the Future" where all social and information systems are inter-linked to offer an ideal living environment.

## 8.3 Project Components

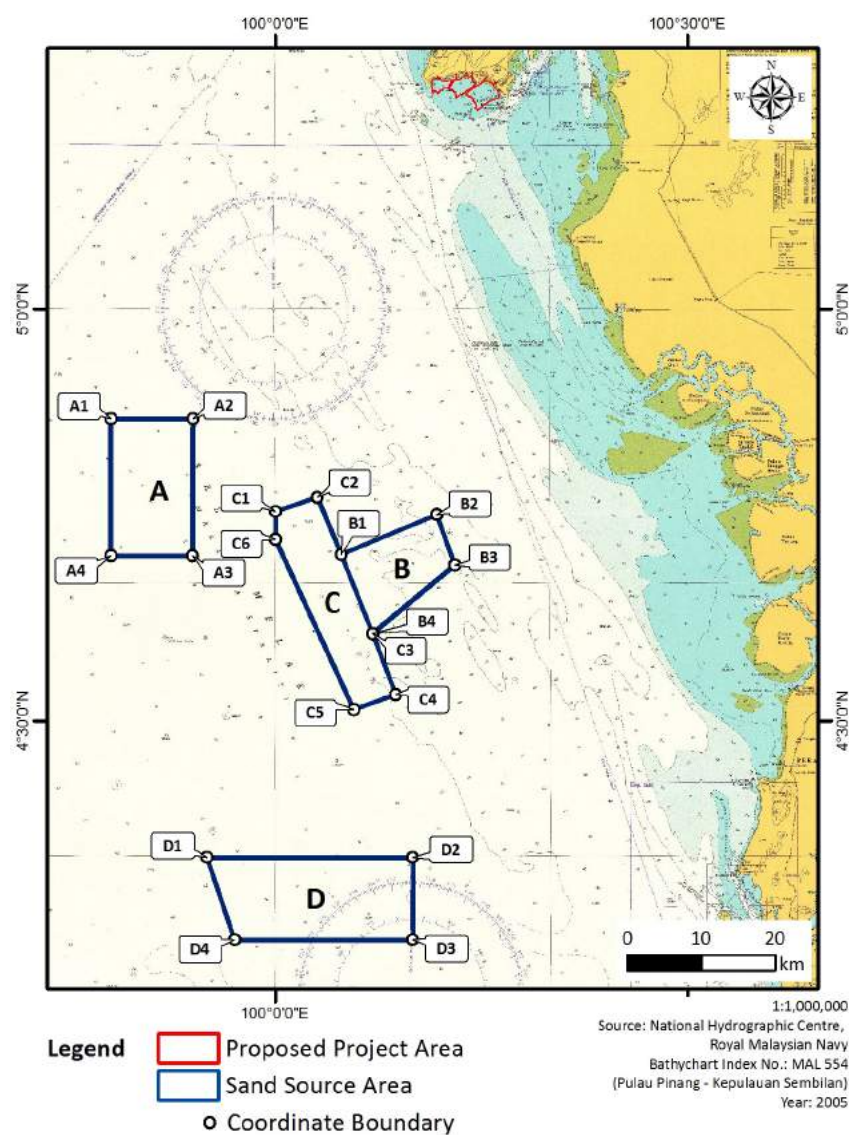
The major components of the Project are as listed below:

### a) Reclamation of Islands A, B and C

The reclamation of Islands A, B and C requires a total fill material volume of approximately 189.1 million m<sup>3</sup>. There are four potential sand source areas offshore within Perak waters (T.5 and F.2). Several potential rock source locations for the construction of revetment as edge protection of the reclaimed islands are indicated in T.6.

**T.5** Coordinates of the potential sand source locations

Point	Latitude	Longitude	Point	Latitude	Longitude
<b>Area A</b>			<b>Area B</b>		
A1	4° 52' 0.0" N	99° 48' 0.0" E	B1	4° 42' 7.0" N	100° 4' 47.0" E
A2	4° 52' 0.0" N	99° 54' 1.0" E	B2	4° 45' 0.0" N	100° 11' 45.0" E
A3	4° 42' 0.0" N	99° 53' 58.7" E	B3	4° 41' 20.0" N	100° 13' 4.0" E
A4	4° 42' 0.0" N	99° 48' 0.0" E	B4	4° 36' 20.0" N	100° 7' 5.0" E
<b>Area C</b>			<b>Area D</b>		
C1	4° 45' 12.0" N	100° 00' 0.0" E	D1	4° 20' 0.0" N	99° 55' 0.0" E
C2	4° 46' 17.0" N	100° 3' 4.0" E	D2	4° 20' 0.0" N	100° 10' 0.0" E
C3	4° 36' 20.0" N	100° 7' 5.0" E	D3	4° 14' 0.0" N	100° 10' 0.0" E
C4	4° 31' 55.0" N	100° 8' 46.0" E	D4	4° 14' 0.0" N	99° 57' 0.0" E
C5	4° 30' 50.0" N	100° 5' 42.0" E			
C6	4° 43' 11.0" N	100° 0' 0.0" E			



## F.2

Potential sand source areas

## T.6 Potential rock source locations

Potential Rock Source Location	Distance to Batu Kawan Jetty (km)	Distance from Jetty to Project Area (nm)
Batu Kawan, Pulau Pinang	-	16
Kampung Batu Sepuluh, Kulim, Kedah	53	-
Near Bandar Seri Mahkota	38	-
Teluk Tempoyak	-	6

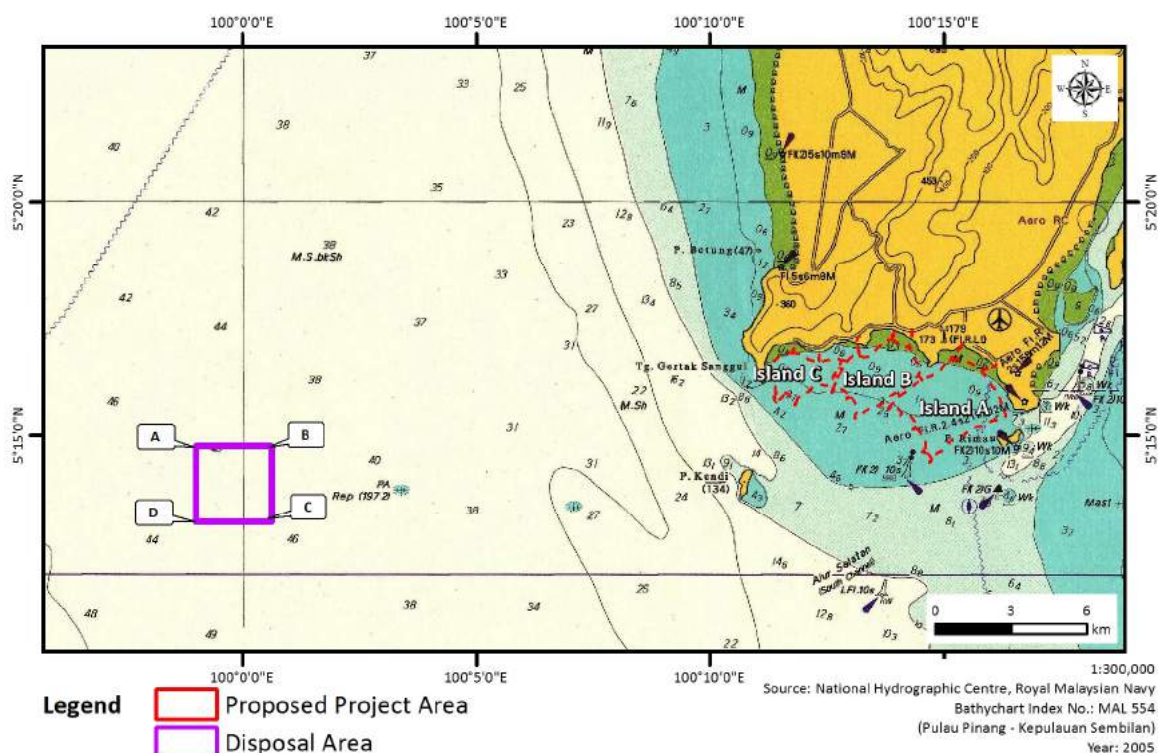
## b) Dredging of access channels

The access channels of 40 m wide and -2 m CD deep will be dredged between the reclaimed islands as well as between the reclaimed islands and Penang Island. Once the reclamation works start, all channels will be widened by up to about 250 m wide. The estimated dredging volume is 6.9 million m<sup>3</sup>. The dredged material will be loaded onto split hopper barges and disposed of at a designated disposal ground to be approved by the Marine Department and DOE. A discussion with the Marine Department has proposed west of Pulau Kendi as the disposal ground (F.3). The coordinates of the proposed disposal ground is tabulated in T.7.

**T.7**

Coordinates of the proposed disposal ground for dredged materials

Point	Latitude	Longitude
A	5°14'45.6"N	99°58'59.2"E
B	5°14'45.6"N	100°00'36.6"E
C	5°13'08.0"N	100°00'36.7"E
D	5°13'07.9"N	99°58'59.3"E



**F.3** Proposed disposal ground for dredged materials




A separate EIA study (First Schedule) is required for the disposal of dredged material at the designated disposal ground. This separate EIA will need to be submitted to DOE Penang for its approval.



## 8.4 Project Activities and Phasing


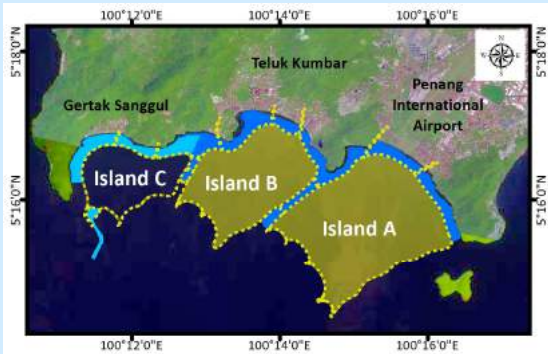
A summary of the Project activities and phasing is shown in T.8. An estimated volume of materials of each Project activity is shown in T.9.

**T.8** Summary of Project activities and phasing

Phase	Description
Pre-dredging Stage	 <ul style="list-style-type: none"> <li>a) Land clearing; biomass removal and disposal</li> <li>b) Construction of access road <ul style="list-style-type: none"> <li>■ Length: Approximately 1 km</li> </ul> </li> <li>c) Construction of temporary workers' jetty <ul style="list-style-type: none"> <li>■ Length: 50 m</li> </ul> </li> <li>d) Construction of workers' quarters <ul style="list-style-type: none"> <li>■ Area: 4 acres</li> </ul> </li> </ul>
Dredging to Create Access Channel Stage	 <ul style="list-style-type: none"> <li>a) Dredging details: <ul style="list-style-type: none"> <li>■ Bottom width: 40 m</li> <li>■ Length: 17.8 km</li> <li>■ Depth: -2 m CD</li> </ul> </li> <li>b) Dredging volume: 2.3 million m<sup>3</sup></li> <li>c) Offshore disposal ground - Off Pulau Kendi</li> <li>d) Work duration: 1 year</li> </ul>
Phase 1: Reclamation and Widening of the Access Channel	 <ul style="list-style-type: none"> <li>a) Reclamation of Island B <ul style="list-style-type: none"> <li>■ Size: 1,400 acres</li> <li>■ Total reclamation volume: 58 million m<sup>3</sup></li> </ul> </li> <li>b) Widening of the dredged channel around Island B <ul style="list-style-type: none"> <li>■ Width: 250 m</li> <li>■ Length: 8.1 km</li> <li>■ Depth: -2 m CD</li> <li>■ Dredging volume: 2.2 million m<sup>3</sup></li> </ul> </li> <li>c) Construction of bridge piers</li> <li>d) Work duration: 7 years</li> </ul>



**T.8** Summary of Project activities and phasing (cont'd)

Phase	Description
Phase 2: Reclamation and Widening of the Access Channel	 <p><b>Legend</b></p> <p><u>Completed Components :</u></p> <ul style="list-style-type: none"> <li>Dredging           <ul style="list-style-type: none"> <li>1. 40m Access Channel</li> <li>2. Island B Access Channel - 250m</li> </ul> </li> <li>Reclamation (Island B)</li> </ul> <p><u>Activities in this scenario :</u></p> <ul style="list-style-type: none"> <li>Dredging (Widening of Island A Access Channel - 250m)</li> <li>Reclamation (Island A)</li> </ul> <p>a) Reclamation of Island A            ■ Size: 2,300 acres            ■ Total reclamation volume: 93.8 million m<sup>3</sup>            b) Widening of the dredged channel between Island A and Penang Island            ■ Width: 250 m            ■ Length: 5.2 km            ■ Depth: -2 m CD            ■ Dredging volume: 1.6 million m<sup>3</sup>            c) Construction of bridge piers            d) Work duration: 8 years</p>
Phase 3: Reclamation and Widening of the Access Channel	 <p><b>Legend</b></p> <p><u>Completed Components :</u></p> <ul style="list-style-type: none"> <li>Dredging           <ul style="list-style-type: none"> <li>1. 40m Access Channel</li> <li>2. Island B Access Channel - 250m</li> <li>3. Island A Access Channel - 250m</li> </ul> </li> <li>Reclamation           <ul style="list-style-type: none"> <li>1. Island B</li> <li>2. Island A</li> </ul> </li> </ul> <p><u>Activities in this scenario :</u></p> <ul style="list-style-type: none"> <li>Dredging           <ul style="list-style-type: none"> <li>1. Widening of Island C Access Channel - 250m</li> <li>2. Marina on Island C</li> </ul> </li> <li>Reclamation (Island C)</li> </ul> <p>a) Reclamation of Island C            ■ Size: 800 acres            ■ Total reclamation volume: 37.3 million m<sup>3</sup>            b) Widening of the dredged channel between Island C and Penang Island            ■ Width: 250 m            ■ Length: 5.5 km            ■ Depth: -2 m CD            c) A marina and dredging of associated access channel at south-western corner of Island C            d) Total dredging volume: 800,000 m<sup>3</sup>            e) Construction of bridge piers            f) Work duration: 7 years</p>

**T.9** Estimated volume of material for each Project activity

Project Activities	Volume of Material (m <sup>3</sup> )	Total Volume (m <sup>3</sup> )
Reclamation: Phase 1 - Island B Phase 2 - Island A	58,000,000 93,800,000	189,100,000
Dredging: Dredging Phase Phase 1 – Widening of channel Phase 2 – Widening of channel Phase 3 – Widening of channel	2,300,000 2,200,000 1,600,000 800,000	6,900,000
Construction of revetment	4,500,000	

#### 8.4.1 Pre-dredging Phase: Construction of Workers' Quarters

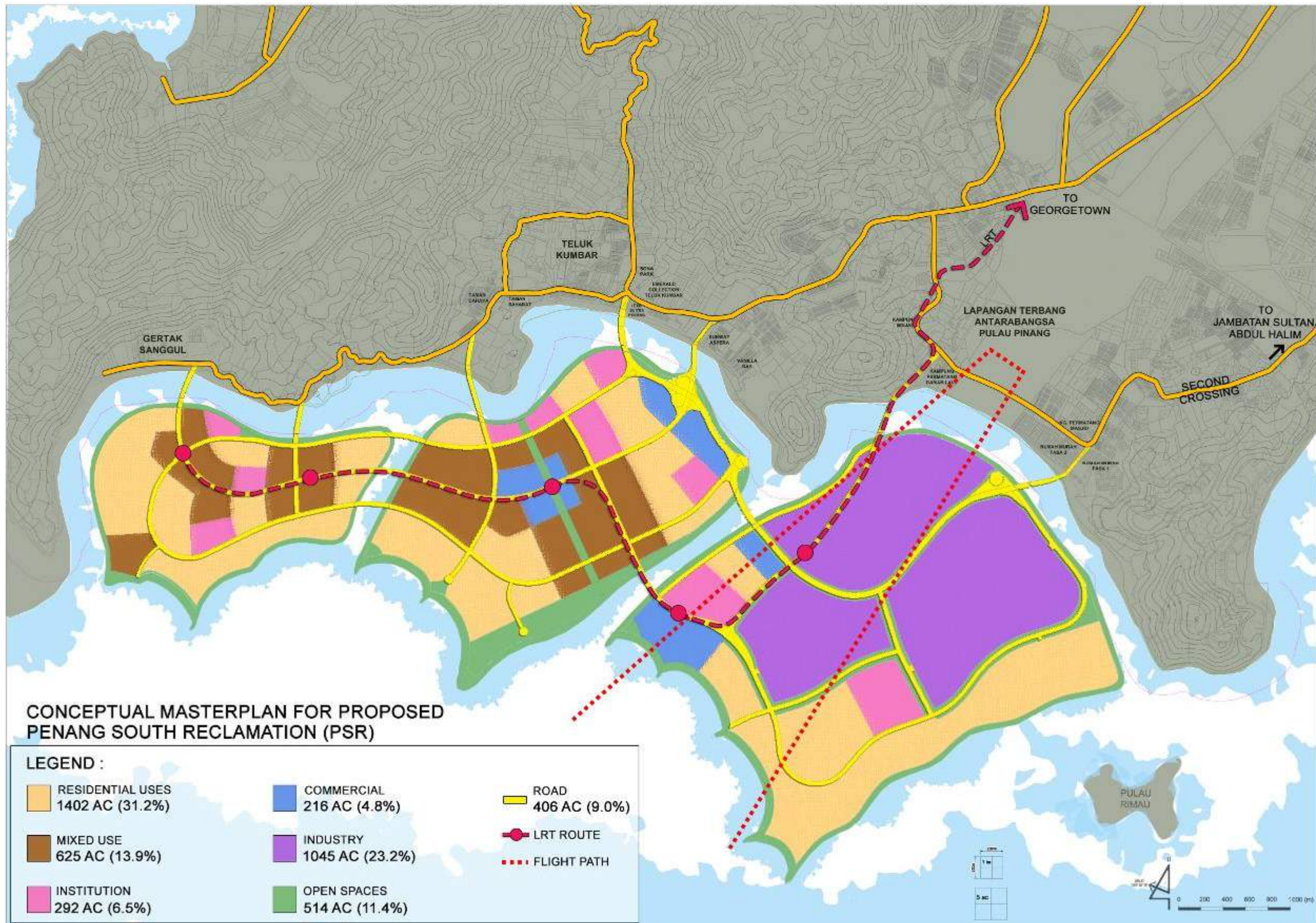
Prior to the start of the dredging and reclamation works, workers' quarters must be set up first. These quarters are proposed to be constructed near Bukit Payung along Teluk Pak Bidan. The area of the quarters is about four acres. The proposed location is about 1 km away via an existing access road connected to Jalan Permatang Damar Laut. The construction of workers' quarters will include the following activities:

- a) land clearing;
- b) earthworks;
- c) surface runoff control;
- d) erosion control;
- e) sedimentation control; and
- f) turfing.

## 8.5 Topside Development Land Use

The proposed development's land use will be made up of residential, commercial, mixed development, industrial (light and medium), public amenities, open spaces and recreational, and infrastructure and utilities. The topside development may be prescribed activities that will need separate EIA studies that are not covered in this EIA report. The top-side development is only addressed as the conceptual master plan of the reclaimed islands. F.4 shows the proposed Project layout plan and its components.





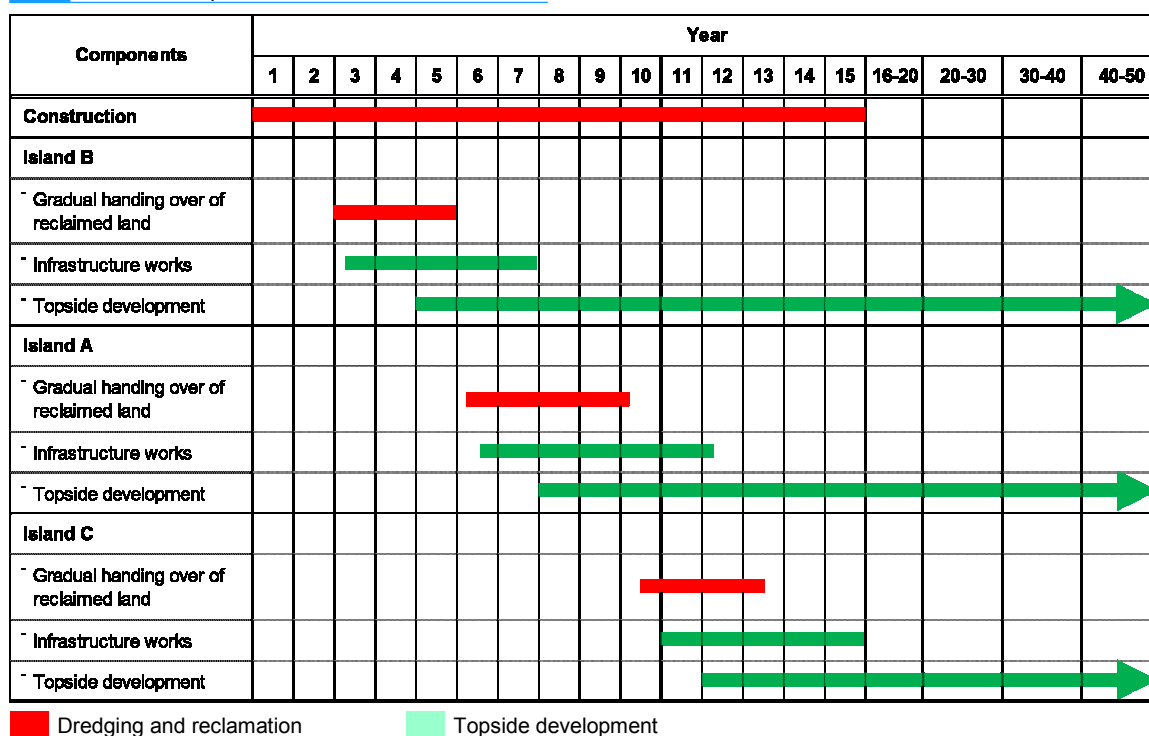
**F.4**  
Proposed topside  
development layout  
plan



## 8.6 Project Implementation Schedule

PSR is a long-term development Project spanning over a development period of 30 to 50 years. Reclamation works will be completed within 15 years whereas topside development could take further 15 to 35 years. Development timeline for PSR is shown in T.10.

**T.10** PSR development timeline



## **9.0 Existing Environment**

The existing environment of the Project site shall be described according to the following:

- a) existing physical environment;
- b) existing biological environment;
- c) existing human environment; and
- d) environmentally sensitive areas (ESAs).

## **9.1 Existing Physical Environment**

The existing physical environment of the whole Project area located within a 5-km radius from the Project boundary will be described in different sections as the following.

### **9.1.1 Land Use**

The area surrounding the proposed Project site displays a coherent land use pattern. The main land use pattern within the study area consists of Forest, Water Bodies and Agriculture. The development patterns of land use at the Southwest District show that the residential development is concentrated around Teluk Kumbar, Bayan Lepas and Batu Maung while industrial activities are concentrated at the Bayan Lepas FIZ.

### **9.1.2 Hydraulic Components**

The existing hydraulic components of the study area will be explained by the following:

- a) bathymetry;
- b) water levels;
- c) currents; and
- d) wave.

#### **9.1.2.1 Bathymetry**

The Project site is generally shallow, with a sea bed level of about  $-0.3$  to  $-4.0$  m CD. There are natural deep channels near the headlands of Tanjung Gertak Sanggul and Tanjung Teluk Tempoyak, indicating relatively fast currents in these areas.

#### **9.1.2.2 Water Level**

The water level within the Project area is fairly shallow ranging between 0 and 1.2 m above Mean Sea Level (MSL).

### 9.1.2.3 Currents

Generally, the mean and maximum current speeds of up to about 0.2 and 0.8 m/s respectively can occur in the vicinity of the Project site for all seasonal conditions. On average, the current is of moderate speed while maximum current speed occurs at Pulau Kendi, Tanjung Teluk Tempoyak and Tanjung Gertak Sanggul.

### 9.1.2.4 Waves

The wave modelling results of the 1 in 1 year and 1 in 60 years return period events under the baseline condition for waves propagating from the 180, 210, 240 and 270°N respectively are as tabulated in T.11.

**T.11** Summary of baseline significant wave heights

Wave Propagation (°N)	1 in 1 year Return Period Event		1 in 60 years Return Period Event	
	Significant Wave Height ( $H_{m0}$ ) (m)	Time Period ( $T_p$ ) (seconds)	Significant Wave Height ( $H_{m0}$ ) (m)	Time Period ( $T_p$ ) (seconds)
180	1.0	5.0	1.4	5.5
210	0.9	5.0	1.2	5.5
240	0.8	5.0	1.2	6.5
270	1.0	5.5	1.5	6.0

### 9.1.3 Climate and Meteorology

The distribution of annual rainfall for the Bayan Lepas main drain, Sungai Bayan Lepas, Sungai Batu, Sungai Teluk Kumbar, Sungai Gemuruh and Sungai Gertak Sanggul basin does not vary much throughout the year. The study area experiences an average of 3,000 mm of rainfall annually. Temperature throughout the year is quite constant with an average of 28°C. The temperature usually peaks in the afternoon with an average of 32°C and falling to its lowest during the evening with an average of 24°C. The relative humidity similarly shows very little variation throughout the year with an average of 80%.

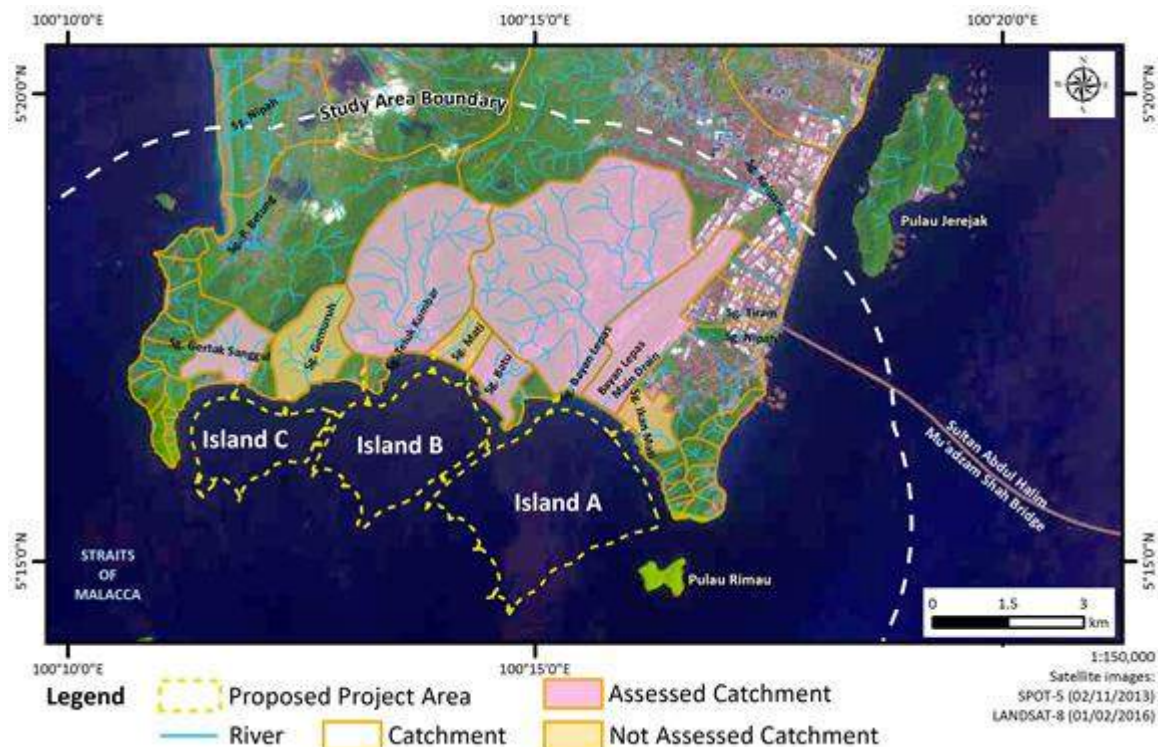


#### 9.1.4 Tsunami

An assessment of combined tidal and tsunami-induced water levels has been carried out using a detailed two-dimensional hydraulic model (MIKE 21 HD model) to assess the impact of the tsunami waves in the waters of southern Penang Island. The simulations were conducted based on the December 2004 tsunami event at four tidal levels i.e. Mean Sea Level (MSL), actual water level (1300 hours, 26<sup>th</sup> December 2004), Mean High Water Spring (MHWS) and Highest Astronomical Tide (HAT) levels. The tidal levels are important for the water level assessment as the water depth, which the tsunami propagates influences the propagation speed, wave attenuation and shoaling of tsunami wave transformation. The simulation results showed that the southern coast of Penang Island has limited exposure to tsunami effects from the Indian Ocean compared to the western and northern coasts of Penang Island due to the relatively-sheltered location of this coastal stretch.

#### 9.1.5 Hydrology and Drainage

There are eight rivers present along the south of Penang Island's coastline. However, only five main catchments were studied namely Sungai Gertak Sanggul, Sungai Teluk Kumbar, Sungai Batu, Sungai Bayan Lepas and Bayan Lepas Main Drain. The other three rivers (Sungai Mati, Sungai Gemuruh and Sungai Ikan Mati) contribute insignificant pollutants downstream, making them negligible. The river catchments are shown in F.5. The area of each main catchment is tabulated in T.12.



F.5 River catchments near the Project area

Rivers	Catchment Area (km <sup>2</sup> )	T.12
Bayan Lepas Main Drain	2.98	Area of main river catchment     Source: Southern Penang Rivers - Water Quality Study (2016)
Sungai Bayan Lepas	7.43	
Sungai Batu	1.22	
Sungai Teluk Kumbar	7.05	
Sungai Gertak Sanggul	1.34	

### 9.1.6 Geology and Geotechnical

The geological assessment is carried out by reviewing available secondary data which are previous works and geological maps, while, the geotechnical assessment study is based on the Preliminary Geotechnical Design Report produced by G&P Professionals Sdn. Bhd.

The south of Penang Island is underlain by Recent Alluvium over Batu Maung Granite. Batu Maung Granite generally consists of medium to coarse grained biotite-muscovite granite with microcline predominates. The age of Batu Maung Granite is Early Permian to late Carboniferous. The overburden material of Batu Maung Granite generally consists of silty sand which is derived from the weathering of granite bedrock. The Recent Alluvium is Quaternary aged which is much younger aged than Batu Maung Granite and generally consists of coastal and fluvial clay, sand and gravel and generally is a soft ground.

The borelog profiles show that the seabed subsoil stratum mainly consists of clay and sandy clay. Some boreholes encountered granite at 37 and 43 m below the seabed respectively. This further confirmed the geological formation of Batu Maung Granite at the proposed site.

#### 9.1.6.1 Reclamation Embankment Stability Analyses

The embankment stability is assessed using a limit equilibrium analysis by Slope/W. The external stability is checked against circular slip surface by Modified Bishop method and non-circular (wedge) slip surface by Spencer's method. The stability analyses of the reclamation fill are summarised in T.13 and T.14.

**T.13** Stability analyses summary for sand bund

Filling Stage	Factor of Safety (Fos)						Remark
	Normal			Rapid Drawdown			
	Circular	Wedge	Min FoS	Circular	Wedge	Min FoS	
Construction							
Sand containment bund	1.4	1.8	1.2	1.6	1.7	1.1	Achieved minimum safety factor
Fill 0.5 m above MHWS with PVD installation and 0.5	1.2	1.3	1.2	1.2	1.3	1.1	Achieved minimum safety factor
Fill to designed surcharge level	1.3	1.5	1.2	1.4	1.5	1.1	Achieved minimum safety factor
Serviceability							
Trim to final platform level	1.5	1.6	1.4	1.5	1.5	1.2	Achieved minimum safety factor

**T.14** Stability analyses summary for rock bund

Filling Stage	Factor of Safety (Fos)				Remark
	Normal		Rapid Drawdown		
	Circular	Min FoS	Circular	Min FoS	
Construction					
Rock containment bund	1.33 (R to L) 1.20 (L to R)	1.20	-	1.10	Achieved minimum safety factor
Fill 0.5 m above MHWS with PVD installation and 0.5 m thick surcharge	1.22	1.20	-	1.10	Achieved minimum safety factor
Fill to designed surcharge level	1.23	1.20	1.20	1.10	Achieved minimum safety factor
Serviceability					
Trim to final platform level	2.07	1.40	1.95	1.20	Achieved minimum safety factor

### 9.1.7 Water Quality

18 water quality sampling stations were identified within the Project area. Marine water samples were taken during fine weather at three depths (surface, middle and bottom) at stations with water depths of more than 5 m. Two-depths sampling was applied for water depths ranging from 3 to 5 m while only one depth sampling was done at those of less than 3 m. The samples were analysed by an accredited laboratory [ALS Technichem (M) Sdn. Bhd.]. *In situ* analyses were also made using portable analytical meters which comply with the standard methods as specified by the US EPA procedures.

Water quality at the coastal region was moderate, but not exactly pristine. DO levels generally remain between 4 to 6 mg/L. Nutrients such as ammoniacal nitrogen ( $\text{NH}_3\text{-N}$ ), nitrate-nitrogen ( $\text{NO}_3\text{-N}$ ) and phosphate were detected, albeit still at low levels and only during spring tide. These imply sufficient dispersion although at these levels, the risk of algae blooms was still present. Although *E. coli* was undetected, the faecal coliform count still remained in the thousands. Hence the coastal region can be deemed as unsuitable for body contact activities. Most turbidity readings of the stations are considerably low. The O&G levels recorded in the surrounding waters at the Project area showed concentrations at less than 1 mg/L at all stations during both spring and neap tides. There is no particular pattern of the heavy metals concentration within the water column, signifying that the metals are of background concentrations in sea water and not due to any localised sources.

The water quality at the estuarine was not exactly pristine. There were instances when organic parameters such as Biological Oxygen Demand (BOD),  $\text{NH}_3\text{-N}$  and phosphate increased, particularly during neap tide. The elevated organics translated to low Dissolved Oxygen (DO) during all tidal cycles. High *E. coli* count were found, which was also in tandem with high presence of faecal coliform. Such circumstances are decidedly unsuitable for body contact. Most pollutants dissipated during spring tide (except faecal coliform which still remained making the water unsuitable for body contact). The pollutants likely dispersed to the coastal region. This may be a cause for concern, as the flushing of pollutants could be disrupted by the presence of the proposed development. There is even potential for accumulation along the strait if the water becomes stagnant (e.g. intertidal). This potential impact needs to be mitigated by ensuring the hydrodynamics of the region is not impeded due to the presence of the islands. With the exception of manganese, iron and arsenic, heavy metals remained largely undetected in most of the river systems. Arsenic could have originated from the soil, which was due to the inherent geomorphology.

### 9.1.8 Sediment Quality

Thirteen sediment quality stations were chosen to obtain baseline sediment samples. The sediment samples were obtained using a Van Veer Grab. The grab was lowered vertically into the river or seabed. The closure of the grab bucket was then triggered when it touched the bottom. The grab was pulled up and the sediment samples were then kept in a labelled plastic container before being sent to the laboratory for analysis. Chemical analyses were conducted in accordance with the relevant standards which are based on the US EPA Standard.

Several parameters such as copper (Cu), zinc (Zn), Total Phosphorus, chromium (Cr) and arsenic (As) showed elevated concentration at some stations. Organic matters were also detected at significant levels for almost all stations. It can be concluded that the sediment quality within the Project area is categorised as “Moderately Polluted” and probably caused by anthropogenic activities.

#### **9.1.9 Air Quality**

The ambient air quality sampling was conducted to know the existing environmental air quality around the Project area. Three stations were selected for baseline sampling. The ambient air was absorbed from the surrounding area using a pre-calibrated portable pump stationed at fixed points. For the Total Suspended Particle (TSP) parameter, the High Volume sampler method was used to collect the samples. These were tested at the laboratory for the concentrations of relevant parameters. The results were then compared with the New Malaysia Ambient Air Quality Standard (DOE, 2014).

The TSP level at station AQ3 is quite high compared to stations AQ1 and AQ2. However, the results for all parameters are below the standard. Therefore, it can be concluded that the existing air quality within the Project area is good.

#### **9.1.10 Noise**

Ambient noise measurements were carried out to establish the existing background noise levels near the sensitive receptors. This information will be used in the noise impact assessment and/or for compliance verification during the construction stage of the Project based on the Planning Guidelines for Environmental Noise Limits Control, Second Edition (2007) published by DOE.

The measurements were performed according to the International Electro-technical Commission (IEC) specifications. The noise parameters measured were  $L_{eq}$ ,  $L_{min}$ ,  $L_{max}$ ,  $L_{10}$  and  $L_{90}$ . Three locations were identified as the noise sampling stations. The baseline results were compared to the following construction noise criteria given in DOE's Interim Guidelines for Maximum Permissible Sound Levels by Receiving Land Use (Schedules 1 and 2). The results recorded were all below the maximum permissible limit for both day time and night time.

#### **9.1.11 Marine Traffic and Navigation**

The marine traffic and navigation assessment was done using qualitative and quantitative methods including local knowledge, experience, data available from the Project Proponent, adjacent port-operating companies, government authorities and agencies, as well as interviews with the fishermen, their associations and local communities.

### 9.1.11.1 Existing Marine Facilities and Utilisation

Penang Port is the oldest and longest established port in Malaysia. It is administrated by Penang Port Commission while Penang Port Sdn. Bhd. is licensed to act as its operator. One of the accesses to Penang Port, called South Channel, is located adjacent to the Project site. T.15 shows the number of vessel calls at Penang Port for the past few years encompassing various types of vessels.

**T.15** Number of vessel calls at Penang Port

Year	Type of Vessel							Total
	Ferry	Container	Tanker	Bulk Carrier	General Cargo	Others	Cruise Vessel	
2013	762	1,557	1,140	210	711	407	1,331	6,118
2014	1,000	1,557	1,058	193	627	428	1,201	6,064
2015	1,180	1,529	1,098	238	610	444	1,128	6,227

Source: Penang Port Sdn. Bhd.

Several marine facilities found within the Penang Port Limit are as follows:

- a) Swettenham Pier;
- b) North Butterworth Container Terminal;
- c) Ferry Terminal;
- d) Butterworth Deep Water Wharves;
- e) Prai Bulk Cargo; and
- f) Private terminals.

Apart from the marine facilities, it should be noted that both of the bridges connecting Penang Island and the mainland are situated within the Penang Port Limit. The bridges are Penang Bridge and Sultan Abdul Halim Muadzam Shah Bridge (The Second Bridge).

Based on the location of the proposed Project site, it is expected that most of the fishermen affected are from Southwest (SW) District of Penang. Focusing on the southern bay of Penang Island, there are a few fishing villages located along the shoreline adjacent to the Project site.

According to the prevailing regulation, no fishing is allowed within one nautical mile from the coastline as it is considered as conservation zone. However, Penang has been exempted from having a conservation zone as per the letter by the Department of Fisheries (DOF) (Ref No: Prk.ML.08/35-22(71)). This exemption is due to complaints from local fishermen through *Persatuan Nelayan Pulau Pinang* of the shrinking fishing area caused by the presence of the conservation zone.



### 9.1.11.2 Existing Marine Traffic Procedures and Safety Rules

Penang Port Control monitors and regulates marine traffic in the Port Area and the respective navigable waters within the Port Limit. The movement of all vessels within the Port Limit must obtain prior permission from Penang Port Control.

Pilotage is mandatory for the movement of ships of 600 Gross Register Tonnage (GRT) and above within the pilotage compulsory area, as well as ships of 200 GRT and above berthing or unberthing at private jetties or the port's wharves.

### 9.1.12 Land Traffic

The study area consists of all major road corridors and junctions likely to be affected by the traffic volumes generated by the proposed PSR development.

Traffic counts were undertaken at major junctions during the AM and PM periods to capture typical traffic conditions during a commuter weekday. These junctions were selected due to their close proximity to the PSR islands.

The major roads that are included in the study area in close proximity to the proposed PSR development are Jalan Permatang Damar Laut, Jalan Teluk Kumbar and Jalan Gertak Sanggul.

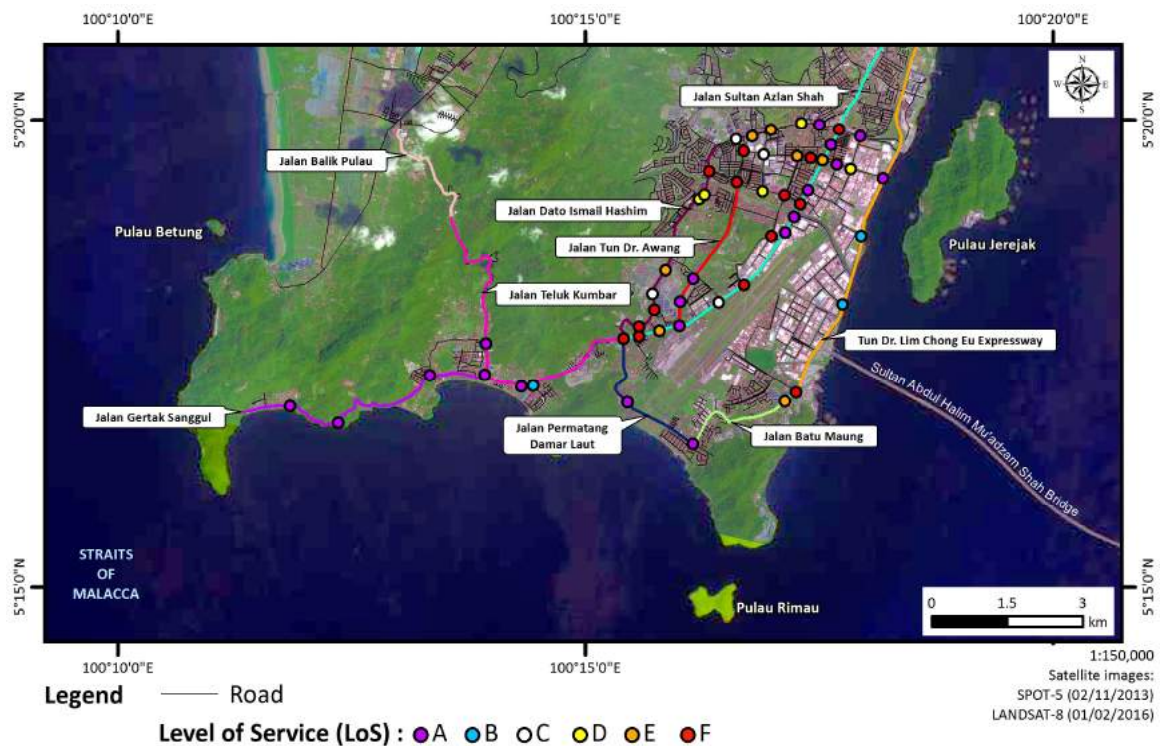
The operational conditions of the roadways are based on the "Level of Service" (LoS) concept to classify the varying conditions of traffic flow. Levels of service are designated from "A" through "F", from best to worst. The current junction performance for the AM and PM peak periods is tabulated in T.16 and shown in F.6 and F.7.

**T.16** Estimated number of junctions for each LoS (2015) (AM and PM)

Level of Service (LoS)		A	B	C	D	E	F
Number of junctions	AM	18	3	7	2	2	20
	PM	19	3	4	5	7	14



**F.6** Existing AM peak hour junction performance



**F.7** Existing PM peak hour junction performance

## **9.2 Existing Biological Environment**

This section presents the findings from terrestrial and marine biology study at the Project site within the study area.

### **9.2.1 Terrestrial Biology**

The terrestrial biology study covers the flora and fauna components as explained in the next sections.

#### **9.2.1.1 Coastal Flora**

This coastal flora survey involved identifying the plant species and mangrove current condition. The plant species identified were then listed. In general, a total 121 plant species from 61 families was recorded from the survey. Almost 75% of the total plants were from non-exclusive category, which is as expected since the survey area is of sandy coastal habitat. 22 exclusive species of mangrove plants were found mostly at riverine and lagoon areas of the survey site. All recorded plant species are commonly found in many other coastal and riverine mangrove areas. No species of conservation interest or rare based on the IUCN Red List Categories and Criteria for mangrove species (Polidoro *et al.*, 2010) were found in the study area.

#### **9.2.1.2 Mangrove**

The health and status of the mangroves found at and within the Project site were undertaken using line-transect sampling and through ground observation (where line-transect inappropriate to be applied).

Eleven species of mangroves belonging to four families were recorded. The most dominant group at the study area was Family Rhizophoraceae, represented by six species, followed by Families Acanthaceae and Sonneratiaceae with two species each and Family Rubiaceae with one species.

#### **9.2.1.3 Fauna**

The study of fauna within the Project area was only focused on avifauna i.e. birds. Other types of terrestrial fauna were considered insignificant for this Project. The objective of the survey was to obtain an inventory of the avifauna of the study area, by using visual and audio identification methods besides photography. Based on the IUCN Red List of Threatened Species, 2007 all avifauna recorded were categorised under the status Least Concerned (LC).

### 9.2.2 Marine Biology

The environmental baseline study involved the collection of primary data for the following:

- a) biological productivity (phytoplankton, zooplankton and macrobenthos);
- b) coral reefs;
- c) turtles; and
- d) fish.

#### 9.2.2.1 Biological Productivity

The primary data collection for biological productivity was based on a stratified sampling method, which involved allocation of sampling points at designated location within and outside the reclamation footprint based on a sampling grid of 1 km x 1 km.

##### a) Phytoplankton

The assessment of phytoplankton at the study area recorded three different phyla i.e. Bacillariophyta, Dinoflagellata and Cyanophyta.

##### b) Zooplankton

There were a total of six phyla recorded i.e. Arthropoda (Crustacea), Chordata, Mollusca, Chaetognatha, Cnidaria and Annelida. Arthropoda, which contributed 79.0% of the total zooplankton density, was the major group in this area, followed by Chordata (7.9%) and Mollusca (6.5%).

##### c) Macrobenthos

Most benthic organisms consume organic sediment as deposit feeders, and in the process, regenerate essential nutrients to the water column. Their density and diversity would thus be a clear reflection of the primary and secondary productivity in the Project site. Several factors are known to influence the distributions of macrobenthos which include sediment types, temperature, productivity, salinity, oxygen and depth (Snelgrove, 2001). A total of four phyla of macrobenthos was recorded at the study area, namely Annelida, Mollusca, Arthropoda (Crustacea) and Echinodermata.

#### 9.2.2.2 Coral Reefs and Associated Marine Fauna

Coral reef assessment was carried at Pulau Kendi and Pulau Rimau. Within the study site, coral reefs are found in the vicinity of Pulau Rimau and Pulau Kendi, and surveyed as part of this investigation. During the survey, the live coral cover in Pulau Kendi was <30% of the total coral area, indicating “fair” coral health. Coral bleaching was also observed at Pulau Kendi. The coral cover in Pulau Rimau was significantly lower i.e. < 5% as compared to its counterpart in Pulau Kendi. The coral cover in the area was reported as “poor” according to Chou *et al.* (1994). The location of the island adjacent to the island of Penang Island may have a direct effect on its coral distribution.

a) Reef Fish

During the survey in Pulau Kendi, a total of 62 fish species belonging to 22 families were recorded. The highest number of fish species was observed at station C1 with 46 species, followed by station C3 (32 species) and station C2 (24 species).

Reef fish found at Pulau Rimau was represented by 25 species that belonged to 13 families. In terms of station, the highest number of species was observed in C5 with 19 species, whereas the lowest was in C6 and C8, of which both recorded 13 species.

b) Invertebrates

In consonance with its relatively disturbed state, there were limited varieties of invertebrates in Pulau Kendi reefs. Most of these are reef-based organisms that rely on other related organisms for forage. A total of 30 taxa of invertebrates was recorded from the current survey, comprising 14 Mollusca, eight Porifera, three taxa from each Arthropoda and Echinodermata, as well as a single taxon from Tunicata and Annelida, respectively.

Pulau Rimau was recorded with 18 taxa that belonged to four families. Among the four families, Mollusca was recorded with the most number of taxa i.e. 9 taxa, followed by Porifera with six taxa. On the other hand, Arthropoda (Crustacea) was recorded with two taxa, while the least number recorded was Echinodermata with only a single taxon. Notwithstanding, the highest taxa were recorded in C7 with 13 taxa, while the lowest was recorded in C8 with eight taxa.

### 9.2.2.3 Turtle

Turtle assessment at south of Penang Island is solely based on secondary data and desktop study. Recorded turtle landings and sightings were obtained from reports, newspapers and journals.

A study of turtle landings in Penang is presented in T.17. Landings fluctuated from 2010 to 2015, with the highest in 2013 (63 landings) while the lowest was in 2014 (35 landings) (Department of Fisheries, 2016). In 2015, only one landing of the Olive Ridley was recorded within the impact zone i.e. in Teluk Kumbar. No landings were recorded in 2016 (January to August) at areas within the impact zone.

**T.17** Number of turtle landings recorded in Penang, 2000-2015

Turtle Species	Year															
	2000 <sup>1</sup>	2001 <sup>1</sup>	2002 <sup>1</sup>	2003 <sup>1</sup>	2004 <sup>1</sup>	2005 <sup>1</sup>	2006 <sup>1</sup>	2007 <sup>1</sup>	2008 <sup>1</sup>	2009 <sup>1</sup>	2010 <sup>2</sup>	2011 <sup>2</sup>	2012 <sup>2</sup>	2013 <sup>2</sup>	2014 <sup>2</sup>	2015 <sup>2</sup>
Green Turtle ( <i>Chelonia mydas</i> )	-	66	39	47	62	42	71	62	44	73	51	60	50	63	35	60
Olive Ridley ( <i>Lepidochelys olivacea</i> )	-	-	1	-	1	1	-	1	3	2	-	-	-	2	-	1

Note: '-' = no data available

Source: <sup>1</sup>Sarahaizad *et al.*, (2012), <sup>2</sup>Department of Fisheries (2016) - unpublished

#### 9.2.2.4 Fish

The fish data that was gathered covered speciation, size/weight and catch per unit effort of fish. A total of 186 individuals of fish, 11 individuals of crustaceans (shrimp, mantis shrimp and crab) and four individuals of cephalopods (cuttlefish) were caught at the study area. The fish caught belonged to 19 families and comprised 36 species, while three families and three species were of crustaceans (mantis shrimp, shrimp and crab) and one family and one species of cephalopods (cuttlefish).

#### 9.2.3 Existing Human Environment

The proposed Project area is stringed by fishing villages which have already been developed or inhabited. It is thus essential to assess this existing human environment in the surrounding areas as it is the locals who will finally end up facing whatever consequences arising from the Project developer's actions. An understanding of the existing socio-economic make-up of a place or locality is essential in order to anticipate the kind of reactions or consequences that may evolve out of a planned action or development.

##### 9.2.3.1 Overall Socio-economy

This section is written to highlight the socio-economic profile of the local residents who will be impacted and to gauge their level of awareness and perception towards the impending Project. In addition, this study also seeks to establish the level of social acceptability of the area with regards to the Project. The settlements covered for this EIA study as well as the arbitrary survey zones are shown in F.8.





The questionnaire survey was directed towards a purposive sample of 635 respondents chosen randomly from among the household heads representing the public, business operators, beach users and fishermen in the impacted zone. Six Focus Group Discussions (FGDs) were conducted involving a total of 126 participants. In addition to that, 17 informal conversations were conducted involving a total of 50 participants with majority (82%) being Malay and the remaining 16% Chinese. A Public Dialogue was also conducted at Lexis Suites, Teluk Kumbar on 17 December 2016, attracting some 853 locals and other interested individuals.

### 9.2.3.1.1 Perceptions Towards the Proposed Project

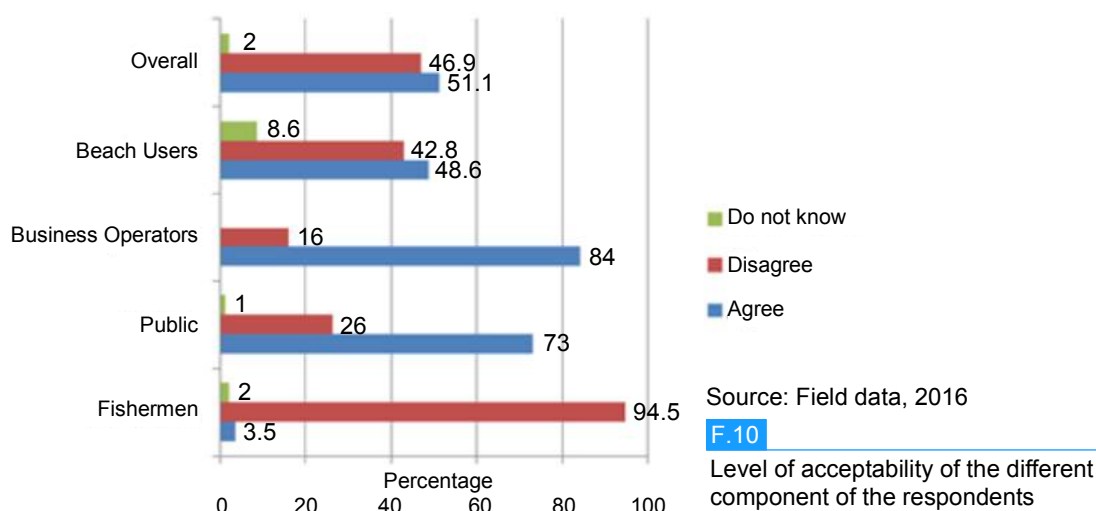
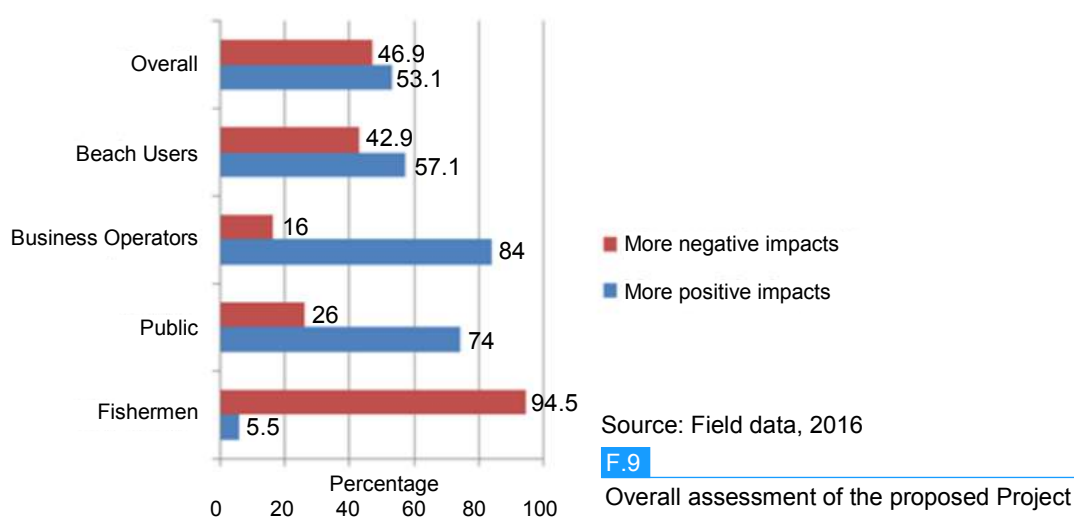
The respondents were asked for their views on the overall development in their part of Penang Island. The responses reflected a mixed view, with the majority of the general public and business operators accounting for 60 and 66%, respectively believing it to be developing very fast, whilst at the same time commenting on more luxury homes being built as opposed to affordable homes. The latter was strongly felt by the fishermen respondents followed by the business operators, beach users and general public (T.18).

**T.18** Perception of overall development in South Pulau Pinang (%)

Characteristics	Fishermen	General Public	Business Operators	Beach Users
Developing very fast	7.5	60.0	66.0	11.4
More luxury homes built than affordable homes	77.5	15.3	32.0	28.6
Progressing fast and clean	1.5	7.0	-	37.1
Too many development and hill-cutting	2.0	6.3	-	-
Good but need to limit development	-	4.7	-	-
Traffic congestion, flooding due to development	2.0	3.0	-	22.9
More development now than before	-	1.0	-	-
Increased cost of living	-	0.3	-	-
Disappearance of village atmosphere	-	0.3	-	-
Too many road repairs	-	-	2.0	-
To develop urban area, not to disturb rural area	8.0	-	-	-
Government only focuses on mega project	1.5	-	-	-
No response/view	-	2.0	-	-

### 9.2.3.1.2 Assessment of Level of Acceptability

Analysis of the data on respondents' assessment of the Project showed that a significant percentage (94.5%) of the fishermen were of the opinion that the Project would bring about more disadvantages than advantages whilst among the general public and business operators the assessment was more (74 and 84% respectively) for the positive aspects or advantages (F.9). There appeared to be a strong disagreement among the fisherman respondents as to its implementation, while a strong agreement among the business operators and general public for it, but the beach users seemed to be divided in two, being equally strong for and against it (F.10).



The more significant reasons for agreeing or disagreeing vary from among the different groups of the respondents, commensurable with their different interests in life. The fishermen respondents seemed to agree if only they would be compensated although they also saw it as making Pulau Pinang more developed (T.19).

**T.19** Reasons for agreeing and disagreeing to the proposed Project (%)

Reasons	Fishermen	General Public	Business Operators	Beach Users
<b>For Agreeing:</b>				
Government Project, need to agree	14.3	-	1.2	-
Business/employment opportunities for future generation	42.8	81.3	48.9	82.4
If given new settlement	14.3	-	-	-
Age factor	14.3	-	-	-
Attract tourists/new opportunity as tourist boat operators	14.3	-	8.3	-
Attract foreign investors to generate Penang's economy	-	12.3	8.3	5.9
Increased growth and development for Penang	-	6.4	-	5.9
Source of state economy/Penang becoming industrial city	-	-	14.3	5.9
Beneficial to future generation	-	-	16.7	-
Improved village area but preserve for heritage	-	-	1.2	-
Able to support population increase	-	-	1.2	-
<b>Total N</b>	<b>100.0 7</b>	<b>100.0 219</b>	<b>100.0 84</b>	<b>100.0 20</b>
<b>For Disagreeing</b>				
Important fish and prawn spawning area	22.8	-	-	-
Other source of funding not from reclamation	17.9	1.3	-	-
Loss of livelihood	13.2	1.3	-	-
Shrinkage of fishing ground/sea area	13.2	-	-	-
Problem of marine water pollution and mud	11.6	30.8	37.5	40.0
Malay fishermen will lose their village and lag behind	6.9	-	-	-
Will benefit specific group only	4.8	1.3	6.3	-
Not beneficial to fishermen/locals but foreigners	4.8	15.4	-	-
Disturb marine ecosystem and life	4.8	-	-	-
Fear of being relocated	-	29.5	-	-
Marginalisation of locals/fishermen/Malays in the future	-	10.3	-	-
More negative impacts will arise	-	10.3	-	-
Will benefit foreign workers more	-	-	37.5	-
Housing development not beneficial to the locals	-	-	18.8	-
Loss of natural sea view, coastal aesthetics, water pollution	-	-	-	46.6
Too many reclamation projects in Penang	-	-	-	6.7
To discuss with the directly impacted surrounding population	-	-	-	6.7
<b>Total N</b>	<b>100.0 189</b>	<b>100.0 78</b>	<b>100.0 16</b>	<b>100.0 15</b>

Source: Field data, 2016

### 9.2.3.2 Fishing Community in the Study Area

This section is written to briefly highlight the background and other related information regarding the local fishermen and their fishing activities in the area, as they would be the ones to be directly impacted. 84.5% of the local fishermen were owner-operators by using their own boats to ply the coastal waters to fish, whilst 15% churned out as *awak-awak* or hired workers to assist the owners go out to fish.

The main fishing gear used in the area is *pukat* or trawl. This is shown when almost all of the fishermen in the study area admitted to using them to fish although there were a few others who had utilised other fishing gears such as *bubu* or fish trap and cast net. Their main landings were fish, prawn and also crab.

The fishermen did not go far to fish as all of them were inshore fishermen combing their own territorial waters right up to Pulau Rimau and Pulau Kendi. As such, the proposed reclamation Project was seen by them as a threat in shrinking their fishing ground further after that of the Second Crossing or Bridge. Fishing is seen to still being considered a traditional vocation for at least one-fifth of the next generation fishing communities.

#### 9.2.3.2.1 Marine Capture Fisheries

This section is a detailed assessment of fisheries and the fishing community within the study area. The assessment was undertaken through discussions and interviews with sample fishing population at the study area. The fishermen were interviewed from major fish landing points at the proposed Project area i.e. Sri Jerjak, Batu Maung, Teluk Tempoyak, Permatang Damar Laut, Sungai Batu, Teluk Kumbar, Gertak Sanggul and Pulau Betung (F.11). Four FGDs were conducted at Sungai Batu, Permatang Damar Laut, Teluk Kumbar and Gertak Sanggul to cater for all fisheries-based stakeholders within the impact zone. Capture fisheries data was also requested from the Penang State Department of Fisheries, Fisheries Development Board (LKIM) and *Persatuan Nelayan Kawasan* south of Penang Island.

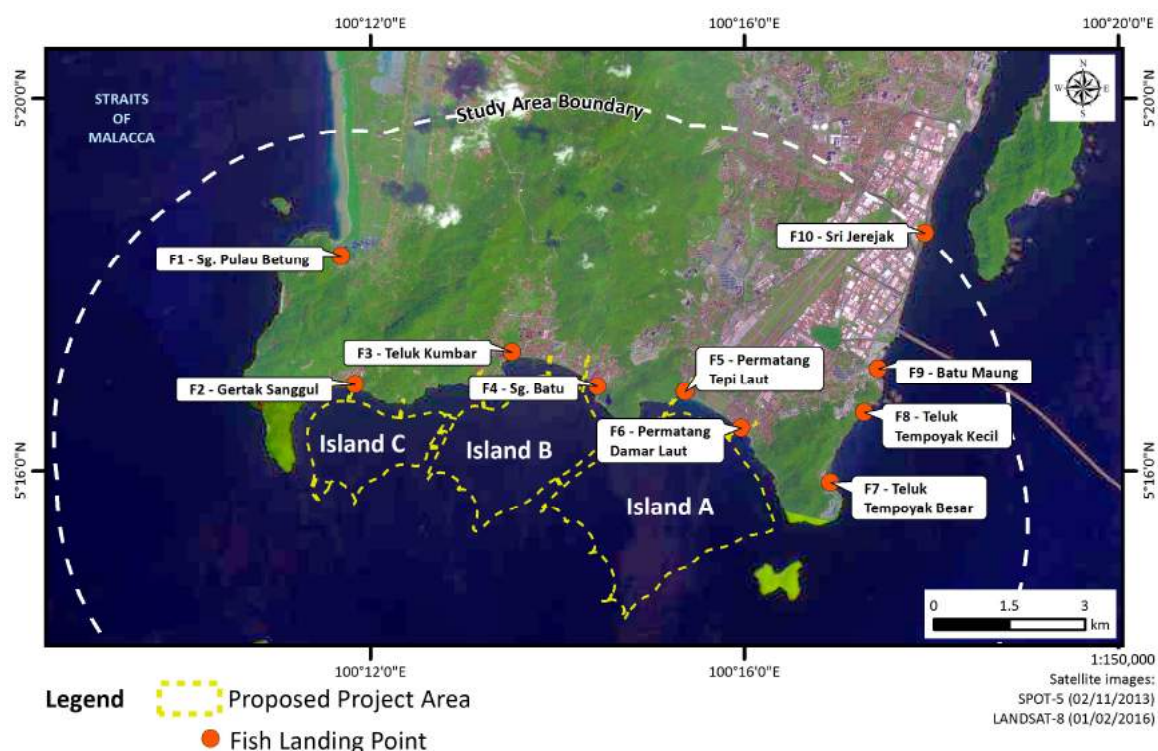
##### a) Overview of Fisheries Industry

In 2015, a total of 2,757 licensed fishermen operated within the impact zone. The highest number of licensed fishermen was at LKIM Batu Maung with 1,591 fishermen, accounting for 57.7% of the total fishermen in the impact zone. This is followed by Pulau Betung (226 fishermen: 8.2%) and Teluk Kumbar (220 fishermen: 8.0%) (T.20). The other fish landing points only had 92 to 185 full-time fishermen.

From the survey that was carried out, the age of fishermen varied between 20 to 90 years old. Most, however, were within 41 to 60 years old (T.21).

In 2015, there were a total of 733 fishing boats licensed in the study area. Most were small boats powered by outboard engines (650 units or 94.0%). The highest number of outboard-powered boats was recorded from Teluk Kumbar (129 units) and Pulau Betung (109 units). On the other hand, inboard powered boats were only recorded from LKIM Batu Maung (77 units), Gertak Sanggul (4 units) and one unit each at Permatang Damar Laut and Teluk Kumbar (T.22).





**F.11** Fish landing points within the study area

**T.20** Number of fishermen working in licensed vessels by ethnic groups in impact zone, 2015

Fish Landing Point	No. of Fishermen				
	Malays	Chinese	Indians	Others	Total
Sri Jerjak	52	30	10	0	92
Batu Maung	785	682	11	113	1,591
Teluk Tempoyak	145	10	2	0	157
Permatang Damar Laut	150	35	0	0	185
Sungai Batu	180	0	0	0	180
Teluk Kumbar	108	112	0	0	220
Gertak Sanggul	10	96	0	0	106
Pulau Betung	120	106	0	0	226
<b>Total</b>	<b>1,550</b>	<b>1,071</b>	<b>23</b>	<b>113</b>	<b>2,757</b>

Note: Data for Teluk Tempoyak Besar and Teluk Tempoyak Kecil are registered under Teluk Tempoyak, Permatang Tepi Laut is registered under Permatang Damar Laut  
Source: Department of Fisheries, Penang, 2016 - unpublished



**T.21** Age profile of the members of Fishermen Association in South of Penang Island

Fish Landing Point	Registered for 2015-2017				Registered Before 2015 (2004 - 2014)				Total
	>60	41-60	20-40	<20	>60	41-60	20-40	<20	
Sri Jerjak	37	82	37	0	19	15	7	0	197
Batu Maung	17	31	15	0	28	18	10	0	119
Telok Tempoyak	22	68	42	0	11	26	14	0	183
Permatang Damar Laut	35	80	64	0	2	18	8	0	207
Sungai Batu	39	72	37	0	11	17	7	0	183
Teluk Kumbar	52	93	40	1	11	26	10	0	233
Gertak Sanggul	39	99	15	0	3	18	8	0	182
Pulau Betung	65	118	60	1	5	16	6	0	271
<b>Total</b>	<b>306</b>	<b>643</b>	<b>310</b>	<b>2</b>	<b>90</b>	<b>154</b>	<b>70</b>	<b>0</b>	<b>1,575</b>

Source: Department of Fisheries, Penang, 2016 - unpublished

Fish Landing Point	No. of Fishing Boat		Total	<p><b>T.22</b> Number of licensed fishing boats at the study area (2015)</p>
	Outboard	Inboard		
Sri Jerjak	50	0	50	<p>Note: Data for Teluk Tempoyak Besar and Teluk Tempoyak Kecil are registered under Teluk Tempoyak, Permatang Tepi Laut is registered under Permatang Damar Laut</p> <p>*Estimated</p> <p>Source: Department of Fisheries, Penang, 2016 - unpublished</p>
Batu Maung	40*	77	117*	
Teluk Tempoyak	85	0	85	
Permatang Damar Laut	91	1	92	
Sungai Batu	90	0	90	
Teluk Kumbar	129	1	130	
Gertak Sanggul	56	4	60	
Pulau Betung	109	0	109	
<b>Total</b>	<b>650*</b>	<b>83</b>	<b>733*</b>	

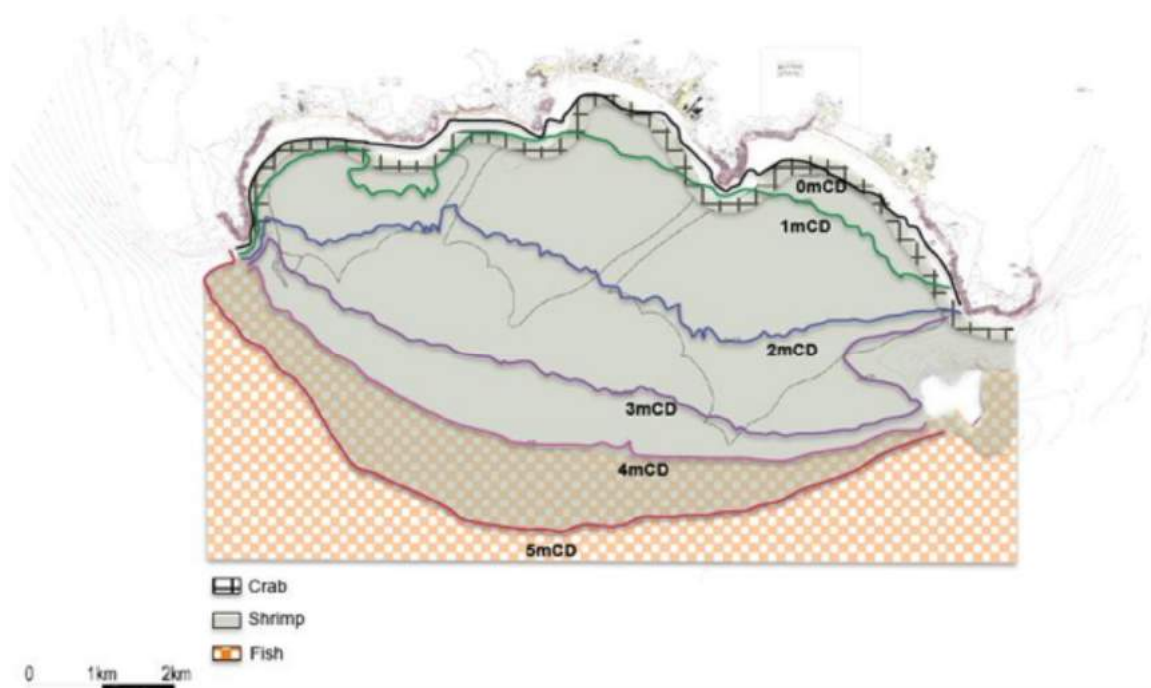
In 2015, there were 1,389 licensed fishing gears in the study area (T.23). Both commercial and artisanal gears were employed. Commercial gear included trawl nets and tuna longlines, while drift/gill nets, hook and lines and bag nets were common in the artisanal fisheries sub-sector.

Fishing activities were undertaken extensively within the proposed reclamation area as well as within the surrounding sea. The fishing area within the zone of impact is provided in F.12. The survey indicated that a significant level of the landings was by artisanal fishermen operating within the zone of impact.

**T.23** Number of licensed fishing gear at the study area (2015)

Fish Landing Point	Commercial Gear		Artisanal Gear			Total
	Trawl Net	Tuna Long-line	Drift Net	Hook and Lines	Bag Net	
Sri Jerjak	0	0	50	0	0	<b>50</b>
Batu Maung	57	6	705	0	5	<b>773</b>
Teluk Tempoyak	0	0	84	1	0	<b>85</b>
Permatang Damar Laut	0	0	92	0	0	<b>92</b>
Sungai Batu	0	0	90	0	0	<b>90</b>
Teluk Kumbar	0	0	130	0	0	<b>130</b>
Gertak Sanggul	0	0	60	0	0	<b>60</b>
Pulau Betung	0	0	108	0	1	<b>109</b>
<b>Total</b>	<b>57</b>	<b>6</b>	<b>1,319</b>	<b>1</b>	<b>6</b>	<b>1,389</b>

Note: Data for Teluk Tempoyak Besar and Teluk Tempoyak Kecil are registered under Teluk Tempoyak, Permatang Tepi Laut is registered under Permatang Damar Laut  
Source: Department of Fisheries, Penang, 2016 - unpublished



**F.12** Fishing grounds at the study area

In 2015, the wholesale value of fish landed at the study area was estimated at RM42.09 million, which amounted to 12.4% of the total wholesale value of fish landings (RM339.21 million) from Penang Island (Barat Daya and Timur Laut) (Department of Fisheries, Penang, 2016 - *unpublished*). The value was contributed by several commercial species such as Bawal and Senangin.

## b) Survey Findings

A total of 250 respondents were interviewed during the survey (T.24). The majority of the respondents consisted of Malays (71.6%) with Chinese fishermen accounting for 28.4%. Chinese fishermen were more predominant in fish landing points like Batu Maung and Gertak Sanggul. Of the 250 respondents that were successfully interviewed, 91.2% of the fishermen were fishing full-time, while the remaining 8.8% were part time fishermen.

The majority (34%) of the fishermen surveyed were between 41 and 50 years old. This age pattern was quite similar among all fish-landing points (T.25).

**T.24** The distribution of fishermen surveyed according to their occupational status and ethnicity

Fish Landing Point	Fishermen Surveyed (Frequency)	Occupational Status (%)		Ethnic (%)	
		Full-time	Part-time	Malays	Chinese
Sri Jerjak	32	11.6	1.2	10	2.8
Batu Maung	37	14.8	-	6.4	8.4
Teluk Tempoyak Kechil	21	7.2	1.2	7.6	0.8
Teluk Tempoyak Besar	9	3.6	-	3.6	-
Permatang Damar Laut	9	3.6	-	3.6	-
Permatang Tepi Laut	29	11.6	-	11.6	-
Sungai Batu	21	6.4	2	8.4	-
Teluk Kumbar	30	8.8	3.2	9.2	2.8
Gertak Sanggul	30	10.8	1.2	3.6	8.4
Pulau Betung	32	12.8	-	7.6	5.2
<b>Total (%)</b>		<b>91.2</b>	<b>8.8</b>	<b>71.6</b>	<b>28.4</b>

Note: Population Surveyed = 250 respondents

**T.25** Distribution of age categories of surveyed fishermen by age cohort and fish landing point

Fish Landing Point	Age Categories (%)				
	20 – 30	31 – 40	41 – 50	51 – 60	> 60
Sri Jerjak	1.2	1.2	5.6	2.4	2.4
Batu Maung	0.4	2.4	4.4	5.2	2.4
Teluk Tempoyak Kechil	0.4	0.8	4.4	2.0	0.8
Teluk Tempoyak Besar	0.8	-	2.0	0.8	-
Permatang Damar Laut	-	-	2.8	0.8	-
Permatang Tepi Laut	1.6	3.6	3.2	1.2	2.0
Sungai Batu	0.8	2.0	2.4	1.6	1.6
Teluk Kumbar	1.2	4.0	2.4	2.8	1.6
Gertak Sanggul	-	2.0	3.2	6.0	0.8
Pulau Betung	1.2	2.0	3.6	2.8	3.2
<b>Total (%)</b>	<b>7.6</b>	<b>18</b>	<b>34</b>	<b>25.6</b>	<b>14.8</b>

Note: Based on total fishermen survey = 250 respondents

The size of the fishing boats ranged from 4.3 to >9.4 m long. About 15.5% of the fishermen had second-hand boats, while the majority (84.5%) owned new boats (T.26). Similar proportions also applied to engine ownership, with 88.6% fishermen owning a new engine, while the remaining 11.4% had bought a reconditioned engine (T.27).

**T.26** Boat ownership (new or second hand)

Fish Landing Point	Boat		Engine	
	New (%)	Second Hand (%)	New (%)	Second Hand (%)
Batu Maung	14.0	4.7	15.0	3.6
Teluk Tempoyak	8.8	1.0	9.8	0.0
Permatang Damar Laut	4.7	0.0	4.7	0.0
Permatang Tepi Laut	8.3	2.6	10.4	0.5
Sungai Batu	6.2	0.0	6.2	0.0
Teluk Kumbar	8.8	1.0	8.3	1.6
Gertak Sanggul	13.5	1.0	13.0	1.6
Pulau Betung	9.3	2.1	10.4	1.0
Pulau Jerjak	7.3	3.1	7.8	2.6
Teluk Tempoyak Besar	3.6	0.0	3.1	0.5
<b>Total (%)</b>	<b>84.5</b>	<b>15.5</b>	<b>88.6</b>	<b>11.4</b>

Note: Boat owner surveyed = 193 persons

**T.27** Engine capacity of fishing boat used by surveyed fishermen by engine size and fish landing point

Fish Landing Point	Engine Capacity (Horsepower, HP) (%)				
	10 - 19	20 - 39	40 - 59	60 - 99	>100 (%)
Sri Jerjak	-	0.5	3.6	4.7	1.0
Batu Maung	0.5	4.7	5.2	7.2	1.0
Teluk Tempoyak Kechil	-	0.5	3.6	4.6	0.5
Teluk Tempoyak Besar	-	-	0.5	3.1	-
Permatang Damar Laut	-	0.0	1.6	3.1	-
Permatang Tepi Laut	-	1.6	6.7	2.0	0.5
Sungai Batu	-	1.0	2.6	3.1	-
Teluk Kumbar	-	1.0	4.1	4.6	-
Gertak Sanggul	0.5	-	5.2	7.3	2.1
Pulau Betung	1.5	1.0	1.0	6.8	2.1
<b>Total (%)</b>	<b>2.5</b>	<b>10.4</b>	<b>34.3</b>	<b>46.7</b>	<b>7.2</b>

Note: Boat owner surveyed = 193 persons

The fishing gears used at the study area include drift/gill net, bottom gill net, hooks and line and portable traps (T.28).

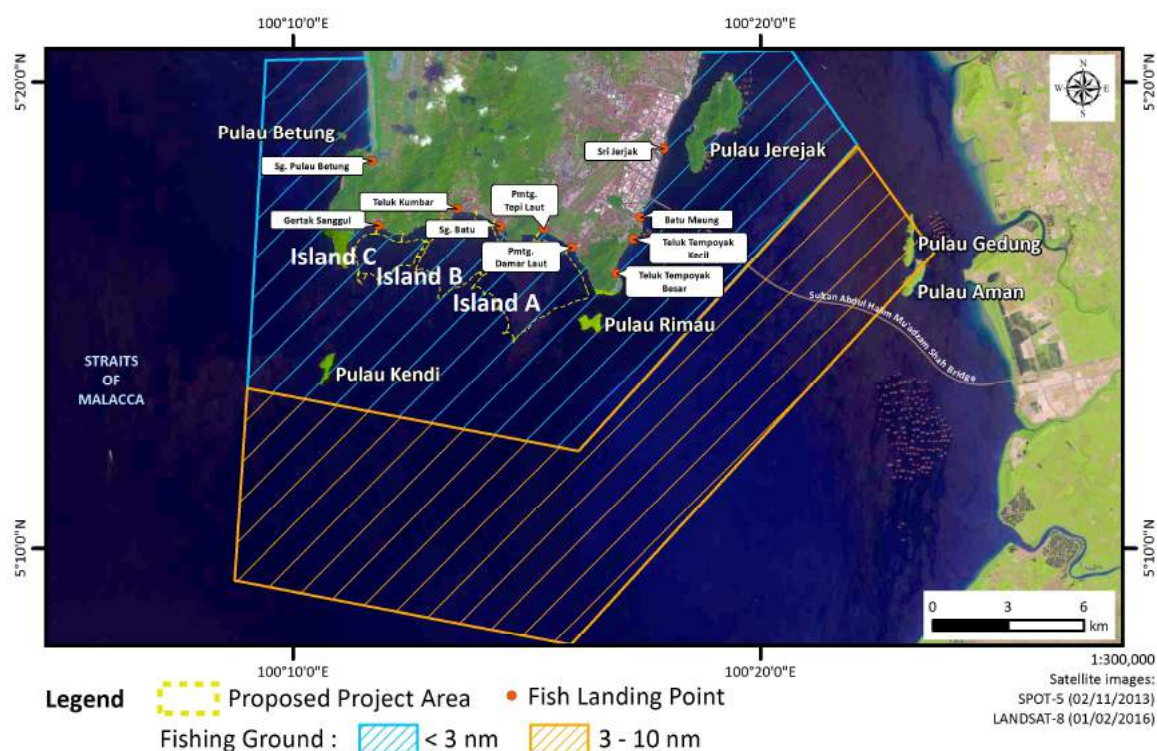
**T.28** Gear group according to engine horsepower

Gear Group		Engine – Powered (Horsepower, HP) (%)					Total (%)
		10 - 19	20 - 39	40 - 59	60 - 99	>100	
Drift/Gill Net	<i>Pukat Temenong</i> (Mackerel Net)	0.5	1.6	4.1	11.4	3.7	<b>21.3</b>
	<i>Pukat Senangin</i> (Threadfin Net)	0.5	6.2	19.7	25.3	4.2	<b>55.9</b>
	<i>Pukat Bawal</i> (Pomfret Net)	1.0	5.7	21.7	26.4	4.6	<b>59.4</b>
Bottom Gill Net	<i>Pukat Tiga Lapis</i> (Trammel Net)	1.6	8.3	30.0	42.6	5.7	<b>88.2</b>
	<i>Pukat Ketam</i> (Crab Net)	-	1.6	4.7	9.8	1.0	<b>17.1</b>
	<i>Pukat Kedera</i> (Mullet Net)	1.0	1.0	-	1.5	-	<b>3.5</b>
	<i>Pukat Jenahak</i> (Snapper Net)	-	-	-	0.5	-	<b>0.5</b>
	<i>Pukat Kerapu</i> (Grouper Net)	-	-	-	0.5	-	<b>0.5</b>
	<i>Pukat Hantu</i>	-	-	-	1.0	1.5	<b>2.5</b>
Hooks and Line	Rod and line	-	-	1.6	4.1	0.5	<b>6.2</b>
	Long-lines	-	-	1.6	4.2	0.5	<b>6.3</b>
Portable Traps	<i>Bubu</i>	-	-	3.1	-	-	<b>3.1</b>

Note: Boat owner surveyed = 193 persons

Based on the interviews and discussions with fishermen, the most important fishing ground was within 3 nautical miles from the coast, with 66% of the fishermen attesting that they fished there regularly. Other major areas of fishing effort were Pulau Kendi and Pulau Rimau. The bulk of the fishermen (92.6%) fished within the boundaries indicated in F.13.

The mean gross income per fisherman was RM1,989.50 per month, ranging from RM500 to RM9,000 per month. About 93% reported their incomes came entirely from fishing, with only 7% supplementing their income from other sources. These other sources included operating restaurants and boat rentals.



**F.13** Major fishing grounds of fishermen based on survey

### 9.2.3.3 Aquaculture Production

Discussions and interviews with aquaculture farmers particularly cage culture operators off Batu Maung (01°18.962' N; 103°26.614' E) and hatchery operators at Permatang Damar Laut, Teluk Kumbar, Gertak Sanggul and Pulau Betung were undertaken.

Three aquaculture systems are employed in the study area i.e. marine cage culture, pond culture and oyster culture. In 2015, aquaculture production in the study area amounted to 2,297.48 tonnes. In addition, shrimp/marine fish fry production (hatchery) was also actively undertaken at the study area.

#### a) Hatcheries and Seed Production

In 2015, there were seven private hatcheries involved in the shrimp fry production, two in prawn fry production and one in oyster production in the study area. Details of the hatcheries operating within the study area are summarized in T.29.



**T.29** Details of hatcheries operating at the study area (2015)

Location	Gertak Sanggul	Teluk Kumbang	Permatang Damar Laut	Pulau Betung	Total
No. of culturist	3	4	2	1	10
No. of hatchery	3	6	2	1	12
<b>Production</b>					
■ Udang Putih ( <i>P. vannamei</i> )					
- Naupli	40 million	755.8 million	-	-	795.8 million
- Post Larvae (PL9-15)	-	396.2 million	105.0 million	-	314.7 million
- Broodstock	-	1,200	-	-	1,200
■ Udang Harimau ( <i>P. monodon</i> )					
- Naupli	-	4.20 million	-	-	4.20 million
- Post Larvae (PL9-15)	-	4.27 million	4.5 million	-	8.77 million
■ Udang Galah ( <i>M. rosenbergii</i> )	-	6 million	12 million	-	18 million
■ Tiram ( <i>C. iredelei</i> , <i>Crassostrea</i> hybrids)	-	-	-	6 million	6 million
<b>Wholesale Value</b>					
■ Udang Putih ( <i>P. vannamei</i> )					
- Naupli	RM28,000	RM40,600	-	-	RM58,600
- Post Larvae (PL9-15)	-	RM4,462,000	RM1,195,000	-	RM5,657,000
- Broodstock	-	RM144,000	-	-	RM144,000
■ Udang Harimau ( <i>P. monodon</i> )					
- Naupli	-	RM29,400	-	-	RM29,400
- Post Larvae (PL9-15)	-	RM128,100	RM135,000	-	RM263,100
■ Udang Galah ( <i>M. rosenbergii</i> )	-	RM420,000	RM720,000	-	RM1,140,000
■ Tiram ( <i>C. iredelei</i> , <i>Crassostrea</i> hybrids)	-	-	-	RM1,500,000	RM1,500,000
<b>Total Wholesale Value (RM)</b>	<b>RM28,000</b>	<b>RM5,224,100</b>	<b>RM2,050,000</b>	<b>RM1,500,000</b>	<b>RM8,802,100</b>

Source: Field data, 2016

b) Grow Out

■ Marine Cage Culture

There are 40 farmers involved in marine cage culture in study area. The locations are related to the sheltered nature of the site and the proximity to feed sources. Most cages are located around Pulau Jerejak and off Batu Maung on the leeward side of the island to protect against strong winds and wave action (T.30).

**T.30** Cage culture information at the study area

Location	Pulau Jerejak	Off Batu Maung	Pulau Betung
No. of culturist	30	8	2
No. of cage	6,885	2,240	400
Area (m <sup>2</sup> )	139,000	49,365	4,500
Fish reared	Kerapu ( <i>Epinephelus</i> sp.), Merah ( <i>Lutjanus</i> spp.), Siakap ( <i>L. calcarifer</i> ), Bawal Mas ( <i>Trachinotus blochii</i> ), Nyok-nyok ( <i>Caranx sexfasciatus</i> )	Kerapu ( <i>Epinephelus</i> sp.), Merah ( <i>Lutjanus</i> spp.), Siakap ( <i>L. calcarifer</i> ), Bawal Mas ( <i>Trachinotus blochii</i> ), Nyok-nyok ( <i>Caranx sexfasciatus</i> )	*Kerapu ( <i>Epinephelus</i> sp.), Merah ( <i>Lutjanus</i> spp.)
Production (tonnes)	1,594.90	*829	*15
<b>Wholesale Value (RM)</b>	<b>38,483,162.70</b>	<b>*20,002,847.75</b>	<b>*290,000.00</b>

Source: Department of Fisheries, Penang, 2016 - unpublished, \*Survey undertaken in 2016

■ Pond Culture (Shrimp Farming)

Two companies were involved in shrimp farming in the study area, i.e. Great Fishore Sdn. Bhd. and Iyin Cooperation Sdn. Bhd. both of which operated at Sungai Pulau Betung. Great Fishore Sdn. Bhd. operated a total of nine ponds while Iyin Cooperation Sdn. Bhd. has 10 ponds. The details of the shrimp farming are tabulated in T.31.

**T.31** Shrimp farming information at the study area

Location	Sungai Pulau Betung
No. of culturist	2
No. of pond	19
Area (ha)	13
Commodity cultured	Udang Harimau ( <i>Penaeus monodon</i> ), Udang Putih ( <i>L. vannamei</i> )
Production (tonnes)	692.32
<b>Wholesale Value (RM)</b>	<b>19,601,239.00</b>

Source: Department of Fisheries, Penang, 2016 - unpublished

## ■ Oyster Farming

Out of five locations where oyster farming is carried out in Malaysia, one is located within the study area i.e. at Pulau Betung. The details of the oyster farm are as shown in T.32.

**T.32** Oyster farming information at the study area

Location	Pulau Betung
No. of culturist	1
No. of pond	150
Area (m <sup>2</sup> )	3,000
Commodity cultured	Tiram ( <i>Crassostrea iredalei</i> )
Production (tonnes)	10.26
<b>Wholesale Value (RM)</b>	<b>409,000.00</b>

Source: Department of Fisheries, Penang, 2016 - unpublished

### 9.2.3.4 Recreational Fishing

In the study area, recreational fishing activities were carried out at Pantai Sri Jerjak, Batu Maung, Teluk Tempoyak Besar, Sungai Batu, Pasir Belanda, Tanjung Karang, Gertak Sanggul and Pulau Betung. Recreational fishing activities were recorded as being more intense during weekends as compared to weekdays. These activities are categorised into shore-based angling and boat-based angling. The staging locations are tabulated in T.33.

**T.33** Staging locations for shore-based and boat-based angling at the study area

Location		Coordinates	
		Latitude	Longitude
Shore-based Angling	Gertak Sanggul	5°16.974'N	100°11.453'E
	Tanjung Karang	5°16.729'N	100°12.407'E
	Sungai Batu	5°16.905'N	100°14.429'E
	Teluk Tempoyak Besar	5°15.732'N	100°17.029'E
Boat-based Angling	Pantai Sri Jerjak	5°18.608'N	100°17.957'E
	Batu Maung	5°17.138'N	100°17.466'E
	Pasir Belanda	5°16.898'N	100°12.648'E
	Pulau Betong	5°18.302'N	100°11.688'E

It is estimated that the direct economic value from the recreational fishing activities amounts to RM 5.229 million per year.

a) Shore-based Angling

Shore-based angling was undertaken primarily at Gertak Sanggul, Tanjung Karang, Sungai Batu and Teluk Tempoyak Besar. Shore-based angling at Gertak Sanggul was mainly carried out at the recreational fee-based pond in the village i.e. Gertak Sanggul Fishing Stage, while shore-based angling at Tanjung Karang, Sungai Batu and Teluk Tempoyak Besar was mostly undertaken at jetties or along the rocky shore. This angling activity is commonly undertaken during weekends.

b) Boat-based Angling

Four boat-based angling locations were recorded at the study area which are Pantai Sri Jerjak, Batu Maung, Pasir Belanda and Pulau Betong. Pasir Belanda was the most productive location for boat-based angling. Two outboard and three inboard powered boats were generally available for rental. Most of these boats were licensed by the Marine Department, Peninsular Malaysia. The second most important location for boat-based angling was Pantai Sri Jerjak, where there were five outboard powered boats available for boat rental.

#### **9.2.3.5 Feedback from the Focus Group Discussion (FGDs) with the Public and Fishing Community**

The feedback and issues raised during the FGDs are summarised in T.34 and T.35.

The various feedbacks, gathered from the informal conversations conducted, clearly portray dual responses - one was that of the fishermen and the other the public. What can be deduced from the various feedbacks was that the fishermen, as the directly impacted stakeholders, were less supportive whilst the public, being indirectly impacted were keener as seen from the support given to the likely benefits that the impending Project would generate. However, they had also cautioned about the likelihood that the locals may not reap the benefits if care was not taken to see to their just distribution.

**T.34** Feedbacks and issues raised in the Focus Group Discussion with the fishermen

Arbitrary Zone	Place	Feedback/Issues
Zone A	Kampung Permatang Tepi Laut	<ul style="list-style-type: none"> <li>■ Concern over the site for Island A as an important fish and prawn area which when reclaimed would destroy it and local fishermen's livelihood since most of them are inshore fishermen.</li> <li>■ Concern over the length of the underwater/seabed pipeline for sand transport to the construction site and its potential to cause damage to fishing gears.</li> <li>■ Fear of relocation due to land being acquired by the private company owning the land where their settlement sits, when and if the latter decides to develop the land in conjunction with the development of the reclaimed island.</li> <li>■ Concern over fishing as a vocation of generational tradition and that it should be improved upon and upgraded.</li> </ul>
Zone B	Kampung Sungai Batu	<ul style="list-style-type: none"> <li>■ Majority disagreed with the proposed Project as they claimed that the area is the most important prawn and prawn spawning area in Penang and that 99 % of the fishermen in Sungai Batu and Teluk Kumbar are involved in prawn landing. Reclamation will destroy the spawning area and livelihood of the local fishermen. Those who agreed, especially among Chinese fishermen, only if the reclamation does not affect their livelihood during construction.</li> <li>■ Worried over the construction method and the surety that disposed materials containing mud would not be washed back to the coasts from its designated disposal area located 30 km away which would potentially threaten and destroy the prawn catching and spawning area.</li> <li>■ Demanded compensation of RM1.5 million each if reclamation is implemented based on the loss and destruction of the prawn catching site which they have to bear to sustain them and the second generation.</li> <li>■ They also demanded for improvement of infrastructural facilities which are especially related to fishing activities such as storage, jetty and generating new economic venture such as seafood eateries or promotion for tourist attraction.</li> <li>■ Questioned the logic of building low cost or affordable housing on a multi-billion cost island, what more when they are sold to a third party.</li> <li>■ Voiced concern over the need to also see into the welfare of the other members of society such as women, youth and children when it was obvious that the focus was zoomed towards the impact on fishermen.</li> <li>■ Fear of marginalisation with the influx of foreign workers into the area.</li> <li>■ Upset with the state government to rationalize the proposed reclamation Project, despite the fact that local fishermen have been grappling to preserve their marine areas from the threat of illegal trawling and <i>rimau</i> net and that the site is an important fishing ground.</li> <li>■ Concern over delayed effects of mud/sediments from the 2<sup>nd</sup> bridge project affecting the water quality and the possibility of a repeat of mud being washed to the shore by the reclamation Project.</li> <li>■ Compensation is necessary, but there needs long term planning for fishermen to carry on fishing legacy. Fishermen need modern settlements, planning to make existing fishermen move towards a more advanced practice, facilities and settlement. Hopefully, part of the island will be allocated for fishermen's use.</li> </ul>

**T.34** Feedbacks and issues raised in the Focus Group Discussion with the fishermen

Arbitrary Zone	Place	Feedback/Issues
Zone C	Kampung Gertak Sanggul	<ul style="list-style-type: none"> <li>■ Concern over the site for Island C as an important fish and prawn area which when reclaimed would destroy it and local fishermen's livelihood as prawns do not thrive in deep water i.e. beyond the reclaimed land.</li> <li>■ Should reclamation be implemented, the fishing community demanded that they be compensated by giving monthly stipend of RM5,000 to fishermen (owner-operator) and RM3,000 to boat crew or <i>awak-awak</i> for the duration until the completion of the Project.</li> <li>■ They also demanded for higher subsidy for petrol and bigger boat should they have to go further for deep sea fishing.</li> <li>■ The need to build special settlement of affordable housing for fishermen since there are still fishermen who are lodgers.</li> <li>■ Suggestion to put artificial reefs in the area to attract and stimulate fish and prawn spawning was not well received as it was said to defeat the purpose when they would be damaged by the trawl nets from "illegal" trawling carried out in the area.</li> </ul>

**T.35** Feedbacks and issues raised in the Focus Group Discussion with the public

Arbitrary Zone	Place	Feedback/Issues
Zone A	Kampung Permatang Tepi Laut	<ul style="list-style-type: none"> <li>■ Perceived concern on the possibility that there will be land acquisition for road widening as access road for transportation of construction materials.</li> <li>■ Fear of relocation due to land being acquired by the private company owning the land when and if the latter decides to develop the land in conjunction with the development of the reclaimed island.</li> <li>■ That they be relocated at one resettlement or a new fishing settlement in order to retain and preserve local tradition and culture.</li> <li>■ Seeking assurance that they be given priority when applying for affordable housing on the island.</li> </ul>
Zone C	Kampung Gertak Sanggul	<ul style="list-style-type: none"> <li>■ Concern over the impact of the reclamation of the three islands on the habitat of fish and other marine life in the area.</li> <li>■ Concern over the impact of the reclamation over the physical sustainability or future existence of Kampung Gertak Sanggul when the impact of increased land value may end up in the locals and private land owners selling off their land.</li> <li>■ Demand to know more about the Project to the very detail of the topside development and the number of job opportunities created and to be briefed during weekends not on weekdays as many were away working.</li> <li>■ Concern over cultural sustainability as future spill-over development from the reclamation may see to the demise of the <i>kampung</i> atmosphere and social as well as cultural values.</li> <li>■ Concern over the preservation of the village historical and cultural heritage as well as traditions.</li> <li>■ Concern over the impact on fishermen who have to go further to fish, hence having to bear higher petrol cost and the fact that the area is an important prawn breeding area.</li> <li>■ Concern on survival of future generations through economic and housing benefits for them and the need to conserve the environment.</li> <li>■ Majority of the locals disagreed with the proposed Project due to its long term negative impacts and wanted the environment to be preserved for future generations.</li> </ul>



#### **9.2.3.6 Feedback from the Public Dialogue**

The dialogue started at 9:00 am with a brief introduction on the Project and its components by the Chief Minister of Penang, followed by the presentation of the EIA studies and findings. Hence, the feedback described in this section mainly refers to the opinions given by those gathered during the Public Dialogue. They were mixed opinions of for and against the proposed development, the latter concerning issues akin to their fishing activities that they were concerned with.

During the Q&A session, the crowd gathered was seen to be slowly leaving the hall as early as 11:30 am and gathered momentum by 12:47 pm apparently for a greater agenda of demonstrating against the project taking the cue from the protest mooted by one of the local peripheral fishermen. The peaceful demonstration was led by the Fishermen Association of Penang.

In the Q&A session, 44 questions and issues were raised by 18 interested participants comprising fishermen/head of Fishermen Units both local and non-local, a cage-culture operator from Pulau Jerjak, a local pig breeder, a chemist, a retiree and even a blogger. While some expressed support for the proposed Project, others mooted concerns.

Four major issues were raised especially by the general public and the fishermen, the latter would be the directly impacted group:

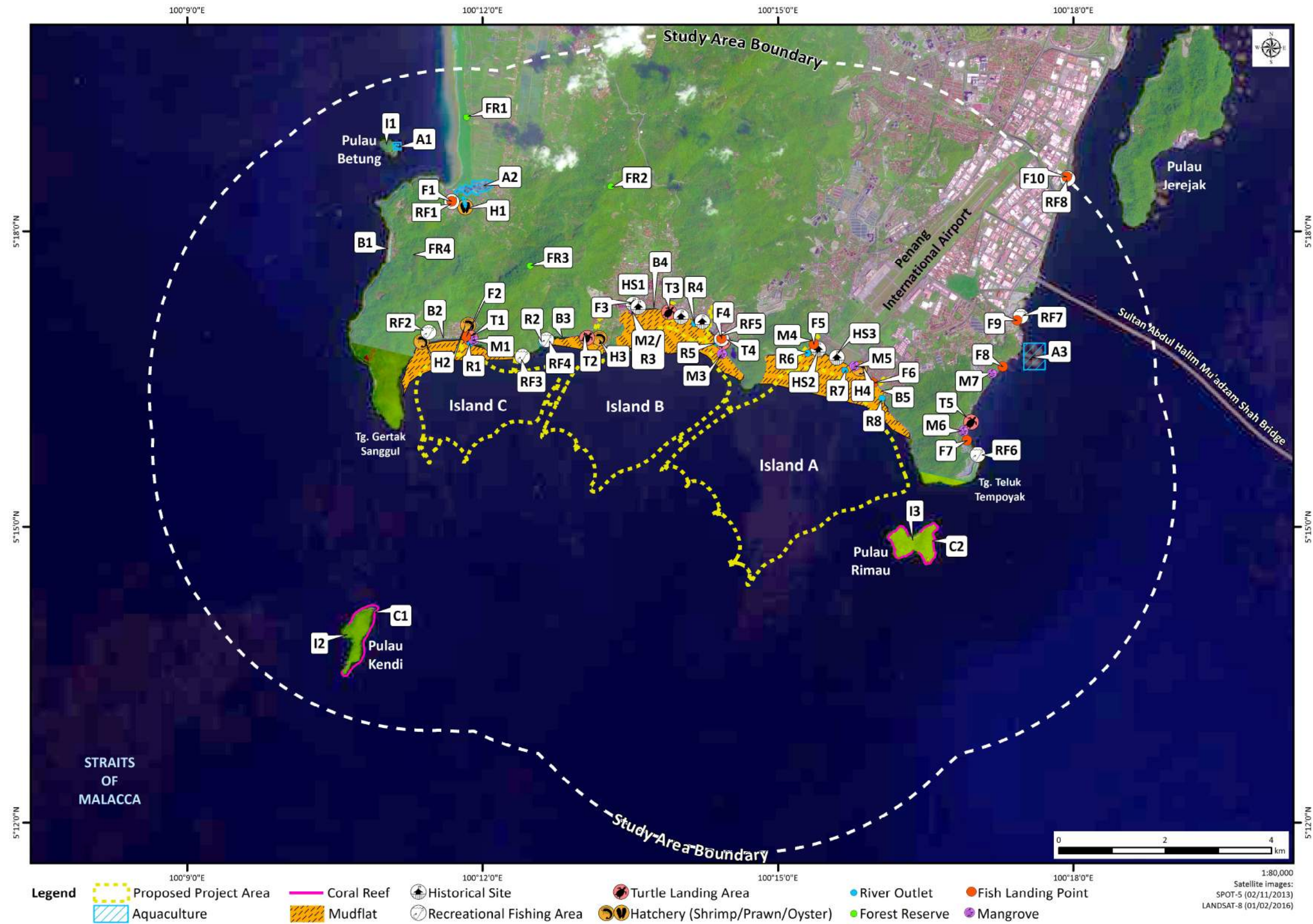
- a) The concern over reclamation affecting fishing activities and livelihood and the associated demand for compensation;
- b) The concern over eligibility and ability of purchasing affordable houses;
- c) The concern over the project's impacts on the environment and the associated aspects covered in the EIA; and
- d) Other local and state issues of concerns such as pig farming and several aspects of the Transport Master Plan.

Issues raised by the representatives of the fishing communities were seen not to be so different from those expressed by the respondents in the social survey, particularly with regards to the concerns of the impacted fishing communities.

Out of 144 filled feedback forms, 63.2% expressed their support, 13.9% expressed their disagreement and the remaining 22.9% were non-committal. Also more than half (57.6%) of the filled forms were written with mere statements of support or against the project and only 61 forms or 42.4% were comments made or given. Most of them were wary of their fishing activities, but a few did caution on matters that relate to the environment, marine ecology in the affected area as well as that the locals be given due consideration and priority for the employment opportunities created from the Project.

#### **9.2.4 Environmentally Sensitive Areas**

The Department of Environment (DOE) Malaysia defines an Environmentally Sensitive Area (ESA) as an area where specific attention or proper consideration is duly given prior to any development being authorised within or in the vicinity of the area. The coverage of the existing environment to indicate the ESAs is within a 5-km radius from the Project area (F.14).



**F.14**  
ESAs within the study area

The ESAs are explained in detail according to the following (T.36):

- a) Physical ESAs;
- b) Biological ESAs; and
- c) Socio-economic ESAs.

**T.36** Summary of ESAs within the study area

Type of ESA	Point	Location	Distance (km)	
Physical	Recreational Beaches	B1	Pantai Pasir Panjang	2.0
		B2	Pantai Gertak Sanggul	0.3
		B3	Pantai Tanjung Asam	0.5
		B4	Pantai Nelayan	0.5
		B5	Pantai Bakar Kapor	0.1
	Island	-	Pulau Betung	3.9
		-	Pulau Kendi	2.9
		-	Pulau Rimau	0.6
	Rivers	R1	Sungai Gertak Sanggul	<0.1
		R2	Sungai Gemuruh	0.4
		R3	Sungai Teluk Kumbar	0.5
		R4	Sungai Mati	0.2
		R5	Sungai Batu	0.2
		R6	Sungai Bayan Lepas	<0.1
		R7	Bayan Lepas Main Drain	0.2
		R8	Sungai Ikan Mati	0.2
	Mudflat	-	Along the coastline: Permatang Damar Laut, Teluk Kumbar and Gertak Sanggul	<0.1
	Historical Structures (WW2 Pillbox)	HS1	Teluk Kumbar	0.1
		HS2	Permatang Damar Laut	0.1
		HS3	Bayan Lepas Main Drain	0.3
Biological	Coral Reef	C1	Pulau Kendi	2.6
		C2	Pulau Rimau	0.6
	Turtle Landing Area	T1	Gertak Sanggul	<0.1
		T2	Pasir Belanda	0.1
		T3	Teluk Kumbar	<0.1
		T4	Sungai Batu	0.3
		T5	Teluk Tempoyak	1.4
	Mangrove	M1	Sungai Gertak Sanggul	0.1
		M2	Sungai Teluk Kumbar	0.5
		M3	Sungai Teluk Kumbar	0.2
		M4	Sungai Bayan Lepas	<0.1
		M5	Bayan Lepas Main Drain	0.3
		M6	Teluk Tempoyak Besar	1.2
		M7	Teluk Tempoyak Kecil	1.7

**T.36** Summary of ESAs within the study area (cont'd)

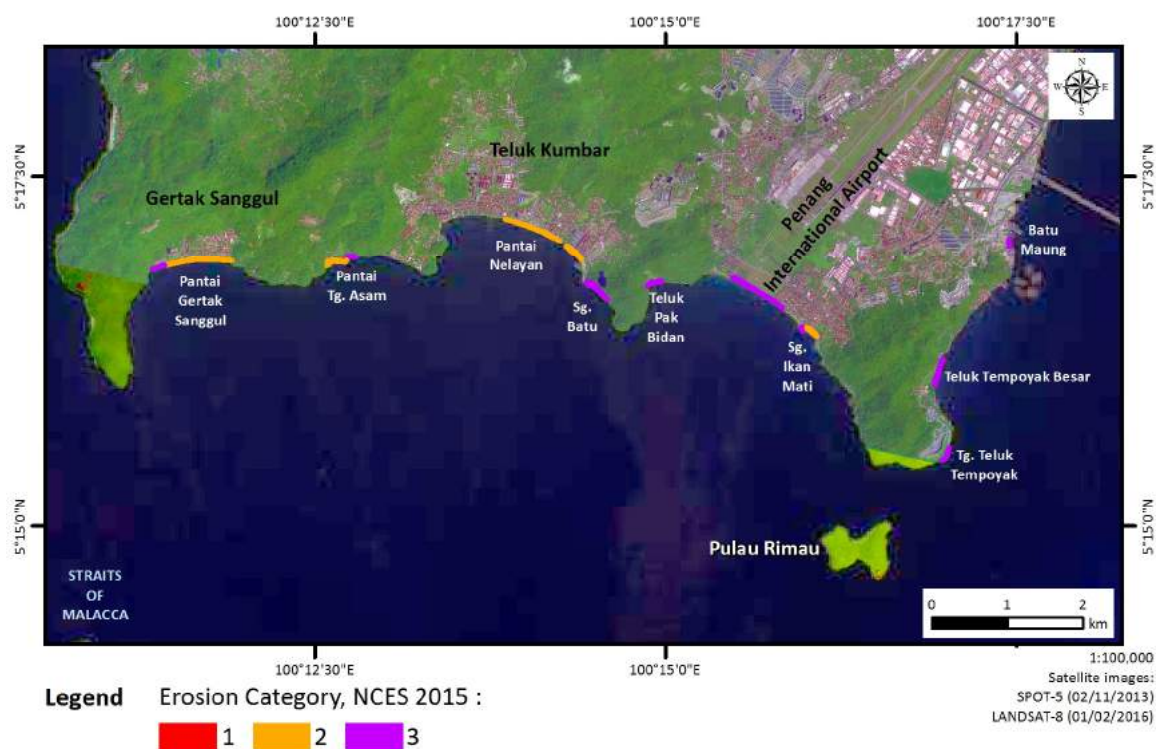
Type of ESA		Point	Location	Distance (km)
Biological (cont'd)	Forest Reserve	FR1	Hutan Simpan Balik Pulau	2.4
		FR2	Hutan Simpan Bukit Genting	2.1
		FR3	Hutan Simpan Bukit Gemuruh	0.8
Socio-economic	Fish Landing Point	F1	Sungai Pulau Betung	2.3
		F2	Gertak Sanggul	<0.1
		F3	Teluk Kumbar	0.6
		F4	Sungai Batu	0.2
		F5	Permatang Tepi Laut	<0.1
		F6	Permatang Damar Laut	<0.1
		F7	Teluk Tempoyak Besar	1.2
		F8	Teluk Tempoyak Kecil	1.9
		F9	Batu Maung	2.4
		F10	Sri Jerejak	4.5
	Recreational Fishing Staging Area	RF1	Sungai Pulau Betung	2.3
		RF2	Gertak Sanggul	0.5
		RF3	Tanjung Karang	<0.1
		RF4	Pasir Belanda	0.5
		RF5	Sungai Batu	0.2
		RF6	Teluk Tempoyak Besar	1.3
		RF7	Batu Maung	2.5
		RF8	Pantai Sri Jerjak	4.5
	Cage Culture	A1	Pulau Betung	3.3
		A2	Sungai Pulau Betung	2.2
		A3	Batu Maung	2.3
	Hatchery	H1	Near Sungai Pulau Betung (1 location)	2.4
		H2	Gertak Sanggul (3 locations)	0.2
		H3	Teluk Kumbar (6 locations)	<0.1
		H4	Permatang Damar Laut (2 locations)	<0.1

#### 9.2.4.1 Physical ESAs

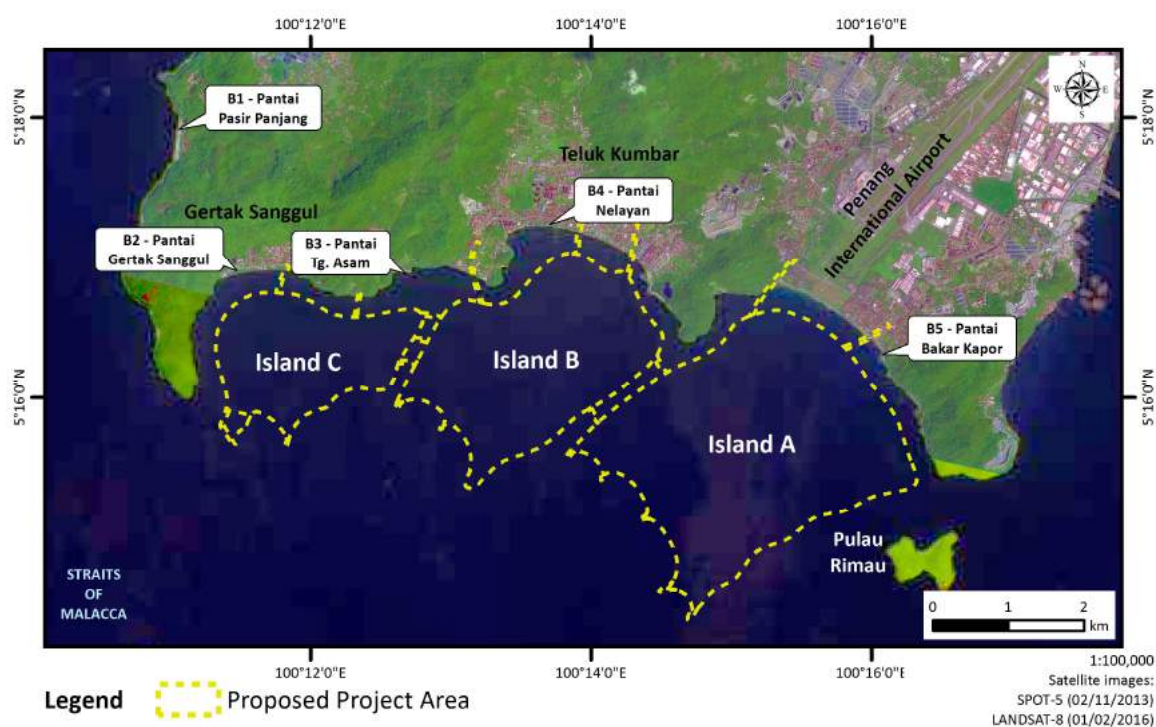
##### a) Beaches

The proposed Project area is approximately 250 m from the southern coastline of Penang Island. The coastline faces the Straits of Malacca and experiences direct impact from currents and waves. The coastline erosion conditions at certain areas are mostly categorised as Category 2 ("Significant") and Category 3 ("Acceptable") (NCES, 2015). The erosion category of Penang Island southern coastline is visualised in F.15. There are recreational beaches found along the coastline as depicted in F.16.





**F.15** Erosion category of south coast of Penang Island coastline



**F.16** Recreational beaches within the study area



b) Islands

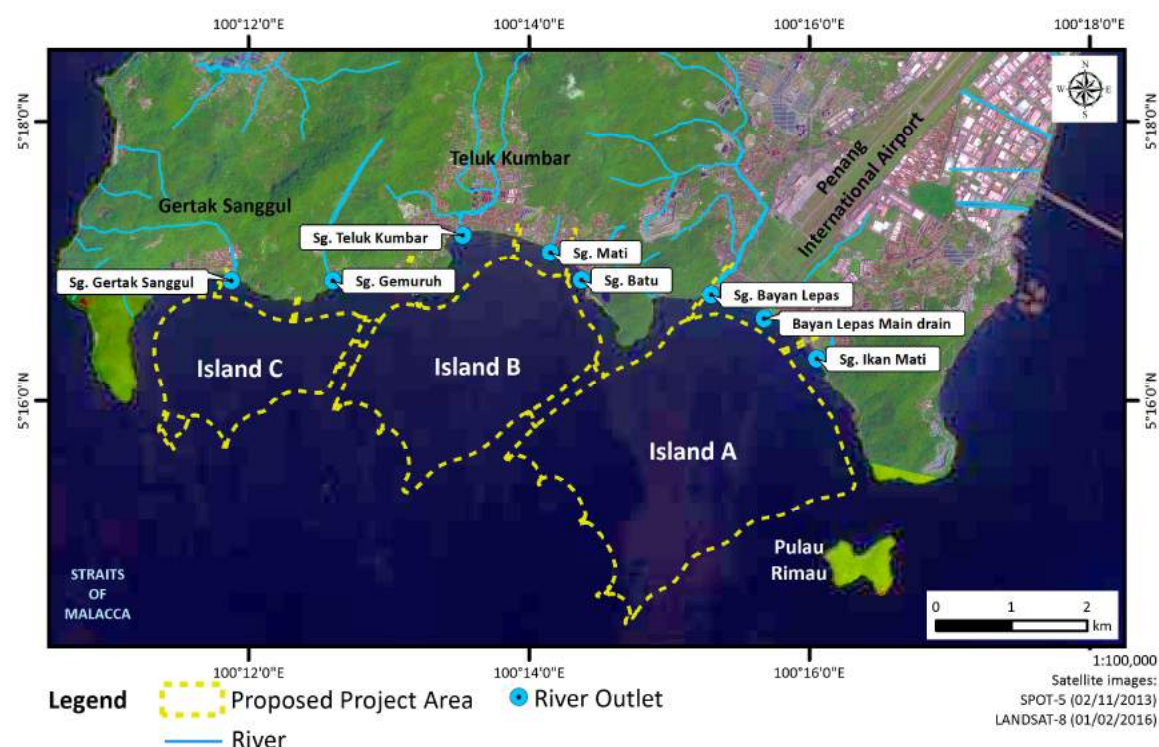
The nearest islands within a 5-km radius from the Project area are Pulau Rimau, Pulau Kendi and Pulau Betung (refer to F.14).

c) River Outlets

There are eight river outlets found along the Penang Island south coast namely (F.17):

- i) Sungai Ikan Mati;
- ii) Bayan Lepas Main Drain;
- iii) Sungai Bayan Lepas;
- iv) Sungai Batu;
- v) Sungai Mati;
- vi) Sungai Teluk Kumbar;
- vii) Sungai Gemuruh; and
- viii) Sungai Gertak Sanggul.

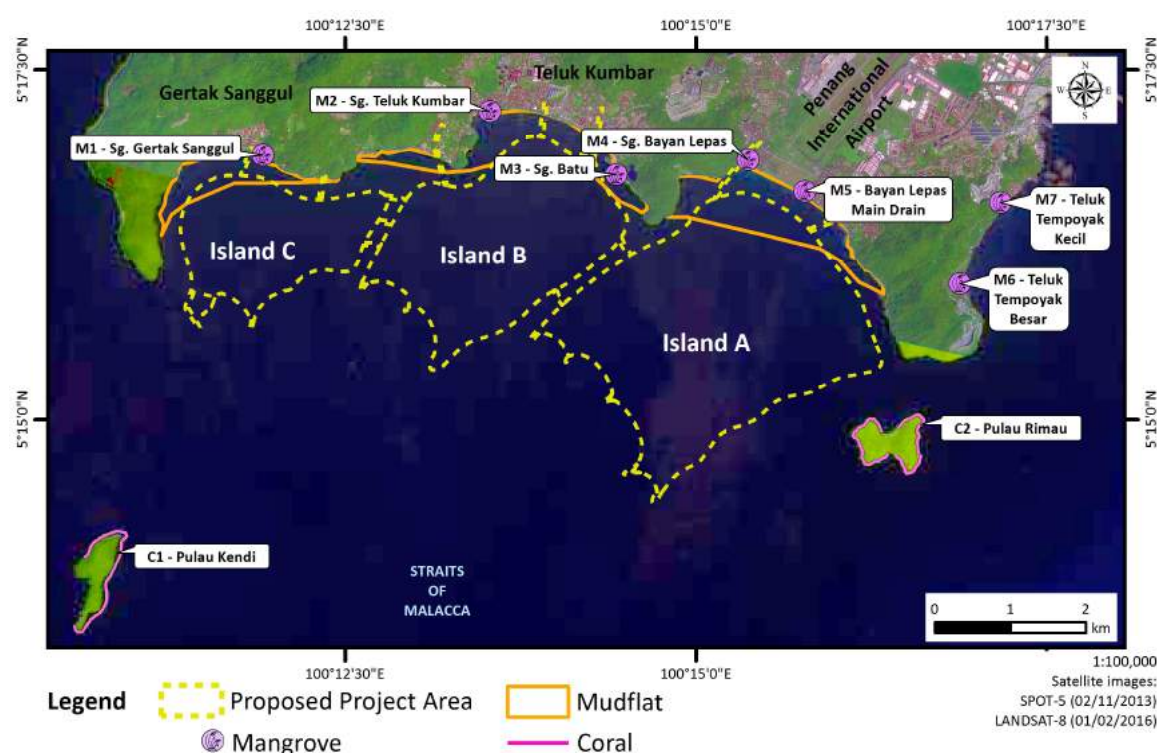
Based on the Water Quality Index (WQI) classification (EQR, 2006), the existing river water quality can generally be categorised as polluted.



**F.17** River outlets at the south coast of Penang Island

#### d) Mudflats

Mudflats normally form at bays that are sheltered from waves. Hence, they are found along the south coast of Penang Island due to its sheltered condition with rocky headlands (F.18). In the south coast of Penang Island, crab fishing is actively conducted within the mudflat area.



**F.18** Mudflats, mangroves and coral reefs found at the south coast of Penang Island

#### 9.2.4.2 Biological ESAs

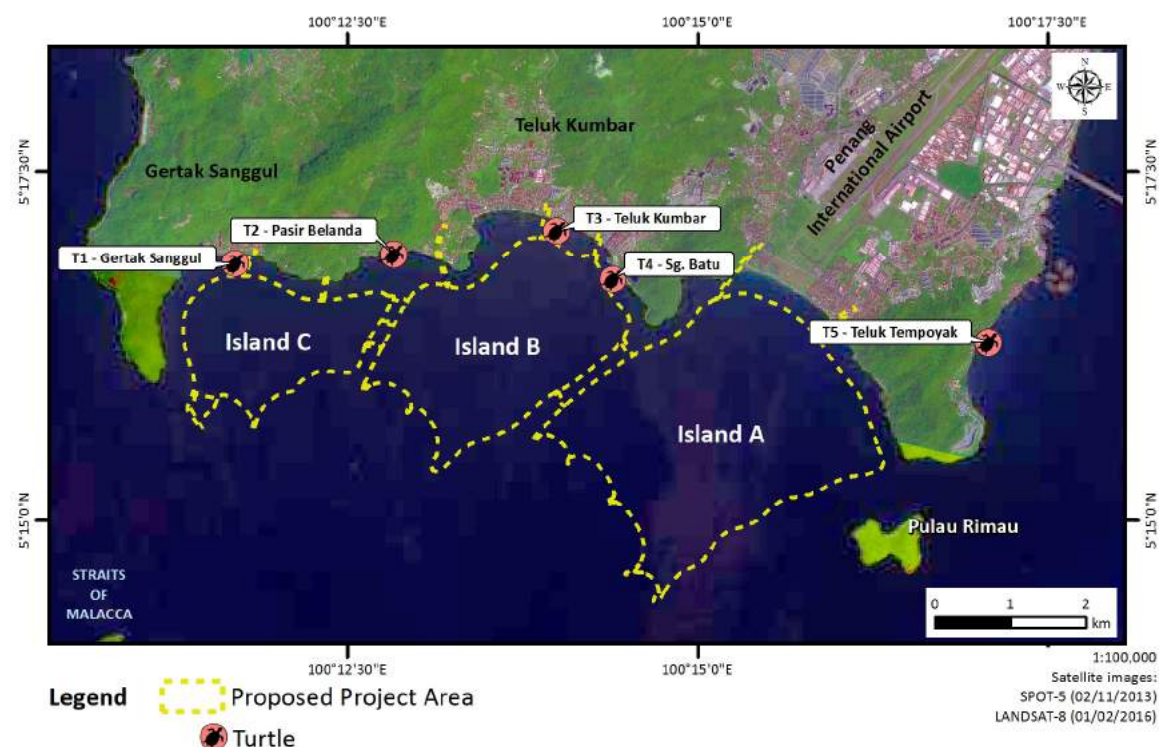
##### a) Coral Reefs

Both soft and hard corals were found at both Pulau Rimau and Pulau Kendi (F.18). From the study, the coral cover in Pulau Kendi was less than 30% of the total coral area which indicates “fair” coral health, while the coral cover in Pulau Rimau was less than 5% which indicates “poor” coral health.

##### b) Turtle Landing Areas

Five landing sites were identified at the south coast of Penang Island namely Teluk Kumbar, Pantai Medan, Gertak Sanggul, Teluk Tempoyak and Pantai Belanda (F.19).

Olive Ridley turtles landing in Teluk Kumbar is once in two years. In recent years, an Olive Ridley female turtle was spotted emerging from the sea to Teluk Kumbar beach to lay eggs (The Star, 2015).



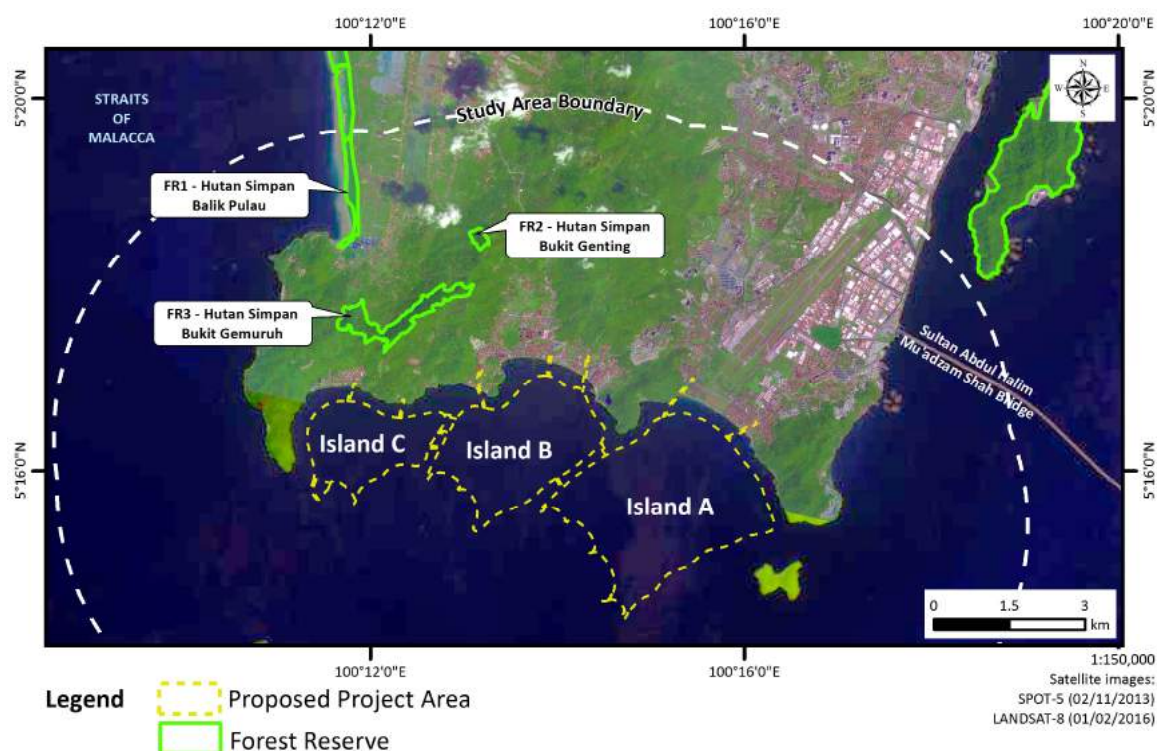
**F.19** Turtle landing sites at the south coast of Penang Island

#### c) Permanent Reserved Forests

In the southern part of Penang Island, most of the forest hill lands are gazetted as Permanent Reserved Forests (PRF). About 93.52 hectares of PRFs are located at southern Penang Island as shown in F.20. The PRFs are Hutan Simpan Bukit Genting, Hutan Simpan Bukit Gemuruh and Hutan Simpan Balik Pulau.

#### d) Mangroves

There are no significant mangrove forests found surrounding the Project area. However, small patches of mangroves were discovered mostly in the rivers at Teluk Tempoyak Kecil, Teluk Tempoyak Besar, Permatang Tepi Sungai, Sungai Bayan Lepas, Sungai Batu and Sungai Gertak Sanggul as mapped in F.18.



**F.20** Permanent Reserved Forests (PRFs) within the study area

### 9.2.4.3 Socio-economic ESAs

There are many villages at the south coast of Penang Island, with some of the working population consisting of fishermen. The robust fishery, aquaculture and hatchery industry at the south of Penang Island makes the south coast an important ESA that needs to be considered.

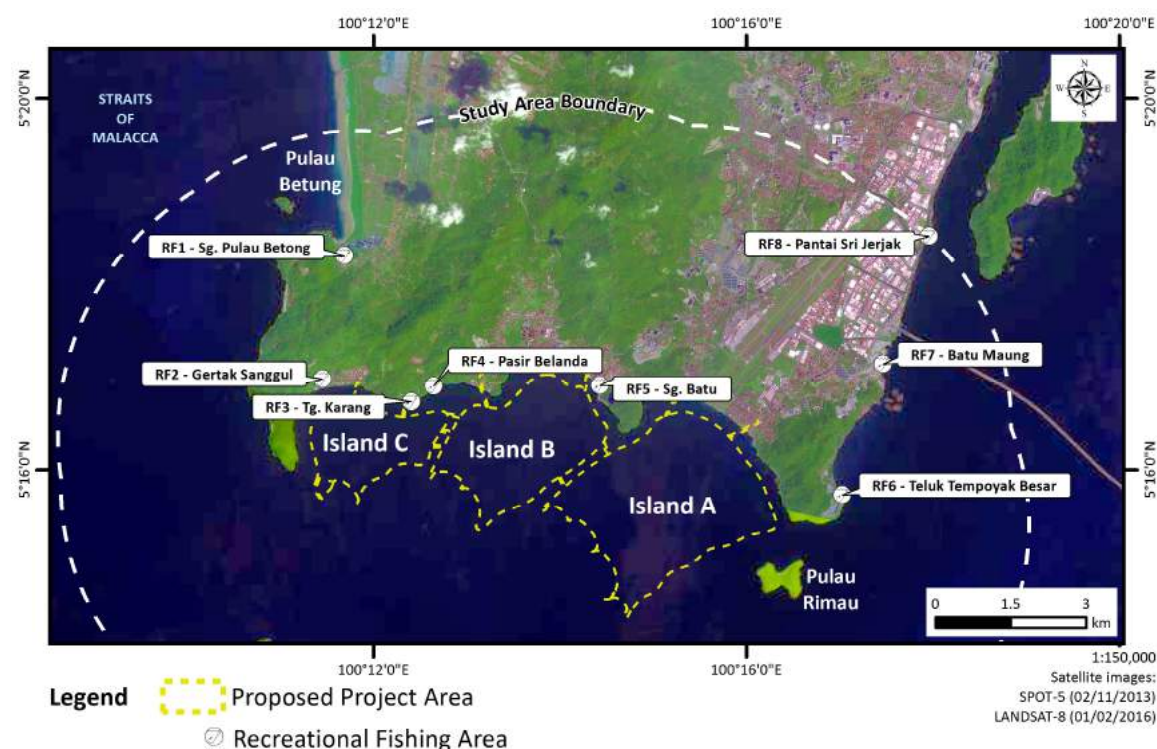
#### a) Fisheries

Some fish-landing points are within the rivers such as in Sungai Bayan Lepas and Sungai Teluk Kumbar. Fish landings in the study area amounted to 4,169.37 tonnes in year 2015, excluding the landings at LKIM in Batu Maung. The highest fish landing was recorded at Teluk Kumbar with 1,083.19 tonnes (26% of total fish landing). The wholesale value of fish landed at the study area in 2015 was estimated at RM42.09 million. This contributed about 12.4% of the total wholesale value in Penang Island (DOF Penang, 2016 - *unpublished*).

#### b) Recreational Fishing

Several major locations near the Project area that are commonly visited for recreational fishing are Pulau Kendi and Teluk Kumbar. The staging areas where these enthusiasts depart from by boat are Pantai Sri Jerjak, Batu Maung, Teluk Tempoyak Besar, Sungai Batu, Pasir Belanda, Tanjung Karang, Gertak Sanggul and Pulau Betung (F.21). It is estimated that the direct economic value from recreational fishing amounts to RM5.229 million per year.





**F.21** Recreational fishing/angling staging locations at the Project study area

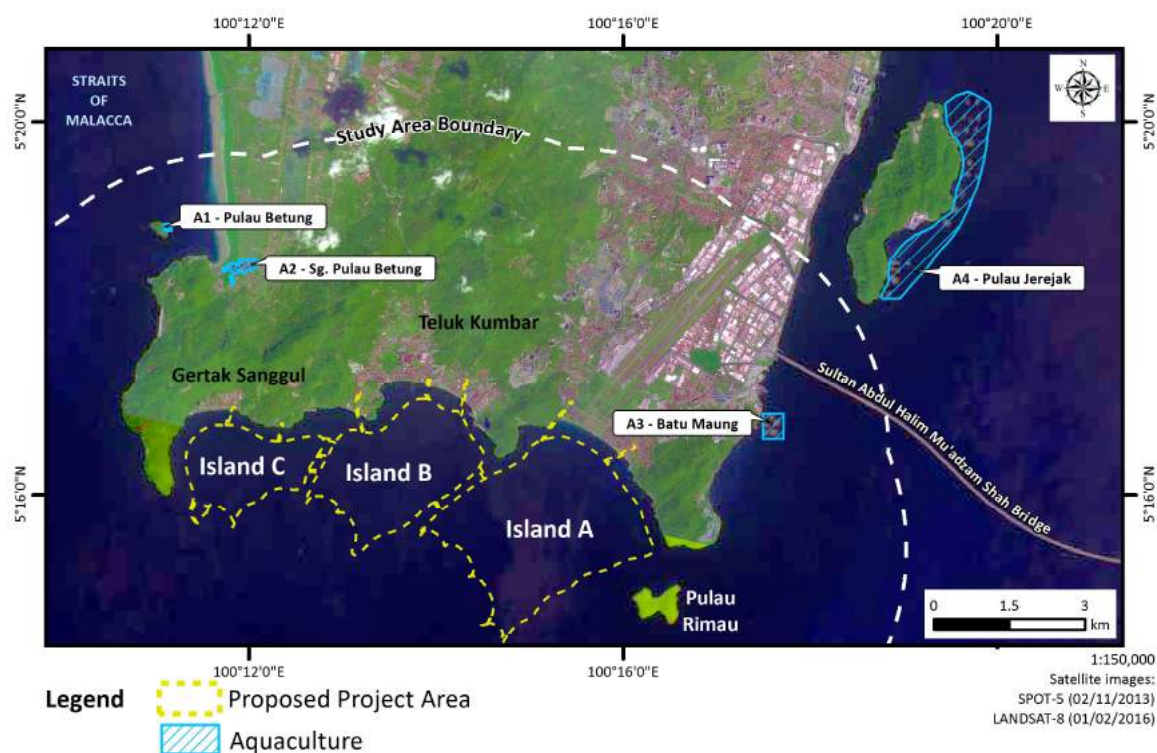
#### c) Aquacultures

Aquacultures near Teluk Tempoyak at the southeast of Penang Island, Pulau Betung and Sungai Pulau Betung at southwest of Penang Island are actively well managed, consisting of cage cultures and pond cultures respectively (F.22). RSNPP had gazetted certain areas at southern Penang Island as Aquaculture Zone for state development planning. These areas are Kampung Perlis Zone near Sungai Pulau Betung, Pulau Kendi Zone and Pulau Rimau Zone. Despite the gazetted areas mentioned, currently there are no aquaculture activities found in Pulau Rimau and Pulau Kendi.

#### d) Hatcheries

The types of hatcheries operating at the south of Penang Island are mostly shrimp and prawn fry. There is only one hatchery that produces oysters which is at Pulau Betung. A list of hatchery operators is tabulated in T.37. The hatcheries extract sea water using pipelines extending out about 5 to 100 m to the sea. The locations of all hatcheries are shown in F.23.

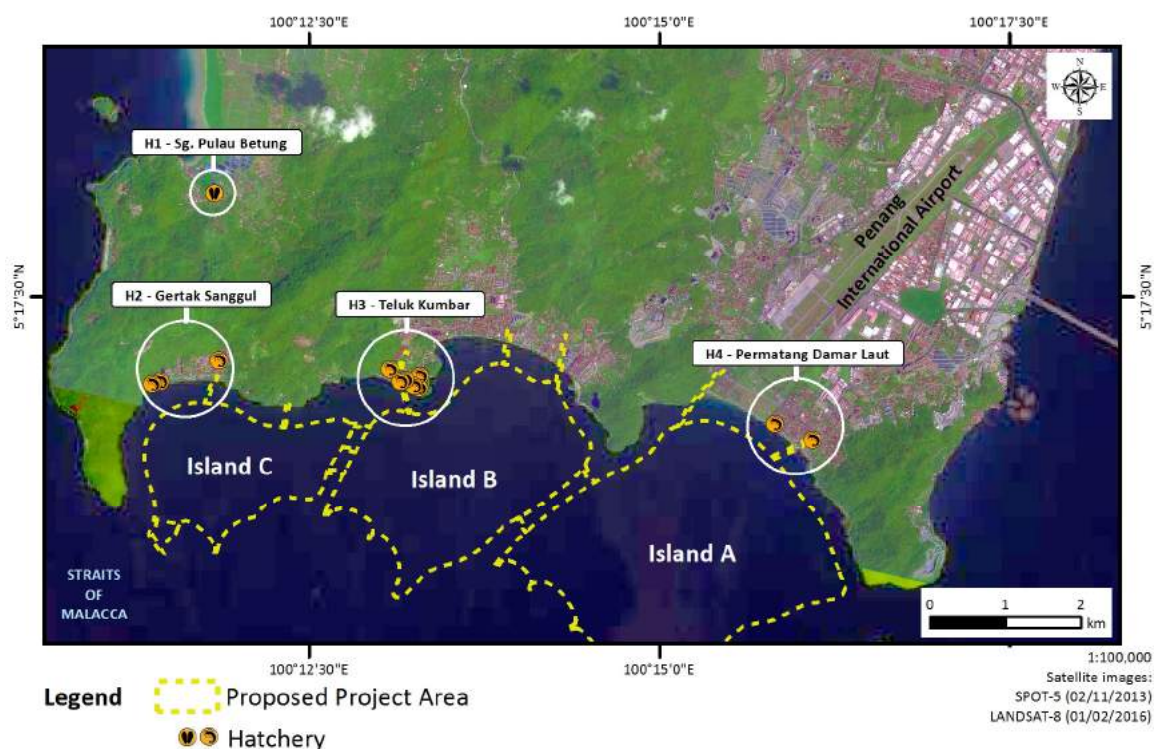




**F.22** Aquacultures within the Project study area

**T.37** List of hatchery operators and their locations within the Project study area

Name	Location	Coordinates	Type
Gertak Sanggol Hatchery Sdn. Bhd.	Teluk Kumbar	5° 16' 56.15" N 100° 13' 17.48" E	Shrimp fry
Gertak Sanggol Hatchery Sdn. Bhd.	Gertak Sanggul	5° 16' 59.02" N 100° 13' 4.57" E	Shrimp fry
Soonjaya Hatchery	Gertak Sanggul	5° 17' 2.94" N 100° 11' 51.28" E	Shrimp fry
BE Biomarine (M) Sdn. Bhd.	Teluk Kumbar	5° 16' 52.21" N 100° 13' 15.28" E	Shrimp fry
Ocean Sea Culture Hatchery	Teluk Kumbar	5° 16' 54.75" N 100° 13' 11.25" E	Shrimp fry
Exauhall (M) Sdn. Bhd.	Teluk Kumbar	5° 16' 53.67" N 100° 13' 10.00" E	Prawn fry
Yu Full Aquaculture Trading	Gertak Sanggul	5° 16' 52.60" N 100° 11' 22.82" E	Shrimp fry
Global Agro Life Sdn. Bhd.	Gertak Sanggul	5° 16' 53.74" N 100° 11' 26.21" E	Shrimp fry
Permatang Aquaculture	Permatang Damar Laut	5° 16' 28.91" N 100° 16' 5.63" E	Prawn fry
Ocean Star Aquaculture	Permatang Damar Laut	5° 16' 36.17" N 100° 15' 49.83" E	Shrimp fry
Sea Harvest Aqua Marine Sdn. Bhd.	Pulau Betung	5° 18' 14.79" N 100° 11' 49.50" E	Oyster

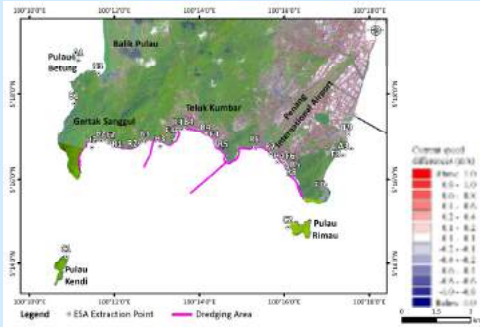
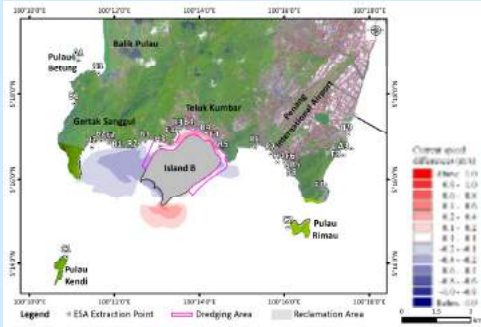
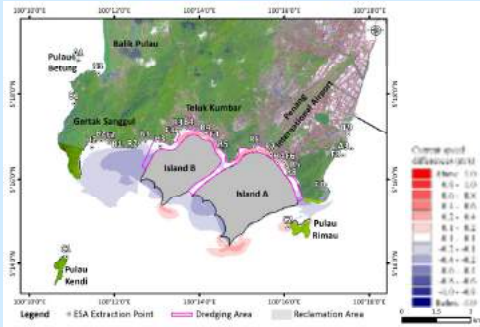
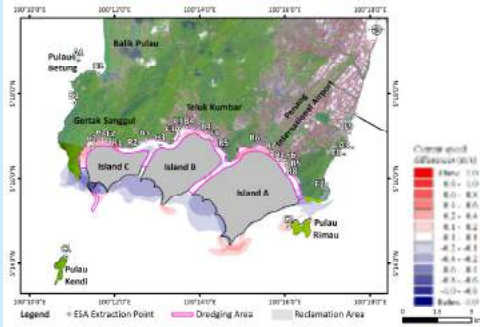
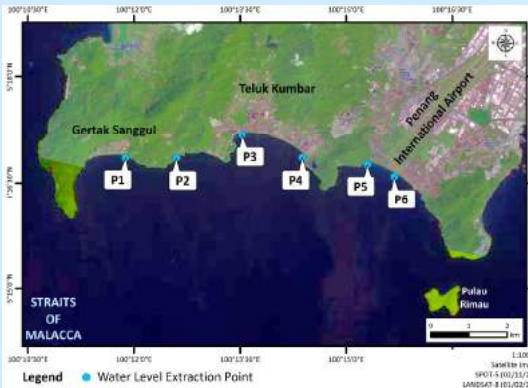


**F.23** Hatcheries within the Project study area

## 10.0 Evaluation of Impacts and Pollution Prevention and Mitigation Measures

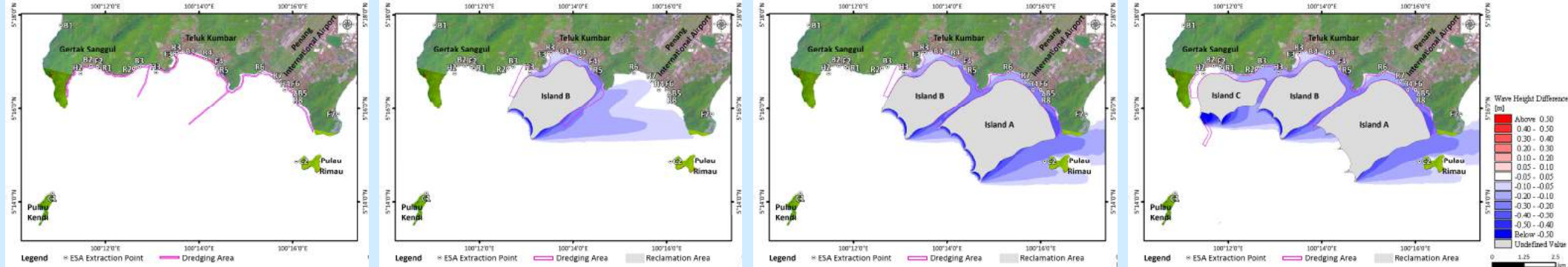
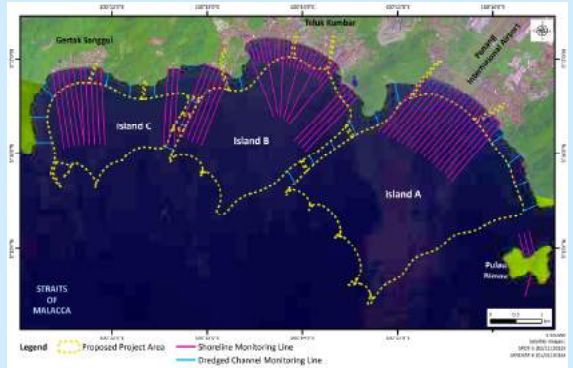
A summary of the impacts and mitigating measures due to the Project activities are shown in T.38.

T.38 Summary of impacts and mitigating measures

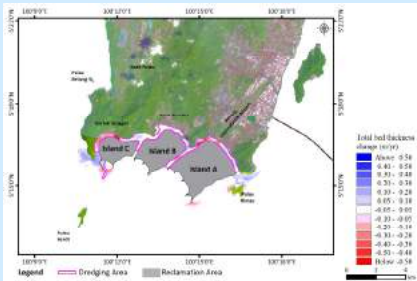
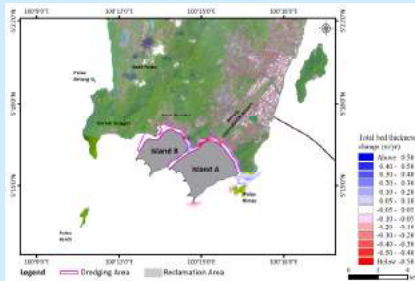
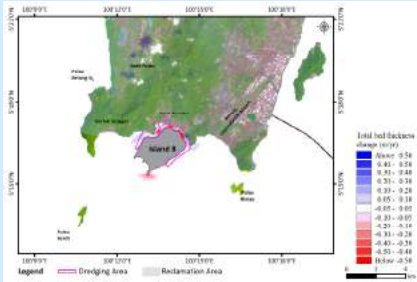
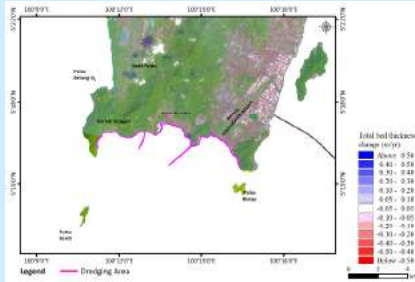
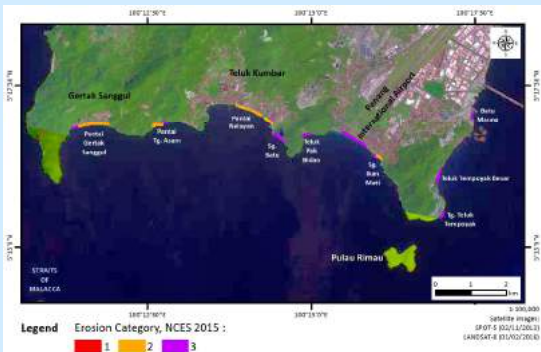
Significant Potential Impact	Magnitude of Significant Potential Impacts	Pollution Prevention and Mitigation Measures (P2M2)	Reference Page																		
1. Hydraulic a) Current	<p><b>Scenario 1</b></p> <p>There are insignificant and localised changes in the mean and maximum current speeds, as compared to the existing condition. The changes are mainly:</p> <p>a) Increased current speeds in the dredged channels; and</p> <p>b) Reduced current speeds along the foreshores where beach enhancement works are proposed.</p> <p>It is unlikely that these changes will affect the safe navigation of the fishing boats.</p> <p><b>Scenario 2</b></p> <p>a) Reduced current speed between Island B and Tanjung Gertak Sanggul, and to a lesser extent, between Island B and Tanjung Teluk Tempoyak by up to 0.15 m/s in the mean current speed and 0.4 m/s in the maximum current speed; and</p> <p>b) Increased mean and maximum currents speeds by up to 0.2 and 0.4 m/s respectively in the dredged channel between Island B and the foreshore of Teluk Kumbar.</p> <p><b>Scenario 3</b></p> <p>a) Increased mean and maximum current speeds in the dredged channel between the reclaimed islands A and B as well;</p> <p>b) Reduced mean and maximum current speeds to the north and south of Pulau Rimau by 0.10 and 0.2 m/s respectively;</p> <p>c) Increased mean and maximum current speeds to the west of Pulau Rimau by 0.15 and 0.4 m/s respectively; and</p> <p>d) Increased mean and maximum current speeds to the east of Pulau Rimau by 0.05 and 0.5 m/s respectively.</p> <p><b>Scenario 4</b></p> <p>a) Reduced current speed near Tanjung Gertak Sanggul by up to 0.15 and 0.6 m/s in the mean and maximum values respectively, due to the marina breakwater protrudes further into the current flow path; and</p> <p>b) Increased mean current and maximum current speeds in the dredged channel between the coastline of Gertak Sanggul and Island C are predicted to be up to 0.15 and 0.4 m/s respectively.</p> <p>Maximum current speed change vs. baseline (pure tide condition)</p> <div><div><p>Scenario 1</p></div><div><p>Scenario 2</p></div><div><p>Scenario 3</p></div><div><p>Scenario 4</p></div></div>	Changes in current speed may alter the existing rate of bed level change. P2M2 for this is covered under Sedimentation and Erosion section	7-15																		
b) Water Level	<p>a) 1 to 2% reductions in water levels at Sungai Gemuruh, Sungai Teluk Kumbar and Bayan Lepas Main Drain in both 1 in 1 year and 1 in 100 years peak discharge events; and</p> <p>b) 1% (0.01 m) increase in water levels at Sungai Gertak Sanggul, Sungai Batu and Sungai Bayan Lepas in both events.</p> <p>With such insignificant increase in water levels, it is unlikely that the upstream flood risks will be increased in Sungai Gertak Sanggul, Sungai Batu and Sungai Bayan Lepas with the implementation of the Project.</p> <div><table><thead><tr><th>Point</th><th>Location</th></tr></thead><tbody><tr><td>1</td><td>Sungai Gertak Sanggul</td></tr><tr><td>2</td><td>Sungai Teluk Kumbar</td></tr><tr><td>3</td><td>Drainage outlet at Teluk Kumbar</td></tr><tr><td>4</td><td>Sungai Batu</td></tr><tr><td>5</td><td>Sungai Bayan Lepas</td></tr><tr><td>6</td><td>Bayan Lepas Main Drain</td></tr><tr><td>7</td><td>Drainage outlet at Permatang Damar Laut</td></tr><tr><td>8</td><td>Sungai Ikan Mati</td></tr></tbody></table></div>	Point	Location	1	Sungai Gertak Sanggul	2	Sungai Teluk Kumbar	3	Drainage outlet at Teluk Kumbar	4	Sungai Batu	5	Sungai Bayan Lepas	6	Bayan Lepas Main Drain	7	Drainage outlet at Permatang Damar Laut	8	Sungai Ikan Mati	No P2M2 required.	7-67
Point	Location																				
1	Sungai Gertak Sanggul																				
2	Sungai Teluk Kumbar																				
3	Drainage outlet at Teluk Kumbar																				
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8	Sungai Ikan Mati																				



T.38 Summary of impacts and mitigating measures (cont'd)

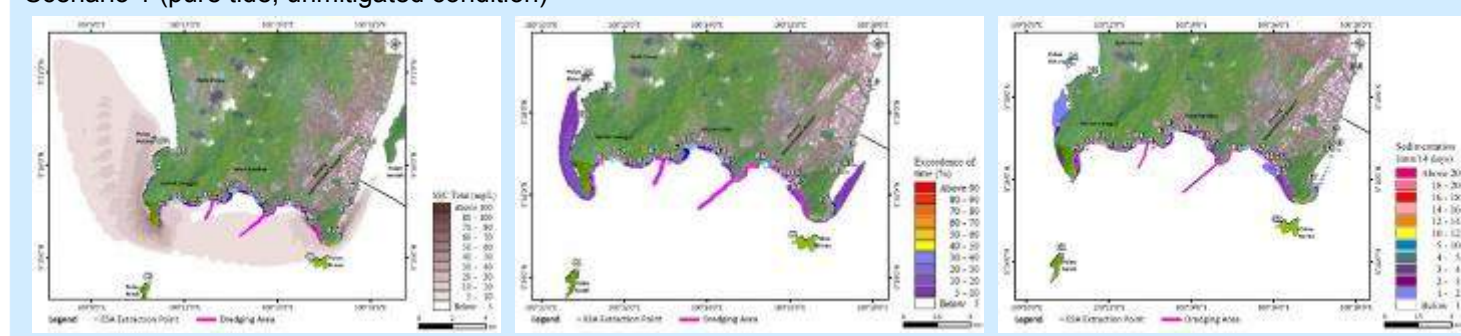

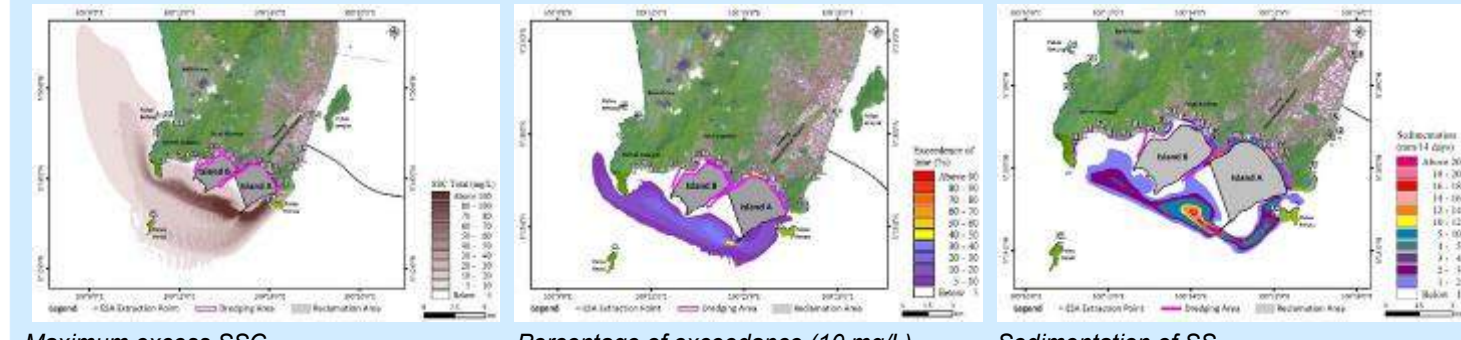
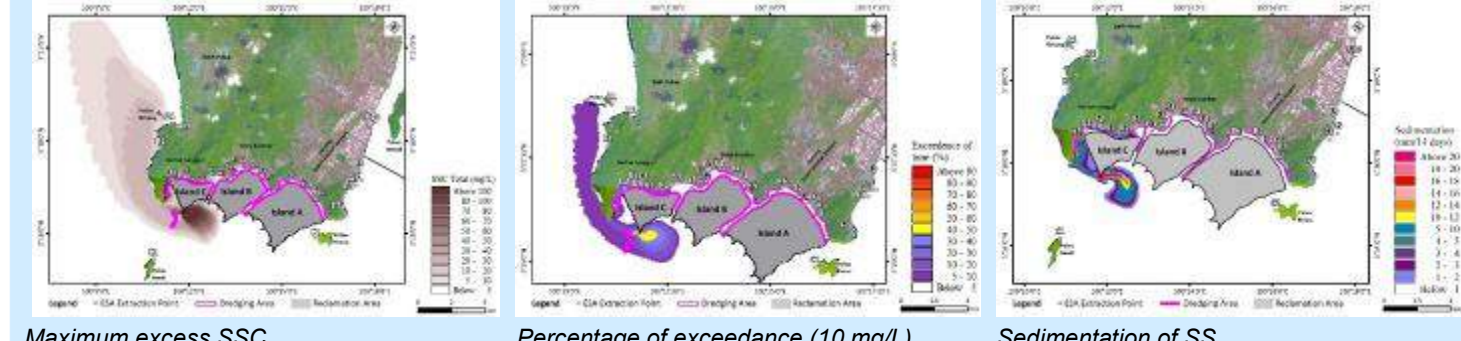
Significant Potential Impact	Magnitude of Significant Potential Impacts	Pollution Prevention and Mitigation Measures (P2M2)	Reference Page
1. Hydraulic c) Wave	<p><b>Scenario 1</b></p> <p>a) There are small reductions in wave height, up to 0.2 m, near the beach enhancement sites, due to the shallower foreshore; and</p> <p>b) Slight increase in wave height of up to 0.2 m is detected within the dredged channel.</p> <p><b>Scenario 2</b></p> <p>a) Localised reductions in wave height of up to about 0.4 m can be observed mainly in the dredged channels and the area offshore of the coastline of Permatang Damar Laut; and</p> <p>b) Reductions in waves coming from 210 and 240°N in the area offshore of the coastline of Permatang Damar Laut by up to 0.3 m. These changes may affect the littoral transport rates along the coastline of Permatang Damar Laut.</p> <p><b>Scenario 3</b></p> <p>a) Wave reduction of up to 0.3 m extends to Pulau Rimau.</p> <p><b>Scenario 4</b></p> <p>a) Reduction in wave height of up to 0.5 m observed within the dredged channels and the artificial beaches of the reclaimed island.</p> <p>Significant wave height difference, MWD = 270°N (1 in 1 year return period event)</p>  <p>Scenario 1      Scenario 2      Scenario 3      Scenario 4</p>	No P2M2 required.	7-69
d) Sedimentation and Erosion	<p><b>Scenario 1</b></p> <p>a) Sedimentation in the dredged channel is up to about 0.1 m/yr.</p> <p><b>Scenario 2</b></p> <p>a) Sedimentation with rate of up to about 0.2 m/yr was observed at some parts of the channel; and</p> <p>b) Erosion of up to about 0.5 m/yr in the dredged channel between Island B and the existing foreshore of Teluk Kumbar.</p> <p><b>Scenario 3</b></p> <p>a) The extent and rate of erosion in the channel between Island B and the existing foreshore of Teluk Kumbar observed in Scenario 2 are reduced to 0.2 m/yr;</p> <p>b) There are localised changes in the projected annual bed level change of up to 0.2 m/yr near Pulau Rimau; and</p> <p>c) Erosion rate of up to 0.5 m/yr is observed in the western half of the channel between Island A and the existing foreshore of Permatang Damar Laut. The eastern half of the channel is predicted to experience sedimentation up to 0.2 m/yr.</p>	<p><b>P2M2 for Bed Level Changes</b></p> <p>a) Monitoring Survey</p> <ul style="list-style-type: none"> <li>Periodic bathymetric and nearshore monitoring surveys will be conducted to assess beach and bed level changes during and after the implementation of the Project. Each survey campaign shall be carried out at three months' interval during the construction phase and half-yearly intervals during the post-construction phase. Reports shall be submitted to DID; and</li> <li>Information from periodic survey can also be used to determine the need and extent of maintenance dredging required after the development is completed.</li> </ul>  <p>Proposed monitoring survey extent and intervals</p>	7-89

T.38 Summary of impacts and mitigating measures (cont'd)

Significant Potential Impact	Magnitude of Significant Potential Impacts	Pollution Prevention and Mitigation Measures (P2M2)	Reference Page	
1. Hydraulic d) Sedimentation and Erosion (cont'd)	<p><b>Scenario 4</b></p> <p>a) The western half of the channel between Island C and the coastline of Kampung Gertak Sanggul is predicted to experience a reduction in projected annual bed level change up to 0.5 m/yr, whilst the eastern half of the channel is expected to experience sedimentation up to 0.2 m/yr.</p> <p>b) The projected annual bed level change near Island A and Pulau Rimau are similar to those of Scenario 3.</p> <p>It is to be noted that the erosion in the dredged channel does not affect the existing shoreline as the results show the 'erosion' happens mostly at the rock outcrops that constrict the flow, thus, increasing the flow speed.</p> <p>Projected annual bed level change</p> <div></div>	<p><b>P2M2 for Erosion</b></p> <p>a) Shoreline Enhancement</p> <ul style="list-style-type: none"><li>Several existing beaches are experiencing significant erosion. Beach enhancement works will be conducted for the existing shoreline.</li></ul> <p>b) Scour Protection</p> <ul style="list-style-type: none"><li>The design of the island edge protection and the artificial headlands of the reclaimed islands need to incorporate scour protection to mitigate erosion. In addition, coastal protection structure also may be provided at the existing shoreline depending on the need and suitability.</li></ul> <p>c) Beach Nourishment</p> <ul style="list-style-type: none"><li>In the event that coastal erosion is detected from the monitoring surveys as an impact of the Project, beach nourishment will be required. The beach nourishment work involves placing of sandy material on the beach slope.</li></ul> <p><b>P2M2 for Sedimentation</b></p> <p>a) Maintenance Dredging</p> <ul style="list-style-type: none"><li>Depending on the outcome of the monitoring surveys, periodic maintenance dredging at will be required to maintain safe navigation and effective flushing in the dredged channels. Dredging interval expected to be at three to five years interval.</li></ul>		7-89
e) Sediment Dispersion	<p><b>Scenario 1</b></p> <ul style="list-style-type: none"><li>Tolerable limits are not exceeded at coral reefs (Pulau Rimau and Pulau Kendi), aquaculture farms (Batu Maung and Pulau Betung) and water extraction point for hatcheries (Sungai Pulau Betung).</li></ul> <p><b>Scenario 2</b></p> <ul style="list-style-type: none"><li>Tolerable limits are not exceeded at coral reefs (Pulau Rimau and Pulau Kendi), aquaculture farms (Batu Maung and Pulau Betung) and water extraction point for hatcheries (Sungai Pulau Betung).</li></ul> <p><b>Scenario 3</b></p> <ul style="list-style-type: none"><li>Excess sediment concentration limits are expected to exceed at Pulau Rimau (coral reef). However, tolerable limits for other ESAs were not exceeded.</li></ul> <p><b>Scenario 4</b></p> <ul style="list-style-type: none"><li>No exceedance of tolerable limits of excess suspended sediment concentrations at the ESAs considered.</li></ul>	<p>a) Construction of Perimeter Bund</p> <ul style="list-style-type: none"><li>Perimeter bund can be constructed first prior to reclamation filling process whereby it will act as a physical barrier in blocking fine material from dispersing to the surrounding area. Two types of perimeter bund that will be used i.e. rock bund and temporary sand bund.</li></ul> <p>b) Silt Curtain</p> <ul style="list-style-type: none"><li>Silt curtain can be used to manage the dispersal of fine sediment. The use of silt curtain is very much dependent on the hydrodynamic conditions of the area i.e. current/wave/tidal actions. As such, silt curtains for this Project will be deployed in conjunction with the temporary sand bund focussing on active work area. This is done to ensure maximum efficiency in containing the sediment dispersion.</li></ul> <p>c) Controlled Dredging and Reclamation Operation</p> <ul style="list-style-type: none"><li>In areas where current speed is expected to exceed 0.5 m/s, it is almost impossible to maintain silt curtains in a working condition. An alternative is to reduce dredging or overflowing from the hopper barges if TSS level exceeds 50 mg/L.</li></ul> <p>d) Dredger Type</p> <ul style="list-style-type: none"><li>The use of grab or clamshell dredgers will vastly reduce overflowing.</li></ul>	7-104	



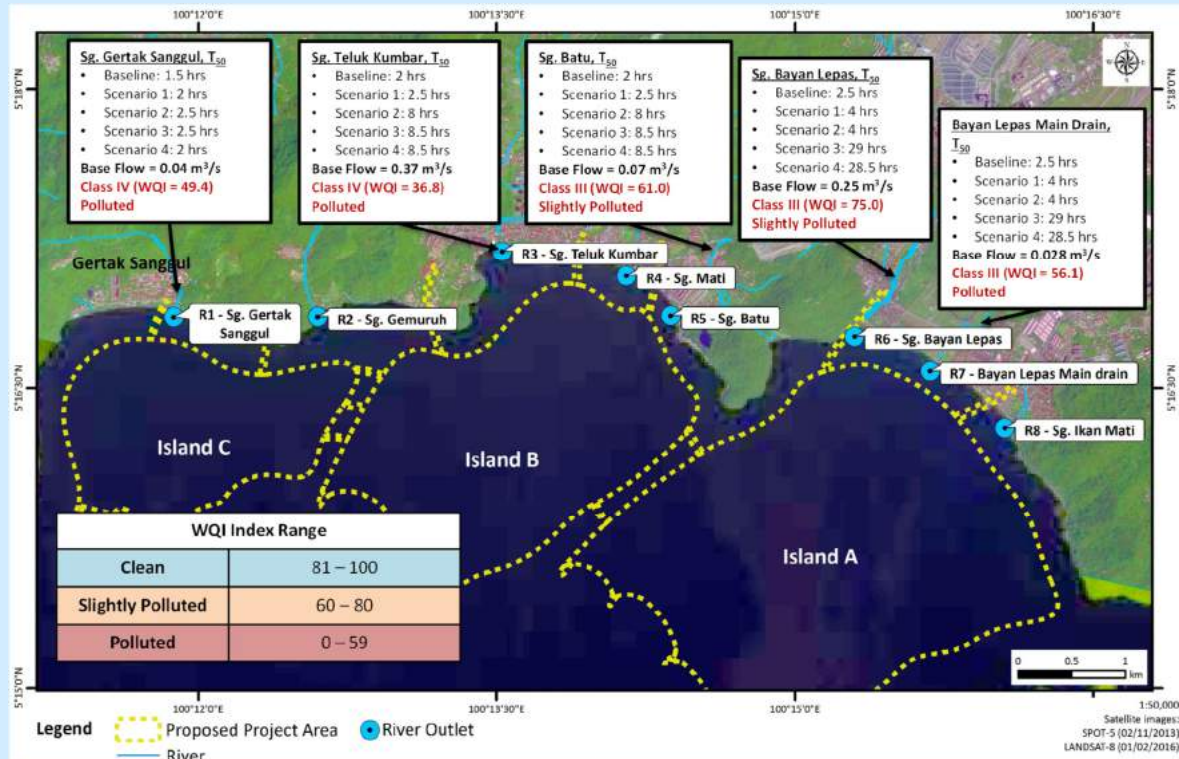
T.38 Summary of impacts and mitigating measures (cont'd)

Significant Potential Impact	Magnitude of Significant Potential Impacts	Pollution Prevention and Mitigation Measures (P2M2)	Reference Page
1. Hydraulic e) Sediment Dispersion (cont'd)	<p data-bbox="507 338 1020 369">Scenario 1 (pure tide, unmitigated condition)</p> <div data-bbox="507 369 1872 709">  <p data-bbox="507 682 753 709">Maximum excess SSC</p> <p data-bbox="982 682 1359 709">Percentage of exceedance (10 mg/L)</p> <p data-bbox="1427 682 1644 709">Sedimentation of SS</p> </div> <p data-bbox="507 737 1020 768">Scenario 2 (pure tide, unmitigated condition)</p> <div data-bbox="507 768 1872 1108">  <p data-bbox="507 1081 753 1108">Maximum excess SSC</p> <p data-bbox="982 1081 1359 1108">Percentage of exceedance (10 mg/L)</p> <p data-bbox="1427 1081 1644 1108">Sedimentation of SS</p> </div> <p data-bbox="507 1136 1020 1167">Scenario 3 (pure tide, unmitigated condition)</p> <div data-bbox="507 1167 1872 1507">  <p data-bbox="507 1484 753 1507">Maximum excess SSC</p> <p data-bbox="982 1484 1359 1507">Percentage of exceedance (10 mg/L)</p> <p data-bbox="1427 1484 1644 1507">Sedimentation of SS</p> </div> <p data-bbox="507 1535 1020 1566">Scenario 4 (pure tide, unmitigated condition)</p> <div data-bbox="507 1566 1872 1892">  <p data-bbox="507 1883 753 1892">Maximum excess SSC</p> <p data-bbox="982 1883 1359 1892">Percentage of exceedance (10 mg/L)</p> <p data-bbox="1427 1883 1644 1892">Sedimentation of SS</p> </div>	<p>a) Construction of Perimeter Bund</p> <ul style="list-style-type: none"> <li>Perimeter bund can be constructed first prior to reclamation filling process whereby it will act as a physical barrier in blocking fine material from dispersing to the surrounding area. Two types of perimeter bund that will be used i.e. rock bund and temporary sand bund.</li> </ul> <p>b) Silt Curtain</p> <ul style="list-style-type: none"> <li>Silt curtain can be used to manage the dispersal of fine sediment. The use of silt curtain is very much dependent on the hydrodynamic conditions of the area i.e. current/wave/tidal actions. As such, silt curtains for this Project will be deployed in conjunction with the temporary sand bund focussing on active work area. This is done to ensure maximum efficiency in containing the sediment dispersion.</li> </ul> <p>c) Controlled Dredging and Reclamation Operation</p> <ul style="list-style-type: none"> <li>In areas where current speed is expected to exceed 0.5 m/s, it is almost impossible to maintain silt curtains in a working condition. An alternative is to stop dredging or overflowing from the hopper barges during periods of fast current.</li> </ul> <p>d) Dredger Type</p> <ul style="list-style-type: none"> <li>The use of grab or clamshell dredgers will vastly reduce overflowing.</li> </ul>	7-104



T.38 Summary of impacts and mitigating measures (cont'd)

Significant Potential Impact	Magnitude of Significant Potential Impacts	Pollution Prevention and Mitigation Measures (P2M2)	Reference Page
2. Water Quality	<p><b>Land Reclamation and Dredging</b></p> <ol style="list-style-type: none"><li>Sediment plume from land reclamation and dredging activities.</li><li>Exposed topsoil from land clearing activities will cause surface erosion that will transport sediment to nearby waterbodies during pre-dredging stage.</li><li>Sewage and greywater generated from the toilets and/or kitchen of the workers' quarters may pollute the surrounding water</li><li>Solid and organic waste from the workers' quarters may produce leachate that can lead to surface and groundwater pollution.</li><li>Spillage and runoff contamination from the stockpile and storage area.</li><li>Spillage may occur from fuel, oil, grease and chemicals stored on board of vessels.</li><li>Pollution from improper discharge of ballast water and bilges.</li></ol> <p><b>Disposal of Dredged Material</b></p> <ol style="list-style-type: none"><li>The disposal of dredged material is not expected to generate significant plume. Remote location and water depth (over 40 m) of the disposal site will render the impact insignificant.</li><li>However, pollution can happen from barges carrying the dredged material e.g. leakage and overfilling causing spillage of dredged material.</li></ol> <p><b>Post-reclamation</b></p> <ol style="list-style-type: none"><li>The presence of new landmass will affect flushing capacity for waters surrounding Project site.</li><li>Main drains and rivers that discharge its water along Penang southern coastline carry substantial load of pollutants.</li><li>Potential of pollutants accumulation along the navigation channel if the water become stagnant. Build-up of nutrients may cause algae blooms and eutrophication.</li><li>Under worst case scenario, retention time (<math>T_{50}</math>) increases to 2.5, 8.5 and 29 hours at Gertak Sanggul, Teluk Kumbar and Permatang Damar Laut respectively.</li></ol>	<p><b>P2M2 for Reduced Flushing Capacity</b></p> <ol style="list-style-type: none"><li>Green River Programme<ul style="list-style-type: none"><li>This measure entails pollution load reduction of sources contributing to rivers in the vicinity which subsequently reaches the coastal zone. Overall, for BOD, a reduction of between 40 to 70% needs to be achieved, whereas for <math>\text{NH}_3\text{-N}</math> the figure was more in the realm of 30 to 81%.</li></ul></li><li>Widening of the Navigation Channel<ul style="list-style-type: none"><li>In the event that the Green River Programme is not feasible, it is recommended to increase the width of the navigation channels between the proposed reclaimed islands and the existing foreshore of Penang Island.</li></ul></li></ol> <p><b>P2M2 for Waste, Material and Pollutant Management</b></p> <ol style="list-style-type: none"><li>Management of biomass from land clearing<ul style="list-style-type: none"><li>Biomass generated from land clearing activity shall be disposed at an approved disposal site.</li></ul></li><li>Best Management Practice for storage<ul style="list-style-type: none"><li>Suitable container and storage area for storage of oil, fuel and other chemicals.</li><li>Container tray must be provided for fuel and oil storage, as well as machineries that hold a significant amount fuel and oil.</li></ul></li><li>Management of Scheduled Waste<ul style="list-style-type: none"><li>Ballast water, bilges, spent oil and other scheduled waste must be managed and disposed according to the Environmental Quality (Scheduled Waste) Regulation 2005</li></ul></li><li>Management of Wastewater<ul style="list-style-type: none"><li>Toilets conforming to the requirement of Ministry of Health and National Water Services Commission (SPAN) must be provided at workers' quarters.</li><li>Direct discharge of sewage and greywater must be strictly prohibited.</li><li>Grease trap should be used to manage oily discharges from the kitchen.</li><li>Facilities to store the wastewater such as septic tank and greywater tank must be provided on board of vessel.</li></ul></li><li>Management of Solid Waste<ul style="list-style-type: none"><li>Good system of solid waste management must be implemented at the workers' base and also on board of the vessels.</li><li>The collected solid waste must be disposed at a site permitted by the Local Authority.</li></ul></li><li>Vessels and Machineries Maintenance Schedule<ul style="list-style-type: none"><li>To anticipate and track maintenance work that will be conducted at site.</li></ul></li><li>Preparation of Emergency Response Plan (ERP)<ul style="list-style-type: none"><li>ERP which includes oil spill prevention and response must be formulated.</li><li>It is recommended that oil spill kit is kept at the Project site.</li></ul></li></ol>	7-134



**T.38** Summary of impacts and mitigating measures (cont'd)

Significant Potential Impact	Magnitude of Significant Potential Impacts	Pollution Prevention and Mitigation Measures (P2M2)	Reference Page
2. Water Quality (cont'd)		<b>P2M2 for Transportation and Disposal of Dredged Material</b> <ul style="list-style-type: none"> <li>a) Dredging and Disposal Monitoring System (DDMS) <ul style="list-style-type: none"> <li>■ All barges deployed for disposal of dredged material must be equipped with DDMS. DDMS will act as a tracking device that monitor the load of dredged material within the barge hopper and track the movement of the barge in real time. DDMS can emit instantaneous alert if the system detect illegal dumping or leakage occurrence.</li> </ul> </li> <li>b) Transportation procedure <ul style="list-style-type: none"> <li>■ Crews involve in transporting the dredged material to the disposal site must prevent “short dumping” from occurring. Overloading of barges must be prohibited to minimise the risk of spillage.</li> </ul> </li> <li>c) Subscription to weather information service <ul style="list-style-type: none"> <li>■ Before embarking on a trip to the dumping area, the crew should check the current weather situation <i>en route</i> with a reliable weather information service. Inclement weather may jeopardize the safety of the barge, which may necessitate short dumping.</li> </ul> </li> </ul>	7-134
3. ESA a) Coral Reefs	<b>Land Reclamation and Dredging</b> <ul style="list-style-type: none"> <li>a) Coral reefs at Pulau Rimau and Pulau Kendi are susceptible to increase in turbidity and siltation.</li> <li>b) Based on hydraulic simulations for excess suspended sediments and sedimentation rate, tolerable limit associated with “Slight Impact” category was not exceeded for all scenarios except during the construction of rock bund along the south-eastern edge of Island A (Scenario 3). The use of silt curtain in this area is impractical due to the maximum current speeds are higher than 0.5 m/s, induced by the rock bund itself.</li> </ul> <b>Post-reclamation</b> <ul style="list-style-type: none"> <li>a) Changes in coastal regime due to the presence of newly-reclaimed islands.</li> <li>b) Variation in current speed is expected to cause alteration in the existing sedimentation and erosion rate. After Island A is completed, the changes in eastern side of Pulau Rimau will experience erosion at a rate of 0.01 m/yr.</li> <li>c) Nutrient enrichment caused by deteriorating water quality following the reduction in flushing capacity may affect coral reefs at Pulau Rimau.</li> </ul>	<b>Offset Programme</b> <ul style="list-style-type: none"> <li>a) Grants or Financial Support for Research <ul style="list-style-type: none"> <li>■ The partial loss of coral reefs at Pulau Rimau shall be compensated by funding in research or conservation effort for coral reefs.</li> </ul> </li> <li>b) Deployment of Artificial Reefs <ul style="list-style-type: none"> <li>■ Artificial reefs will be installed at Pulau Rimau and Pulau Kendi. These artificial reefs will act as a habitat enrichment devices.</li> </ul> </li> </ul>	7-143
b) Turtle Nesting Site	<ul style="list-style-type: none"> <li>a) Current development along the beach in southern Penang Island makes turtle landing become a rare occurrence.</li> <li>b) Once the land reclamation and dredging commence, it will worsen the situation. Thus, the turtle landing site is considered as total lost.</li> </ul>	<b>Offset Programme</b> <ul style="list-style-type: none"> <li>a) Grants or Financial Support for Research</li> <li>b) Funds for turtle related research or conservation effort will be allocated by the Project Proponent as an offset to the loss of turtle landing site. Among organisations that can be selected for the support are: <ul style="list-style-type: none"> <li>i) Turtle Conservation and Education Centre at Pantai Kerachut (Penang National Park), Penang (managed by Department of Fisheries)</li> <li>ii) Turtle and Marine Ecosystem Center (TUMEC), Rantau Abang, Terengganu (managed by Department of Fisheries)</li> <li>iii) SEATRU, Universiti Malaysia Terengganu (UMT)</li> </ul> </li> </ul>	7-148
c) Mangrove	<b>Land Reclamation and Dredging</b> <ul style="list-style-type: none"> <li>a) No significant sedimentation and erosion is projected to occur at the mangroves area.</li> </ul> <b>Post-reclamation</b> <ul style="list-style-type: none"> <li>a) No change in sedimentation and erosion rate at the mangrove area, thus no impact is expected to occur.</li> </ul>	<b>Offset Programme</b> <ul style="list-style-type: none"> <li>a) Mangrove Replanting and Monitoring Programme</li> <li>b) Mangrove replanting programme can help in increasing the coverage area of mangroves in Penang. Because mangroves is known as important habitat for marine organisms as well as the nursery ground for fishes, this programme will assist in sustaining the fish stock in Penang waters.</li> </ul>	7-149

T.38 Summary of impacts and mitigating measures (cont'd)

Significant Potential Impact	Magnitude of Significant Potential Impacts	Pollution Prevention and Mitigation Measures (P2M2)	Reference Page
4. Fishing Industry a) Hatcheries	<p><b>Land Reclamation and Dredging</b></p> <p>a) Increase in suspended sediment level at water intake point will affect their filtration system.</p> <p><b>Post-reclamation</b></p> <p>a) Deterioration of water quality caused by the reduced flushing capacity may render the water unsuitable for hatchery operations. Extensive treatment may be required.</p>	<p><b>P2M2 for Water Quality</b></p> <p>a) Water treatment system upgrade</p> <ul style="list-style-type: none"> <li>Upgrade on the water treatment system will be provided to mitigate the loss of water quality values. Further discussion is needed with the hatchery operators to determine the specifics of the treatment system so that it an effective solution can be developed.</li> </ul> <p><b>P2M2 for Project Footprint</b></p> <p>a) Relocation of seawater intake pipe</p> <ul style="list-style-type: none"> <li>If the seawater intake pipes for the hatcheries are located within the Project footprint, a new suitable location must be identified for relocation of the pipe. The new location proposed must take into account the water quality at that area and must be paired with an appropriate treatment system.</li> </ul>	7-150
b) Cage Cultures	Negligible increase in suspended sediment level at aquaculture cages, thus the impact is deemed insignificant.	No specific P2M2 for this component.	7-153
c) Marine Capture Fisheries	<p><b>Loss of Fishing Ground</b></p> <p>a) Loss of fishing ground caused by the Project's footprint.</p> <p>b) Increase in intensity of fishing activities in unaffected, adjacent fishing ground.</p> <p>c) Fishermen will have to move out further to fish.</p> <p><b>Loss of Fish Nursery Ground</b></p> <p>a) Partial loss of mudflat covered by the reclamation footprint. Mudflat habitat is of great importance to large numbers of invertebrates and fish, supporting complex estuarine food webs and provide nursery and feeding grounds to large numbers fish species.</p> <p><b>Fish Landing Points</b></p> <p>a) Increase in current speed may cause manoeuvring problems for fishermen boat with small engine. However, most of the small-engine boats are located at Batu Maung, Gertak Sanggul and Pulau Betung, while current speed is expected to increase at Permatang Damar Laut and Sungai Batu.</p> <p>b) Sedimentation occurs at Gertak Sanggul and Sungai Batu (0.14 m/yr) which may cause water depth at landing points will become shallow.</p>	<p><b>Offset Programme</b></p> <p>a) Grants or Financial Support for Research</p> <ul style="list-style-type: none"> <li>The Project Proponent shall made contributions to the Fisheries Research Fund to be utilized by Department of Fisheries and/or LKIM and FRI for the advancement of fishing industry in south of Penang Island. This will include study on the migration route of greasyback shrimp.</li> </ul> <p>b) Deployment of Fish Aggregating Devices (FAD)</p> <ul style="list-style-type: none"> <li>The installation of FAD, known locally as <i>unjam</i>, would enable aggregation of fish stocks, which in turn will make fishing easier and may help in reducing the cost of fishing.</li> </ul> <p>c) Fish Stocking</p> <ul style="list-style-type: none"> <li>Fish stocking involves obtaining fish fry or fingerlings from hatcheries and releasing them into the sea. Fish stocking will be done at strategic locations, such as Balik Pulau Forest Reserve or the mangroves of Sungai Acheh. Fish stocking shall be carried out in consultation with LKIM and Dept. of Fisheries.</li> </ul> <p>d) Deployment of artificial reefs (e.g.: Pulau Kendi)</p> <ul style="list-style-type: none"> <li>Artificial reefs will be installed at strategic locations subject to further study post-EIA.</li> </ul> <p>e) Construction of eco-engineering structures on PSR</p> <ul style="list-style-type: none"> <li>Structures such as revetments and geo-tubes will be installed around PSR islands in efforts to create new habitats for the marine ecosystem</li> </ul>	7-154



**T.38** Summary of impacts and mitigating measures (cont'd)

Significant Potential Impact	Magnitude of Significant Potential Impacts	Pollution Prevention and Mitigation Measures (P2M2)	Reference Page
5. Marine Biology and Fisheries	<p><b>Land Reclamation and Dredging</b></p> <ul style="list-style-type: none"> <li>a) Dredging activities will cause disturbance and removal of benthic infauna and alteration of the substance upon which colonization depends. This will in turn affect its stability as a fish or shellfish food habitat.</li> <li>b) Increased suspended solids in the water column due to reclamation activities may inhibit light penetration thus limiting the primary productivity of the immediate aquatic environment.</li> <li>c) Migration of fishes and free-swimming or mobile aquatic fauna to safer or less disturbed areas as a natural response to changes in the marine environment.</li> <li>d) High level of suspended sediments will impact the plankton and macrobenthos productivity.</li> </ul> <p><b>Transportation and Disposal of Dredged Material</b></p> <ul style="list-style-type: none"> <li>a) Oil discharge or leakages from the vessels may pollute the pelagic and benthic ecosystems.</li> <li>b) Settlement of sediment from the disposed materials will smother the benthic communities at the sea bottom. However, this is a short-term impact.</li> </ul> <p><b>Post-reclamation</b></p> <ul style="list-style-type: none"> <li>a) The original physical, biological resources and productivity prevailing at the proposed Project area would largely be lost permanently, particularly the coastal mudflats and its associated flora and fauna.</li> <li>b) Losses of such magnitude are likely to be key drivers of declines in biodiversity and ecosystem services in the intertidal zone of the region.</li> </ul>	No P2M2 required.	7-158
6. Marine Traffic and Navigation	<p><b>Land Reclamation and Dredging</b></p> <ul style="list-style-type: none"> <li>a) The movement of the fishing vessels will be restricted during the land reclamation and dredging period.</li> <li>b) The daily commute of fishermen boats will become longer because of the restriction thus incurring additional fuel costs.</li> <li>c) Risk of collision between the work vessels and fishermen boats, especially during the process of casting their net.</li> <li>d) Structures constructed during land reclamation and dredging works present a safety risk for fishermen and other marine users, especially at night.</li> <li>e) Transportation of rocks from Seberang Perai will cross the South Channel. However, considering the low number of vessels using South Channel, the impact is deemed insignificant.</li> </ul> <p><b>Transportation and Disposal of Dredged Material</b></p> <ul style="list-style-type: none"> <li>a) The route to dumping area will go nearby Pulau Kendi, which is a popular ground for fishermen and recreational fishing activities. The constant movement of barge will present collision risk between the work vessels and fishermen/angler boats, especially at night.</li> </ul> <p><b>Post-reclamation</b></p> <ul style="list-style-type: none"> <li>a) No discernible impact to marine traffic and navigation is expected during this stage as vessels will be demobilize from the Project site.</li> <li>b) During topside development phase, a marina will be built on Island C. The presence of marina will bring about additional marine traffic into the Project area.</li> </ul>	<p><b>P2M2 during Project Implementation Stage</b></p> <ul style="list-style-type: none"> <li>a) Marine Traffic Control Centre <ul style="list-style-type: none"> <li>■ A marine traffic control centre shall be established at site to monitor, manage and records the movement of vessels deployed for the Project.</li> </ul> </li> <li>b) Working Area Boundary Mark <ul style="list-style-type: none"> <li>■ A minimum of four lighted buoys must be installed around the Project site to mark the working area boundary. Location of the lighted buoys must be approved by the Marine Department and the lighted buoys must be constructed as per Marine Department's specification.</li> </ul> </li> <li>c) Adherence to Penang Port Regulations <ul style="list-style-type: none"> <li>■ The movement of vessels coming in and going out of Port Limit Area must be reported to the Penang Port Authority. Pilotage may be required as stated in the prevailing law.</li> </ul> </li> <li>d) Ensuring Vessels Seaworthiness <ul style="list-style-type: none"> <li>■ Vessels deployed for the proposed Project must be in seaworthy condition. The vessels also must be manned by competent crews that aware on the operational regulations within the Penang Port Limit.</li> </ul> </li> <li>e) Dissemination of Information on the Latest Condition at Project Site <ul style="list-style-type: none"> <li>■ The Project Proponent must establish a close rapport with the local fishermen associations to ensure the correct and up-to-date information is transmitted to them.</li> </ul> </li> </ul> <p><b>P2M2 during Post-Reclamation (Operation Stage)</b></p> <p>In order to accurately assess the impacts from the additional traffic by the marina, it is advisable for a Marine Traffic Risk Assessment (MTRA) to be conducted.</p>	7-160



**T.38** Summary of impacts and mitigating measures (cont'd)

Significant Potential Impact	Magnitude of Significant Potential Impacts	Pollution Prevention and Mitigation Measures (P2M2)	Reference Page																																											
7. Land Traffic (cont'd)	<p>Junction performance are pinch points that are the controlling factor in determining effective traffic throughput and ultimately the capacity of the road network. The key performance indicator for junction is the controlled delay(s) which can be expressed as Level of Service (LoS).</p> <p>With Development scenario, which includes the Bayan Lepas LRT extension to PSR, PIL, PIL2A and JTDA, bring about a sharp reduction (100%) in the number of junctions operating at LoS F when compared with Without Development scenario. There are also increase in number of junctions performing at LoS A, B and C. Thus, in general, it can be deduced that there is an improvement in traffic condition as the proposed development also include a number of new external connection as well as upgrading of the existing roads at Jalan Teluk Kumbar, Jalan Permatang Damar Laut and Jalan Gertak Sanggul.</p> <p>Junction count according to the LoS</p> <table><tr><th rowspan="3">LoS</th><th colspan="4">Junction Count</th></tr><tr><th colspan="2">AM</th><th colspan="2">PM</th></tr><tr><th>Without Development</th><th>With Development</th><th>Without Development</th><th>With Development</th></tr><tr><td>A</td><td>17</td><td>22</td><td>15</td><td>20</td></tr><tr><td>B</td><td>6</td><td>6</td><td>5</td><td>7</td></tr><tr><td>C</td><td>9</td><td>11</td><td>8</td><td>8</td></tr><tr><td>D</td><td>4</td><td>8</td><td>4</td><td>10</td></tr><tr><td>E</td><td>1</td><td>5</td><td>3</td><td>7</td></tr><tr><td>F</td><td>15</td><td>0</td><td>17</td><td>0</td></tr></table>	LoS	Junction Count				AM		PM		Without Development	With Development	Without Development	With Development	A	17	22	15	20	B	6	6	5	7	C	9	11	8	8	D	4	8	4	10	E	1	5	3	7	F	15	0	17	0	<p><b>P2M2 for Land Traffic</b></p> <p>a) External Connectivity</p> <ul style="list-style-type: none"><li>■ The proposed Project will be connected to the regional road network with nine access and egress points that include Pan Island Link 2 and Jalan Tun Dr Awang Link.</li></ul> <p>b) External Public Transport Network</p> <ul style="list-style-type: none"><li>■ The implementation of Bayan Lepas LRT will serve the proposed Project area.</li></ul> <p>c) Internal Public Transport Network</p> <ul style="list-style-type: none"><li>■ Some section of the Bayan Lepas LRT will run within the proposed development.</li><li>■ Good internal public transport network will be provided on the reclaimed island, the options of electric bus and trams will be considered. In addition, feeder buses for the LRT system will also be provided to facilitate traveling from various locations on the islands to LRT stations.</li></ul> <p>d) Bicycle Lane Provisions</p> <ul style="list-style-type: none"><li>■ Segregated cycle lanes are proposed to be provided so that cyclists are not vulnerable to vehicular traffic.</li></ul> <p>e) Car Parking Management Schemes</p> <ul style="list-style-type: none"><li>■ A simple way to encourage the use of sustainable modes of transport is to limit car parking. The quantum of parking for high-rise residences and offices will be minimized where viable.</li></ul> <p>f) Water Taxis</p> <ul style="list-style-type: none"><li>■ Water taxis will be provided around the perimeter of newly-reclaimed islands and along the navigation channel.</li></ul>	7-163
LoS	Junction Count																																													
	AM		PM																																											
	Without Development	With Development	Without Development	With Development																																										
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D	4	8	4	10																																										
E	1	5	3	7																																										
F	15	0	17	0																																										
8. Noise	<p><b>Pre-dredging</b></p> <p>a) Noise impact is not significant during this phase because the nearest sensitive receptors are located 400 m away and buffered by hilly terrain and lush vegetation.</p> <p><b>Land Reclamation and Dredging</b></p> <p>a) Certain land reclamation activities, such as rock bund and rock revetment construction, will produce noticeable level of noise caused by the movement of excavator on the rock barge, transferring the rocks from barge to lorry and rock laying activities.</p> <p>b) Issue on noise pollution from rock bund construction is expected to be apparent if the activity is carried out at night.</p>	<p><b>P2M2 during Pre-dredging</b></p> <p>a) Physical hoarding</p> <ul style="list-style-type: none"><li>■ Physical hoarding will be built along the perimeter of the construction site.</li></ul> <p><b>P2M2 during Land Reclamation and Dredging</b></p> <p>a) Best Management Practice for noise control</p> <ul style="list-style-type: none"><li>■ Noise emitting machineries shall be placed behind physical barriers and fitted with effective exhaust silencer.</li></ul> <p>b) Restriction on working hours</p> <ul style="list-style-type: none"><li>■ Working hours for activities that may cause significant noise impact to sensitive receptors, such as piling and rock bund construction nearest to residential area, must be restricted from 7:00 am to 9:00 pm where practical.</li></ul>	7-173																																											
9. Air Quality	<p><b>Pre-dredging</b></p> <p>a) Exposed topsoil from land clearing activities for workers’ quarters may generate dust.</p> <p>b) Construction vehicles travelling along the access road may cause dust to scatter to the surrounding area, especially at the entry point.</p> <p><b>Land Reclamation and Dredging</b></p> <p>a) While vessels and machineries deployed will produce emission from their exhaust, the location where they operate (at sea, away from residential area) will significantly reduce the impact on air quality.</p>	<p><b>P2M2 during Pre-dredging</b></p> <p>a) Best Management Practice for Dust Control</p> <ul style="list-style-type: none"><li>■ The access road for the construction of workers quarters must be laid with crusher run so that dust generation will be minimal.</li><li>■ Tyre washing facility that consist of wash trough and water jet must be provided at the entry point of the access road.</li></ul>	7-175																																											

**T.38** Summary of impacts and mitigating measures (cont'd)

Significant Potential Impact	Magnitude of Significant Potential Impacts	Pollution Prevention and Mitigation Measures (P2M2)	Reference Page
10. Historical Structure	Pillboxes located at Permatang Tepi Laut and near Bayan Lepas Main Drain will be unaffected by the proposed development.	No specific P2M2 proposed for this component.	7-177
11. Tsunami	Tsunami impact on the existing shoreline will mainly reduce after the development is fully completed.	<ul style="list-style-type: none"> <li>a) Implementing early warning system based on networking with the relevant government agencies.</li> <li>b) Identifying early signals of impending tsunami.</li> <li>c) Identifying signs of rapid recedence of sea levels.</li> <li>d) Emergency readiness by taking heed of issuance of official tsunami warnings.</li> <li>e) Preparation and dissemination of tsunami maps of tsunami risk zones.</li> <li>f) Perform constant review of tsunami preparedness plans through public involvement via public hearings.</li> </ul>	7-177
12. Human Environment and Socio-economy	<p><b>Pre-dredging</b></p> <ul style="list-style-type: none"> <li>a) Physical conflict could easily develop as a result of the differences in culture and subculture, values, attitude and tolerance level among the different ethnics and races of the workers housed together at the workers quarters.</li> <li>b) Alleged increase in crimes and diseases unknown to the country or the reappearance of those which had long since been eradicated such as malaria and tuberculosis brought by the foreign workers.</li> </ul> <p><b>Land Reclamation and Dredging</b></p> <ul style="list-style-type: none"> <li>a) The requirement of several hundred workers will boost the local labour market or employment opportunities.</li> <li>b) Loss of fishing ground, employment and income for the local fishermen.</li> <li>c) The deployment of workers will push up the current population size of the study area. Increased population size would bring about increased demand in basic goods and services which can be capitalized by local entrepreneur.</li> <li>d) Tranquillity of the southern Penang Island will be affected by the land reclamation and dredging activities.</li> <li>e) Local fishermen will be affected psychologically out of fear that the reclamation will eliminate the fishing ground as well as the additional cost for fishing as they need to go out further.</li> </ul> <p><b>Post-reclamation</b></p> <ul style="list-style-type: none"> <li>a) Topside development of the newly-reclaimed islands will generated direct employment opportunities.</li> <li>b) Direct employment will contribute to additional local income from the salary paid and the amount spent locally.</li> <li>c) Capital investment spent in purchasing local goods and service will contribute to the local economy.</li> <li>d) Assessment rates, quit rent, fees, royalties as well as utilities charge will contribute to the revenue of local authorities and service provider.</li> <li>e) In-migration of workforce will change the demography and socio-cultural mix as well as increasing demand for housing and other services.</li> <li>f) The natural panorama of the sea view fronting the traditional fishing settlements of South Pulau Pinang will change forever.</li> </ul>	<ul style="list-style-type: none"> <li>a) The condition of the base or workers' camps would have to fit into a certain decent living standard that provide well-ventilated space, basic amenities, proper sanitation and non-crowding.</li> <li>b) Racial clashes and other social problems could be avoided if workers' interest is looked after, cordial relationship maintained and cultural understanding and tolerance inculcated.</li> <li>c) Workers of similar religious background should be housed together to avoid open disrespect of the religious and social affinities of others.</li> <li>d) The Project should strive to have some local recruitment ratio for it to be relevant in the development of the area. Targets for the proportion of local recruitment may be set.</li> <li>e) Proper health screening for foreign workers.</li> <li>f) <i>Ex-gratia</i>/Compensation for the affected fishermen.</li> <li>g) Best Management Practice for matters that can cause public nuisance such as noise and dust.</li> <li>h) Local fear and worry could be managed or overcome with greater rapport between the Project Proponent and the affected fishermen especially in discussing the issue and striving for a two-way agreement or a win-win situation.</li> <li>i) If population increase is expected (especially with the kind of development being offered), the most basic mitigation would be to anticipate the characteristics of the in-migrants so as to be proactive in formulating plans in meeting the needs of the different age and gender of the new communities.</li> <li>j) Problems of integration and clash of lifestyles may lead to failure and disappointment. These could be avoided if the residential areas created would not be exclusively enclaved, with equal opportunities being opened for all to participate in the everyday doings and regular happenings in the local area or impact zone.</li> </ul>	7-186

## **11.0 Environmental Management Plan**

The Environmental Management Plan (EMP) is prepared as a mean to manage various environmental impacts that may arise during the construction and operational phases of the development, as well as to facilitate the personnel associated with the Project. The EMP is a concrete plan of action which is explicit, illustrative, action-oriented, time-bound and definitive.

The objectives of the EMP includes identifying the key environmental issues related to the project and proposing effective mitigating measures considering the Proponent's environmental management programme. The EMP not only ensures the effective implementation of the environmental protection and/or conservation measures, but also will address the key issues and concerns raised by the EIA stakeholders during the lifetime of the project. During the implementation of the EMP, the compliance of the EMP to all the relevant environmental requirements will be adhered to.

### **11.1 Guided Self Regulation Through Environmental Mainstreaming Tools**

A self-guided regulation (GSR) will be adopted by the Project Proponent for mainstreaming of environmental agenda. The mainstreaming tools employed will enhance self-regulation and will be translated into regulatory requirements on effective implementation of the EMP.

During the implementation of GSR the Project Proponent shall comply with all statutory requirements while the environmental consultant shall verify the implementation of the project in accordance with EIA conditions of approval (COAs). Several mainstreaming tools will be utilised by the Project Proponent throughout the project implementation, which include the following:

#### **11.1.1 Competent Person**

The environmental consultant and environmental auditors who have been certified by the Director General of DOE as a competent person are the responsible individuals to supervise the environmental components (potentially impacted) during reclamation and dredging operation.

#### **11.1.2 Environmental Policy**

The Penang State Government as the Project Proponent and their Project Delivery Partner (PDP), shall commit to be the industry leader in Quality, Safety, Health and Environmental (QSHE) by providing timely delivery of quality products/services, safe and healthy working condition and environmentally sustainable and responsible approach to their business.

### 11.1.3 Environmental Management Committee

Environmental Management Committee (EMC) shall be established by the State Government through the PDP to ensure all the proposed P2M2s are implemented accordingly. The EMC would provide independent and external advice, information, and recommendations to the Project Proponent on environmental issues relating to the proposed Project while being responsible for identifying applicable best management practices and provide counsel on how to integrate them into Environmental Compliance Programme. The two types of EMC include Environmental Regulatory Compliance Monitoring Committee (ERCMC) and Environmental Performance Monitoring Committee (EPMC). The committee will be comprised of representative from the State Government, PDP, Work Package Contractor (WPC), environmental consultant, environmental officer (EO) and other relevant technical individuals to the proposed Project. The Project Proponent must have an office for Environmental Management on site.

The roles and responsibilities of these individuals as a whole should uphold the adequate implementation of the EMP.

- a) *Penang State Government* - The Penang State Government is the ultimate owner of the Project and the highest decision making party in the Project. A steering committee headed by State Executive Councillor has been formed as the highest decision making body for the Project. The steering committee will delegate some of its authority to a Special Purpose Vehicle (SPV) to oversee the day to day operation of the Project.
- b) *Project Delivery Partner* - The Project Delivery Partner (PDP) is employed by the State Government to manage day to day operation of the Project. PDP is tasked with implementation of all the measures in the Environmental Management Plan (EMP) and supervision to ensure the Work Package Contractor (WPC) adhered to the Conditions of Approval (COA) and all Environmental Regulations. PDP will be assisted by Environmental Consultant (EC) and Environment Officer (EO) to carry out its duty.
- c) *Environmental Officer* - The EO is responsible for matters directly relevant to the environmental components of the Project, and on matters concerning the implementation of the EMP throughout each phase of the project. The EO shall investigate and report any environmental issues that occur on site during the implementation of the project and recommend corrective measures to prevent the issues from recurring.

### 11.1.4 Mini Laboratory

The contractor shall provide and maintain a mini laboratory or provide necessary equipment on site to facilitate necessary inspection of water, sediment and other necessary aspects of the environment. The mini laboratory must be equipped with proper testing apparatus and must be able to carry out simple analyses necessary for the proposed Project.

#### **11.1.5 Performance Monitoring, Compliance Monitoring and Impact Monitoring**

- a) *Performance Monitoring* - Performance monitoring (PM) is to prevent system function failures and to ensure that it is working properly and optimally. For this project, the PM is required for the efficiency of perimeter rock bund structures and the silt curtains and vessels operations.
- b) *Compliance Monitoring* - The compliance monitoring (CM) programme for this Project will include water quality, sediment quality, air quality and noise monitoring and monitoring of the disposal of dredged material.
- c) *Impact Monitoring* - The impact monitoring (IM) will cover offset monitoring, bathymetry survey and public complaint monitoring.

#### **11.1.6 Environmental Auditing**

An environmental audit of the PSR Project will be proposed during the construction phase. This is to assess the overall environmental compliance, the compliance with the environmental mainstreaming requirements and the fulfilment of the Environmental Pledge by the Project Proponent.

#### **11.1.7 Record Keeping**

Information related to the results of the monitoring activities, compliance with the approval conditions, and the efficiency of the proposed mitigation measures will also be recorded on a regular basis.

#### **11.1.8 Data Analysis and Interpretation**

The samples obtained during the monitoring activities will be analysed using accredited laboratories and by the subject experts affiliated with the proposed Project.

#### **11.1.9 Reporting and Communication**

Monthly and quarterly reporting of findings, issues identified and corrective measures implemented should be reported to DOE. The findings from on-site monitoring conducted must be reported to the EO before the monthly reports are submitted.



#### **11.1.10 Future Improvement and Budget**

Funding and budget allocation shall be provided by the Project Proponent which could further improve the effectiveness of proposed mitigation measures, the regulatory compliances and corporate environmental image of the organisation. Future improvement works will be identified through EMC if the proposed mitigation measures are found to be inadequate or inappropriate.

### **11.2 Emergency Response Plan**

On-site emergency plans will be prepared to protect human lives, public health, environmental resources, socio-economic and cultural resources and public and private properties in any case of an accident or natural disaster affecting or relating to the Project. This plan covers several events that may occur by equipment failure, human mistakes or natural causes at or nearby the Project site.

### **12.0 Study Findings**

From the overall assessment, it can be concluded that the proposed development is expected to cause various degree of impacts on the environment, social as well as the surrounding land use. The State Government is advised to commit in implementing all mitigating measures proposed so that this development will be beneficial to the local communities and the Penang State.