04 PROJECT OPTIONS

4.1 Introduction

Several Project options are made to give a clear basis for choice among the options for the decision-maker and the relevant parties involved. These will briefly be described in this chapter. The Project options are as follows:

a) Layout options; and
b) No-build option.

4.2 Layout Options

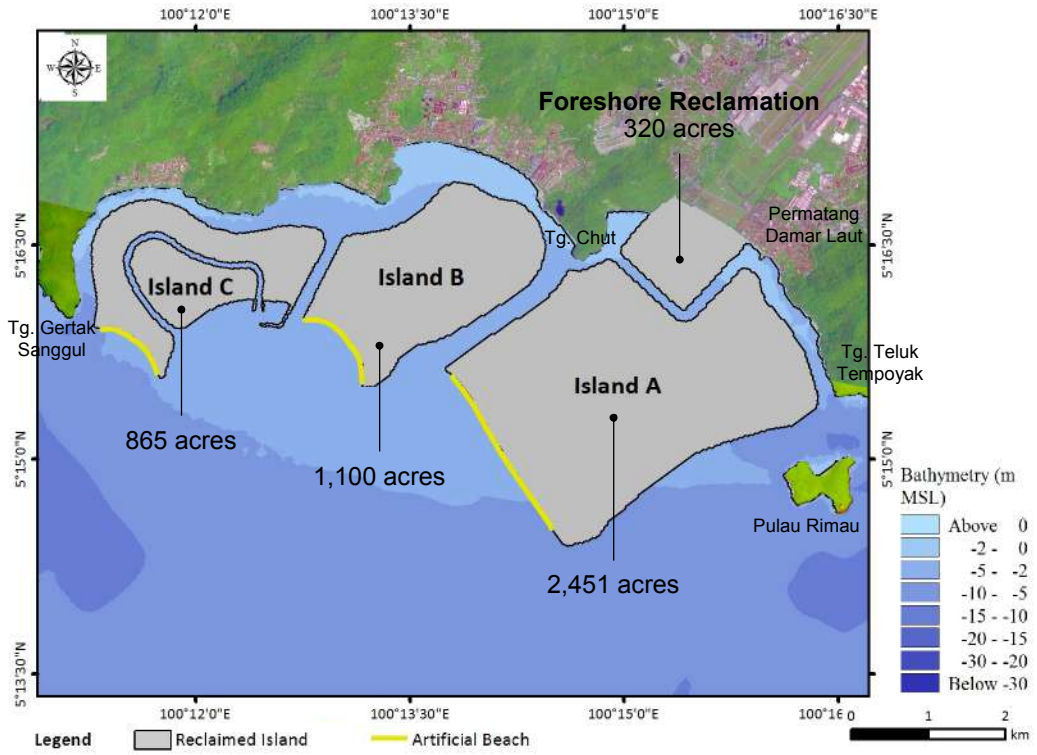
The layout options involve the optimisation of the reclaimed island's shape, taking into account the minimisation of potential impacts to the environment. It is to be noted that the initial configurations of Islands A, B and C were fixed according to the orientation of the existing bays of the south coast, which reduces resistance to the hydrodynamic forces. Island C has a marina breakwater located at its east coast and a channel. This layout selection process will mostly focus on the sizing of Island A because of poor flushing in the channel to its west. Issues such as the fishermen's accessibility to and from the sea and possible airport extension in future were also considered.

Hydraulic modelling was conducted on four options as follows:

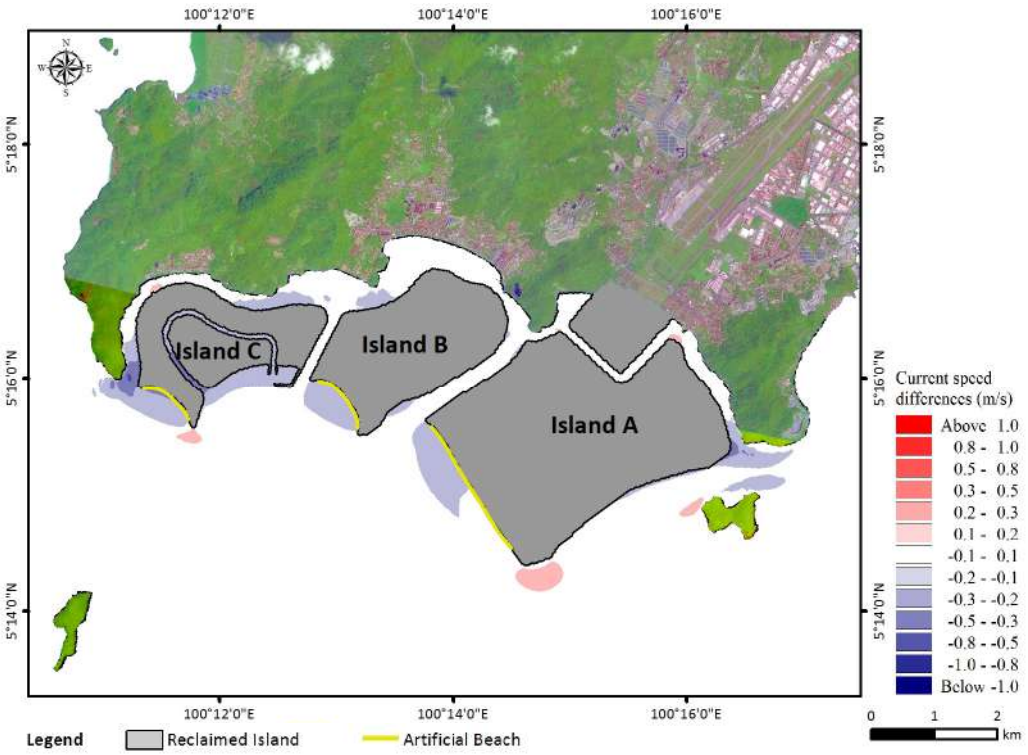
a) Reclaimed islands with foreshore reclamation for airport extension;
b) Streamlined edges of Island A with foreshore reclamation for airport extension;
c) Reduction of size of Island A with no foreshore reclamation; and
d) Increased number of embayed beaches at the south coastlines of all islands.

4.2.1 Option 1: Reclaimed Islands with Foreshore Reclamation for Airport Extension

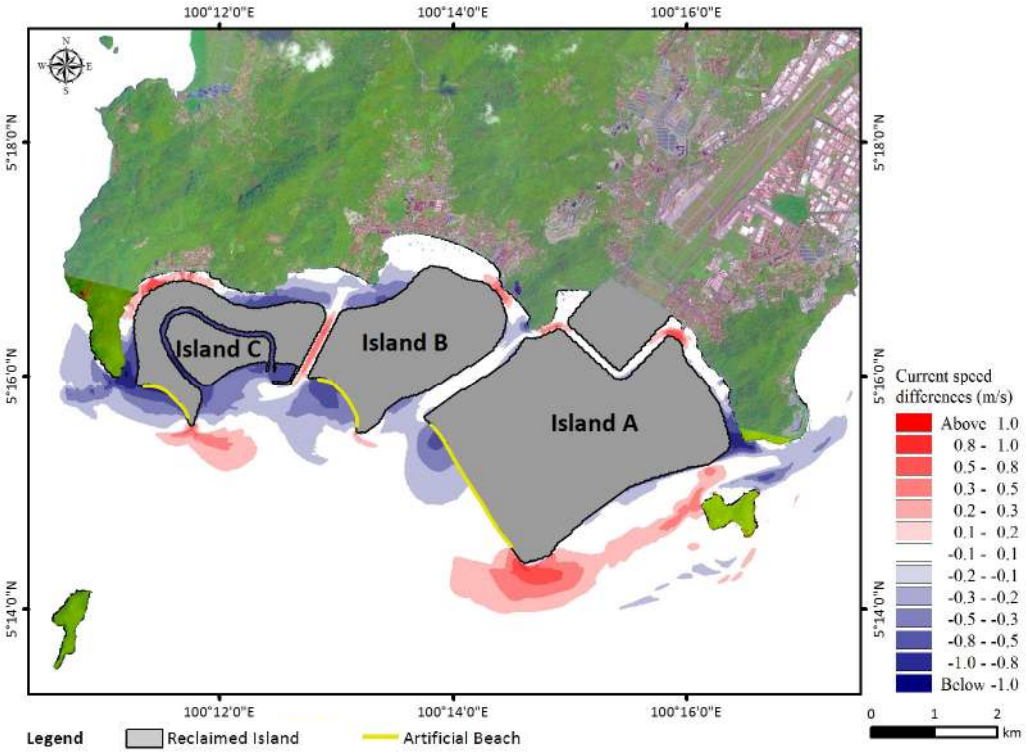
Option 1 (F4.1) allows a minimum of 200 m width of access channel for fishermen at the eastern part of Island A and Penang Island. The sizes of Islands A, B and C are 2,451, 1,100 and 865 acres respectively. This option provides a foreshore reclamation area of 320 acres for airport extension. It allows a minimum of 120 m width of access channel between the airport extension area and Island A. The current changes (F4.2) around the reclaimed islands show that there are areas of low currents in the 200 m wide channel, specifically at the sharp bend around the airport extension. The southeastern corner of Island A seems to have caused changes in current speeds near Pulau Rimau. 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.



F4.1 Option 1: Reclaimed islands with foreshore reclamation for airport extension



a) Changes in mean current speed

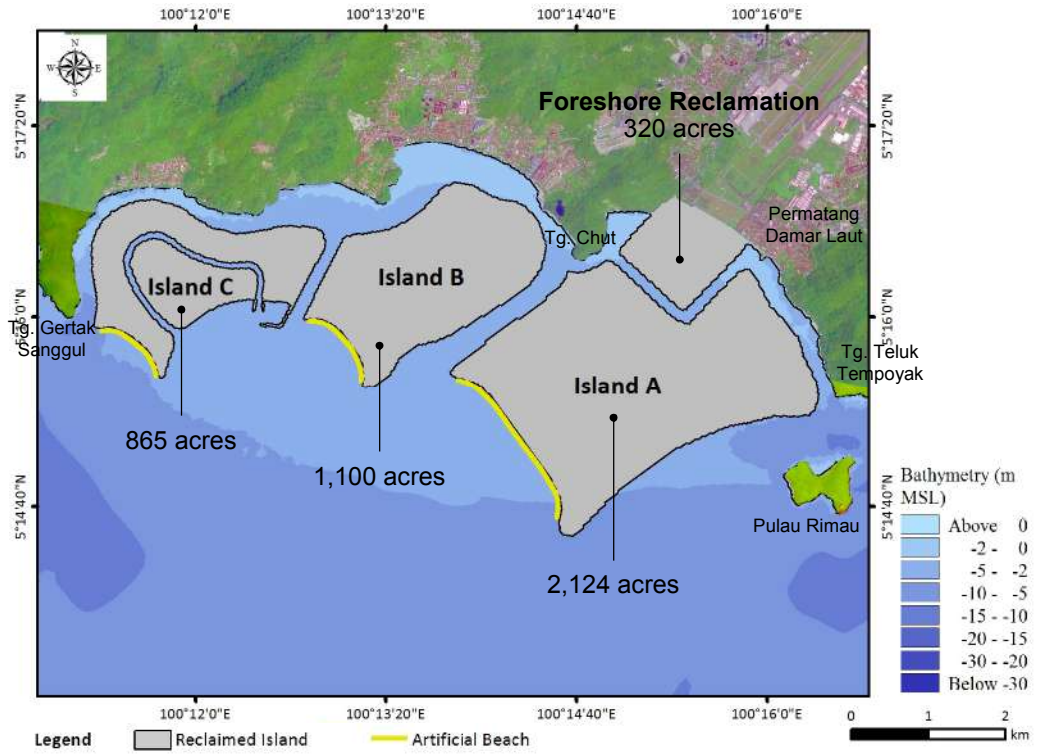


b) Changes in maximum current speed

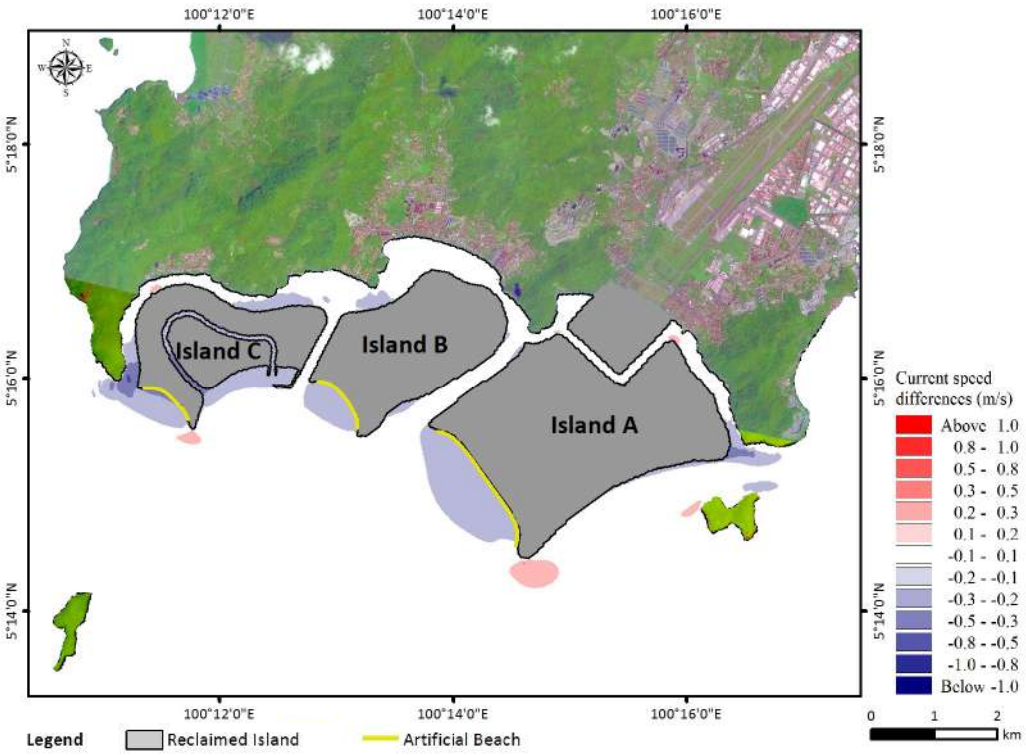
F4.2 Changes of current speed for Option 1

4.2.2 Option 2: Streamlined Edges of Island A with Foreshore Reclamation for Airport Extension

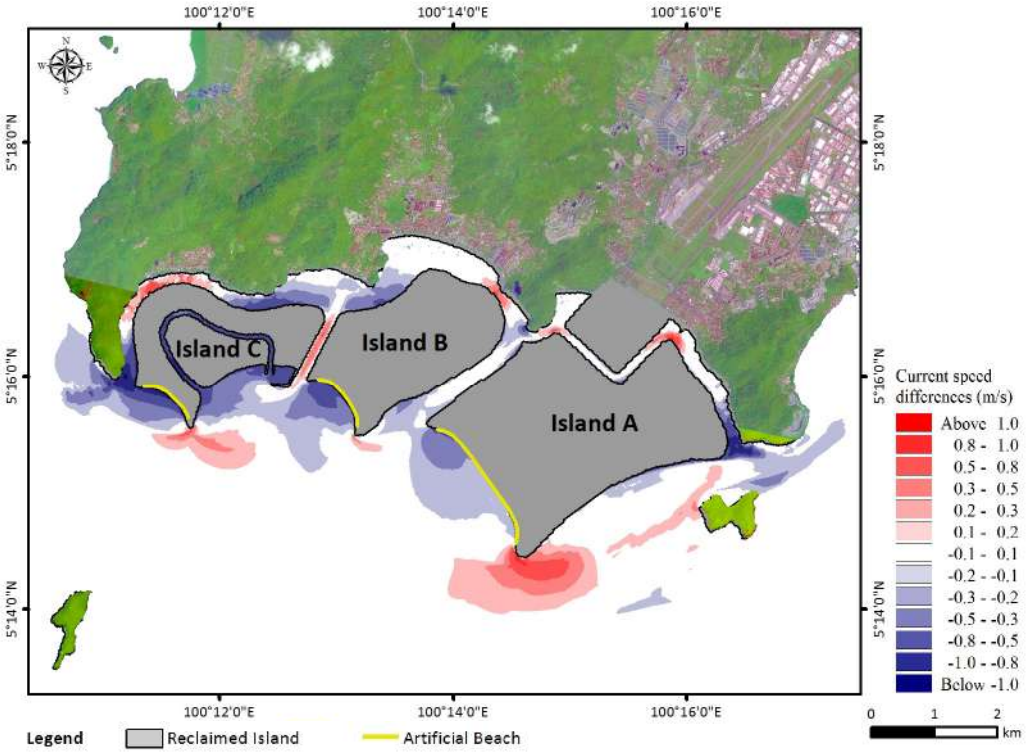
Option 2 proposed to streamline the edges at the southern and eastern coastlines of Island A to make the shape less resistant to hydrodynamics (F4.3). The area of Island A is reduced from 2,451 acres to 2,124 acres. This layout shows reduction of the changes in current speeds (F4.4) near Pulau Rimau, making it less vulnerable to erosion. Nevertheless, high rate of erosion is expected to occur at the southeastern tip of Island A. In the access channel, increased current speed is observed in the channel around the airport extension. Better flushing within the channel may help. However, at Tanjung Teluk Tempoyak, the current speed decreases, making the area susceptible to sedimentation. Therefore, this option is not opted for.



F4.3 Option 2: Streamlined edges of Island A with foreshore reclamation for airport extension



a) Changes in mean current speed

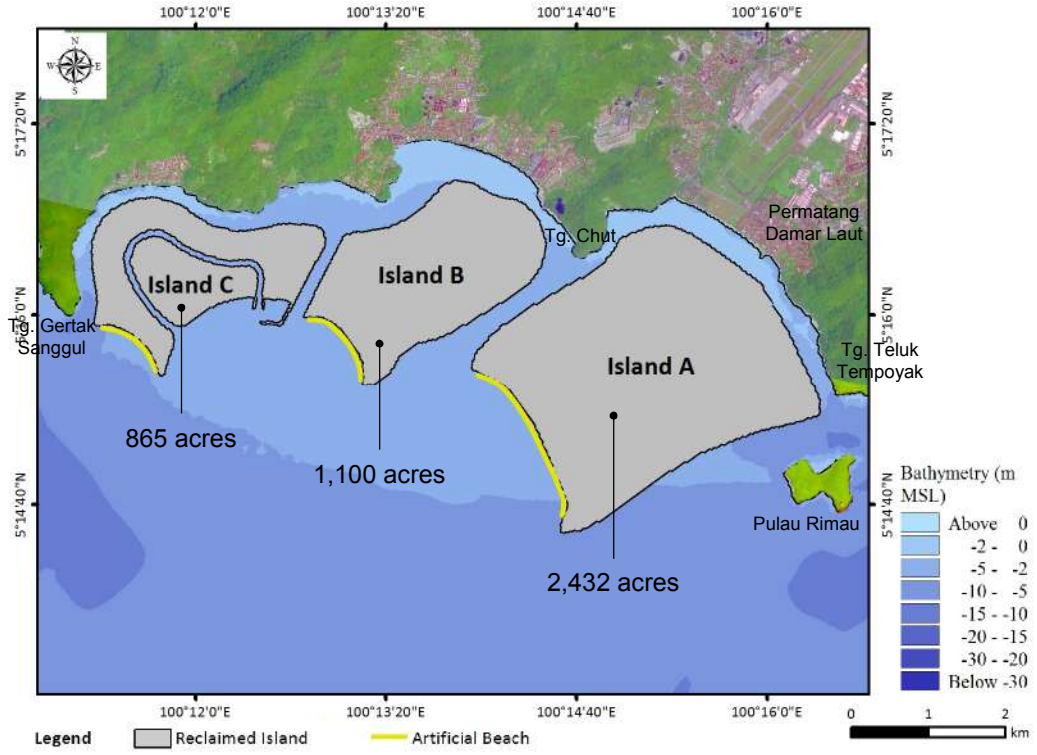


b) Changes in maximum current speed

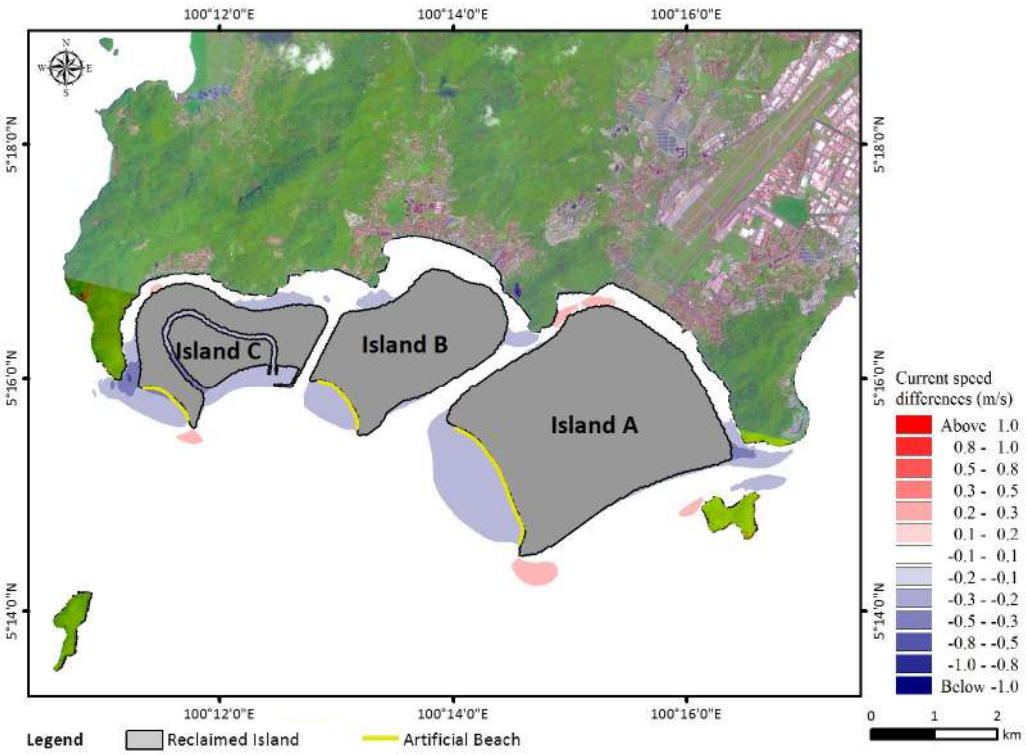
F4.4 Changes of current speed for Option 2

4.2.3 Option 3: Reduction of Size of Island A with No Foreshore Reclamation

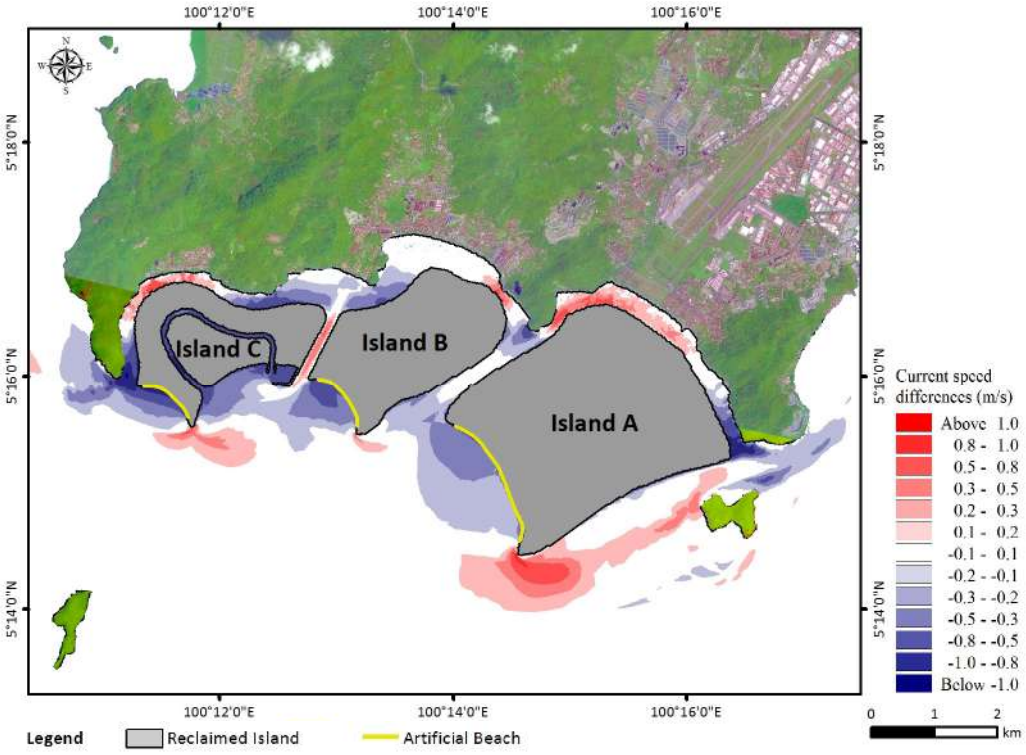
In Option 3, the area of Island A has been changed to 2,432 acres (F4.5). The shape of Island A is now streamlined with the bay between Tanjung Teluk Tempoyak and Tanjung Chut. This option still allows a minimum of 200 m width of access channel for the fishermen, with no requirement for foreshore reclamation for airport extension. The sharp edge at the tip of Island A is minimised to reduce the water current speed which consequently decreases the possibility of erosion of the island. Decrease of current speed (F4.6) in the access channel particularly at Tanjung Teluk Tempoyak and Tanjung Gertak Sanggul is observed, making it more prone to be silted up. Despite that, the current speed increases in the access channel between the reclaimed islands and Penang Island, ensuring easy access to the fishermen. The marina breakwater at Island C is, however, too far to be accessed from deep waters. More improvements need to be made, making this option not viable.



F4.5 Option 3: Island A with no foreshore reclamation



a) Changes in mean current speed



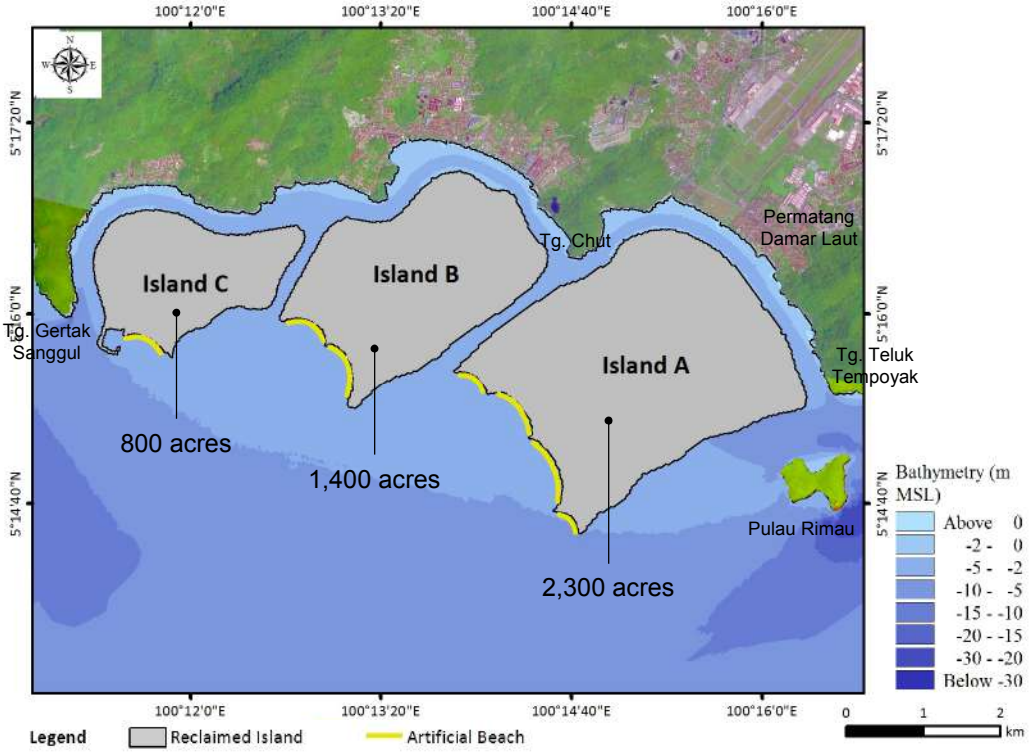
b) Changes in maximum current speed

F4.6 Changes of current speed for Option 3

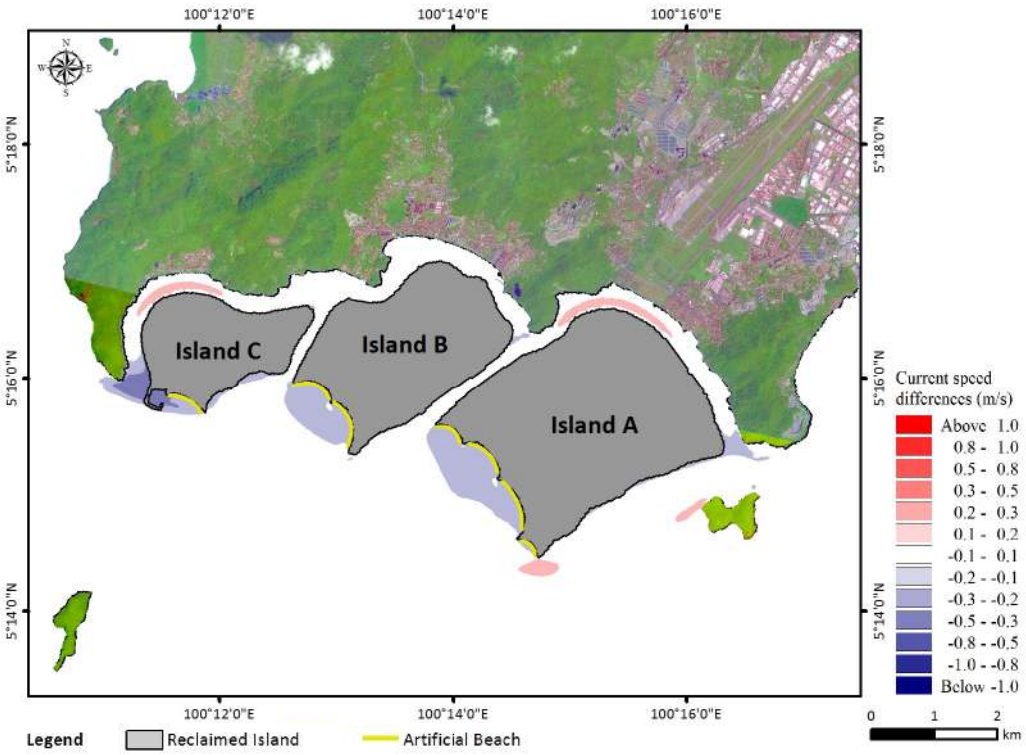
4.2.4 Option 4: Increased Number of Embayed Beaches at the South Coastlines of Reclaimed Islands

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, which further reduces the littoral transport rates (F4.7). The access channel is now widened to 250 m and follows the existing foreshore to maintain the widen channel width. The marina breakwater on Island C is relocated to the southwestern corner for a shorter navigation route from deeper water. The channel in Island C is also removed due to poor flushing capacity. This configuration has less current speed changes (F4.8) near Pulau Rimau, making it less susceptible to erosion. There will also be higher current speed in the access channel between Island A and Penang Island which may lead to better flushing.

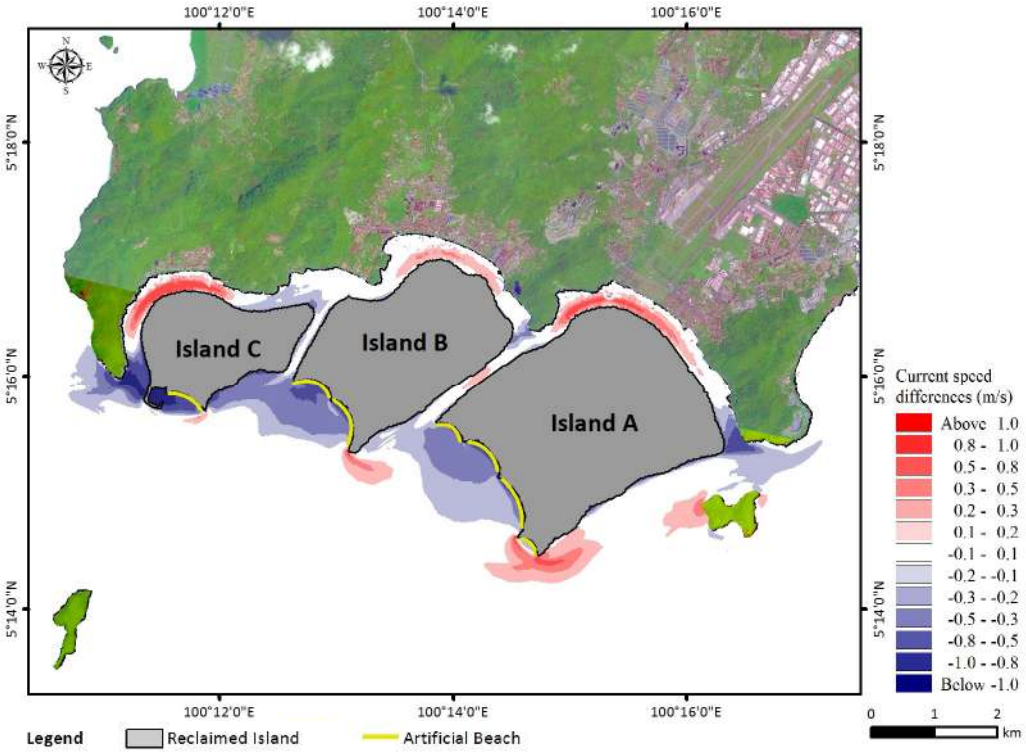
This option is established as the chosen layout with consideration of the hydraulic modeling results and discussions with the PDP and master-planner.



F4.7 Option 4: Increased number of embayed beaches at the south coastlines of reclaimed islands



a) Changes in mean current speed



b) Changes in maximum current speed

F4.8 Changes of current speed for Option 4

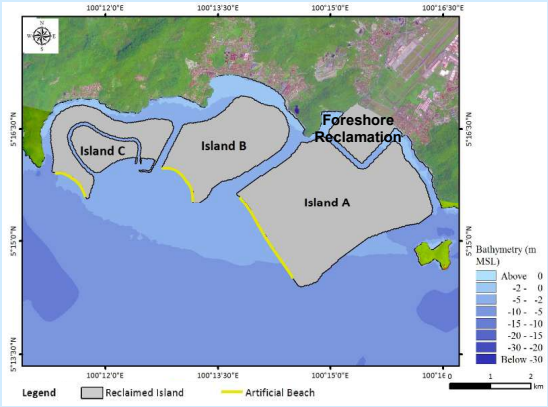
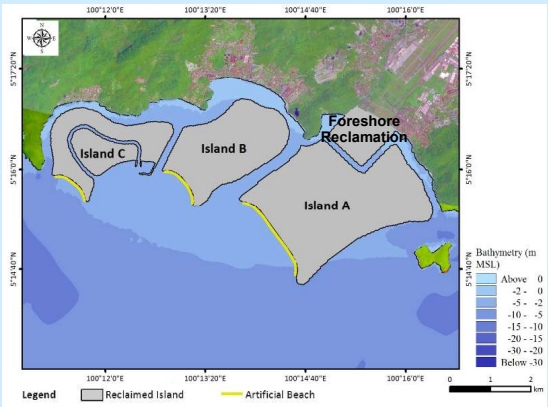
4.3 No-Build Option

The no-build option assumes that the proposed PSR Project is not implemented. This will hinder any plan for the expansion of Bayan Lepas FIZ which subsequently will impede the projected economic growth. In addition, the problem of scarcity of land for housing and development on Penang Island which is currently being faced could not be adequately addressed and resolved.

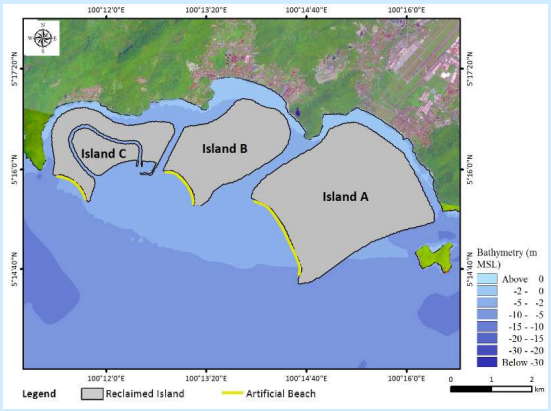
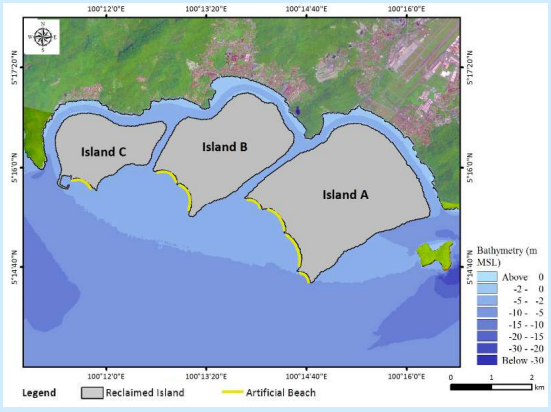
4.4 Conclusion

A summary of the Project options are tabulated in T4.1. The PSR Project is proposed to be developed at the southern coastline of Penang Island, having a configuration of three reclaimed islands with a total area of 4,500 acres: Island A with 2,300 acres, Island B with 1,400 acres and Island C with 800 acres.

T4.1 Summary of Project options

Option	Layout
Option 1: 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.
Option 2: 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.

T4.1 Summary of Project options (cont'd)

Option	Layout
Option 3: Reduction of size of Island A with no foreshore reclamation	 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 selected.
Option 4: Increased number of embayed beaches at the south coastlines of reclaimed islands	 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. There will be higher current speed in the access channel between Island A and Penang Island. This option is established as the chosen layout with consideration to the hydraulic modelling results and discussions with the PDP and master-planner.