CHAPTER 4

PROJECT OPTIONS

4.1 Site Options

The Proposed Project involves development on rehabilitation land from an existing Jelutong Landfill covering an area of 36.42 Hectares (90 acres) which will be rehabilitated as well as reclamation land to be developed for working platform covering an area of 28.33 Hectares (70 acres) with the proposed components outlined in **Chapter 5** of this EIA report. The area for reclamation land is already identified earlier in the Penang Structure Plan 2030 as shown in earlier **Figure 3.1**.

Thus the project options relevant for the Proposed Project and to the Project Proponent can be discussed from three aspects namely redevelopment options, reclamation options and finally whether to proceed or not to proceed as in the 'Build' or 'No Build' options as discussed below.

The site options are limited as the site involving with the redevelopment of existing landfill landmass and proposed reclaimation land that are zoned for residential and commercial land use with related amenities as outlined in the master planning for the entire area. The site is chosen for the following reasons:-

- There is a need to ensure that the Joint Development between PLB Engineering Berhad and the State Government is full filled;
- There is a need to rehabilitate and make safe of the Jelutong Landfill; and
- There is a need to provide further growth in Penang.

4.2 Redevelopment Options

Three potential redevelopment options were outlined in the Jelutong Landfill Site, Preliminary Investigation & Conceptual Closure Options Appraisal report prepared for PDC's appointed consultant in 2014 which are as follows:-

A. Option A - Parkland

Total closure of the existing Jelutong Landfill and rehabilitating the entire site as a parkland area whereby some materials would need to be recycled and reused in adjoining coastal reclamation works in order to restore the site with on-site materials.

A parkland option would comprise the safe closure of the site, whereby this approach would not involve the recovery of any waste materials present on site for reuse in reclaiming land from the sea. The primary objectives of rehabilitation for parkland would require the following items as a minimum:-

- Regrading of the site to achieve safe slopes which are geotechnically stable in the short and long term. Consideration of the stability of the eastern slopes, where sea levels are greatest would be a primary objective to be considered in the overall parkland reclamation option;
- Design and construct a perimeter containment system which is intended to prevent leachate discharge directly to the marine environment and surrounding groundwater (where applicable). Tidal influences need to be considered as part of this approach, together with the appraisal of the geotechnical stability around the perimeter toe of the wastes. The key design consideration for a cut off wall is the stability of the existing waste slopes to ensure the containment integrity of a perimeter cut of wall is not compromised in the event movement/consolidation of the wastes takes place. Leachate collection and treatment would also be required unless an impermeable cap is integrated into the system;
- Design and construction of an appropriate capping layer to reduce long term leachate generation rates to acceptable levels. The capping system would also need to manage stormwater runoff and facilitate the collection and control of landfill gas generation and leachate control;
- Installation of a robust gas collection and control system across the site. The system would have to be incorporated into the capping layer design, and include sub-gas collection layers and vertical gas collection wells. The gas collection well network need to be connected to a flare or combusting engine, thus reducing greenhouse gas emissions and reducing the lateral control of gas towards existing residential properties to the north;
- Installation of a series of leachate collection wells into the base of dumpsite as this will reduce discharge into the sea. Once containment and capping of the site is completed, leachates should be removed to a point where leachate levels in the wastes are maintained below low tide levels for a period until the wastes are stabilized and leachate concentrations are reducing as the wastes mature.

B. Option B – Redevelopment Of Jelutong Landfill

Total redevelopment of the entire Jelutong Landfill is not considered to be a viable option for the following reasons:-

- Hazards posed by the generation of high volume of landfill gas in the site preclude development until the gassing regime has been controlled and stabilized to acceptable levels. Based on preliminary estimates of gassing activity the permanent development can only be considered if there is major material recovery, earthworks and construction of safe development platforms are undertaken;
- The waste slopes are up to 45^0 along many parts of the site perimeter, with some of instability noted along the eastern parts of the landfill where waste slippage has occurred in the past;
- The base of the waste along the eastern edge of the site is approaching deeper water based on 2012 bathematic survey. A deepeng of the sea occurs immediately to beyond the eastern slopes. Instability due to steeping of the marine clay surface may result in greater instability over the long term;
- The waste height is currently 35m above sea level. It is therefore preferable to reduce the height of the waste to improve the amenity of surrounding communities. This height reduction will also reduce the risk of instability in the long term;
- Without significant sorting of waste materials, development on the landfill site using traditional piled foundation technique is considered to be difficult, and some cases may not be possible; and
- Development with piled foundations may also increase the risk to the marine environment from piling through the marine clays.

It is noted that much of the waste deposited at the site since 2003 comprise construction, demolition and soil wastes. It is considered that much of these materials could be recovered and reused in the construction of development platforms.

Complete redevelopment of the Jelutong Landfill without any sorting or recovery of materials may render any redevelopment technically difficult due to geotechnical stability and highly variable bearing capacity of the wastes couple with the restrictions in achieving appropriate piling depths due to obstruction and the need to avoid creating secondary leachate migration pathways, the risks of total redevelopment are likely to be prohibitive.

It is therefore considered that a combined approach of creating both parkland and development areas is the most optimum solution. In order to provide a combined end use of both park and development, further land will need to be created adjacent to the site to enable material sorting and recovery to proceed.

C. Option C – Closure Of The Jelutong Landfill And Removal Of Wastes

Complete removal of wastes would reduce the need for any large scale remediation works similar to those described in earlier Option A. Waste removal would also provide an opportunity to recover a much greater proportion of the landfill wastes which may be present in the site. However, the complete closure and removal of wastes is considered to be technically difficult for the following reasons:-

- Significant odor and dust generations are expected for a large scale landfill relocation;
- The relocation of large volumes of wastes may consume available air space in newly constructed engineered landfills on the mainland. This is likely to present more problems to the state's waste management practices; and
- A third party site would be required to undertake a program of material/resource and recovery. The high proportion of materials which comprise construction/demolition wastes would need to be separated, sorted, crushed and screened and used in the construction of engineered fill development platforms. It is preferred that any such material recycling operation would be conducted close to the landfill to avoid excessive transport costs. It is therefore probable that any materials recovered would be used to create development areas possibly along adjoining sections of coastline.

D. Selected Option

Based on the above options appraisal, the Jelutong Landfill, Preliminary Investigation & Conceptual Closure Options Appraisal Report, 2014 recommended that a combination of strategies including in each of Options A to C are adopted for the Jelutong Landfill. It is considered that the parkland will need to be part of the solution, together with a program of material recovery and bulk earthworks to facilitate the construction of develeopment areas within the Jelutong Landfill. Also further development area as close to the dumpsite would also need to be included in this strategy to facilitate material recovery/recycling.

This combined approach is largely dictated by the following:-

- The need to cap, contain and manage putresicble wastes within the dumpsite. The need to contain leachates to present discharge to the marine environment is considered a priority in this regard;

- The need to reduce waste heights to improve amenity for surrounding communities. It is therefore considered that some reshaping of the waste profile is required in order to achieve this;
- The need to consolidate the hazards associated with gassing round is apparent in order to create some land suitable for redevelopment within the landfill. In order to achieve this, recovery of the construction, demolition and soil wastes would be required. This would also reduce the current waste heights and improve amenity;
- Substantial excavations would be required across large parts of the dumping site to facilitate the consolidation of putrescible wastes into once 'cell' within the Jelutong Landfill;
- The need to consolidate putrescible wastes into once cell, it is likely that over excavation of parts of the landfill will be required in areas where development platforms are to be constructed in order to achieve the following:-
  - reduction in long term risks to future users and property from the migration of landfill gas;
  - enable the safe deployment of piled foundation techniques, reducing the risk of obstruction and ensuring that deeper leachate migration pathways are not created which may result in secondary leachate migration to the marine environment; and
  - would enable a large proportion of materials to be recovered, recycled and used to construct engineered fill development platforms within the landfill and also along other sections of the coastline. This could not only enhance the current landfill but also provide additional land along the coastline.

The combined parkland/development approach would require an additional parcel of land in order to facilitate the recovery of reusable materials from the excavations within the landfill wastes. Due to the lack of available land in Penang, it is necessary to propose the creation of reclaimed land as part of the strategy.

Material reuse and recycling is an integral part of the preferred strategy. The proportions of suitable material for reuse will also be a critical determining factor in the success of the combine parkland/development reclamation strategy. It is considered possible that continuing waste disposal without the availability of additional stretches of coastline to reclaim would render this approach impractical as there would be insufficient space to process materials on site without any prior destination made available.

4.3 Reclamation Options

Overall, the Jelutong Landfill is in a very poor condition. Thus the primary reclamation objectives that can be considered are as follows:-

- There must be containment of leachates to protect the marine environment. This will also protect sediment quality within the southern channel;
- The management, collection and control of landfill gases to reduce hazards/risk to propose and adjacent built properties as well as to reduce risks to current properties to the north of the site;
- Improvements to the geotechnical stability of the landfill, particularly as the highest point is 35 m above mean sea level;
- Improvement to the visual aesthetics and amenity of the neighborhood, taking into account issues related to traffic, coastal aesthetics with regards to waste height; and
- Achieving a 'safe closure' in accordance with the Ministry of Housing Guidance for Safe Closure and Rehabilitation of Landfills/Dumpsites.

The reclamation concepts can be viewed from the following:-

- Strip (Land Based) reclamation concept; and
- Island concept.

The strip (land based) reclamation concept involves a simple extension of the existing coastline whilst the island concept is the creation of an island or multiple island, which would provide the commercial advantage of greatly increased water access and frontage, improved general amenity and a clearly self contained reclamation staging and development phasing. It would create a strong image but permit an individuality of character and purpose for each island. In any case, detailed engineering is required to optimise the land configuration.

For the Proposed Project the strip (land based) reclamation concept is a better option for the following reasons:-

- Land is made available adjacent to the Jelutong landfill which can be used initially as a working platform in rehabilitating the Jelutong Landfill; and
- Shallow waters in the South Channel may cause adverse impacts to the coastal hydraulic regime if the island concept is mooted.

Thus due to the above the strip reclamation concept is the most viable concept to cater for land reclamation.

4.4 Shape For Reclamation

Prior to determining the layout for the proposed reclamation works, optimization study has been carried out for optimal selection. Three (3) layouts were originally proposed for the optimization study as shown in **Figure 4.1 to Figure 4.3.** Details of the acreage for each option is listed in **Table 4.1.**

Table 4.1
Acreage Of The Proposed Options

Layout	Site Rehabilitation Acreage	Reclamation Acreage	Total Acreage
Option 1	100	65	165
Option 2	100	101	201
Option 3	100	60	160

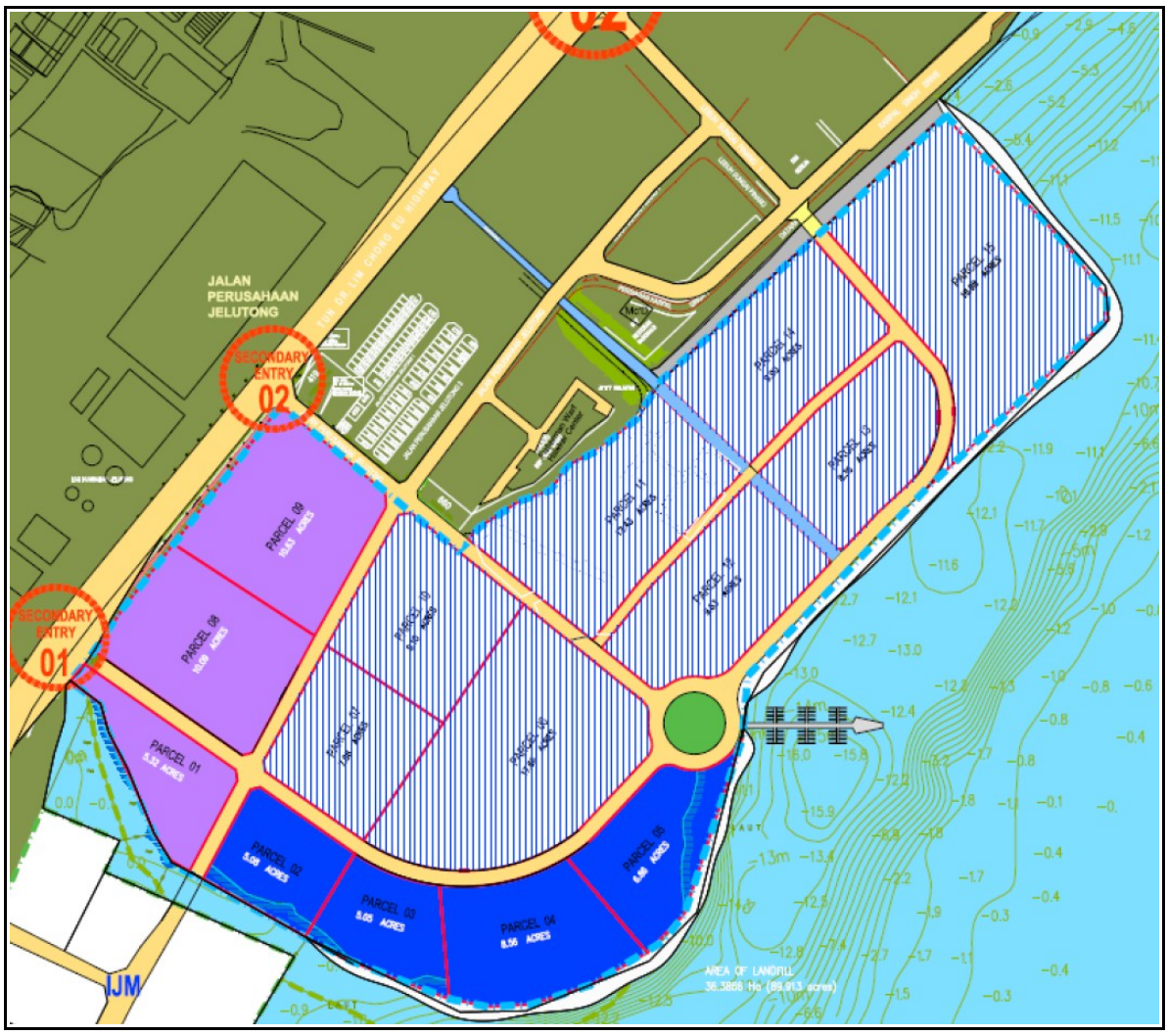

Figure 4.1 Layout Option 1

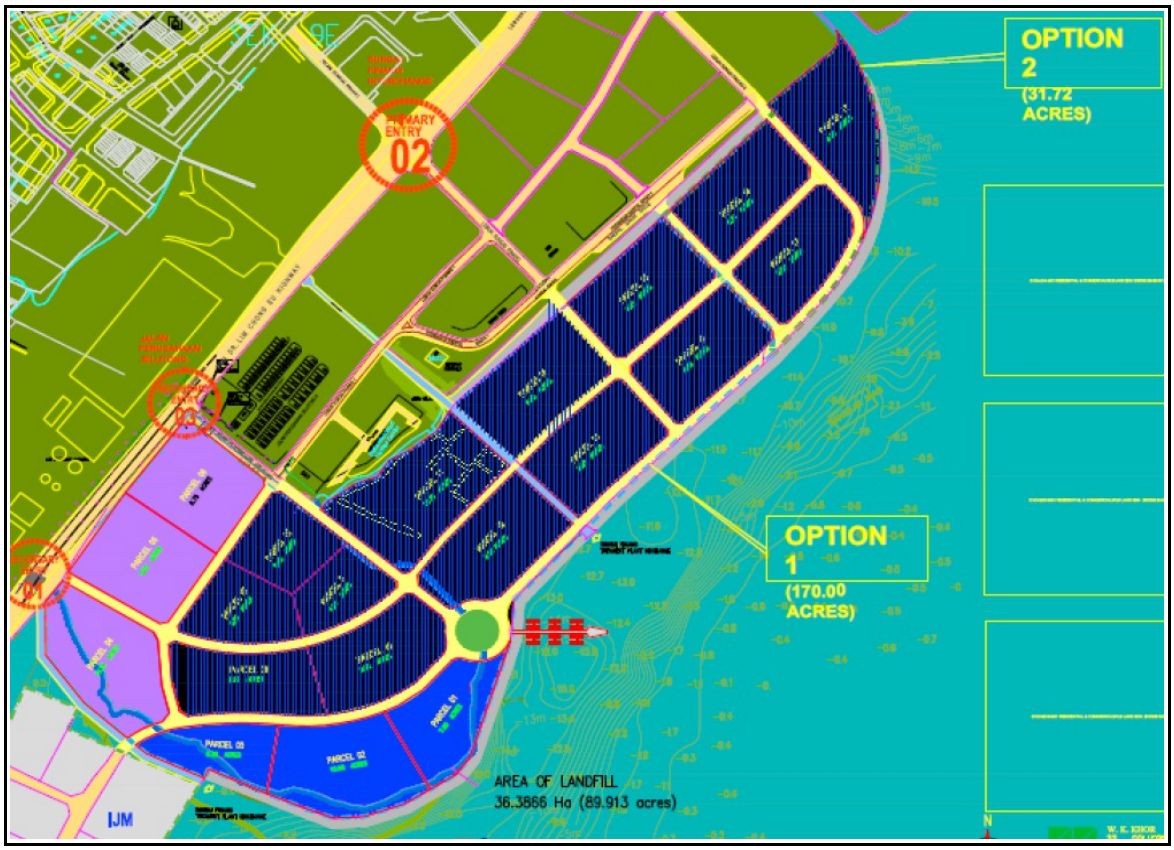

Figure 4.2 Layout Option 2

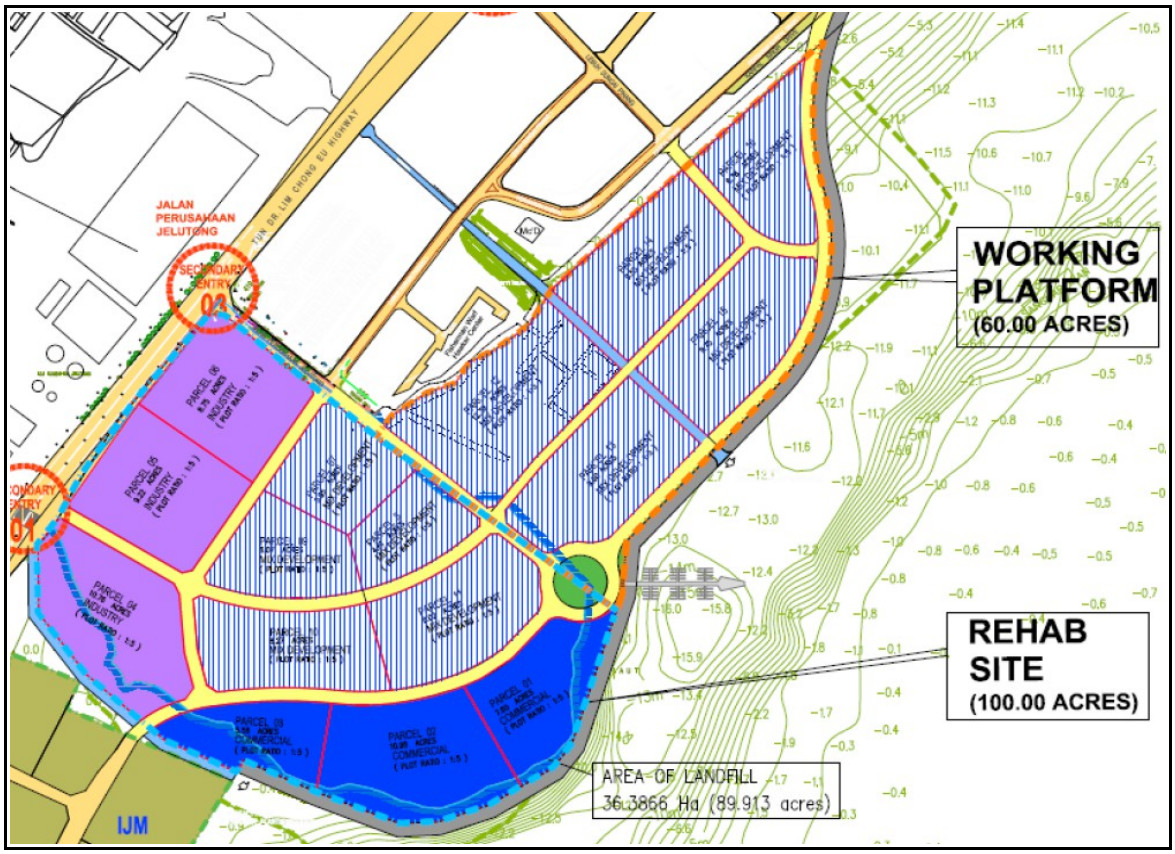

Figure 4.3 Layout Option 3

The optimization study was carried out by assessing the current flow and the differences in current pattern due to the proposed reclamation options.

A. Existing Current Flow Pattern

The existing current pattern within Penang Strait shows that the typical flow pattern for flood tide is towards the south direction, whereas the current pattern reverses to flow towards the north direction during ebb tide as shown in **Figure 4.4 to Figure 4.6.** The range of current speed is found to be higher during spring tide where there is a higher variation of tidal water level, with the current ranging up to 1.2 m/s, whereas the current speed reduces considerably to less than 0.9 m/s during neap tide.

An analysis of the overall mean and maximum current speed within the Study Area indicates that the mean current speed is within the range of 0.6 m/s while the maximum current goes up to 1.3 m/s within the areas of deep waters and navigation channels. The current speed is lower along the shoreline and within shallow waters.

B. Optimization

The proposed Project may alter the hydrodynamic regime in term of current speed. Each of the proposed layout has been modelled and assessed to determine the potential impacts arising from each of the proposed layout as shown in **Figure 4.7 and Figure 4.8.**

- **Option 2 (201 acres)** has the largest impacts to the sea environment. It causes an increment of current speed at the navigation channel up to 0.7 m/s between the proposed Rehabilitation Working Platform area and middle bank. Current speed reduction is also observed at Sg Pinang river mouth north of the proposed Rehabilitation Working Platform area up to 0.5 m/s;
- **Option 1 (165 acres)** of Rehabilitation Working Platform area has similar impact with Option 2, however in smaller spatial extent and magnitude; and
- **Option 3 (160 acres)**, modified from Option 1 (165 acres) with smooth-curved layout at the north of the proposed Rehabilitation Working Platform, significantly reduced the impact of current reduction at the northeastern side of the Project site to less than 0.4 m/s, lower as compared to Option 1 and Option 2. Less significant impact on river mouth siltation at Sg Pinang is anticipated.

Following the impact assessment on current speed for the three options, Option 3 has been selected as the most optimal layout configuration with the least impacts on the surrounding environment.

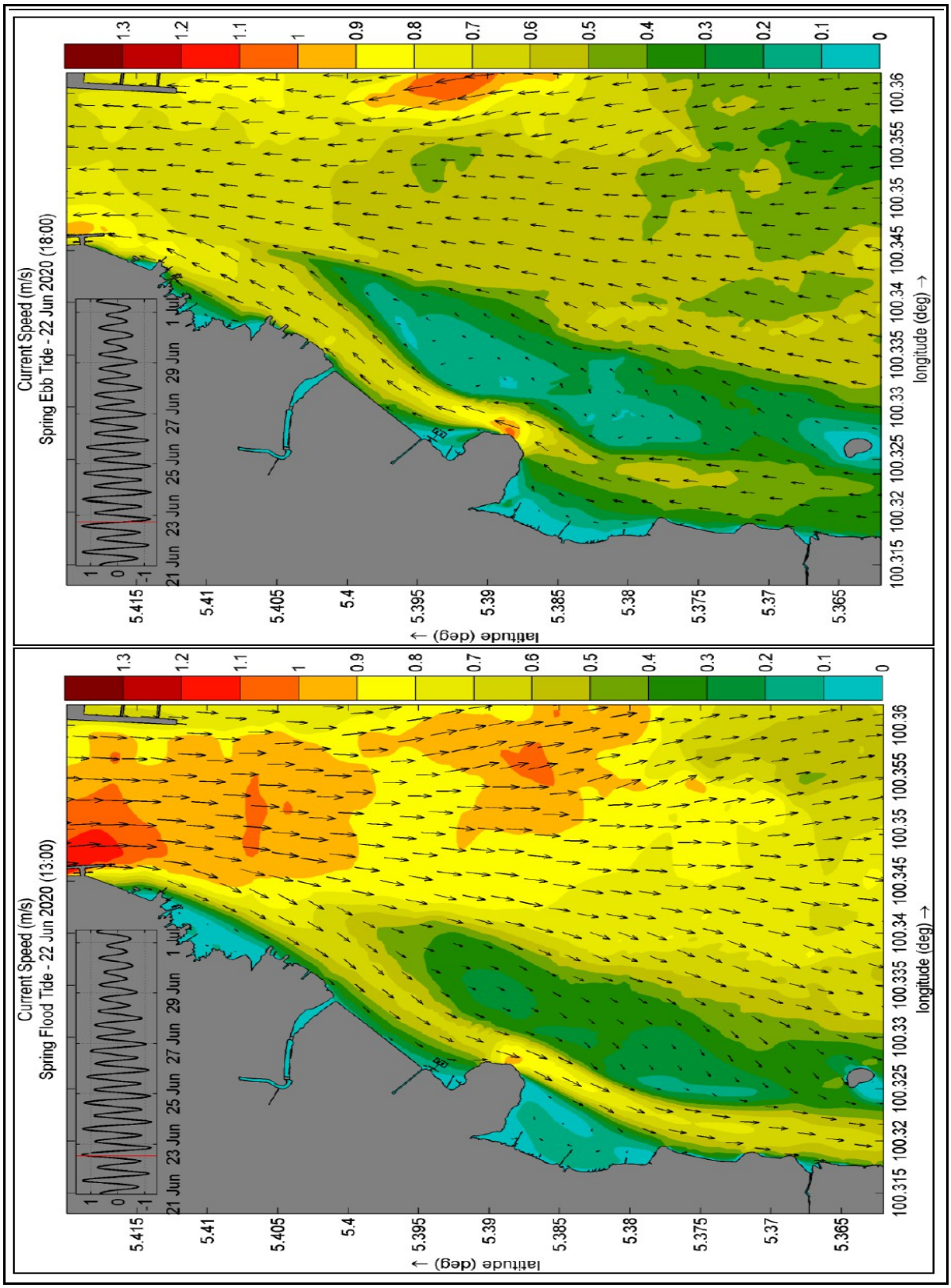

Figure 4.4 Typical Current Flow Pattern For Spring Flood And Ebb Tides Within Penang Strait

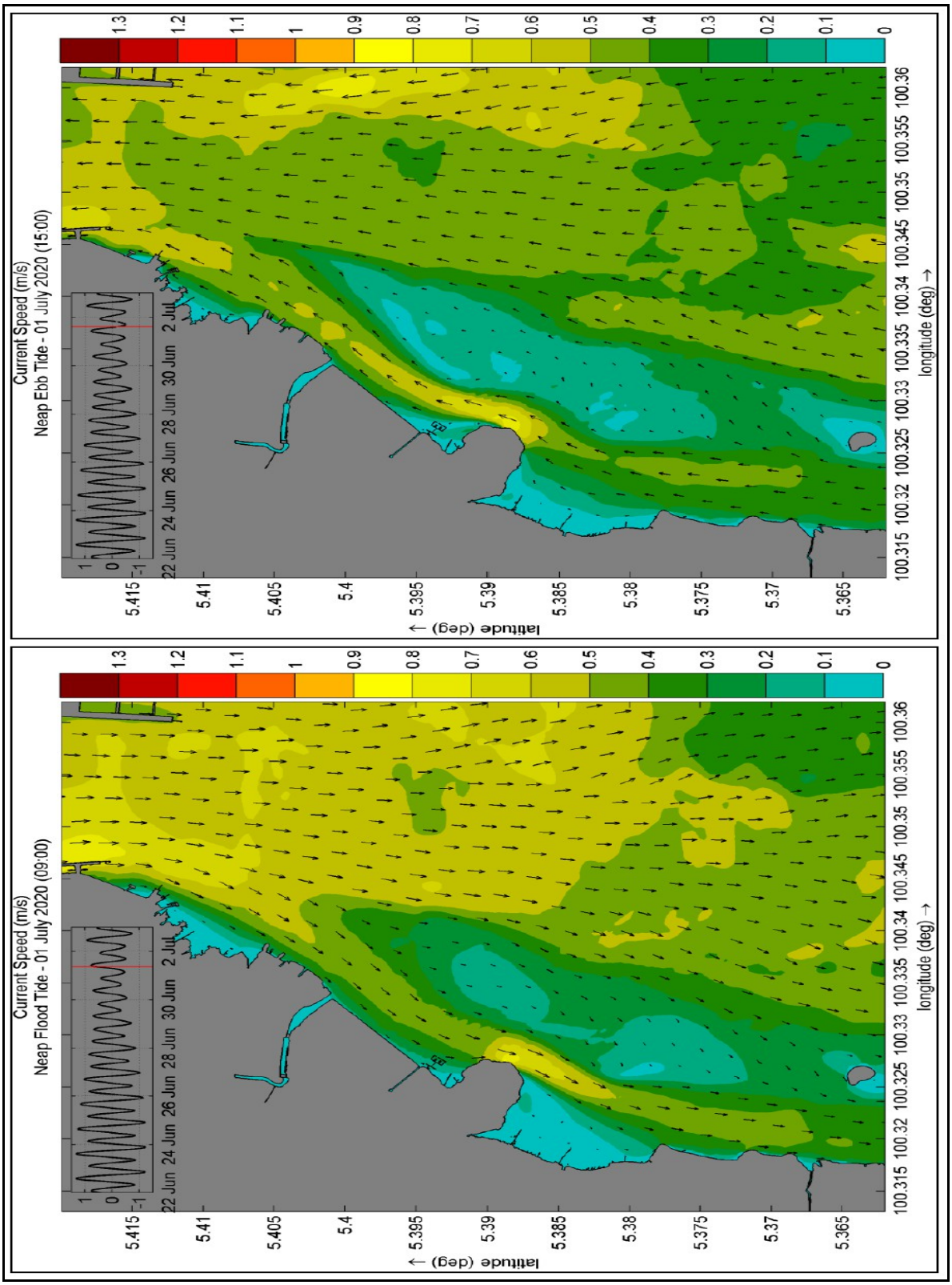

Figure 4.5 Typical Current Flow Pattern For Neap Flood And Ebb Tides Within Penang Strait

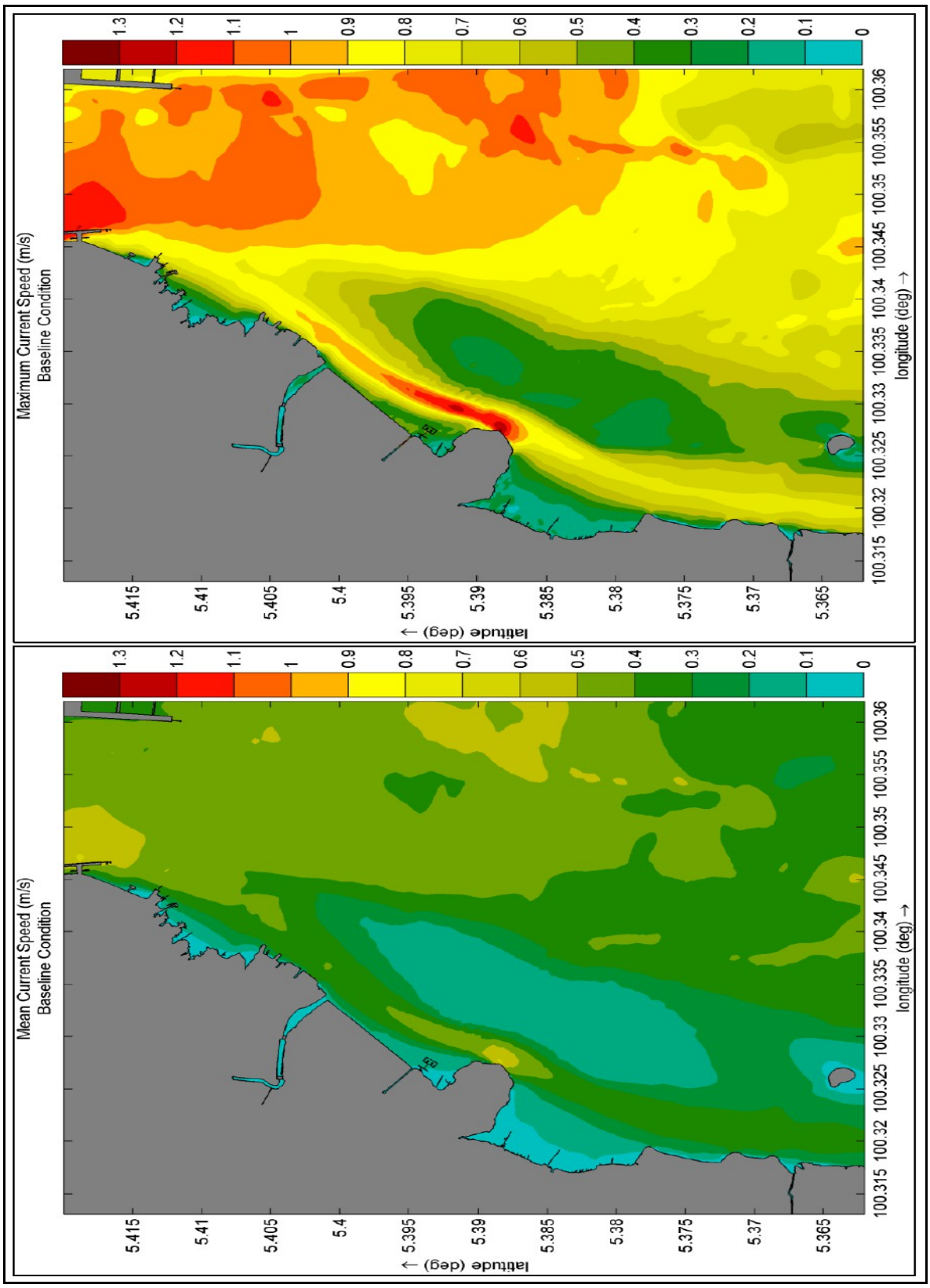

Figure 4.6 Mean And Maximum Current Flow Within Penang Strait

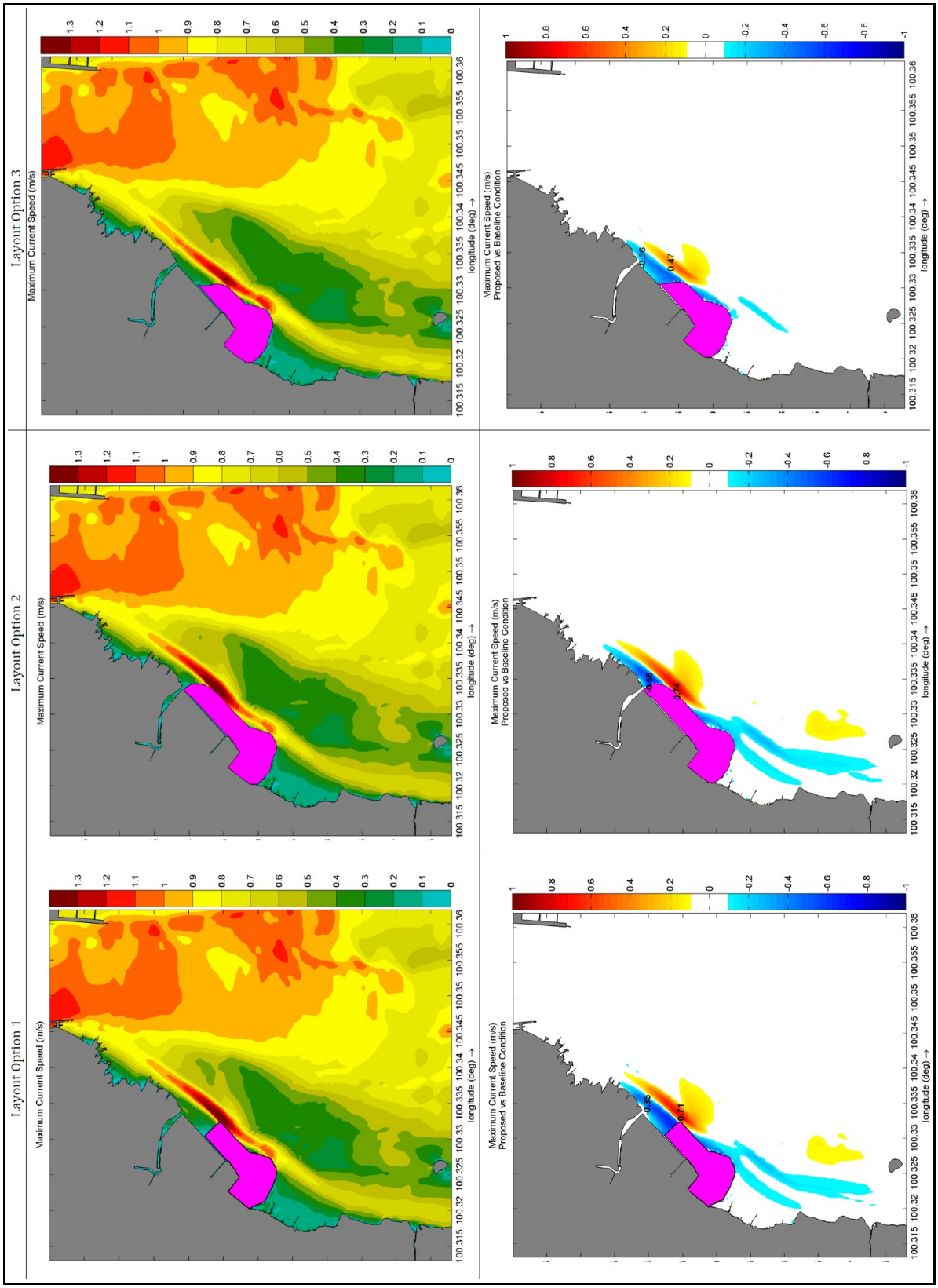

Figure 4.7 Optimization Study For Layout Options Based On Maximum Current Speed

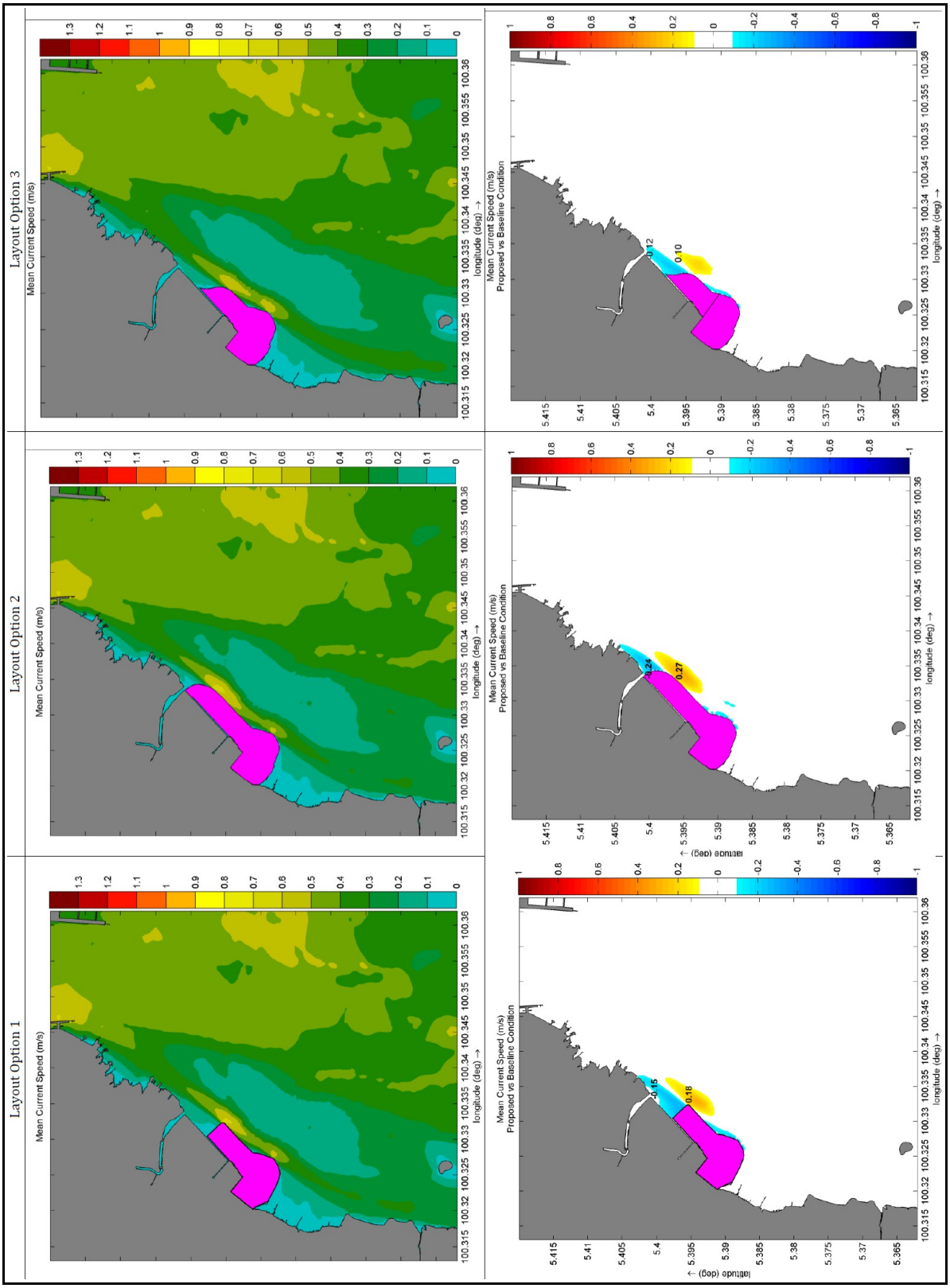

Figure 4.8 Optimization Study For Layout Options Based On Mean Current Speed

4.5 'Build' Or 'No Build' Option

The 'Build' option as proposed by the Project Proponent, comprises basically of a mix development area while the 'No Build' option would mean that the site will be left as a landfill and an eyesore for the area.

However the 'Build' option would ensure the following:-

- Aesthetic improvement to the coastline by enabling a reduction in waste height to be achieved. In order to achieve this, addition section of the coastline has to be reclaimed to provide a destination for recovered materials to be placed;
- Enable material recovery/recycling to be undertaken to provide reuse of construction/demolition materials and soil material at site;
- Provide geotchnical stability of the landfill to be improved;
- Provide an increased area suitable for redevelopment and provide additional coastline for reclamation; and
- Provide an opportunity to close the Jelutong Landfill and render it safe thereby reducing risks to nearby properties.

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