

PAC Paper 2/98

1 Introduction

The Green Island Development (GID) Project comprises a total of approximately 186 ha of reclamation between the coast of Kennedy Town and Green Island at the western corner of Hong Kong Island. These reclamations are intended to provide land for residential development, an improvement in environmental and traffic conditions in the Western District, and land for a number of planned major strategic routes.

Babtie BMT has been commissioned by the Government of the Hong Kong Special Administrative Region, Territory Development Department (TDD), Hong Kong Island and Islands Development Office to undertake studies on the Ecological, Water Quality and Marine Traffic Impacts associated with the GID.

The critical MTIA objectives have been to ensure that all pertinent data is collected in order to allow a clear assessment of the scale, extent, significance and severity of the potential marine impacts. To aid in the achievement of the maintenance of vessel safety, the MTIA has conducted a number of varied tasks. The MTIA report summarises the findings, conclusions and recommendations of the principal tasks conducted during the Study period including:

- traffic surveys and transits on vessels adjacent to Green Island;
- the development and simulation of a representative marine traffic route structure adjacent to Green Island for both present and future case scenarios;
- the fast-time ship manoeuvring simulation of vessels in waters adjacent to Green Island;
- an assessment of the fairway and mooring buoy reprovisioning requirements;
- the development of the wave regime prior to, and after the construction of the GID, and
- an assessment of the nature of the GID seawalls and PCWA layout proposed for the GID, and any influence it may have on navigation.

2. Surveys

In order to develop a thorough understanding of the marine traffic around Green Island the following surveys were conducted:

- passages adjacent to Green Island on private launch, fast & conventional ferries, and ocean going vessels; -
- visual vessel traffic surveys across the Sulphur Channel, North Green Island Fairway, Southern Fairway and East Lamma Channel, covering a period of 76 hours;
- video recording of Marine Department Vessel Traffic Control (VTC) radar, covering a period of 174 hours, and
- capture of "tagged" ocean-going vessel from Marine Department VTC radar, covering a period of approximately 240 hours.

The high usage of the waterspace adjacent to Green Island, by a wide range of vessels was identified, with approximately 2800 vessels passing through the Study Area adjacent to Green Island within 24 hours, and over 800 vessels passing through the Sulphur Channel during daylight hours.

3. Present Case Navigation and Traffic Structure

The simulation of two large vessels (150 and 170m long), manoeuvring through the Sulphur Channel, and into the North Green Island Fairway, respectively, from the East Lamma Channel was conducted. The behaviour of these simulations, Figures 1a) & 1b), was shown to represent adequately the behaviour of vessels identified by the radar surveys. It was therefore considered appropriate to use these models to assess key manoeuvres around the proposed GID reclamation.

23 separate traffic routes were identified from the survey data, and representative traffic distributions with respect to vessel size, speed and time were developed within an animated marine traffic simulator. This was run over several days representing a full 24 hour cycle of traffic activity, and a two hour period between 18:00-20:00 was identified as containing the peak traffic volumes with approximately 350 vessel movements during this time. The busiest water space was identified as the convergence of the North Green Island and Southern Fairway with approximately 160 vessels passing through a 200x200m square grid during the 18:00-20:00 peak period. High vessel encounter rates in this area, and through the Sulphur Channel were also recorded, Figures 2a) & 2b).

4. Future Case Navigation

Fast time manoeuvring simulations of vessels around the GID were conducted to examine the ability of vessels to enter a new 320m wide Southern Fairway located 140m north of the northern extremity of the GID. This baseline fairway arrangement, initially developed in the Green Island Reclamation Feasibility Study (GIRFS), Figure 3, provided the same distance between the southernmost reprovisioned buoy and the north of the GID as currently exists between Little Green Island and the southernmost line of buoys.

Both east and westbound transits showed that the turn around the reclamation could be handled with ease by both vessels used in the simulation, Figures 4a) and 4b). As one of these vessels modelled is the largest likely to use the Southern Fairway north of Green Island, it is concluded that the proposed baseline shape of the reclamation and the alignment and width of the fairway are satisfactory, from the viewpoint of navigation of a single vessel.

Conventional ferries to Cheung Chau will suffer increases in journey time of approximately 2 minutes, while journeys to Lamma will increase by approximately 4.5 minutes. This time penalty has been examined using a load-passage queue simulator. It is seen that the additional times are of the order of those experienced at present as a result of traffic congestion, bad weather, poor visibility etc., and can be readily absorbed by the operators, without the requirement for extra vessels to maintain service levels.

5. Future Case Traffic Structure

The impact of the GID reclamation was assessed under current traffic volumes and with respect to the predicted traffic for the year 2011, developed within the MARAD Strategy Study. Initially, in order to examine the impact of the GID alone the present traffic route volumes were examined with the GID in place.

It was noted that the GID alone (assuming the GIRFS fairway is adopted) results in an increase in vessel encounters, during a full 24 hours, of approximately 17%. However the nature of these encounters is changed, with the high values at the convergence of the North Green Island and Southern Fairways now reduced and spread across a larger area north of the GID, Figures 5a) & 5b).

Peak encounters values north of the new Public Cargo Working Area (PCWA) during the 18:00-20:00 period are actually reduced by approximately 25% from the peak values identified at the convergence of the two fairways.

The current traffic structure was then increased to account for projected traffic increases proposed in MARAD for the year 2011. These increases, which were applied to the appropriate routes and vessel classes in transit around Green Island amounted to an increase of approximately 35% on the total vessel movements within the Study Area from 2800 vessel movements to 3800 per day.

The baseline GIRFS future case scenario of a 140m inshore traffic zone and 320m wide Southern fairway was examined with the 2011 traffic forecasts. The increases in traffic volume within the new fairway structure led to approximately 20% more encounters over the present case traffic volumes with the GID in place, during a 24 hour period.

The analysis illustrated particularly high levels of encounters by high speed craft (which account for approximately 50% of all instances within the Southern Fairway and off the northwest corner of the reclamation). High waterspace usage was also produced by the movement of ocean-going vessels within the Southern Fairway. The particularly high encounters and waterspace usage associated with the safe passage of ferries and ocean-going vessels gave rise to concern, and were considered unacceptable for the maintenance of an adequate level of marine safety. As a consequence a number of alternative fairway arrangements were examined.

- Scenario 3: The establishment of a wider inshore zone at 140m, a Southern Fairway width of 200m and a fast ferry track to the north of the Southern Fairway at 120m width. Traffic volumes are for 2011, with ocean-going vessels required to access Kellett Bank from the Western Fairway.
- Scenario 4: The establishment of a wider inshore zone at 200m, a Southern Fairway width of 320m and a fast ferry track to the north of the Southern Fairway at 160m width. Traffic volumes are for 2011.
- Scenario 5: As Scenario 4, but with the addition of a 500m wide north/south PCWA crossing lane.
- Scenario 6: This option assumes traffic at 2011 with an Inshore traffic zone at 200m and the Southern Fairway at 400m, with centre line buoyage, essentially creating traffic separation. The 500m wide PCWA crossing lane is maintained.

Extensive analyses and assessment have been conducted to evaluate the impact of the different traffic control and mitigation measures analysed within the traffic simulator. The preliminary conclusions of the further assessments conducted can be summarised as:

- The original fairway alignment proposed by the GIRFS study is insufficient, from the point of view of vessel safety, and further fairway waterspace should be provided.
- The benefits of traffic separation for the high speed ferries, are clearly illustrated, and such a system should be considered when traffic levels, and particularly volumes of fast ferries, approach the levels modelled in 2011.

- The application of a crossing lane from the PCWA has been shown to have positive effects on the encounters within the Southern fairway, but to the detriment of a localised high area of vessel encounters north of the PCWA.
- A wide single fairway with east-west separation, and a wide inshore zone, provides a comprehensible traffic structure that results in levels of encounters and densities of a similar magnitude, to those that would be encountered should the GID not be developed.

The following preliminary recommendations are proposed to provide satisfactory levels of vessel safety following construction of the GID. They include the phased implementation of mitigation measures to accommodate the prevailing traffic regime, and allow the marine community to move from the transition of the Green Island Area from an "unrestricted high traffic volume" area to a "restricted high traffic volume" area.

- Prior to marine construction operations of the GID, and following dredging and reprovisioning of the GMBs the Southern Fairway should be reprovisioned with an inshore zone of 200m width and a main fairway of 480m width.
- The new Southern fairway should be made into two separate lanes, with all vessels traversing the Southern Fairway required to leave a central buoy to portside;
- Marine Department should establish a control station on the top of Green Island to control, via the use of launches, construction traffic, the flow of traffic into Kellett bank, and advise pilots and masters of ocean-going vessels on traffic within the Southern Fairway. This should be operational prior to construction work commencing on the GID.
- Upon start of construction of the GID the Sulphur Channel will be closed to ocean-going vessels. The requirements for prohibitions on other craft should be examined following development of the reclamation sequencing.

Should traffic within the Southern Fairway rise to the levels simulated within the traffic models, or there arise a perception of increased vessel congestion the following options may also be adopted:

- Speeds of fast ferries limited to approximately 25 knots until clearing the PCWA area, and.
- Where possible ocean going vessels could enter Kellett bank from the Western Fairway and depart via the Southern Fairway.

6. **Reprovisioning of Buoys & the Western Quarantine & Immigration Anchorage.**

The fairway options examined result in the reprovisioning of Government Mooring Buoys (GMBs) into Kellett Bank, and subsequently into the area currently occupied by the Western Quarantine and Immigration Anchorage (WQIA). This encroachment is essential should the number of GMBs within this area of the harbour be maintained. Figure 6 illustrates the proposed fairway arrangement with a like-for-like reprovisioning of mooring buoys, providing 29 "A" buoys and 18 "B" buoys within the new Kellett Bank area.

Options for resiting the WQIA within the Western Harbour, were examined on the basis of operational, marine and metocean parameters. Discussions with interested Departments were conducted.

It is recommended that a site within the southern half of the North Lamma Anchorage may provide a suitable site for the relocation of the WQIA. A slightly more severe wave environment may be mitigated against by the provision of catamaran or SWATH vessels, while a shore base on Lamma may be established to support operations.

7. Seawalls & PCWA Marine & Engineering Issues

The seawalls proposed by the GIRFS were reviewed with respect to their suitability. It was recommended that the vertical walls originally proposed in the GIRFS for the northern shore of the GID be replaced by wave absorbing seawalls in order to reduce the problems of wave reflection in this area. Wave studies indicated that failure to do so would result in substantial wave energy reflected into the Kellett Bank area.

The arrangement of the PCWA was also examined and alternatives proposed to provide similar wharf lengths, but with better wave shelter and water quality.

Figure 1a)

Present Case Navigation - 171m Vessel, Eastbound Transit

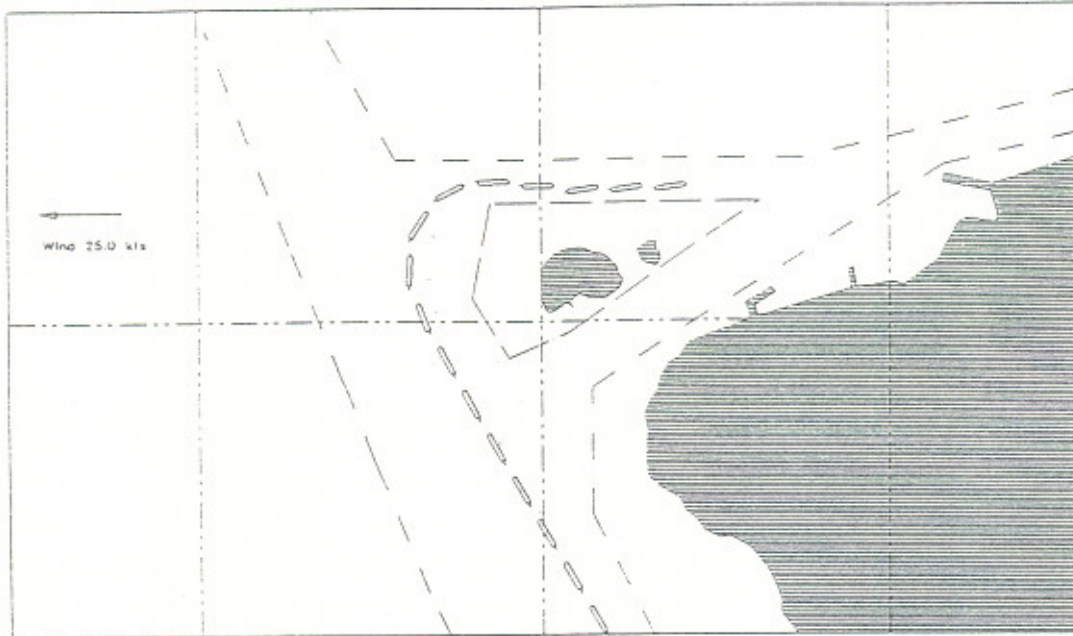


Figure 1b)

Present Case Navigation - Large General Cargo Vessel,
Eastbound Transit

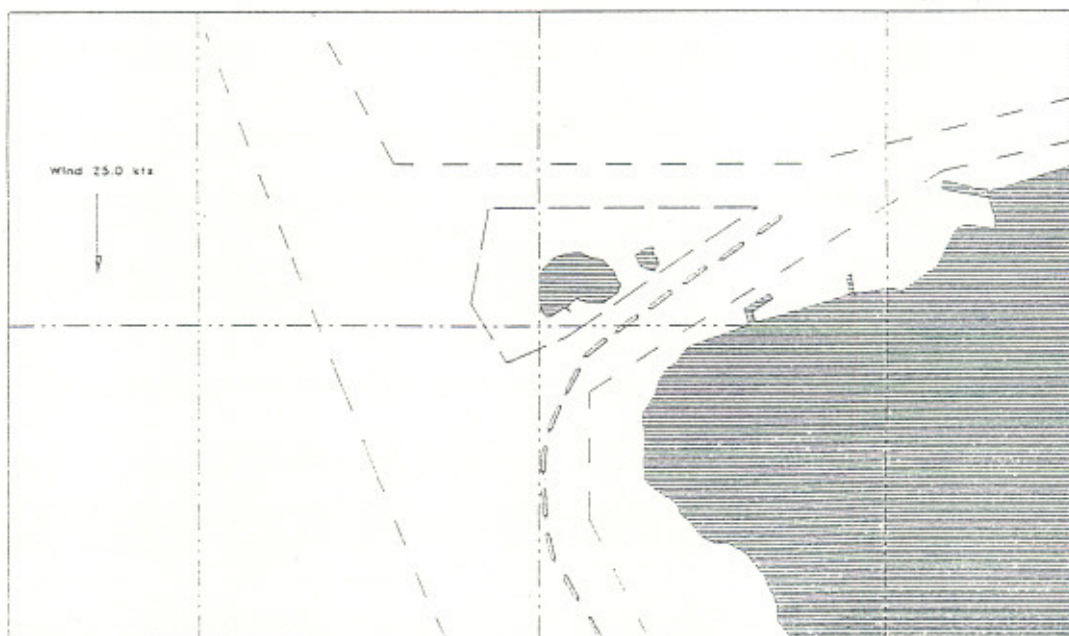


Figure 2a)

Present Case Traffic Movement Distribution

Vessel Movements Distribution: All Vessels, Period 18:00-20:00

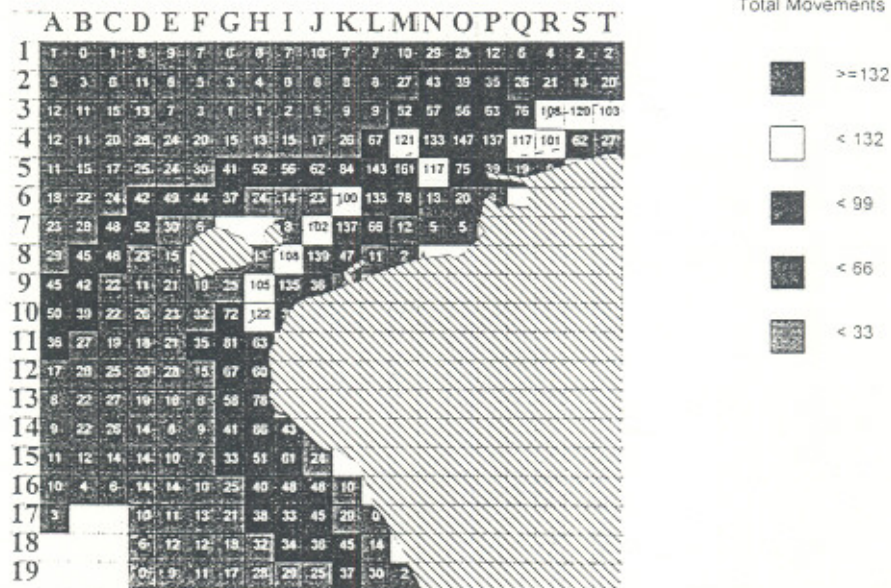


Figure 2b)

Present Case Traffic Encounter Distribution

Vessel Encounters Distribution: All Vessels, Period 18:00-20:00

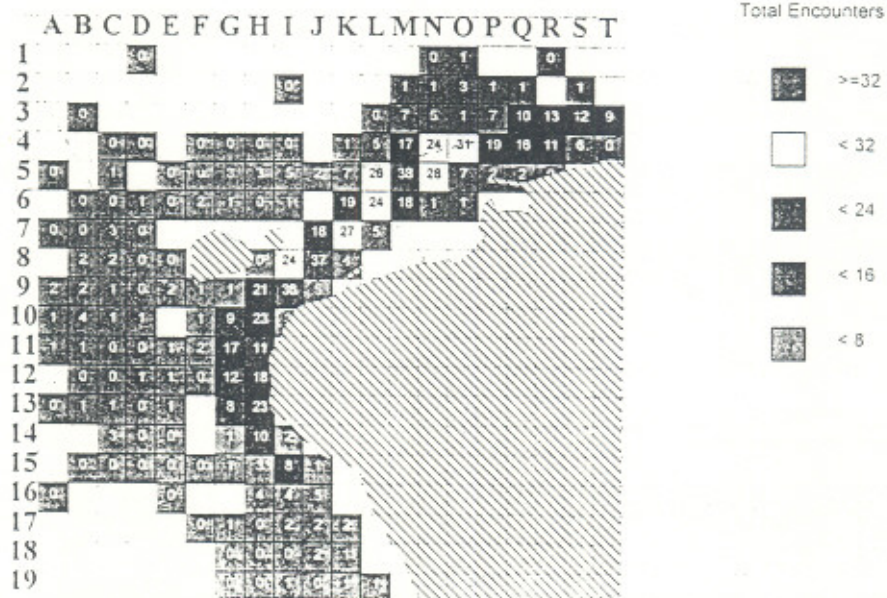


Figure 3

Baseline GIRFS Fairway Alignment

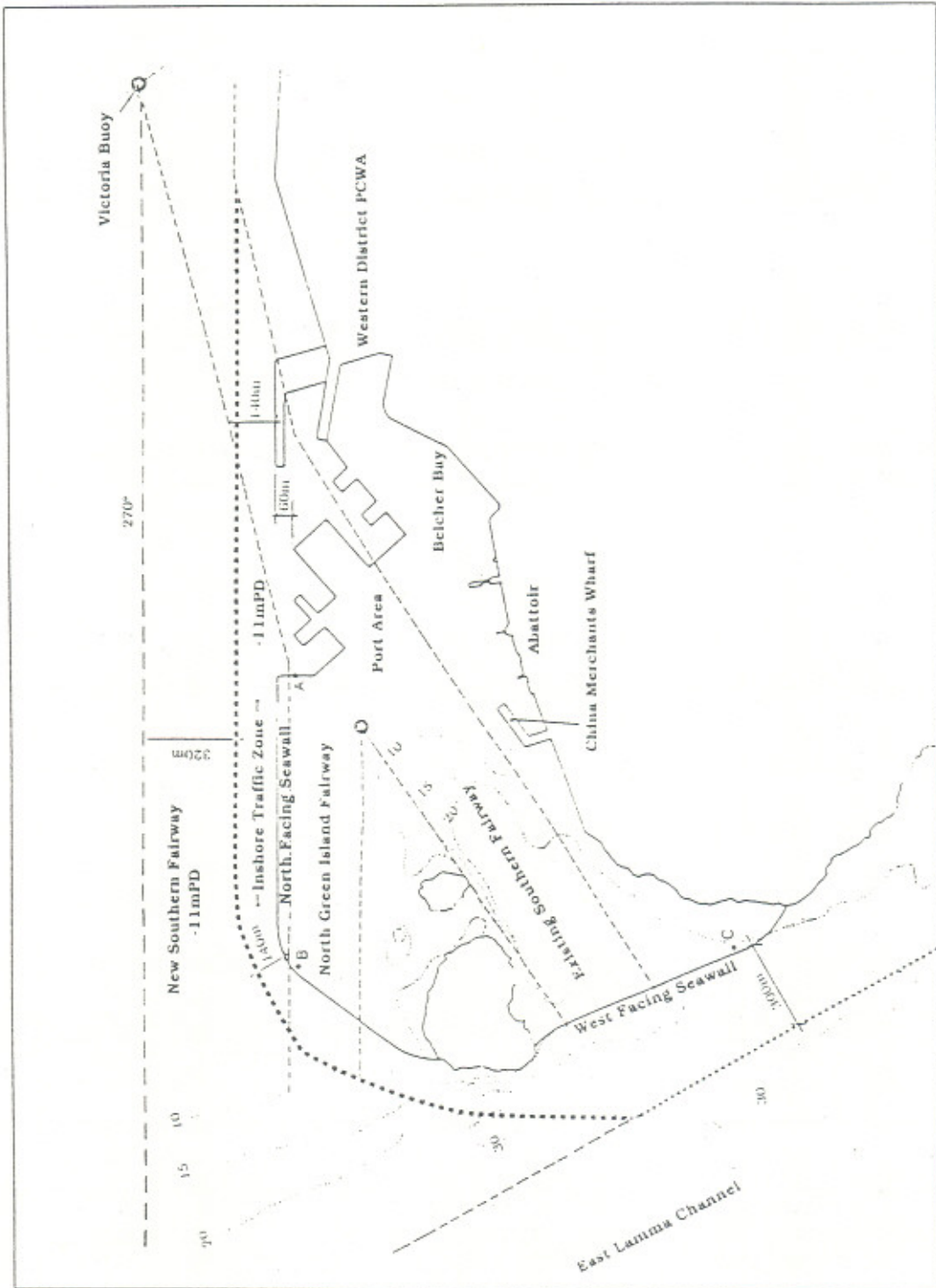


Figure 4a)

Future Case Navigation - 171m Vessel, Eastbound Transit

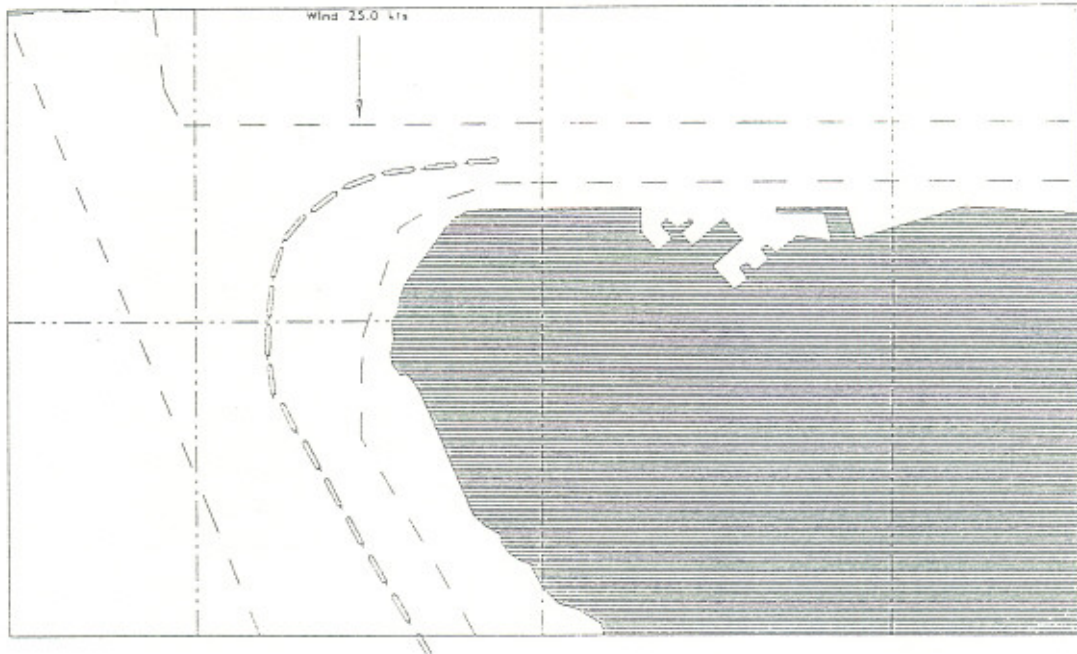


Figure 4b)

Future Case Navigation - Large General Cargo Vessel,
Eastbound Transit

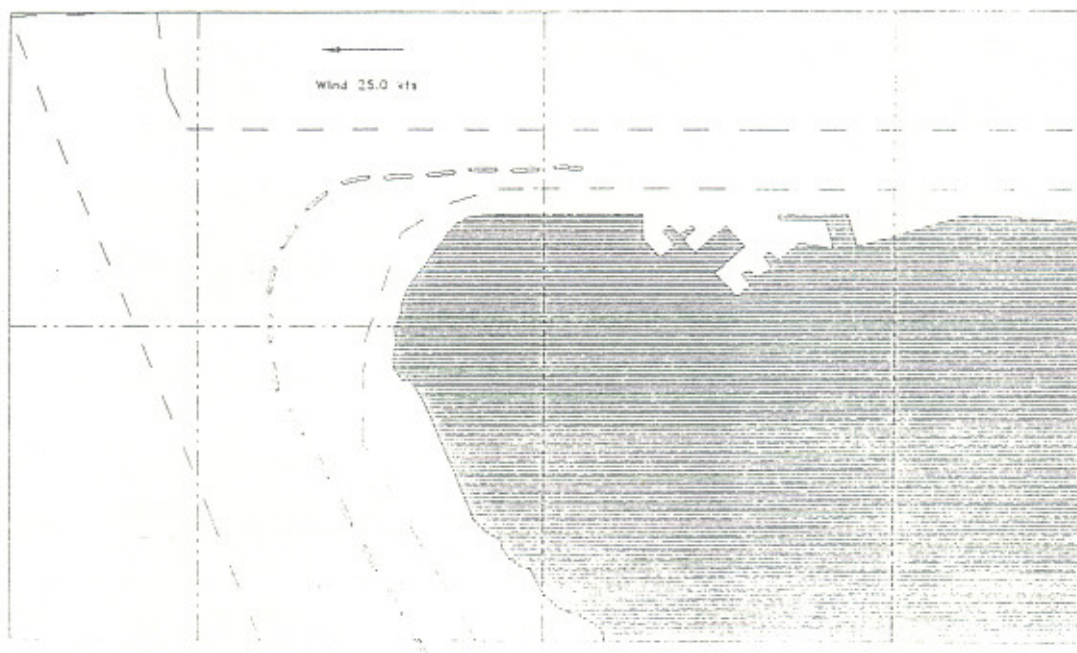


Figure 5a)

Present Case Traffic Volume with GID

Vessel Movements Distribution : All Vessels, Period 18:00-20:00

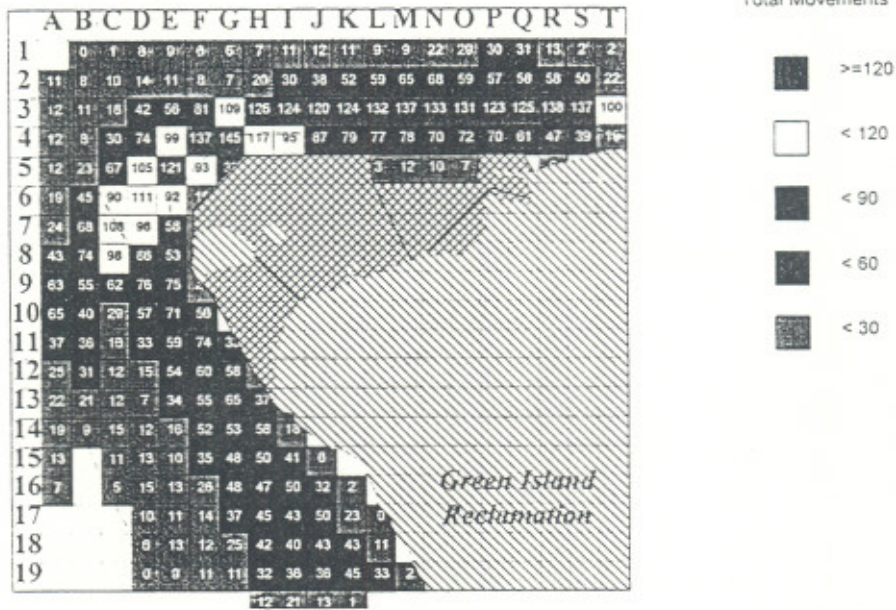


Figure 5b)

Present Case Traffic Volume with GID

Vessel Encounters Distribution : All Vessels, Period 18:00-20:00



Figure 6

Preliminary Proposed Alignment

