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1 INTRODUCTION

1.1 Project Initiator

The project proponent for this development is Sabah Ports Authority and the principal contact in respect to the project is:

SABAH PORTS AUTHORITY
4th Floor, SPA Headquarters Bldg
Jalan Tun Fuad Stephens, Tanjung Lipat
88617 Kota Kinabalu, Sabah
Tel: 088-256 155
Fax: 088-243 284
Contact Person: Encik Ramli Amir (General Manager)

1.2 EIA Consultant

The consultant for the Special-EIA study is:

ERM Borneo Sdn Bhd
(A subsidiary of Environmental & Risk Management Sdn Bhd)
Suite 8, 10th Floor, Wisma Perindustrian
Jalan Istiadat, Likas
88400 Kota Kinabalu, Sabah
Tel: 088- 247 573
Fax: 088-266 572

K. L. Office:
Suite 22.03-22.04,
22nd Floor, Plaza 138
No 138, Jalan Ampang
50450 Kuala Lumpur
Tel: 03-2164 6037
Fax: 03-2164 9777
Contact Person: Mr. Rod McBride (Managing Director)

1.2.1 Supporting Laboratory

Chemical and analytical services for water, air and noise quality monitoring has been provided by:

Environmental Science (M) Sdn Bhd
No 38, Jalan Tembaga SD 5/2H
Bandar Sri Damansara,
52200, Kuala Lumpur
Tel: 03-62736013
Fax: 03-62759325
Contact Person: Ms Felicia Choo/Mr. Zulkifli Ahmad

1.2.2 Hydraulic Consultant

The hydraulic field work and modelling has been conducted by:

Danish Hydraulic Institute
Suite 10, 8th Floor, Wisma Perindustrian
Jalan Istiadat, Likas
88400 Kota Kinabalu, Sabah
Tel: 088-260780
Fax: 088-260781
Contact Person: Mr. Tom Foster (Regional Manager)

The list of consultants involved in the preparation of this Special-EIA is listed in Table 1-1 and the detailed CVs of the team members are attached in Appendix 1.

Table 1-1 Special-EIA Study Team Members

Name	Designation	Academic Qualification	Assignment Contribution
R.W. McBride DOE Reg. Consultant ERM Borneo	Study Coordinator	Environmental Health Building Surveying Fire Technology	◆ Overall Coordination ◆ Hazard Assessment ◆ Emergency Response Planning
Den Shu Chien DOE Reg. Consultant ERM Borneo	Senior Environmental Consultant	B.Sc. (Hons) (Environmental Science) M.E. (Environmental)	◆ Existing Environment ◆ Environmental Management ◆ Environmental Impact and Mitigating Measures
Wong Suh Chuen DOE Reg. Consultant ERM Borneo	Environmental Consultant	B.Sc. (Biology and Chemistry)	◆ Existing Environment ◆ Environmental Impact and Mitigating Measures
Lim Pek Boon DOE Reg. Consultant ERM Borneo	Environmental Consultant	B. Sc. (Hons) (Biochemistry) M. Phil. (Environment and Natural Resources)	◆ Existing Environment ◆ Environmental Impact and Mitigating Measures
Mette Kristensen	Archaeologist	B.Sc. & M.Sc. (Archaeology)	◆ Archaeology study
Danish Hydraulic Institute (DHI) L. Tom Foster	Hydraulic Consultant	B.Eng. (Hons) Civil M.Sc. (Coastal Engineering) DIC (River Morphology)	◆ Hydraulic Study - Coastal Process/River/Estuary Process study ◆ Water Quality ◆ RIAM Analysis
Danish Hydraulic Institute L.Tania Golingi	Environmental Scientist/ Marine Biologist	B.Sc. (Hons) (Environmental)	◆ Ecology ◆ Marine Flora and Fauna ◆ Mangrove Study
Iklim Consult Sdn Bhd Allan Dumbong	Socio Economics	B.A (Hons) (Political Science) MBA	◆ Socio Economic Analysis ◆ Land use ◆ Fisheries
Scott Wilson (M) Sdn Bhd L. Graham Leslie Bodell	Traffic Study (Land Based)	B.Sc. & M.Sc. Transportation Planning	◆ Land Traffic Impact Study
Danish Maritime Institute (DMI) Capt. Jargen Thau	Navigation Study	Captain Merchant Marine	◆ Marine Navigation

1.2.3 Purpose of Terms of Reference

EIA is a mandatory requirement under the Conservation of Environment (Prescribed Activities) Order 1999. The proposed port development, which involves 83.6 hectares of coastal reclamation falls under Conservation of Environment (Prescribed Activities) Order, 1999

Activities 7(iii)

Construction of Port facilities (including water houses, godown, container yards and cargo storage facilities) or open jetties with a length of 100 metres or more or closed landing jetties for commercial use along any of the rivers or sea front, and

Activities 3 (iv)

Reclamation of land, whether by the sea or along river banks, for housing, commercial or industrial estate.

There are two types of EIA in Sabah, namely Normal and Special EIA. Special EIAs cover project that are regarded as having a special interest for the public and /or having a special magnitude regarding environmental impact.

ECD will determine which projects are required to undertaken a Special-EIA. However, the criteria used to determine if a project might undertake a Special-EIA include:

- Location in an environmental sensitive area
- Location of densely populated area
- Aesthetic or cultural concerns
- Voiced public interest or concern

A draft TOR has been submitted to ECD for consultation and ECD has advised through correspondence [JKAS/PP/05/600-1/15/1/5 Jld 2 (7)] that a Special EIA is required for the proposed container port development.

A copy of the ECD's correspondence is provided in Appendix 2.

Subsequently the second draft TOR was submitted and displayed for public comment on 10 – 27 August 2001. Comments were gathered and reply to the comments was submitted to the ECD on 12th October 2001 (Appendix 3). This TOR is prepared taking into account the comments from the review panel, NGOs and members of the public.

The preparation of the Terms of Reference (TOR) is considered as an important step in the EIA procedure. These will establish the content and scope of the work to be undertaken in the study. The TOR will be project and site specific and depending upon requirements, may range from an investigation of a few localised impacts, or extend to an EIA report.

The Sabah State Government has developed a "Terms of Reference for Detailed Environmental Impact Assessment" in an effort to minimise physical, biological and social impact of coastal development on the West Coast of Sabah. The present TOR has been prepared; accommodating both the EIA guidelines of the Sabah Environmental Conservation Department as well as adopting the Terms of

Reference developed by Sabah State Government. The TOR details the purpose of the impact assessment and itemises the potential environmental impacts.

1.2.4 S-EIA Study Guidelines

The S-EIA study and report has been undertaken in accordance to the following guidelines issued by DOE, ECD and DID:

1. The Handbook For Environmental Impact Assessment (EIA) In Sabah, February 2001 by Environmental Conservation Department.

2. The West Coast Of Sabah Shoreline Management Plan approved by Sabah State Government in September 1998

3. The EIA Guidelines For Coastal Land Reclamation published by the Malaysia Department of Environment (December 1998)

4. The Erosion Control For Development Project In The Coastal Zone published by the Drainage and Irrigation Department (1997)

5. The General Guidelines For Coastal Engineering Hydraulic Studies Using Computer Models published by the Drainage and Irrigation Department (May 1999)

2 BACKGROUND INFORMATION

2.1 The Project

The Sabah Ports Authority (SPA) intends to construct a new container port facility at Sapangar Bay, Kota Kinabalu. The new facility will alleviate the ever-increasing load of general and container cargoes anticipated to pass through Kota Kinabalu Port in the Year 2000 and beyond. The cargoes are likely to be generated by the development of the Kota Kinabalu Industrial Park as well as the Free Trade and Commercial zones in Sapangar Bay area. Furthermore, the emergence of the BIMP-EAGA will increase trade among neighbouring countries of Malaysia.

The Sabah Ports Authority is the project proponent with Sri Dayabena Contractor (S) Sdn Bhd as the main contractor. The detailed design is carried out by the joint venture between Jurutera Perunding Kinakota Sdn Bhd (JPK) and Scott Wilson (Malaysia) Sdn Bhd (SWM).

The container port project is envisaged to include coastal reclamation for container storage facilities and construction of wharf structure to cope with the anticipated cargo traffic.

The proposed site has a total area of 83.6 hectares to be reclaimed and further developed into a container port. The project will be developed in four phases according to the needs and the reclaimed area allocation for all the phases are distributed as follows:

Phase I	20.3 ha
Phase II	13.2 ha
Phase III	33.5 ha
Phase IV	16.6 ha

A 1100m piled jetty and wharf will be built in 3 stages.

Upon completion, the first phase of development will provide the terminal with enough capacity for at least 5 years of operation before expanded to Phase II. The proposed port will be developed according to the following scheduled

Development Phases	Commissioning Year
1. Phase I	2003
2. Phase II	2010
3. Phase III	2015
4. Phase IV	2020

Figures 2.1 to 2.4 depict details of the four phases of the development reclamation and wharf structures and their relationship to the other important features within Sapangar Bay.

Figure 2-1 Wharf and reclamation of Phase I

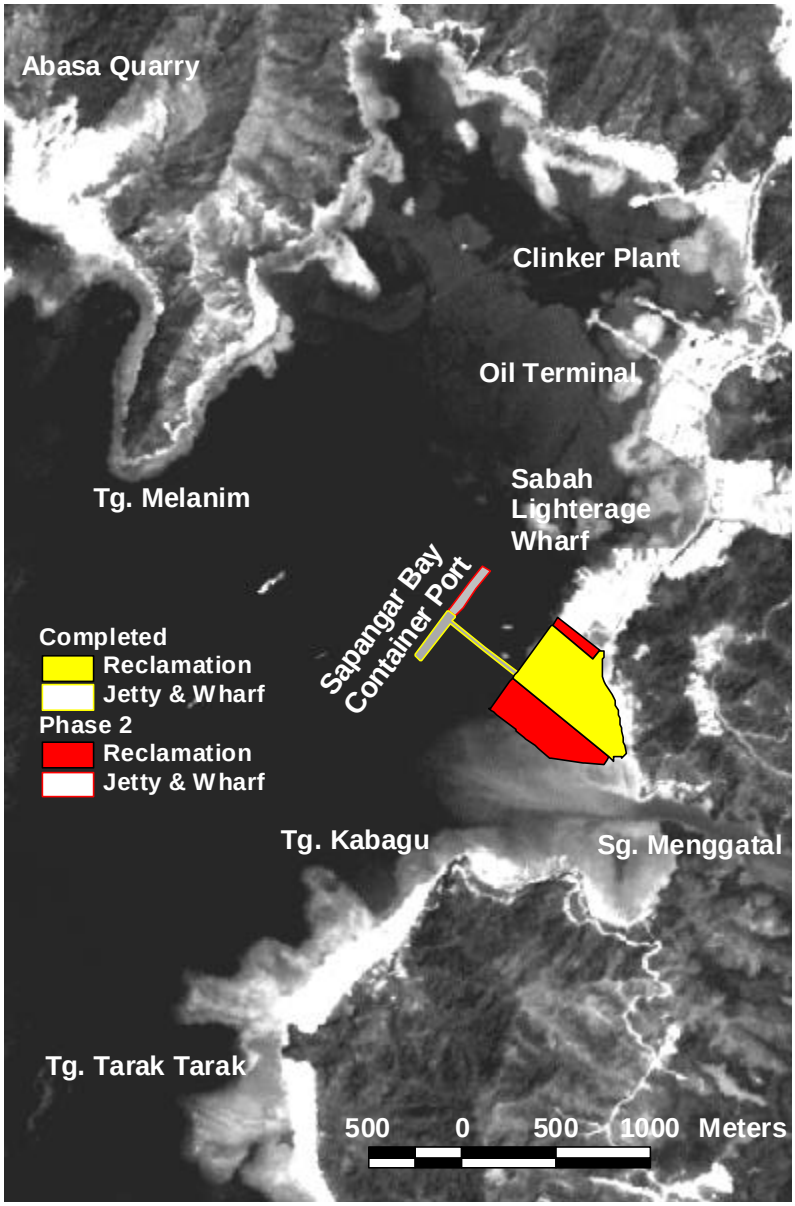

Figure 2-2 Wharf and reclamation of Phase II

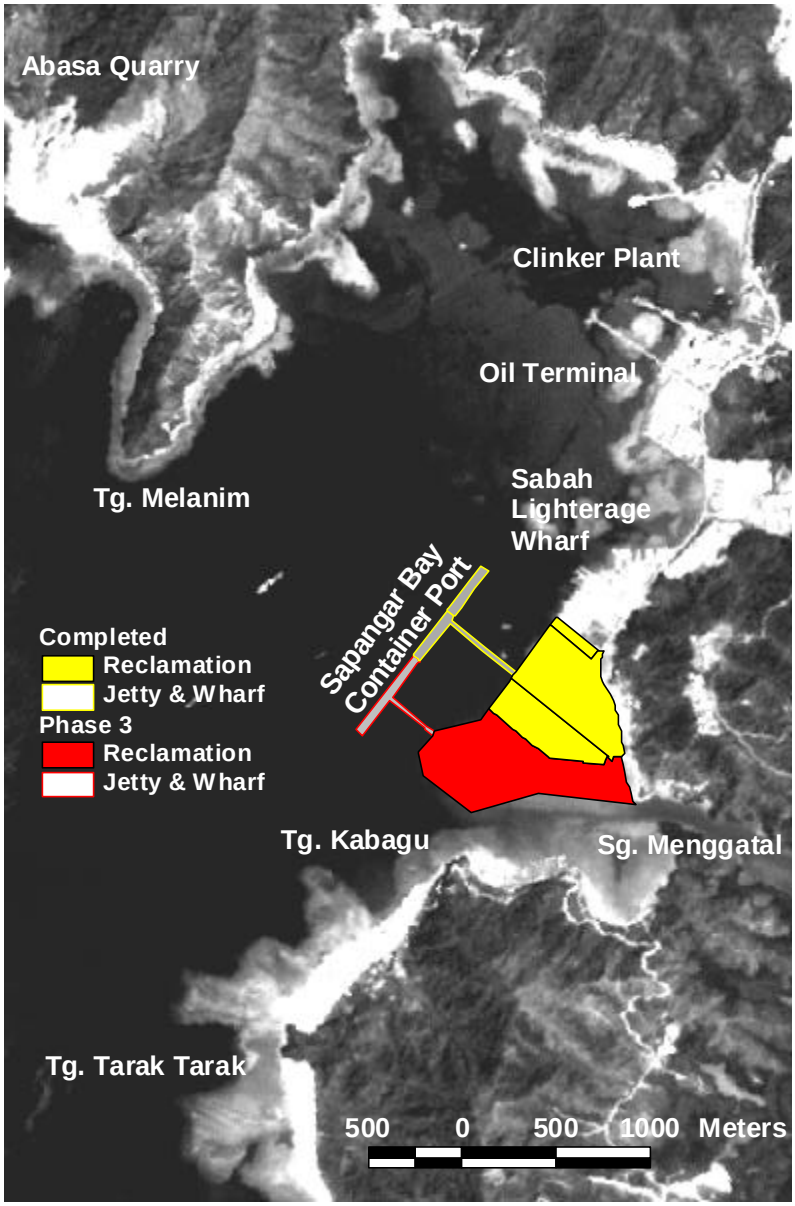

Figure 2-3 Wharf and reclamation of Phase III

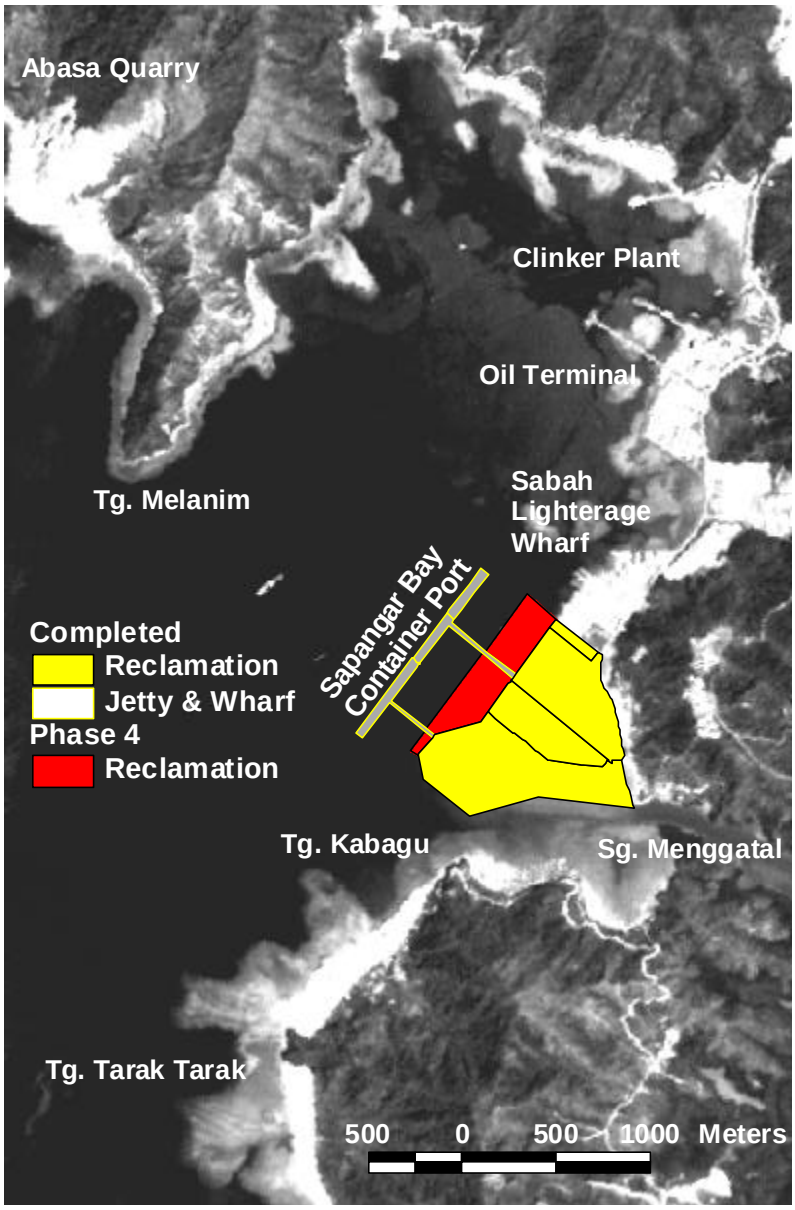

Figure 2-4 Wharf and reclamation of Phase IV

The container port project will be implemented in four different phases according to the need. Out of the four phases, only Phase I is well defined and designed in any detail. Phases II, III and IV are possible expansion options to be reviewed and adopted later.

The descriptions of all the phases are provided as follows:

(a) Phase I

i) During Phase I, the quay space available will be 300m on the main berth and 240m on the inner berth.

ii) Within the total onshore area of 20.3ha, the space provided at the 9 rubber tyred gantry (RTG) serviced blocks in the yard is adequate for 1,824 TEU ground slots, allowing for a stack height of 2.5 containers on average.

iii) Based on the assumptions recorded above, the Phase I development will just be adequate for the traffic predicted up to 2006, about 197,000 TEU. The constraints are the two gantry cranes on the main quay, the maximum of 16 hours working per day on the inner berths and the provision of a cross roadway through the 9 RTG blocks in the yard.

(b) Phase II

i) In Phase II, the berth will be extended to the north increasing the length from 300m in Phase I to 600m.
ii) Phase II will be able to handle to a maximum capacity of 396,000 TEU.
iii) The land area of the terminal will be increased from 20.3ha in Phase I to 33.5ha in Phase II. Although the land area built in Phase II is smaller than Phase I, a far greater proportion of the area would be available for stacking containers, and sufficient space would be available for the additional 1,800 – 1,850 ground slots needed to bring the total capacity to 470,000 TEU.

(c) Phase III

i) In Phase III, the quay will be doubling from 550m to 1,100m in total.
ii) Additional 33.5 ha of land proposed under Phase III would take the total backup area to 67ha, which would be more than adequate to support the workload that could be handled at the berths
iii) Throughput ten times those expected when the terminal opens are clearly a long way into the future. The size of facility needed to handle that traffic is comparable in size with many existing international terminals and could be provided under Phase III at Sapangar Bay.

(d) Phase IV

i) In Phase IV, the option exists of extending land areas seawards, on either side of the access bridges to the berths, providing an additional area of 16.6ha. In practice this is an alternative area for reclamation to that shown in Phases II and III.

Figure 2.5 shows the layouts of the proposed Sapangar Bay terminal.

Figure 2-5 Layout of Proposed Container Port

2.2 Borrow Area

2.2.1 Land

For this particular project, earth borrowed inland material and quarry materials have been proposed to be used as fill material.

Borrow materials for Phase I will be obtained from the residual excavated soil materials that are generated from bulk earthwork for the construction of a warehouse development, which is located within 1 km of the project site.

Due to its proximity, the fill material will be transportable via the existing section of the Sapangar road leading to the proposed port. Although there will be obvious benefits to the costs of the works there will also be a substantial mitigation of the possible environmental impacts that would undoubtedly arise from the transportation of such large volumes over a relatively short period.

Phase II, III and IV will be constructed in another 5 to 20 years time. At such, it is not realistic to identify the borrow material at this stage. However, to ensure the sustainable development of the port project, the availability of borrow areas has been identified in Section 5.

Even though exact borrow areas for Phase II, III and IV have not been identified by the project proponent at this stage, future selection of borrow areas should follow the following criteria's:

(1) Availability of material with acceptable quality
(2) Environmental Impact due to extraction and transportation
(3) The cost of material
(4) The cost of extraction
(5) The cost of transportation
(6) The geotechnical characteristics of the fill material
(7) The chemical component of the fill material to prevent contamination of the seawater.

2.2.2 Sea

Discussion (on 8th July 1999) held with Department of Drainage and Irrigation (Sabah) indicated that, land based material is still being permitted to be used as filling material for coastal reclamation projects in Sabah. However the location, quantity and quality of fill material and the environmental impact due to extraction and transportation of the fill material may be subject to the findings of the Environmental Impact Assessment on the respective borrow area.

A copy of the minutes of meeting is attached in Appendix 4.

As the available marine sand borrow area is limited and far from the mainland, hence, this option is less favoured by Sabah Port Authority due to high cost and it is also not favourable from an environmental point of view as fill material extraction from the sea bed would mean further disturbance to the sensitive marine ecology.

2.2.3 Reclamation Works

Reclamation material will be drawn from a land borrow area within the project vicinity. The material will be excavated using PC 200 type tracked excavators and loaded onto 10 wheel trucks for transport to the site. The trucks will end tips on site and the material will be pushed into location using bulldozer.

The road between the borrow area and site will be maintained using backpusher blades and brushes to remove any material on the roads. Wheels of trucks leaving the borrow area and the site will be washed just prior to leaving each area.

Before the fill material is placed containment in a form of bund will be constructed along the perimeter of the reclamation area. The bund will:

- Retain the fill
- Minimise the escape of fill material into surrounding areas during construction.
- Provide access for equipment and personnel during construction.

The bunds will be constructed from a material with a similar specification to filling material for the reclamation. The containment bund should be capable of retaining the finer particles of the fill material whilst affording the temporary protection against wave action.

Prior to construction of the coastal protection structure, consolidation of the underlying material has to be taking place. The detailed analysis of the soil parameters encountered during the soil investigations has concluded that a programme of vertical drains combined in certain areas with the use of vacuum treatment will be sufficient to obtain 90% consolidation within six months. Installation of vertical drains or sand drains is suggested.

In this project a combination of vertical drain and vacuum treatment will be carried out to accelerate the soil consolidation.

For this reclamation project, armour layers comprised of quarry rocks and filter layer will be used as the revetment structure. This structure will be able to provide excellent protection and tolerate minor consolidation or settlement without structural failure. The structure will also allow for the relief of hydrostatic uplift pressure generated by wave action.

2.3 Project Activities

The project activities that will involve throughout the project development are summarised as follows:

Table 2-1 Project Activities

Project Components	Project Activities
1. Investigation/ Survey	1. Hydrographic Survey
	2. Geotechnical Investigation
	3. Archaeological Study
	4. Hydraulic Study
	5. Marine Ecology Study
	6. Land Traffic Study
2. Reclamation	1. Sourcing of Fill Materials
	2. Contruction of Containment/Bund Structures
	3. Materials Filling
	4. Ground Treatment- Vertical Drains&Vaccum Treament
	5. Construction of Permanent Boundary Protection Structure-Revetment
3. Construction	1. Earthworks
	2. Establishment of Site Office
	3. Construction of Jetty/ Access Bridge
	4. Construction of Building, drainage and fire fighting facilities
	5. Installation of Utilities such as electricity,telecommunication systems, sewerage system, water supply
	6. Improving of external road leading to the port area
	7. Construction of internal access road
3. Operation and Maintenance	1. Container transportation through land and Marine.
	2. Customs clearance
	3. Workshop to maintain and repair all handling equipment, vehicles, attachments and other equipment.
	4. Container handling equipment and machinery 5. Containers stacking
	6. Port Administration including canteen
	7. Security

2.4 Description of the project site

The proposed project site is located at the northern side of the Menggatal River estuary, in the southern part of Sapangar Bay. Sapangar Bay is a deepwater bay, about 10km north of Kota Kinabalu city and port. It is situated between latitudes 6º 04' N and 6º 05' N and longitudes 116º 07' E and 116º08' E. The site can be accessed by the Sapangar Road, which ends at the Sabah Marketing Corporation (SAMA) reclaimed area. The Kota Kinabalu Industrial Park, Free Trade Zone and Free Commercial Zone are located about 5km northeast away from the project site. Figure 2.6 shows the location of the project site.

Figure 2-6 Overview of the Project Location, 10km North of Kota Kinabalu on the South West side of Sapangar Bay

The proposed port will be reclaimed on an open sea area, which is located in an existing industrial area at Sapangar Bay. A hill is located further inland to the east of the project area. The dominant vegetation features are scrub forest, grasslands and swamps. Similarly most of the idling rubber and mixed horticulture area to the north east of the project area is now earmarked for housing development and the Kota Kinabalu Industrial Park.

The southeast side of the bay is characterised by a sheltered littoral beach immediately south of Sg. Menggatal. The eastern side of the Bay is characterised by heavy industry and port facilities, while the northern side of the bay is characterised by small – medium scale industry. The western side of the bay is fronted by several water villages, but is essentially unspoilt. The SW side of the bay is characterised by the islands of Pulau Sapangar, Pulau Udar Besar and Pulau Udar Kecil. These islands have potential from the environmental conservation and tourism perspective and were alienated in the West Coast Shoreline Management Plan as a protected area. The northernmost of these three islands has subsequently been identified as a component for the proposed Sapangar Bay Naval Base and it is thus feared that the tourism potential of all three islands may decrease in the future due to the potential restricted areas around the naval facilities.

The shoreline Management Plan (SMP) for the Sapangar Bay area as sown in Figure 2.7 indicates that the proposed Sapangar Bay Container project forms the southern boundary of the Sapangar Bay Port Development area, which was identified by the SMP as being suitable for reclamation activities associated with port development.

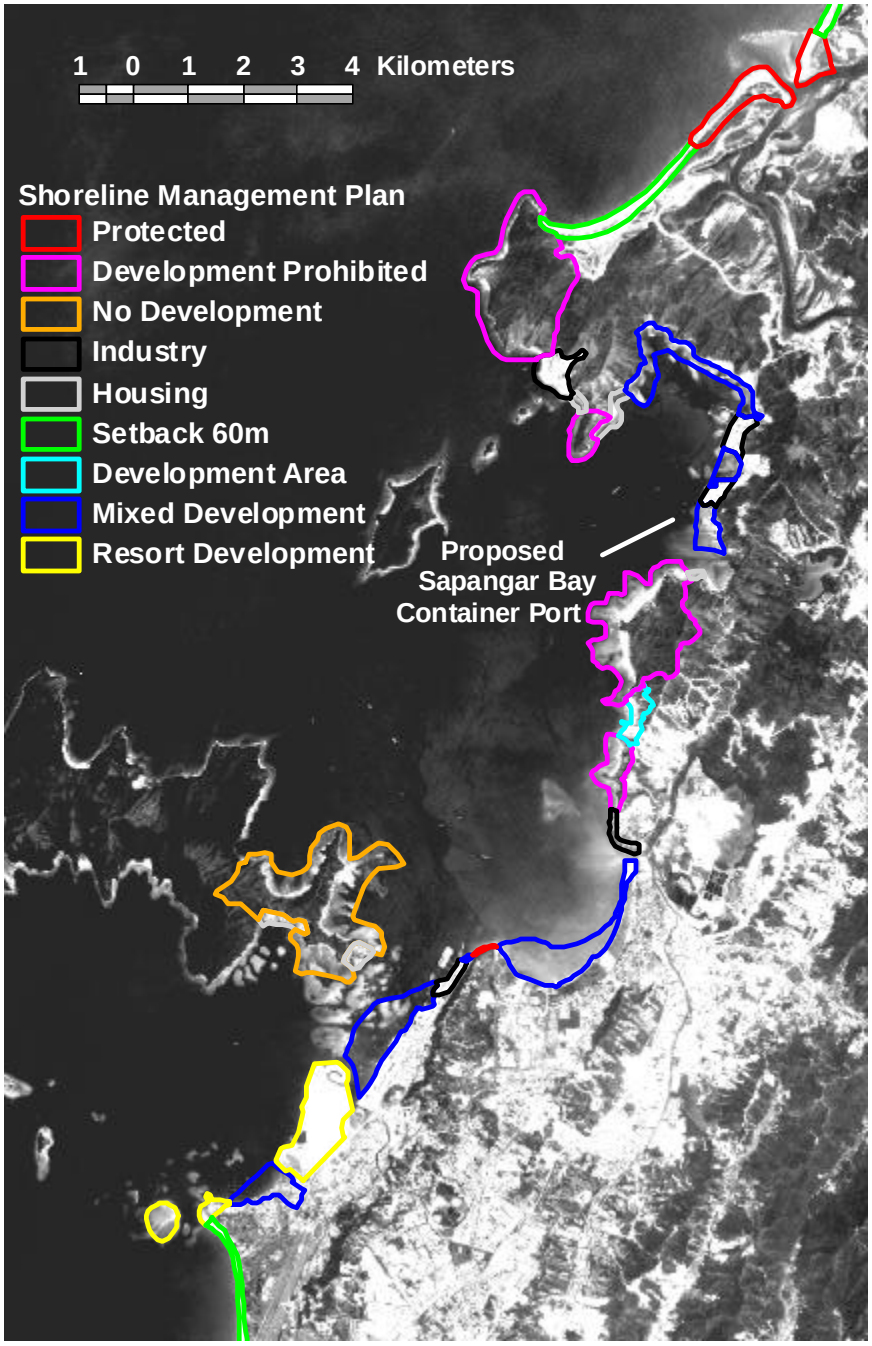

Figure 2-7 West Coast of Sabah Shoreline Management Plan, Sapangar Bay

The Sapangar Bay is currently been occupied by either private corporations or public enterprises for the past 20 years. Among the industries found in this area are listed in the following Table 2.2:

Table 2-2 Industries found within the project vicinity

No.	Industrial Plants	Nature of Business	Distance from Project Site
1	Shell Sapangar Installation	Petroleum	Within 2km to the North
2	BP Sapangar Depot	Petroleum	Within 2km to the North
3	Esso Sapangar Installation	Petroleum	Within 2km to the North
4	Cement Industries Berhad	Cement clinker	Within 2km to the North
5	Petronas Dagangan	Petroleum/LPG	Within 2km to the North
6	Wangsa Maju Industries	(Timber Yard, Timber Processing, and Furniture)	Within 2km to the North
7	Sapangar Chemical Industries	Manufacturing urea formaldehyde	Within 2km to the North
8	Solid Gleam Sdn Bhd	Manufacturing urea formaldehyde	Within 2km to the North
9	Sabah Electricity Power Barge	Power	Within 3km to the North
10	Motorol Chemical	Petro chemical	Within 1km to the North
11	Sabah Lightherage Sdn Bhd	Exporting timber/woods	Adjacent to Phase I to the North
12	Kauluan Sdn Bhd	Processing animal feeds etc.	Within 3 km to the North

2.5 Project Status

The EIA study of the proposed project was initiated prior to the gazetting of the Conservation of Environment (Prescribed Activities) Order 1999. As a result, the original Terms of Reference has been administrated and submitted to Federal DOE (Headquarter) for review.

However, further to DOE (HQ) recent notification through their correspondence dated 13th February 2001[ref: AS 50/013/402/010 Jld 2 (3)] regarding the newly approved Environmental Quality (Prescribed Activities)(Environmental Impact Assessment)(Amendment) Order 2000, where Environmental Quality (Prescribed Activities)(Environmental Impact Assessment) Order 1987 is no longer applicable to activities prescribed [except for activity 7 (viii)] under the First Schedule of the Conservation of Environment (Prescribed Activities) Order 1999.

As a result, a Terms of Reference is now required to be revised according to ECD's format and requirement for further approval.

During the course of the report preparation since the early stage of DOE submission, several studies have been conducted and the following approvals and procedures have been obtained and conducted:

(1) Public Announcement for Original Terms of Reference
(2) Presentation of the Terms of Reference to the selected Review Panel
(3) Approval of Original Terms of Reference to Department of Environment
(4) DOE (Federal) notification about the newly approved Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) (Amendment) Order 2000.

The above listed correspondences are attached in Appendix 5.

3 SCOPE OF WORKS FOR THE SPECIAL EIA STUDY

3.1 Key environmental Issues

The key environmental issues likely to arise as a result of the development of the project will be identified and quantified using acceptable prediction methodology. The results indicate certain degree of potential impacts of the environment and shall be evaluated against the applicable law, standards, regulation, guidelines, etc.

The TOR has identified the key environmental issues, which are likely to undergo direct and indirect modification from the construction phases and operational activities of the development.

The following impacts categories will be referred in the S-EIA report:

(a) Reclamation and Construction Impacts

The impacts discussed under this section are defined as those that are temporal whereby the environmental stress factor will be removed once construction is complete

(b) Post Construction Impacts

This group of impacts are derived by the Marine and Hydraulic specialist to emphasise on all environmental stress factors resulting from the port development, which are permanent in nature, the impacts of which are by default permanent. The obvious example here is direct loss of habitat from reclamation in coral, seagrass or mangrove areas.

(c) Operational Impacts

The impacts discussed under this section are defined as those that are continuous due to the port operation such as waste effluent generation and noise generated from machinery.

The environmental impacts are classified into the three categories; physical, ecological and socio-economic and are listed in the following Table.

Table 3-1 List of Environmental Key Issues to be studied

Environmental Components	**Key Environmental Issues**
1. Construction and Reclamation Stage	
(a) Physical Issues	Impacts related to sediment spill from the reclamation activities Impacts on water quality as a result of reclamation
	Impacts on ambient underwater noise levels as a result of pilling Impacts on ambient noise level
	Impacts on ambient air quality
(b) Ecology Issues	Habitat impacts from suspended sediments
	Habitat impacts from sedimentation
(c) Socio Economic Issues	Displacement of People
	Disturbance to fishing activities
	Archaeology impacts
	Transportation and navigation safety Construction waste disposal
	Handling of construction material and machinery
2. Post Construction Stage	
(a) Physical Issues	Impacts on sedimentation
	Impacts upon tidal circulation
	Impacts upon coastal morphology
	Impacts upon upstream flooding
	Flushing of Sungai Menggatal Water quality
(b) Ecology Issues	Direct loss of habitat
3. Operational Stage	
(a) Physical Issues	Impacts on water quality
	Impacts on air quality
	Impacts on noise quality
(b) Ecology Issues	Wake and propeller wash impacts
	Endangered species
(c) Socio Economic	Land and marine traffic
	Fishing activities
	Employment
	Occupational safety and health
	Fire hazard
	Land use impact Utilities, infrastructure and public amenities
	Solid waste generated

Several key environmental issues described above are inter-related especially coastal hydraulic and their impacts on marine habitat. To avoid overlap in describing the assessment method, it is best that these environmental issues be described as one section rather that explained individually.

3.2 Methodology Of Impacts Identification and Prediction

(A) *Physical Issues*

Reclamation into the estuary of Sungai Menggatal may change the hydraulic regime of the river causing increased water level and changes to the river profile, particularly Phase III, which will constrict the river mouth. Possible changes in salinity and water quality will also need to be addressed, particularly the latter as drainage from Kota Kinabalu Industrial Park is proposed to be discharged into this river system.

A hydraulic study and water quality assessment of the upstream reaches will be undertaken to determine the magnitude of effects. A hydraulic modelling package will be used to examine the change in average flow velocity and water before and after the port development. This will enable the potential magnitude of impacts on salinity, sediment transport and flooding to be judged. The shape of the reclamation will also be reviewed to reduce negative effects.

3.2.1 Hydraulic Study Description

The proposed hydraulic impact studies consists of two (2) phases:

Phase 1 – Primary Field Survey and Data Collection

Existing data will be assimilated and areas of missing or lacking knowledge identified. Field surveys will be initiated to address these shortfalls in the existing data sets in order to expand the detail, spatial and temporal coverage of the existing data to a level suitable for the Special-EIA. In addition, baseline environmental monitoring data will be collected as a documentation of the existing environment prior to construction. Repeat monitoring during construction will then form the basis for documenting compliance with environmental quality objectives.

This phase is divided into three (3) tasks:

- Task 1 Sourcing of existing data
- Task 2 Field surveys
- Task 3 Data management

Phase II – Physical Chemical and Biological Impacts

Advanced numerical models will be utilised to assess the impact of the proposed development upon the marine and estuarine environment, the main issues being:

a) Impact upon water exchange in the Menggatal and resulting impacts upon:

- Marine ecosystems (mangroves)
- Water quality
- Sedimentation
- Flooding

b) Impact upon marine circulation and resulting impact upon:

- Marine ecosystems (coral/seagrass)
- Water quality

This phase is divided into three (3) tasks:

- Task 4
  Hydraulic impact model of Sapangar Bay and Sg Menggatal

- Task 5
  Water quality impact model of Sapangar Bay and Sg.Menggatal

- Task 6
  Sedimentation model of Sapangar Bay

3.2.1.1 Task Description

Task 1: Sourcing of Existing Data

A large quantity of data is available for the Sapangar Bay area, not only from DOE/DID, but also primarily from the numerous EIA's performed on the region. The data from the earlier studies has been assimilated by the Shoreline Management Plan study and these data can be assumed to be directly available for the present study, data dissemination being one of the primary aims of the SMP.

Data is available from the SMP for the following areas:

- Bathymetry
- Tide and ocean currents
- River discharges
- Operational and design wave conditions
- Design water level conditions
- Bottom sediments
- Suspended sediments
- Water quality
- Eutrophication
- Marine habitats/ecosystems

Since conclusion of the SMP, this data has been supplemented by a DHI financed internal research projects and detailed Acoustic Doppler Current/Flux measurements are available in the study area and a detailed mangrove monitoring campaign has been initiated.

The large quantity of existing data available through the SMP and other sources will be reviewed in the context of the present study, and the data volume controlled to ensure only relevant data is brought forward into the main study.

Task 2: Primary Field Surveys

Task 2.1: Bathymetric Surveys

In order to ensure accurate performance of the hydraulic models in the vicinity of the development area and within the potential impact area, a high-resolution bathymetric

survey is required. The coverage of the bathymetric survey is shown in Figure 3.1. Data will be collected using an online digital echo sounder, differential GPS positioning and navigation software package with the following specifications:

Positioning:	OMNISTAR Differential GPS with nominal 1ó accuracy of ± 1m.
Depth:	Sonarlite single beam echo sounder with nominal 1ó accuracy better than ± 0.2m taking into account environmental factors.
Water level correction:	Water level recorder at Kota Kinabalu port.
Calibration:	Twice daily bar check.
Survey lines:	15m
Sampling frequency:	1 hz.
Navigation:	NaviPac

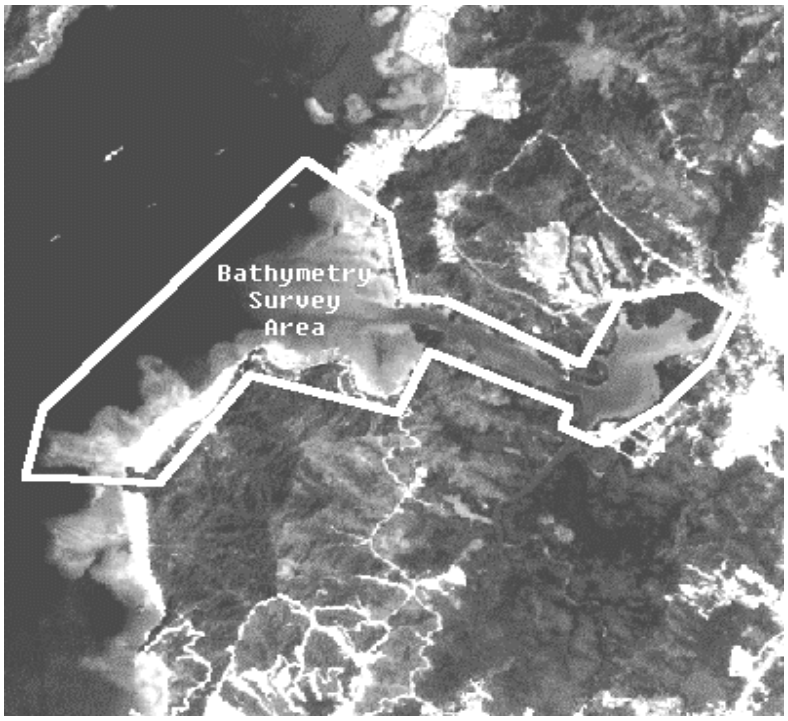

Figure 3-1 Proposed bathymetry survey area.

The survey is aimed at providing DTM input to the hydraulic model, and as such the resolution and accuracy reflect the resolution and accuracy of the numerical models. Within the Menggatal estuary, the bathymetry survey information will be extended with depth information derived from species inundation relationships and other indicators concerning elevations within the mangrove fringe to enable the correct simulation of the tidal prism.

Task 2.2: Current Measurements

A quantification of the tidal prism within Sg. Menggatal is essential for the hydraulic modelling tasks. The confined nature of the entrance however makes this a straightforward task either by drogue tracking or directional current metre. One cross section is sufficient with measurements to be taken on spring and neap tide.

Task 2.3: Water Quality

To supplement existing monitoring data, specific sampling in Sg. Menggatal and the adjacent marine waters will be executed with the aim of establishing the pollution loads necessary for the water quality modelling. The sampling for the pollution load estimate will be co-ordinated with the baseline water quality monitoring and current measurements.

An estimated 34 water quality samples will be collected at sufficient stages of the tide and at sufficient stations to enable loading estimates to be made. In particular, samples will be taken in conjunction with flow measurements and rainfall measurements to establish the representivity of the sampling campaign. Analysis for the following basic parameter set will be made either insitu or by an approved laboratory:

- Temperature
- Salinity
- E-coli
- BOD
- COD
- DO
- NH_4

Particular attention will be taken to establish the loadings from the major Department of Fisheries fish farm at the head of the Menggatal. Figure 3.2 shows the sample locations.

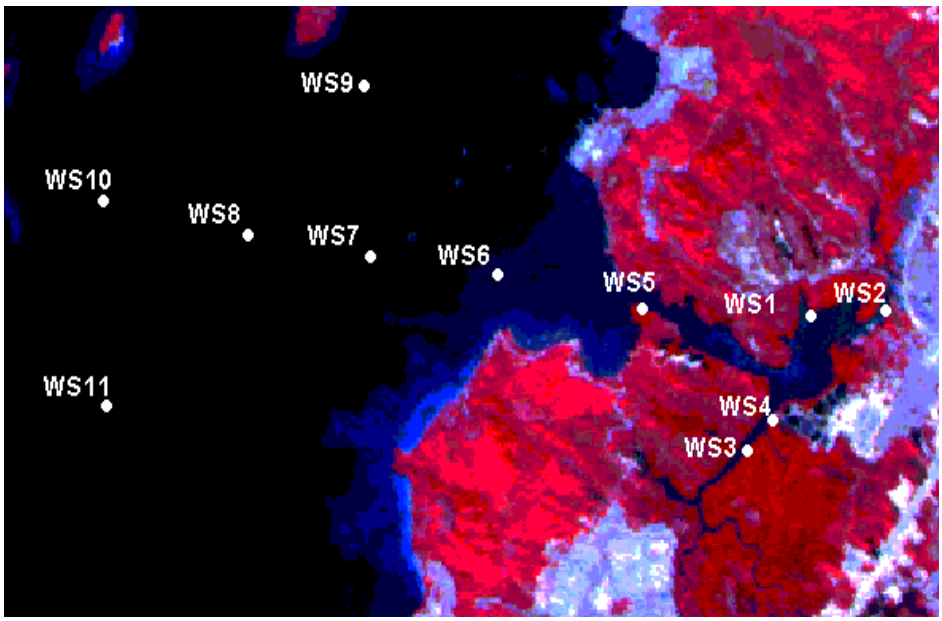

Figure 3-2 Water quality sampling locations.

In addition to the hygienic water quality parameters stated above, sampling within the Menggatal estuary will also be made in order to ascertain the nutrient loading with parameters conforming the West Coast of Sabah Shoreline Management Plan requirements with respect to eutrophication analysis.

Task 2.4: Suspended Solids

To address the issue of sedimentation of riverine sediments in the mouth of the Sg. Menggatal as a result of the development, information on suspended solids emanating from the river is required. It is also essential to establish the background concentrations over the various marine habitats, such that the impact assessment regarding sediment run-off from the reclamation can be based upon relative changes rather than absolute values, which provides for easier interpretation with respect to potential impacts.

Approximately 40 suspended solid samples will be recovered and analysed for total suspended solids and mean suspended solids grading.

A bottom sediment sampling investigation will also be carried out. A total of 7 sediment samples collected using a 15kg Van Geer grab sampler, which would be indicative of the surface 20cm of the bottom sediments, should be sufficient. The recovered sediment samples will be analysed for heavy metals, organic content and hydrogen sulphide.

Task 3: Data Management

All data captured will be in digital format. The resulting database will be maintained in Arc View, which is the standard GIS platform across most of the Sabah State Government. A copy of all relevant project data contained in the spatial database will be delivered to the state government and DID at the conclusion of the study.

Task 4: Marine Hydraulic Impact Model of Sapangar Bay and Sg. Menggatal

The regional hydraulic MIKE 21 model of Kota Kinabalu-Sapangar Bay area developed by DHI for the West Coast of Sabah Shoreline Management Plan, has been further refined by DHI during the course of 1998 for the Kota Kinabalu Waterfront and Likas Bay reclamation projects with extensive in-house Acoustic Doppler Profile (ADCP) measurement of the tide and regional current flux around Sapangar Bay and Pulau Gaya being taken in April 1998. Additional project specific current and water level data will be taken in the Sapangar bay area as part of the present project. Figure 3.3 shows the extent of the data coverage.

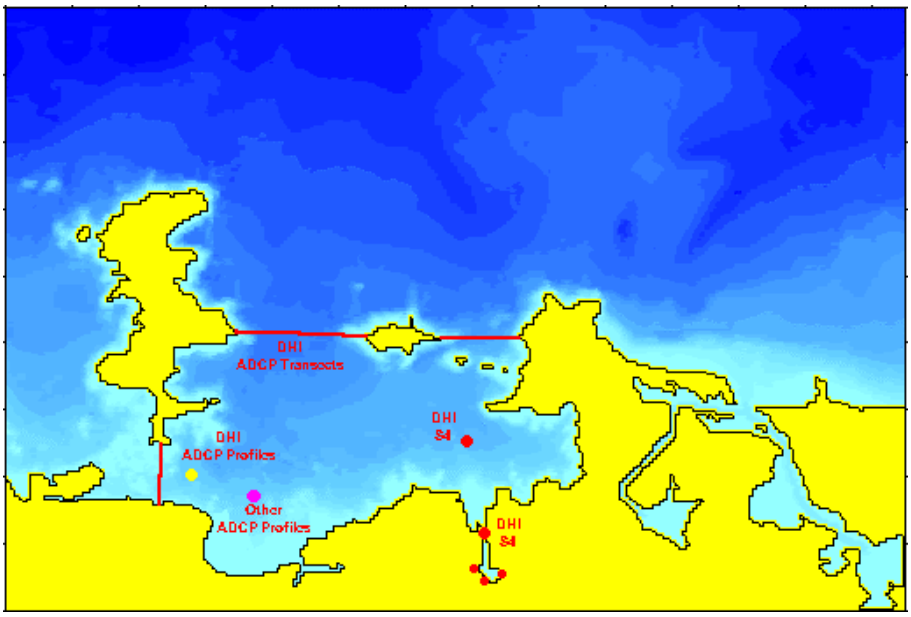

Figure 3-3 Existing and Planned Current Data for Model Calibration-Verification.

These data enable a highly reliable tidal model to be created in the Kota Kinabalu-Sapangar Bay area.

The information provided by the SMP project also enables the effects of seasonal monsoon currents to be considered, which prove to have a dominating effect on the water exchange into and out of Sapangar Bay, with surface currents in the order of 30cm/s previously being recorded offshore of Sg. Menggatal.

The model area proposed for the present study is identical to that developed by DHI from the regional SMP and Likas Bay models in 1998 and shown in Figure 3.4.

The model bathymetry resolution/detail needs to be enhanced in the vicinity of the mouth of the Sg. Menggatal and the Menggatal estuary introduced into the model and this will be accomplished by a local bathymetry survey as described in, Task 2.1.

The Menggatal estuary will be simulated as a nested sub-grid within the regional marine hydrodynamic model with anticipated resolution in the order of 15m. Figure 3.3 shows the anticipated boundaries to the nested model area.

The simulation period will be a 7-day sub-set of a representative spring-neap tidal cycles plus 3-days model warm-up with three (3) basic regional climatic conditions being investigated for the Phase I development. NE monsoon, SW monsoon and transitional, as the regional processes prove to have a dominating effect upon the transport and fate of material entering the water column from which the dominant seasonal condition will be established such that simulations for Phases II and IV the impact assessment will be restricted to just one season. For phase III, which has potentially the largest impact all three (3) representative seasonal scenarios, will be considered.

In addition to the basic scenarios listed above a further test will be made to establish if the project area is affected by the proposed developments in the Likas Bay and Kota Kinabalu waterfront areas.

Hydraulic study will also address the impact of the Naval Port on the boundary conditions to the proposed Container Terminal Hydraulic model area. The Naval Port will be introduced on a basis of 3 million m^3 reclamation area, this being the best available information on the area.

The hydraulic model will run for all four (4) phases of construction to provide hydrodynamic input to the sediment plume and water quality models described in the followings and to provide a direct quantification of the impact of the reclamation on the nearshore currents in the development area.

Task 4.1: Impact on Flooding in the Menggatal Estuary

The impact of the development upon water levels in the Menggatal will be investigated for the Phase I/II and Phase III development configurations by introducing the estimated 1in 20 year fresh water flow entering Sg. Menggatal from the 4 or so major streams feeding the lower estuary. The simulations will look at a worst case coincidence of flood with tide and a mean coincidence of flood with tide.

Results will be presented as difference in water level between the existing no development situation and the post development situation. Explicit flood inundation mapping will not be performed as the impacts are expected to be small, given suitable mitigation (particularly for phase III). The significance of any increased flood levels in the inter-tidal area will, however, be compared to the location of existing developments/habitations in the area in case compensation dredging is not a viable mitigation alternative. In this case detailed a flood impact assessment may be required at a future stage.

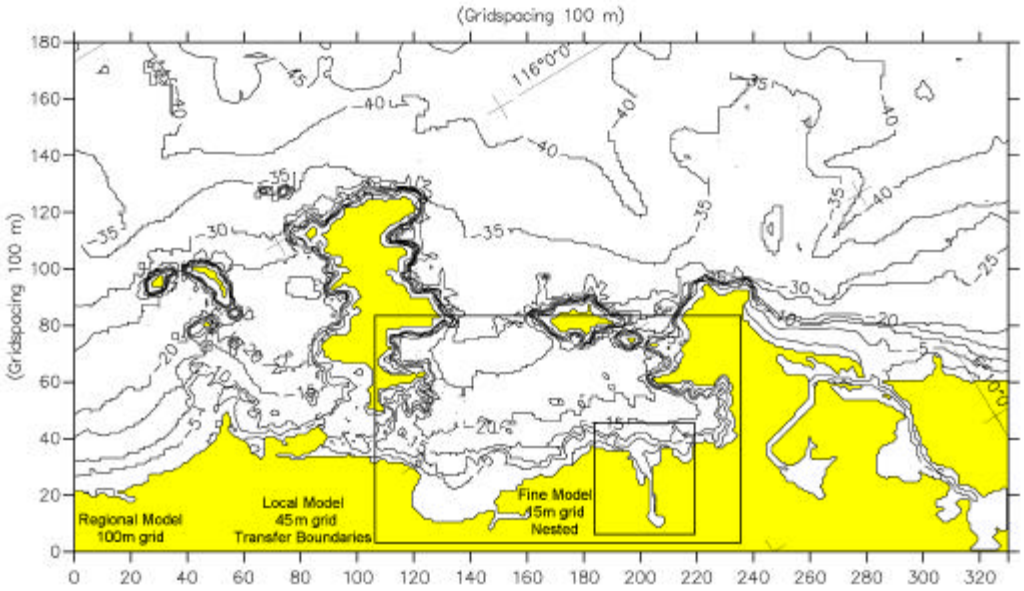

Figure 3-4 Marine Hydraulic Model Area.

Task 5: Water Quality Impact Model for Sapangar Bay and Sg. Menggatal

Task 5.1: Salinity

The impact of the development, particularly Phase III, upon the tidal prism and the salinity balance within the Menggatal will be assessed as the salinity is an important

factor in governing the species composition of the mangrove fringe and hence its function as fish breeding and feeding grounds.

MIKE 21 AD will be utilised to simulate the salinity characteristics within the Menggatal for the existing and post Phase III construction situation. The simulations will be performed for a representative rainfall hydrograph covering the 7-day design simulation period.

Task 5.2: Hygienic Water Quality

There are several sources of bacterial pollution within the Menggatal and the hygienic water quality may be influenced by the development due to changes in the flushing characteristics.

MIKE 21 WQ will be used to simulate the transport and decay of total coliform and faecal coliform from the various loading sources within the Menggatal most notably, Taman Sapangar, Kg. Unggun, Kg. Selembangan and Taman Kuala Menggatal, which is undergoing rapid development in association with KKIP. Loading estimates will be based upon a population assessment for the main kampungs utilising the loading relationships documented in the SMP. Model calibration will be made against recovered water quality samples as described in task 1.

The water quality simulations will consider a representative rainfall hydrograph over the 7-day design simulation period for one dominating regional current scenario only. Phase Phase III and I developments will be considered. Phases II and IV being judged to represent negligible additional impact over preceding development stage.

Task 5.3: Oxygen Depletion

The Ministry of Agriculture's fish farm at the head of the Menggatal discharges oxygen depleted water into the estuary, which combined with the oxygen demand within the estuary, leads to the possibility of poor dissolved oxygen conditions if the flushing of the estuary with oxygen rich marine water is reduced.

The oxygen balance within the estuary will be considered excluding the description of nutrients utilising MIKE 21 WQ. The number of simulations is identical to that listed under task 5.2. The assessment will also consider the impact of the project on the transport and dispersion of ammonia released as part of the discharge from the fish farm.

Task 6: Sedimentation Model for Sapangar Bay

Task 6.1: Sediment Plume Impact

The transport and fate of material entering the water column during dredging and reclamation activities is generally the prime source of impact resulting from marine reclamation projects, particularly in environments which possess sensitive habitats such as coral reefs, which are highly susceptible to changes in light conditions resulting from the shading produced by suspended sediment plumes and the sedimentation resulting from the deposition of suspended sediments.

The proposed site of the Sapangar Bay container terminal is, however, fairly sheltered from wave and current activity such that, combined with the fact that the fill will be from land sources, the impact of suspended sediments released during the

reclamation process is not as significant compared to reclamation involving borrow dredging and marine fill, for example.

Nevertheless, even with careful bunding of the reclamation area, sediment over-spill will occur, particularly, during rain and thus it is important to consider the impacts of the resulting sediment plumes upon the coral reef and seagrass habitats found in the vicinity.

This assessment will be conducted using DHI's MIKE 21 MT Sediment Plume Model, which includes the transport, rate and re-suspension of sediments as a result of current and wave action.

The model area and simulation period will be identical to the hydraulic model set-up described under task 2.1 above. The following reclamation cases will be considered:

Phase I One (1) Bund-wall re-suspension / overflow scenario
NE, SW monsoon and transitional
One (1) capital dredging scenario
Worst case hydraulic conditions

Phase II One (1) Bund-wall re-suspension / overflow scenario
Worst case hydraulic conditions

Phase III One (1) Bund-wall re-suspension / overflow scenario
Worst case hydraulic conditions
One (1) compensation dredging scenario
Worst case hydraulic conditions

Phase IV One (1) Bund-wall re-suspension / overflow scenario
Worst case hydraulic conditions

In addition to the listed eight (8) scenarios, a provisional two (2) scenarios is allowed for in order to investigate modified operating procedures/restrictions, which may or may not be required in order to meet environmental quality objectives and to establish suitable disposal areas if disposal of capital dredging material is required.

Model results will be presented as 2-dimensional mean excess suspended solid concentration and net excess deposition fields over the simulation period.

This will enable the % light attenuation over the habitats to be established, which proves to be the best indicator of potential impact to coral reef and associated ecosystems. These will be compared to the habitat maps developed from the field surveys and the existing background concentration/deposition resulting from discharges from Sg. Menggatal.

The light attenuation figures will be compared to documented figures for critical and sub-critical limits established from Environmental Monitoring Programs of major dredging works in the region, for example, the Bali Turtle Island Monitoring executed by DHI in association with the Danish Water Quality Institute during 1996-1998.

If the sediment plume is carried into the Menggatal, sedimentation fields will be compared to existing mangrove habitats and species sedimentation tolerance.

Task 6.2: Sedimentation Impact

Reduced flow through the mouth of Sg. Menggatal may lead to deposition of suspended sediments carried through the river system. With time, this could lead to exacerbated flood levels, particularly if the sedimentation is concentrated in the entrance area, which could further reduce the tidal prism.

Based upon the sediment loading estimates developed from the field surveys, MIKE 21 MT will be utilised to investigate depositions before and after the development from which a qualification of the sedimentation impact can be made. Only the phase III development will be considered, the other phases of development being judged not to result in significant sedimentation impact.

3.2.2 Baseline Water Quality

Ballast water are not considered to be a concern for this project because vessels will primarily be taking on ballast water, rather than discharging it, as the net activity will be importation of goods, and secondly because vessels will be assumed to comply with the IMO Guidelines for Preventing the Introduction of Pathogens from Ballast. The seasonal occurrence of red tide will be acknowledged so as not to export or import the algae into the Bay.

Existing water quality will be evaluated both from existing DOE records and any other recent relevant sampling in the area and from a proposed program of sampling at various stations and tidal phases in Sungai Menggatal and Sapangar Bay.

Accidental spillage of oil can greatly affect the water quality, this impact will be considered in the S-EIA.

3.2.2.1 Water Quality Monitoring

Water quality monitoring will be undertaken to gather baseline water quality data to be used for environmental management. The water quality parameters are inline with the parameters set by the DOE. Some parameters may be excluded if they are deemed not significant in terms of relevance to this particular project.

(a) Marine Water Quality

Baseline conditions for marine water quality will be determined. The water quality results should be compared to the Interim National Marine Water Quality Standards (Malaysia), for compliance to support the marine aquatic resources and recreational activities. The parameters to be measured are listed in Table 3.2.

(b) River and Estuary Water Quality

Water quality becomes important as there are streams (Menggatal River) flowing around the proposed project areas. The parameters to be measured are listed in Table 3.2. Marine sediments will also be collected and analyse for the parameters listed under Table 3.2.

Figure 3.2 shows the proposed location of water and sediments sampling points.

Table 3-2 Parameters and Location of Water Sampling.

Parameter	River Water	Marine Water	Marine sediment	Estuarine water
1. Physical	• pH • DO • Temperature • Turbidity • Salinity • Suspended Solids	• pH • DO • Temperature • Turbidity • Salinity • Suspended Solids		• pH • DO • Temperature • Turbidity • Salinity • Suspended Solids
2.Anions	♦ NO^-_3 ♦ NO^-_2 ♦ Total Nitrogen ♦ NH_4^+ ♦ PO^{-2}_4 ♦ Total Phosphorous ♦ Chlorophylls-a	♦ NH_4^+	• Hydrogen Sulphide	♦ NO^-_3 ♦ NO^-_2 ♦ Total Nitrogen ♦ NH_4^+ ♦ PO^{-2}_4 ♦ Total Phosphorous ♦ Chlorophylls-a
3.Heavy Metals /cations	• Cr • Cd • Hg • Pb • As • Ni • Cu	• Cr • Cd • Hg • Pb • As • Ni • Cu	• Cr • Cd • Hg • Pb • As • Ni • Cu	• Cr • Cd • Hg • Pb • As • Ni • Cu
4. Organics	• BOD • COD • Oil and Grease	• BOD • Oil and Grease	• Organic Contents	• BOD • COD • Oil and Grease
5.Microbial	• E-coli • Faecal Coliform	• E-coli • Faecal Coliform		• E-coli • Faecal Coliform
6.Sampling Points	• 4 stations	• 6 stations	• 7 Samples	• 1 station

3.2.3 Baseline Air Quality

Operation of a container port in itself causes few emissions other than from transport sources. These include road going lorries, internal site vehicles and container vessels. Experience shows that, when well regulated, such low levels of emissions have no deleterious effect.

Construction of the reclamation may cause dust nuisance at Sapangar Bay Settlement, Kg Selembangan/Numbak and UiTM. Measures to minimise such nuisance will be identified. Baseline air quality will be sampled and drawn from existing records for the vicinity.

3.2.3.1 Air Quality Monitoring

Air Quality should be measured periodically to determine baseline data for parameters such as dust, hydrogen sulphide and carbon monoxide.

Hydrogen sulphide data is required due to the possibility of its release in tidal land filling as a result of pressure from fill material. Hydrogen sulphide is normally trapped in anaerobic sediment with high organic content. Therefore it is necessary to have baseline data for comparison. Baseline data on vehicle emissions and noise can be calculated based on known traffic volumes.

(a) Total Suspended Particulate (TSP)

Sampling of ambient air for total suspended solids (TSP) using pre-calibrated Volume sampler for 24 hours sampling. TSP expected to be measured at 4 stations with 3 samples at each station.

The collected TSP samples will be analysed using gravimetric technique. Result of TSP will be expressed in term of $\mu g/m^3$.

(b) Hydrogen Sulphide

Sampling of Hydrogen Sulphide in ambient air using pre-calibrated trigas sampler by chemical absorption technique for a period of 12 hours. The loaded sampler will be analysed using colorimetric method.

H_2S samples will be collected at 4 stations with 2 samples at each station.

3.2.4 Noise level

Noise levels in the vicinity of the site are currently low, despite the level of activity in the northern part of Sapangar Bay. Construction and operation (particularly 24 hours) will give rise to higher noise levels at Sapangar Bay Settlement, Kg Selembangan/Numbak and UiTM. The daytime and night-time noise levels at these receptors will be predicted and mitigation measures identified.

The contribution to noise levels of container terminal traffic (including construction traffic) on Sapangar road will also be evaluated. Noise will be evaluated both in terms of Lmax and Leq, and former being particularly relevant to night-time operations since it is a better indicator of sleep disturbance.

3.2.4.1 Ambient Noise Monitoring

Ambient Noise proposed to be measured at 6 locations, for 3 times in a day during daytime and night-time. Measurements of Laeq, LA90, LA50, LA10 will be recorded for a period of 30 minutes each time with 5 minutes interval.

Figure 3.5 shows the location of Air and Noise sampling points.

Figure 3-5 Location of Noise and Air Monitoring stations

(B) Biological System

3.2.5 Habitat and Marine Biodiversity

Changes in water quality may affect the fish stocks in Sapangar Bay area. Impacts will be determined through reference to the Fisheries Department (Annual Fisheries Statistics) and discussion with local fishermen.

Effects on the mangroves through changes in water quality will be evaluated.

3.2.6 Benthic Biology

The mouth of Sg. Menggatal is a soft bottom environment and supports benthic life that may be an important transition area between the Menggatal Mangrove swamp area and the sea.

The reclamation will smother some areas of the benthic community, either directly or through drifting of fill during reclamation. Although other EIAs for Sapangar Bay suggest the seabed fauna to be of little significance, this site will be investigated specifically (in varying levels of detail within the area of 500m downstream of the reclamation) to determine the significance of any resources found in a regional context based on existing records.

3.2.7 Marine Habitat Survey

Construction activities of the Sapangar Bay Container Port will involve dredging of navigational channel, dumping of filling material, site clearing etc. Such activities would result in increase in turbidity, colour and sediments in the water and subsequent siltation of sediments on the stream bed. The consequences could be severely affected water quality, which in turn would create conditions unfavourable to aquatic life. The Tunku Abdul Rahman Park, a marine park located about 7.5 km from the project site will be considered in the assessment of sediment plume or sedimentation impacts.

The operation of the port would involve wastewater and sewage discharge, which would in turn deteriorate the water quality which affect the aquatic life.

Thus to assess these potential impacts on aquatic life, a biological survey around the project site is required to establish the existing status of the marine ecosystems in the study area and to identify representative species/areas to form the baseline for the environmental monitoring and management program.

The key marine habitats are:

Coral reefs	Degraded reefs are found in close proximity to the site with better quality reefs to the south within 2km of the site.
Seagrass beds	A moderately large area of seagrass is located within 1.5km of the site.
Soft bottom	The mouth of Sg. Menggatal is a soft bottom environment and important transition area between the Menggatal Mangrove swamp area and the sea.

Mangrove The Menggatal estuary is an important mangrove habitat. This issue is covered under the Terrestrial habitats section (§3.3.8).

All three habitats are essential to the bio-diversity of the Sapangar Bay area in particular and the Kota Kinabalu area in general, and the maintenance of the breeding and feeding areas represented by these habitats is essential to the fish stocks in the area. Although already badly degraded, further impacts to these habitats may result in significant changes to an already stressed balance in the nearshore fishing grounds.

(a) ***Coral reefs***

Primary survey techniques will include Line Intercept Transect (LIT) survey; single point dive (Scuba search) and manta tow where relevant to expand the spatial coverage.

Records of the following will be made according to the standards laid down in the West Coast of Sabah Shoreline Management Plan:

- % Live coral
- % Dead coral
- % Soft coral
- % Rubble
- % Algae
- % Seagrass
- % Sand
- % Others
- Key Species

The recovered data will be introduced into a GIS and the point, line and Manta tow data expanded utilising existing data upon known reef locations from the SMP study in order to give a clear picture of the reef ecosystem in the Sapangar Bay area.

In preparation of the environmental monitoring during construction, four (4) representative monitoring stations in the potential impact area and one (1) control station outside the impact area will be surveyed and instrumented for the following parameters:

- Growth rate
- Bleaching
- % Dead coral
- Diversity
- Recruitment

The monitoring station will be revisited once during the present study period (3 months after first survey) to enable baseline data on growth rate and re-colonisation to be established. Repeat visits to these sites during construction will then form the basis for documenting the impact of the construction work upon this ecosystem.

Figure 3.6 shows the planned location of the monitoring sites C1 to C4 with C4 being the control station outside the anticipated impact area. The plot also shows the approximate location of the proposed port development (blue phase 1 and 2), green Phase III.

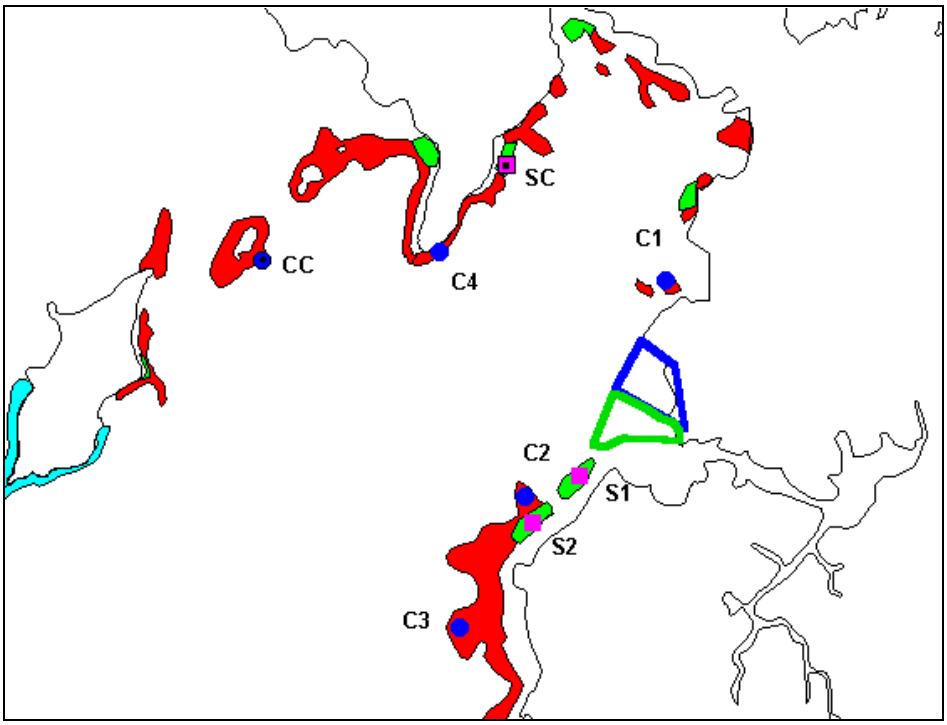

Figure 3-6 Proposed Coral Reef and Stationary Monitoring Stations

(b) ***Seagrass***

A survey of the spatial distribution of key species of seagrass/macro algae will be made in the Sapangar Bay area to supplement information available from the West Coast of Sabah SMP.

Of the identified areas, three (2) representative seagrass/macro algae stations within the potential impact area and one (1) control station outside the impact area will be identified and surveyed to allow repeated monitoring visits during the construction period. One (1)-monitoring repeat will be made during the present study period. Monitoring sites will be investigated for:

- No. of shoots per m^2
- Shoot length
- Shoot growth rate
- Dry weight leaves per m^2
- Dry weight roots per m^2
- Sugar content
- Key Species

Seagrass comprise the dugong's sole diet, thus pollution and destruction of seagrass beds pose a threat to the survival of this endangered species. Detailed survey of sea grass area where Dugongs have been present will be undertaken to determine the sensitivity of the area to external disturbance with regards to the Dugong.

(c) ***Soft Bottom Habitats***

Diver transacts will be run in the vicinity of the proposed development area to establish the importance of the soft bottom habitats with a representative control section outside the Menggatal area. This is, however, not viewed as an important task due to the predominance of soft bottom habitats in the Kota Kinabalu area. Nevertheless, there is a requirement to investigate in order to ensure that the site is of no special interest.

(d) ***General***

During all marine habitat surveys, a record of fish species and number will be taken and a record of nearshore fishing activities in terms of number of boats/fishermen in order to establish the importance of the area with respect to nearshore fishing. However, the latter is not a substitute to the detailed assessment of impacts to near shore fishing, which will be studied as part of the socio-economic impact assessment.

3.2.8 Terrestrial Habitat

A detailed survey of the Menggatal Mangrove area is required in order to establish the sensitivity of the ecosystem to changes in flushing characteristics. This will utilise quantitative methods to determine the floristic composition (dominant species, species richness and diversity), structural composition (seedling, sapling and adult tree density, estimated biomass, species importance).

Further, it is necessary to establish the baseline monitoring stations for the environmental monitoring and management plan to be executed during the construction period.

Three (3) baseline stations will be established in the Menggatal Estuary. Control stations outside the potential impact area are available from DHI's mangrove monitoring research activities.

Indicators to be recorded are:

- Seedling density
- Seedling growth rate
- Sediment levels
- Number of roots
- Sediment density
- Sediment salinity
- Foliage cover

In addition to the monitoring stations, mapping of the extent and species distribution and living condition of the mangrove fringe will be made. In addition to allowing an environmental quality statement to be made, this species investigation provides an appropriate method for establishing the bottom elevations in the mangrove fringe and thus the tidal prism for the hydraulic model study, without requiring extensive terrestrial land survey. The species mapping will be facilitated by utilisation of remote sensing imagery as a supplement to the field survey.

The appointed marine specialist has in fact already established one (1) monitoring site in the Menggatal as part of an ongoing research project into the impacts of development activities funded by International Research Grant and supported by DANCED and the Ministry of Culture, Environment and Tourism and this information will be beneficial to the impact assessment and EMMP.

(C) Socio-Economic System

3.2.9 Land use and Development

Based on the field checks and landuse map, the land use types presently existing in the proposed area, include: residential/backyard orchards, ridge conservation area (secondary forest), existing industrial installations in Sapangar Bay area, academic facilities such as school and university (UiTM). All these facilities and residential areas are located within three kilometres radius from the proposed development. Just slightly outside the 3 km radius are the University Malaysia Sabah, Kota Kinabalu Polytechnic, Kota Kinabalu Industrial Park, a quarry, the Karambunai Country and Golf recreational resort. The Karambunai Country and Golf resort are located behind the hill from Sapangar Bay, in the North. The resort is planning to encourage ecotourism by setting aside a large parcel of land near the resort for this purpose. Although this resort is located outside the radius, the S-EIA will take this into account if any environmental impact might affect the ecotourism plan.

The construction of Sapangar Bay Port will not affect the current land use pattern, as it does not involve acquiring a sizeable amount of existing land. The Port will be constructed on land reclaimed from the sea. However the construction of the Port will stimulate growth in the area. Urbanisation will take place to a higher degree.

3.2.10 Social System and Organisation

Most of the houses around the project site are located along the Kuala Menggatal riverbank, and along the shoreline. A preliminary estimation of the ethnic origin of the household around the project area are approximately 50% are of the Bajau community, 40% the Filipino (suluk) community while the rest are of the Bugis/Indonesian Kadazandusun, Malays and Chinese origin. This composition is not inclusive of the workers and employees of the various installations and factories in the area who do not live in the area.

On the premise of availability of facilities, services and infrastructure, condition of housing and amenities, household items, income and the general environment of the villages, the living standard of household is reasonable.

The prospect of a better living standard and quality of life for households depends greatly on the on-going development in the immediate region. With the availability of extensive commercial, industrial and economic development, the household may benefit from any trickling down effect.

Thus to study the impact on the immediate communities (within 3km radius), surveys of people at Kg. Kabagu, Kg Selembangan/ Numbak, Sapangar Bay Settlement, Kg Pengasawan/Kg Kuala Menggatal, Kg Gentisan etc will be evaluated to determine their attitudes to the proposals and to relocation. They will also be consulted to obtain baseline data on water quality, air quality, noise, flooding and fisheries.

3.2.11 Economic Impacts

(a) Employment

The new Container Port will be a net provider of jobs, both directly through employment at the Port and indirectly through the provision of services to the Port. Jobs will also be created as a result of increased prosperity associated with increased trade. The S-EIA will report the figures directly available for each category of job creation, and employment opportunities in general.

The State Fisheries Department has proposed to establish an exclusive zone for the local fishermen at Kuala Menggatal. The specific location of the proposed exclusive zone will be determined and the potential impact from the proposed container port development to the function of this exclusive zone will be assessed.

(b) Health and Safety

Throughout history, insidious health hazards and disease have been introduced by man through development projects. Many examples of the past leave no doubt that a primary focus of Special Environmental Impact Assessment must be concerned with potential human health effects.

In the case of Port Development, prediction of health impacts are usually based on certain scientific criteria which includes knowledge of baseline health indicators of inhabitants within the vicinity of the proposed Project, their disease incidence and sanitary habits.

The S-EIA will thus analyse in detail the possible health hazards and environmental dangers of existing and proposed Projects. Further, adequate measures will be incorporated into Project Plans and their implementation to prevent the occurrence of health and environmental hazards.

(c) Physical Safety

Employees/operators at risk: In terms of operation of Port Development, some areas of a container port are dangerous and at most ports there are incidents each year of injuries and fatalities. However, most, if not all, of these can be avoided by the introduction of a strict and controlled Safety and Health policy.

Third party risks: The potential for third party risks from normal activities within the container terminal is negligible. Vessels visiting will not be able to directly impact on local communities due to the shallow depth of the coastal waters. The only areas of risk are those from container and other freight vehicles on the roads to and from the site. Such risks are, however, no greater than the risks accepted for road traffic in general.

3.2.12 Utilities and Amenities

(a) Housing

The proposed project will not generate significant amount of community, which will cause high demand in housing. Detailed assessment of the availability of affordable local housing, particularly in KKIP is not necessary. Areas of resettlement of villages moved from the site will also be assessed.

(b) Education

The education level of the people residing within the project area will be surveyed and reported accordingly.

(c) Utilities

It is assumed that where housing is provided in a new urban development such as KKIP the necessary support services will also be provided. These issues will therefore not be specifically assessed in this S-EIA unless a new community is specifically created for the Container Port.

3.2.13 Land Traffic Study

Access to the port will initially be via the existing Sapangar Road, which will be upgraded by others.

There would be a significant amount of traffic generated in the form of dump trucks and other transport lorries carrying construction materials.

(a) *Objectives*

i) To conduct a traffic impact assessment to identify the strategic and local effects of the development on the existing road network of Kuala Menggatal area, Kota Kinabalu;

ii) To provide recommendations to ensure smooth traffic flow upon completion of the development;

iii) To describe the strategic and local transport planning and traffic benefits to be gained by Port of Sapangar and Kuala Menggatal through the development of port expansion at Sapangar Bay, including public transport initiatives such as bus stop facilities along the Sapangar Road;

iv) To identify any road widening works or traffic management systems required by the development;

v) To identify any junction improvement works required for the existing or proposed junctions adjacent to the proposed development.

vi) To assess the traffic measures included within the development and to confirm their adequacy.

(b) *Scope of Works*

i) Data Collection

ii) Traffic generation rates will be derived from previous studies of similar developments. A future design year would be selected for the purposes of the network capacity evaluation, which would coincide with the targeted date of occupation.

iii) Traffic generated from the proposed development will be overlain on the design year traffic forecasts to produce traffic forecasts for the evaluation of network capacity.

iv) Network Capacity Assessment

An assessment will be made of road link and junction capacity to determine whether the envisaged road network would be able to handle the traffic demand. Assessment of road link capacity is on the basis of volume/capacity ratios, while the capacity of road junctions is assessed based on standard capacity formulae for traffic signals, give-way junctions and roundabouts, dependent on junction type.

Based on the traffic flow forecasts, recommendations will be made on the number of access points required to service the full development, and the form of the access junctions.

3.2.14 Marine Navigation Study

The primary aim of the marine navigation study is to address the environmental issues associated with navigation to and from the proposed Sapangar Bay Container Port for inclusion in the Special Environmental Impact Assessment Study.

The study will transgresses into some operational issues, however, it is stressed that operational and environmental issues should not be confused. The present report shall be viewed as a component of the EIA and not a definition of Standard and Emergency operating procedures (SOP/EOP), which are operational and not environmental issues.

After discussions with the Port Engineer and Operations Officer, it is clear that the Port fully appreciates their responsibility to comply with all relevant marine operational guidelines, such as provision of updated chart information, allocation of anchorage areas and definition of standard and emergency operating procedures (SOP/EOP) *prior to commercial operation* of the port. These operational issues will be addressed during the 3 year construction period in compliance with all existing Malaysian and international standards.

The Marine navigation study covers the following scope of works:

1.0 Description of Marine Traffic - including the statistics on size of ships calling the Port
1.1 Existing Facilities and Utilisation
1.2 Future Utilisation
1.3 Container Vessels
1.4 Existing Port Operating Procedures
1.5 Accident Statistics
  1.5.1 Sabah Ports Authority
  1.5.2 The Marine Department
  1.5.3 Sabah Ports and Harbours Department
  1.5.4 Other Sources of Data
  1.5.5 Conclusion

2.0 Navigation approach to Sapangar Bay
2.1 The approach
  2.1.1 Teluk Gaya
  2.1.2 Teluk Sapangar
  2.1.3 Restrictions on Access to Sapangar Bay Container Port
  2.1.4 Basic Restrictions on Size of Vessels calling at the port
2.2 Turning Circle

2.3 Tug boats
2.4 Navigation Risks
2.5 Vessel out of control
2.6 Reefs
2.7 Night time navigation
2.8 Usage Conflicts

3.0 Potential Environmental Impacts
3.1 Ballasting
3.2 Approach speed
3.3 Impact Upon Endangered Species
3.4 Loss of Reef Habitat

3.2.15 Aesthetic and Cultural

Development of Sapangar Bay is constrained by topography of the land, as well as existing and future possible major developments including residential housing, road works. In functional terms the container port must have deep water, be protected from wave action, be close to Kota Kinabalu and have good infrastructure links for the efficient movement of goods in and out of the port area.

It is acknowledged that developments in Sapangar Bay might considerably impair the landscape when viewed from within the Bay, but since they are confined at present to the eastern side they have not disrupted long distance views. The Container Terminal will follow this general approach. There is however, the opportunity to minimise the visual effects and perhaps to enhance the existing industrial environment by the provision of appropriate planting to screen the site.

In general, there is no direct impact on any landform of significant visual value.

3.2.16 Archaeological Value

The Government recognises the value of irreplaceable prehistoric and historic cultural resources and is committed to protect them from damage. Cultural heritage and archaeological sites are the main witness to the historical past. It is therefore impertinent to let them be destroyed by the reclamation activities during the construction of the Port. An assessment of the project site for any archaeological remains will be conducted. The presence of any archaeological will be ascertained and assessment of the impacts will be made and strategies will be developed to soften the impact.

To address these issues, the archaeological study will cover three main tasks:

(a) Literature Search

A considerable amount of literature is available covering the recent history of the Sapangar bay area. The primary aim of the literature search is to identify if there is any possibility that wrecks exist in the immediate area of the reclamation and/or navigation access corridors. Where relevant, the literature survey will be expanded to include interviews with veteran's associations etc who may be able to provide additional information concerning events in the Sapangar bay area during the 1940's.

The Sabah museum will also be used as a primary source of information both in terms of the recent history of the area and the earlier historical significance.

Geological records will also be assessed to establish the level of sea-level rise that has occurred in the area in recent historical times this may be important with respect to the location of artefacts and/or the possibility of archaeological remains.

(b) Marine Survey

Three forms of survey will be conducted:

- **Manta Tow**

Manta Tow will be used to provide wide area coverage within 1km of the reclamation area. The manta tow survey will concentrate on identifying larger objects on the seabed. The seabed will be documented by underwater photography/video as relevant. The success of manta tow is highly dependent upon visibility. The frequent occurrence of poor visibility in the study area is therefore reflected in the boat and diver support requirements that are increased to reflect anticipated lost time due to poor visibility.

- **Line transects**

Approximately four lines will be used to cover the immediate reclamation and navigation area. For each line transect the diver survey will turn over the bottom sediments to a depth of ca. 30cm every 5m-10m along the transect line, bottom conditions permitting. Any artefacts uncovered will be bagged against location.

- **Detailed assessment**

On the basis of the results of the manta tow and line transects two areas will be identified for further assessment.

Depending upon the results of the two proceeding surveys, this more detailed assessment may either be in the form of:

Additional bottom transects to document surface artefacts. Excavating several 1m square areas to a depth of ca 40cm, bottom conditions permitting. This is preferable to auguring which has been unutilised in previous marine archaeology surveys in the Likas Bay area without success as, due to the narrow core diameter, such techniques are highly unlikely to yield results.

(c) Terrestrial Survey

As the Tuaran area has earlier been found to yield important historical artefacts, a survey of the terrestrial sites to be disturbed by the development is considered essential. This will again be performed using line transect techniques with ca. 1m pits to be excavated every 10-20m down the survey line. Exposed rock formations will also be scrutinised for any fossils as relevant.

3.2.17 Socio-Economic Approach and Methodology

This study will be conducted using the standard approach method, which consist of structured questionnaire and personal interviews.

(a) Stage 1:Define Study Area

The first stage of this study will consist of defining the study area as well as the study objective. The main issues, the data needed and principles of assessment are taken into account.

(b) Stage 2:Understanding the target area

At this stage secondary data are gathered to understand the profile of community (If any). After having a good understanding of the background of the community/study area involved, a structured questionnaire is prepared. Discussions with relevant Government Departments or Agencies might also be necessary.

(c) Stage 3:Formulation of Structured Questionnaires

Formulation of structured questionnaire is based on the scope of the study and also based on the available information gathered earlier.

The questionnaire will consist of information pertaining to the number of household, occupation, monthly income, source of income, opinion on the proposed project etc.

(d) Stage 4:Field Survey

During the field survey, the social economic team member will approach the village concerned where questionnaire will be distributed. To compliment the structured questionnaires personal interviews will be conducted with the community leaders.

(e) Stage 5:Data Analysis and Interpretation

The structured questionnaire will then be analysed. The result of the survey will then be interpreted and communicated to the parties concern for further action.

3.2.18 Rapid Impact Assessment Matrix

Several methods exist to analyse, understand, summarise and present the results of environmental impact assessment in a transparent form. The method called the Rapid Impact Assessment Matrix (RIAM) has been utilised by the West Coast of Sabah Shoreline Management Plan executed by DHI between 1997 and 1998 for the Sabah State Government and Government Staff have received considerable training in this method of assessment and it is thus adopted for the present study.

Other methods such as Environmental Cost Benefit Analysis (ECBA) or Leopold Matrix could have been adopted and a preference for ECBA by the S-EIA review panel has been indicated. However, it is the consultant's opinion that the lack of information concerning the true values of environmental resources in the Sabah context makes an ECBA approach less than transparent. For example, economic values for resources such as whale sharks have to be placed by the consultant. Without a true picture of the distribution of whale sharks off Sabah waters, placing an economic value on the potential disturbance of these animals is fraught with difficulty and compromise. RIAM on the other hand allows a subjective categorisation based upon magnitude, importance and reversibility, which are fully transparent both for scrutinization and potential modification by the authorities, a facility difficult to implement in EBCA where the thinking behind the dollar value is not always available or readily alterable.

RIAM (Rapid Impact Assessment Matrix) is an analysis and presentation tool that scope defines components that are important insofar as they are indicators of change (either positive or negative). These components are selected from four main categories;

i) Physical / Chemical

Covering physical and chemical aspects of the environment including finite (non-biological) natural resources and degradation of the physical environment by pollution.

ii) Biological / Ecological

Covering biological aspects of the environment, including renewable natural resources, conservation of bio-diversity, species interactions, and pollution of the biosphere.

iii) Sociological / Cultural

Covering human aspects of the environment, including social issues affecting individuals and communities, together with cultural aspects, including conservation of heritage, and human development.

iv) Economic / Operational

Qualitatively identify the economic consequence of environmental change, both temporary and permanently, as well as the complexities of project management within the context of the project activities.

These components are evaluated against defined criteria that are universal to all impact assessments. The subjective judgements by the assessor are converted into a figure on defined scales, and in turn the RIAM matrix formula converts these into values within a series of ranges. These scores allow the RIAM to easily display the results of the assessment and record them with full transparency.

3.2.19 Project Abandonment

Abandonment during the planning stage would not result in any significant environmental impacts as the proposed project involved reclaiming an open sea area such that there will be no requirement for site clearing.

Abandonment during the operational stage requires the project proponent to consider plans for the removal or disposal of temporary structures and facilities. Abandonment plans need to be addressed

3.2.20 Summary of Methods for Assessment Of Impacts

Table 3.3 summarised the assessment methods that have been described in the aforementioned sections.

Table 3-3 Summary of Assessment Methods

Impacts	Methods Of Assessment
1. Coastal Process	♦ Primary Field Survey and Data Collection ♦ Physical Chemical and Biological Impacts ♦ MIKE 21 model
2. Flood	♦ The impact of the development upon water levels in the Menggatal River will be investigated by introducing the estimated 1m 20 year fresh water flow.
3. Air Quality	♦ Baseline Air Quality Monitoring ♦ Reviewing of Surrounding historical Air Quality data
4. Noise Quality	♦ Baseline Noise Monitoring ♦ Noise prediction using Basic Point source equation.
5. Water Quality	♦ Baseline Water Quality Monitoring ♦ Reviewing of Historical Water Quality data ♦ Water Quality Modelling using MIKE 21 AD and WQ ♦ Sedimentation Model, using MIKE 21MT
6. Marine Habitat	♦ Coral reef: Transect survey : Single point dive and : Manta tow ♦ Seagrass: Survey of spatial distribution ♦ Soft Bottom Habitat: Transect survey ♦ Fish: Record of fish Species.
7. Terrestrial	♦ Terrestrial Survey and mapping of the extent and species distribution and living condition of the mangrove fringe will be made
8. Socio- Economic	♦ Rapid Impact Assessment Matrix (RIAM) ♦ Questionnaire ♦ Personal interviews
9. Archaeology	♦ Literature Search ♦ Marine Survey ♦ Terrestrial Survey
10. Land Based Traffic	♦ Determine generated Traffic ♦ Established Baseline traffic Condition ♦ Develop Mitigation Measures
11. Marine Navigation	♦ Reviewing of Existing Marine Traffic Data ♦ Determine generated Marine Traffic ♦ Assessment of Turning Circle ♦ Impact on Environmental Issues

3.3 Mitigating Measures

For each of the evaluated significant impacts, there shall be preventive and abatement measures to prevent and reduce the adverse impacts. General mitigating measures that will be studied are described as follows. However detail proposed mitigating measures could only be made upon completion of details impact evaluation and identification. Alternatives to these mitigating measures will also be formulated when necessary.

3.3.1 Physical Issues

- Bunding of reclaim boundary
- Realignment of reclaimed boundar/configuration
- Settling pond for rainfall run-off
- Compensation dredging
- Scheduling of Pilling/Construction operation

3.3.2 Ecology Issues

- Relocation of Affected Corals
- Sceduling of Pilling operation

3.3.3 Socio-Economic Issues

- Public Meeting / dialogue
- Proper Signage
- Emergency Response Plan
- Proper Waste Management
- Sewerage Treatment Plant
- Navigation Turning Circle

3.4 Residual Impacts

Potential environmental impacts may remain after mitigating measures, which have been adopted into the project, plan to reduce or to eliminate significant potential environmental impacts. Significant potential environmental impacts, which remain after mitigating measures, have been applied and will be addressed in the S-EIA.

These impacts may require monitoring should the project be allowed to proceed.

It is therefore recommended that as part of the EIA, formal specifications for the EMMP baseline are prepared and sites identified and surveyed. In the present context, environmental management refers to the control of the construction activities through optimisation of work schedules and practices for achieving environmental quality objectives and the initiation of mitigation measures in the event that tolerance limits are exceeded, whilst minimising disruption to construction activities.

3.5 Environmental Management and Monitoring Plan

The majority of the impacts arising from the proposed Sapangar Bay Container Port will occur during the reclamation and construction phase. It is, therefore, essential that the reclamation and construction works are closely monitored and controlled through a well-formulated environmental management plan (EMP). The following

specifications provide an outline of the scope, implementation, objectives and enforcement of the EMP. Following standard DOE practice, a detailed EMP specification document will be prepared and submitted for approval 2 – 3 months prior to commencement of construction to refine the general outlines presented in this section.

For the project, this environmental management plan outline comprises the main pro-active mitigation measures for the reclamation and construction phase of the project. With the execution of the EMP scheme as proposed below, it is the Consultant's opinion that all significant impacts during the construction phase can be avoided.

As the project will be constructed in phases a separate EMP will be required as and when construction of a given phase commences.

3.5.1 Overall Monitoring and Management Strategy

The strategy for the Environmental Monitoring and Management Programme shall be applied in connection with the reclamation works for the Sapangar Bay Container Port is based upon the principle of feedback monitoring.

The principles of feedback monitoring indicates the monitoring form the construction process as described as follows:

i. Environmental Baseline

A series of environmental control stations should be established and instrumented prior to construction. These stations should be chosen to be indicative of the areas likely to suffer adverse impacts as a result of the development.

ii Elaboration of work plans

The contractor will formulate a work plan specifying the distribution of work time, procedure and space. The work effects can be assessed by forecast modelling.

iii Control monitoring

Monitoring of daily variables will be undertaken. If daily limits are violated, mitigating will be take place with predetermined plans.

iv Habitat monitoring

Biological monitoring will be is performed to an appropriate time schedules for anticipated response rates.

Regular monitoring is paramount to the success of the environmental management plan. Repeat survey of the monitoring stations should be undertaken on a time scale over which impacts are expected to be resolved or mitigation of impacts may be required. The following initial schedule is anticipated:

(a) Mangroves
(b) Corals
(c) Seagrass
(d) Underwater Noise

(e) Ambient Noise
(f) Ambient Air
(g) Water quality
(h) Suspended sediment stations
(i) Fish stock
(j) Bird survey
(k) Beach levels
(l) Ebb shoal morphology
(m) Tidal prism
(n) Water levels
(o) Archaeology
(p) Land Traffic

3.5.2 Environmental Audit

An important component of the management plan is the production of regular environmental audits. This is the primary form of information transmission to the authorities.

An environmental audit will be produced at the end of the construction period to document impacts occurred during construction phase. The SEIA will make proposals for the key environmental management features to be adopted in the operation of the proposed port to control environmental effects.

3.6 Authorities to be consulted

Particular environmental aspect of a proposed project may be subject by law, government policy or local planning to approve or consider by government agency, statutary agency or local authority. To ensure the proposed project formal and informal consultation with concerned agencies/Department shall be initiated and incorporated in the environmental impact assessment and should continue throughout.

The following authorities will be consulted during the course of the S-EIA studyt assessment.

i) Environmental Conservation Department
ii) Department of Environment
iii) Department of Port dan Dermaga Sabah
iv) Sabah Deaprtment of Mineral and Geoscience
v) Sabah Town and Country Planning Department
vi) Sabah Department of Public Works
vii) Sabah Drainage and Irrigation Department
viii) Sabah Fisheries Department
ix) Sabah Marine Department
x) Kota Kinabalu City Council
xi) Sabah Land and Survey Department
xii) Sabah Ports Authority
xiii) Meteorilogical Services Department
xiv) University Teknology Malaysia (UiTM)
xv) District Council

4 WORK SCHEDULE

The original TOR has been submitted to Department of Environment and was approved on 29th December 1999. Most of the specialist studies have been commissioned since then.

It is expected that, the TOR review process will take about 2 to 3 weeks upon the public announcement and the Special EIA report could then be finalised upon receiving comments from the review panel and the public.