



LANTAU PORT & WESTERN HARBOUR DEVELOPMENT STUDIES

FINAL REPORT

EXECUTIVE SUMMARY

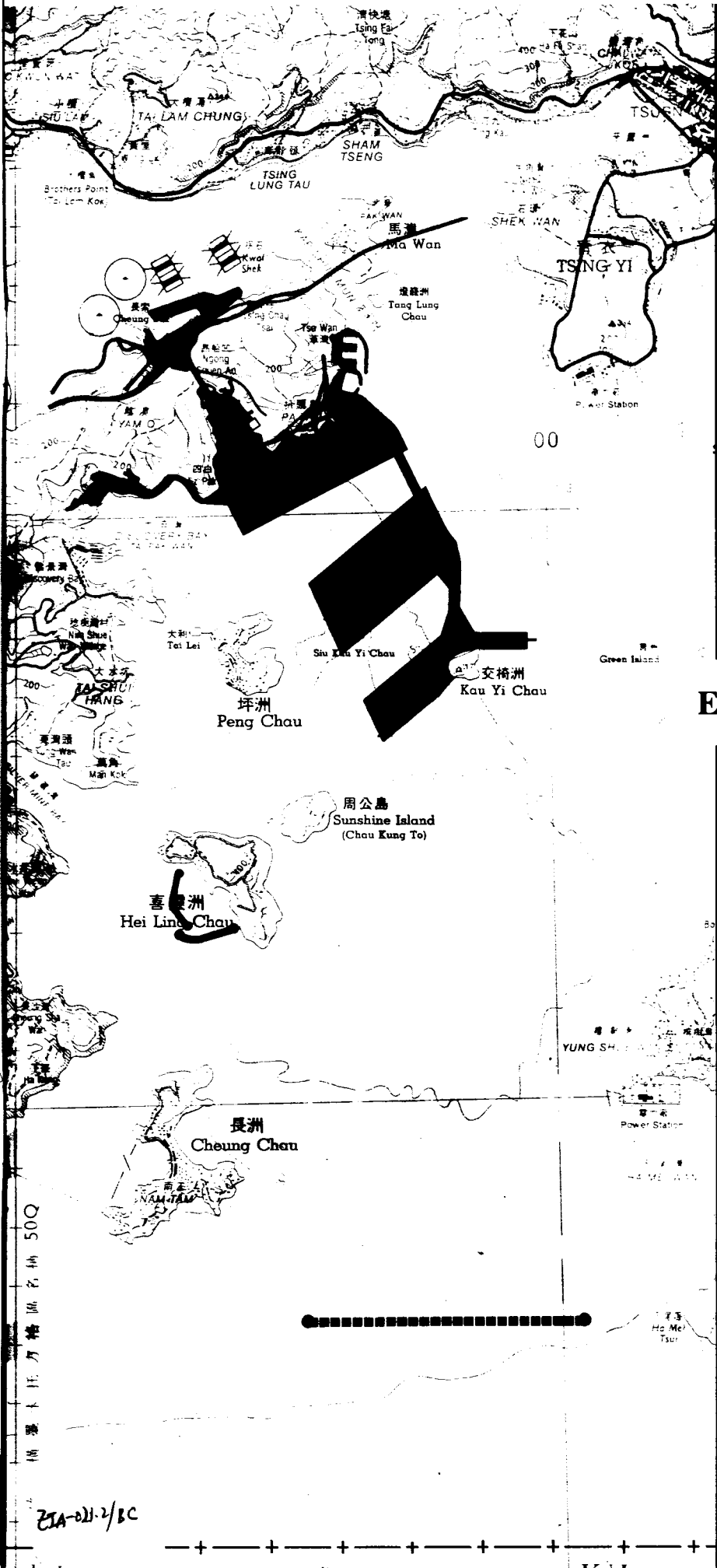
- I MAIN REPORT - TEXT
- II MAIN REPORT - DRAWINGS
- III E I A REPORT
- IV PENG CHAU REPORT
- V STUDY ADDENDA

March 1993



APH CONSULTANTS

in association with
Urbis Travers Morgan Ltd.
MVA Asia Ltd.
BMT Group



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CONTENTS

THE STUDY	2
PLANNING CONTEXT	5
PLANNING REQUIREMENTS	7
PREFERRED CONCEPT PLAN	9
RECOMMENDED OUTLINE DEVELOPMENT PLAN	13
KEY FEATURES OF THE PLAN	15
ENVIRONMENTAL ASPECTS	19
IMPLEMENTATION	21
FINANCIAL ASPECTS	25
CONCLUSIONS	28

FIGURES

1 Port and Airport Development Strategy (PADS)	2
2 Primary and Extended Study Areas	3
3 Alternative Concepts - Container Port	9
4 Alternative Concepts - Lamma Breakwater	10
5 Main Channel Arrangements - East Facing Port	10
6 Main Channel Arrangements - West Facing Port	11
7 North Shore Development	12
8 Marine Services Support Area & Ship Repair Yards	12
9 Main Components of Lantau Port	13
10 Overview of Recommended Outline Development Plan	14
11 Lantau Port - Phased Development	16
12 Transport Network	17
13 Summary Implementation Schedule	24
14 Estimated Government Net Annual Cash Flows	27

THE STUDY

Background

The Port and Airport Development Strategy (PADS) Study recommended that the majority of Hong Kong's future port needs be accommodated on an artificial peninsula in the northern reaches of Western Harbour and that a breakwater be constructed between Lamma and Cheung Chau Islands to provide protection to the new port and to create additional sheltered anchorage area in the Western Harbour (Figure 1).

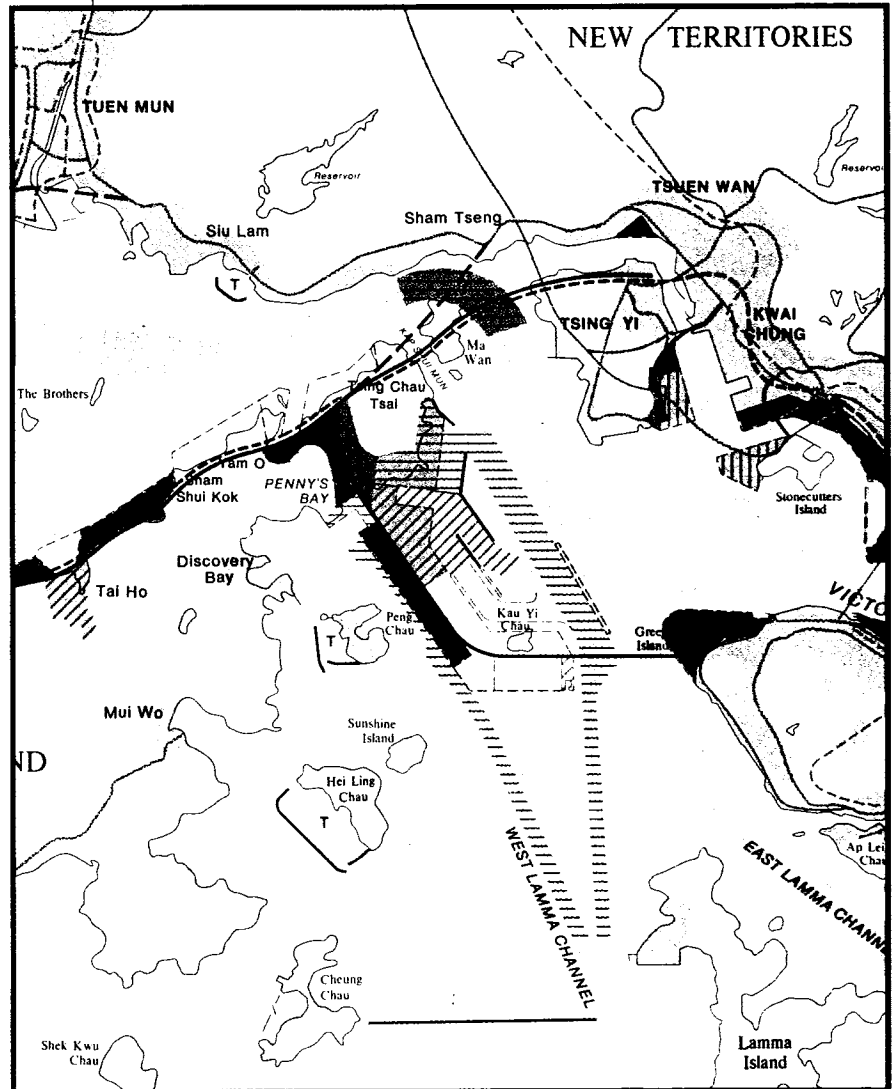


Figure 1
Port and Airport
Development Strategy
(PADS)

The Lantau Port Peninsula and Western Harbour Development Studies were commissioned to assess the feasibility of the PADS proposals. These two Studies, both of which were awarded to APH Consultants, started in August/September 1991.

The Studies have been carried out jointly and reported upon as the Lantau Port and Western Harbour (LAPH) Development Study.

Study Areas

The Study Areas (Figure 2) cover the whole of the Tsing Chau Tsai peninsula including Yam O Wan, Penny's Bay and Discovery Bay and extend to the south of Lamma and Cheung Chau Islands. The area includes the main islands of Ma Wan, Peng Chau and Hei Ling Chau.

Extended study areas have been used where necessary to cover all aspects relevant to the Study.

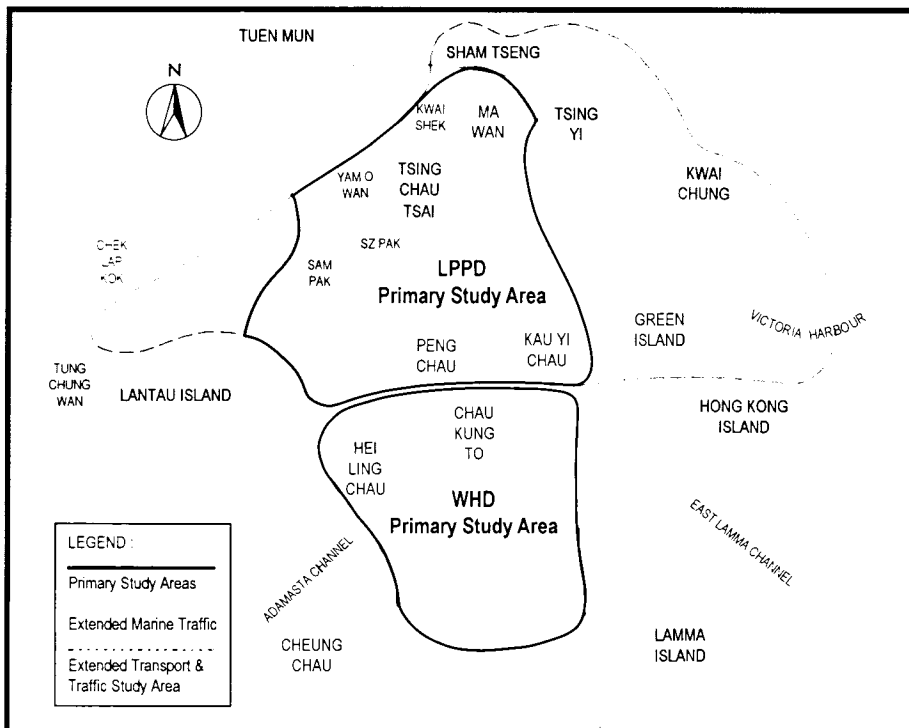


Figure 2 Primary and Extended Study Areas

Objectives

The primary objective of the LAPH Study has been to provide Hong Kong with a coherent and flexible development plan to satisfy the anticipated port and harbour needs for the next 20 years and beyond and to allow Hong Kong to maintain its position as a leading regional and world port. An important consideration in defining this plan has been the objective to maximise private sector participation in the implementation of the proposed developments.

The development plan was required to provide for an economic and efficient port and harbour which could be progressively implemented in a flexible manner responsive to changing needs and requirements.

Study Process

The Study has determined planning requirements and parameters and undertaken the necessary planning, analyses, modelling and feasibility determinations for all proposed engineering works in sufficient detail to allow progression to detailed planning and design.

Environmental protection and impact mitigation has been integrated with the planning and engineering work. Site investigations and surveys have been carried out to provide supplementary information needed for the Study.

A phased implementation programme has been defined together with associated cost, revenue and cash flow estimates. Actions which are required to implement the Study's detailed recommendations have been itemised.

The Study has been carried out in the following four main stages :

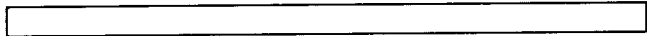
- The Initial Stage reviewed and updated PADS in the light of the latest information and Government requirements and identified a shortlist of development options.
- The Preferred Concept Plan Stage took the findings of the Initial Stage and identified the preferred option.

- The Phase I Development Stage defined the details of a first stage of implementation to meet the requirement that the first container berth would go into operation at the same time as the Lantau Fixed Crossing opened.
- The Final Stage completed all required evaluations and studies and defined the Recommended Outline Development Plan and the Recommended Master Landscape Plan for the Study Areas.

In addition to the main study, supplementary studies investigated:

- The preferred institutional arrangements to be adopted for the implementation of the proposed developments.

- Marine traffic associated with Hei Ling Chau typhoon shelter.
- The accommodation of feeder berths within Lantau Port.
- Re provisioning for Cheoy Lee Shipyard and China Light & Power's Penny's Bay power station supply berth.



Reporting

In total, ten main reports, 25 Working Papers, eleven Discussion Papers and nine ancillary reports have been prepared during the currency of the Study.

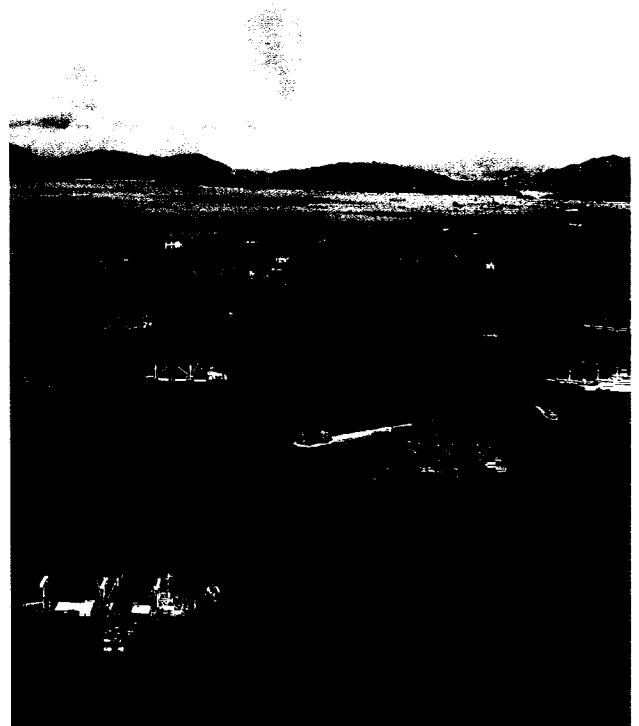
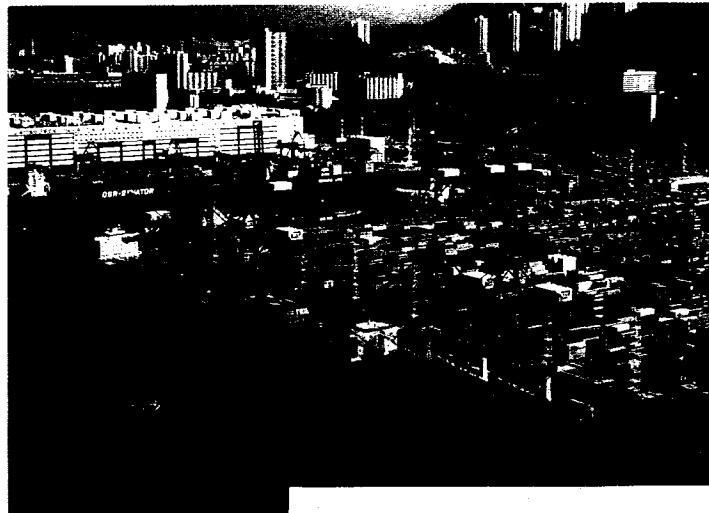
The Phase I Development Report is an integral companion volume to the Final Report of the Study.



Other Studies

Apart from PADS (December 1989) and the subsequent PADS Development Statement No. 2 (August 1990) which are fundamental to the LAPH Study, other studies have influenced the Study findings or had a significant bearing on the details of the Recommended Outline Development Plan.

Important amongst these are the Study of Port-related Industrial and Commercial Enterprises (SPICE) (June 1992), the Second Comprehensive Transport Study (May 1989), the Airport Master Plan Study (December 1991) and the North Lantau Development Study (April 1992).



PLANNING CONTEXT

The LAPH Site

The majority of the Study Area landforms are hilly grasslands with the more interesting vegetation generally confined to the coastal fringes and upland valleys. The area includes many scenic and amenity locations and is used for recreational pursuits.

In the area designated for the port peninsula, water depths are mainly 5m to 12m. The north shore of Tsing Chau Tsai peninsula comprises a steeply sloping shore leading to a deep channel with over 20m of water depth between 400m and 500m from the shore. Within the main body of the Western Harbour, water depths are generally 7m to 10m, with the 10m contour running approximately east/west centred on Cheung Chau.



The Tsing Chau Tsai peninsula is dominated by igneous rock.

The areas of water are generally underlain by an igneous bedrock. Overlying the bedrock is a mantle of weathered rock and alluvium covered by soft marine deposits.

The soft marine deposit is, for the greater part, 20m thick with its base 20m to 25m below sea level. The alluvium deposits and decomposed rock layers extend generally a further 15m to 25m. This results in the elevation of the unweathered bedrock surface varying between 50 m and 70 m below sea level, except in the vicinity of land masses and other rock outcrops.

The wave climate in Western Harbour is primarily made up of the combined effect of offshore waves which propagate into the Western Harbour and waves generated locally by wind action.

The extreme offshore wave height is predicted to be 12.5m with a period of between 13 sec and 16 sec.

In the vicinity of Lamma and Cheung Chau Islands, the offshore wave heights are typically reduced by some 65%, largely as a result of refraction and the sheltering effects of the Lema Islands.

The wave climate at the port peninsula represents the combination of wave action from the south between Lamma and Cheung Chau Islands, from the south-east through the East Lamma Channel and local wind generated waves.

The movement of sediment is principally from the Pearl River estuary around the north end of Lantau Island and through Western Harbour before discharging through the West Lamma area and the East Lamma Channel. The concentrations of suspended sediment are generally low. In areas outside dredged fairways, the sea bed level is stable with virtually no net erosion or siltation. In the dredged fairways to Victoria Harbour, siltation in the order of 50 mm/yr occurs.

Existing and Committed Uses

The existing situation on land is characterised by a low level of urban development and industrial activity with relatively small residential populations, Discovery Bay and Peng Chau being the more important. Existing land based industrial activities are limited to Cheoy Lee Shipyard and China Light & Power's power station, both in Penny's Bay.

The existing marine uses are numerous and include many ferry routes; anchorage areas such as Pun Shan Dangerous Goods Anchorage; shipping channels; floating dock units off the north shore of Tsing Chau Tsai peninsula; log ponds in Yam O Wan; pilot, customs and port health boarding activities; marine borrow, back fill and dumping activities; commercial, local and subsistence fishing; fish culture areas; gazetted and un-gazetted beaches; and recreational and water sports activities.

Committed developments within the Study Area relate mainly to PADS developments. The most significant of these is the corridor for the North Lantau Expressway and the Airport Railway which crosses the northern side of Tsing Chau Tsai peninsula. Tsing Chau Tsai peninsula was also designated a mega-borrow area by PADS. Hong Kong Resorts plans also exist to expand the population of Discovery Bay to a maximum of some 20,150.

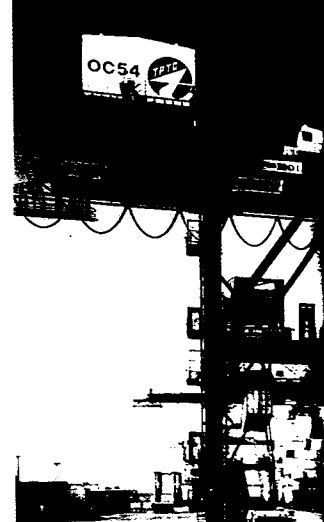
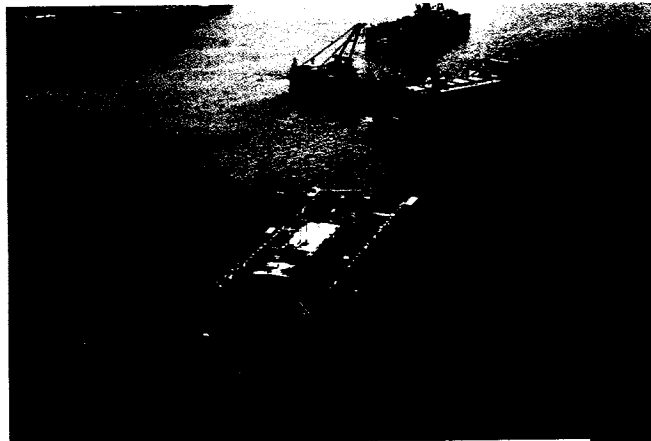
Environmental Context

Air quality is generally good. There are no significant obstructions to the prevailing easterly winds, and essentially no confined areas exist within the Study Area. Water quality reflects the semi-estuarine nature of the Territory and generally meets Water Quality Objectives. Existing noise levels are low, reflecting the rural undeveloped character of the area.

Seabed sediments are mostly clean but with some contaminated mud present. Marine fauna in the intertidal and subtidal zones appears to be sparse. The Study Area supports a fishing industry providing significant employment.

Significant archaeological and historic remains in the Study Area which could be influenced by the proposed developments are limited to three sites. There are no known Fung Shui matters which could interfere with the proposed developments.

Sewage discharges from the larger population concentrations are potentially significant in view of the very low level of treatment which is applied and the sensitivity of the water body to nutrient build up.



PLANNING REQUIREMENTS

Shipping Forecasts and Projected Port Facilities

Shipping forecasts and projected Hong Kong wide port facility needs, which have been used as a basis for the Study, have been derived largely from the Port Development Strategy Review (May 1991). These forecasts differ significantly from those used for PADS (December 1989), in that the total number of container berths required on Lantau by 2011 have been reduced from 26 to 17 and there is no longer a requirement for multi-purpose terminals.

A key ingredient of the forecasts for Lantau Port is that it will serve freight movements related to the PRC's import and export trade. The success with which this objective can be achieved, will, for an important part depend upon the ease and efficiency with which freight can be transferred between Lantau Port and the PRC hinterland. Road, river and rail modes of transportation are available to achieve this and these have been taken into consideration in preparing the Recommended Outline Development Plan.

Specific Requirements

The main components upon which the Recommended Outline Development Plan is based comprise :

- Container terminals,
- River trade transshipment wharves (RTTW),
- Marine services support area (MSSA),
- Floating docks and related shore facilities,
- Ship repair yards,
- Marine approach channels and fairways,
- Anchorages,
- Typhoon shelters, and
- Serviced land.

For planning purposes, the implementation of these facilities was allocated to four distinct but nominal development phases.

The establishment of container berths is the main driving force for the majority of the developments planned for the Study Area, and this has been adopted as the principal parameter for defining development phases. Thus the four



Phases are those which correspond with the realisation of a total of four, eight, twelve and seventeen container berths respectively.

The first container berth of Phase I will commence operation at the same time as the Lantau Fixed Crossing opens which is now anticipated to be in May 1997. The four Phases are contiguous and they end in 2000, 2003, 2007 and 2011.

The resultant phased schedule of main component implementations is shown in Table 1, which gives the facilities scheduled to be operational at the end of each development phase.

Provision for serviced land intended for industrial uses has been broken down into a mix of uses falling into three main categories: container back-up areas, for which 10 ha per container berth has been allowed; port-related industry, for which an ultimate allowance of 40 ha has been made; and general industry, with an ultimate allowance of 31 ha.

In addition to the main components given in Table 1, it has been necessary to provide the following facilities to complement or support the main components :

- Port facilities, including aids to navigation, a Lantau Port main approach channel, breakwaters within Lantau Port and, eventually, the Lamma Breakwater. Serviced land created as a result of reclamation adjoining Lamma Breakwater.
- Transport infrastructure and reserves covering expressways and primary and secondary distributor and local roads, in addition to public transport systems and reserves for a freight rail link to the mainland and the Island (MTR) Line extension to Yam O.
- Utilities comprising water, electricity, telecommunications and gas.
- Services comprising stormwater drainage and discharge, sewage collection, treatment and discharge, and refuse disposal/transfer facilities.
- Government, Institutional and Community facilities.
- Re provisioning needs.

ITEM	PHASE I (2000)	PHASE II (2003)	PHASE III (2007)	PHASE IV (2011)
PORT FACILITIES :				
Container terminals :				
- berths (No.)	4	8	12	17
- terminal area (ha)	80	160	240	340
- back-up area (ha)	40	80	120	170
River Trade Transhipment Wharves :				
- quay face (m)	400	700	1,300	2,000
- back-up area (ha)	7	12	22	34
Marine Services Support Area :				
- quay (m)	400	400	800	800
- back-up area (ha)	2	2	4	4
Floating docks & shore-related facilities :				
- sea area (ha)	135	180	180	180
- back-up area (ha)	15	20	20	20
- quay face (m)	1,150	1,535	1,535	1,535
- typhoon moorings (No.)	6	8	8	8
Ship repair yards :				
- quay (m)	0	1,400	1,400	1,400
- back-up area (ha)	0	9	9	9
Anchorage (ha)	1,169	1,979	3,095	3,095
Typhoon shelters (ha)	50	50	50	50
SERVICED LAND :				
Business Park (ha)	10	20	40	40
General Industrial (ha)	13	18.1	23.2	31
Government, Institutional & Community (ha)	6.3	6.3	6.3	6.3

Note: The figures given for each Phase are cumulative

Table 1 Phased Development of LAPH Main Components

PREFERRED CONCEPT PLAN

Introduction

The Recommended Outline Development Plan is based upon the Preferred Concept Plan. Initial coarse screening resulted in five alternative concepts for Lantau Port and the equivalent of three alternative arrangements for Western Harbour. The Lantau Port alternative concepts (Figure 3) comprised the Peninsula concept (east facing only), the Island concept (east and west facing) and the Basin concept (east and west facing).

The Western Harbour arrangements involved three possible channel configurations and three alternative Lamma Breakwater locations.

Evaluation for the selection of the Preferred Concept Plan was carried out in three stages.

First, the preferred Lamma Breakwater location was identified. Second, the preferred Western Harbour arrangements (incorporating the preferred Lamma Breakwater) were selected; one for east facing port options and one for west facing port options. Third, the preferred Lantau Port and Western Harbour Plan was identified.

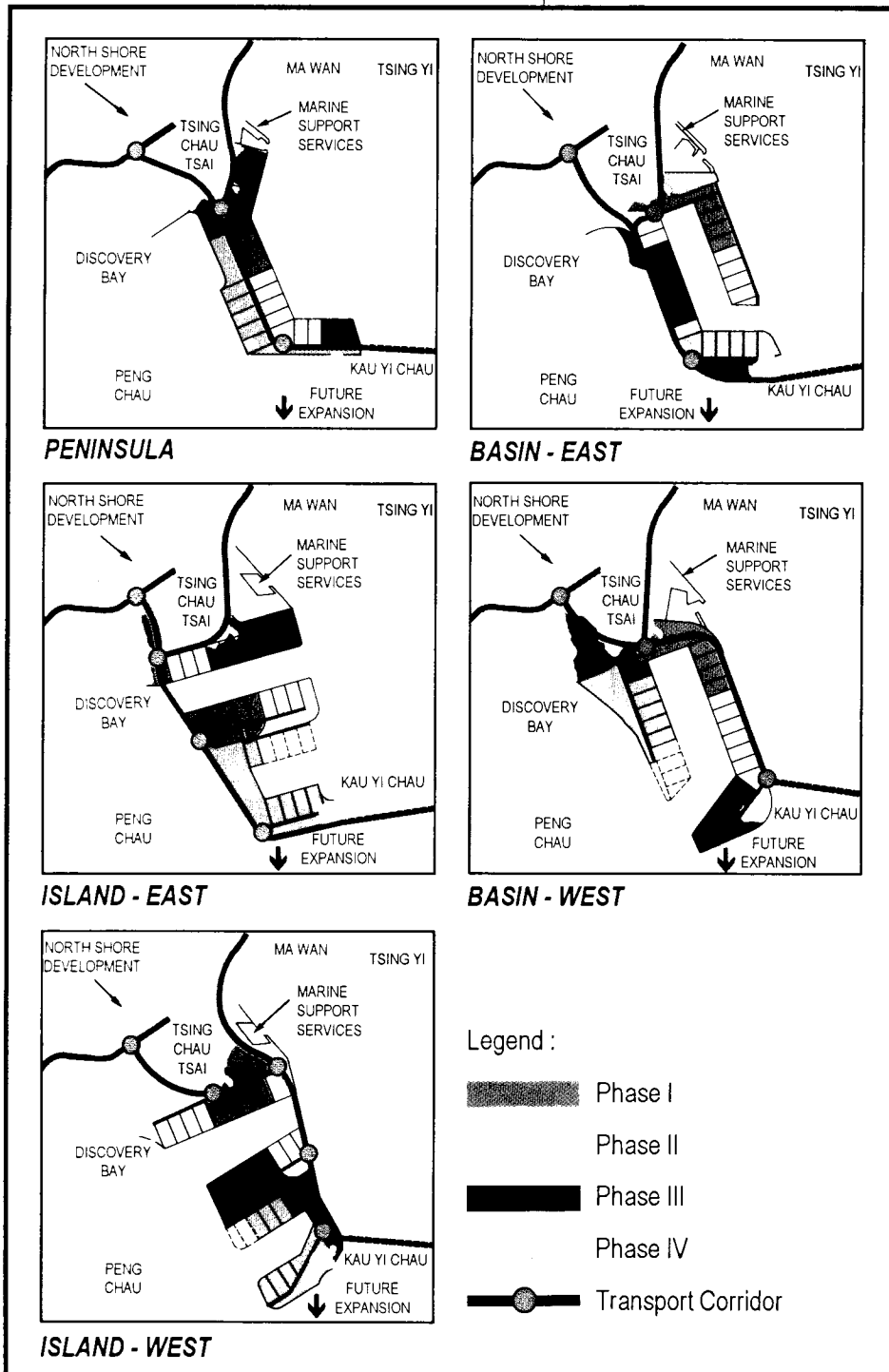


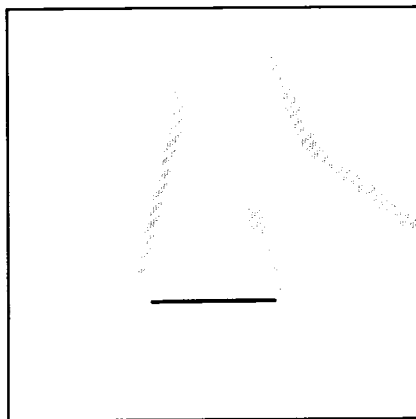
Figure 3 Alternative Concepts - Container Port

Lamma Breakwater

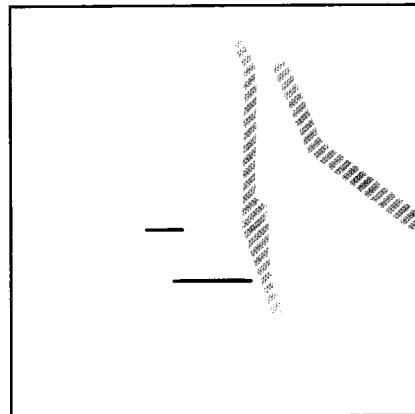
As conceived under PADS, the role of the Lamma Breakwater was to provide protection to Lantau Port and to mid-stream operations in the southern reaches of Western Harbour.

The shortlisted Lantau Port concepts require protection but this can be more economically provided by a breakwater located close to the port. Further, it is now Government policy that mid-stream operations will not take place in the southern reaches of Western Harbour.

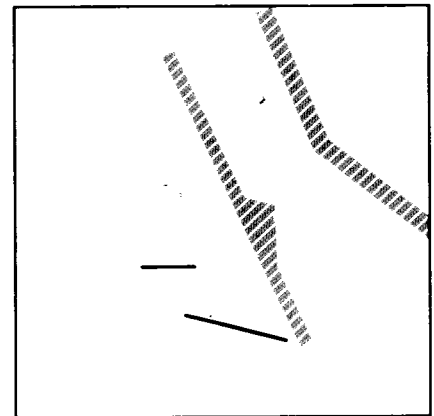
The Study was required to investigate the possibility and potential of



LAYOUT No.1



LAYOUT No.2



LAYOUT No.3

LEGEND :

———— Breakwater

Figure 4 Alternative Concepts - Lamma Breakwater

reclaimed land behind the Lamma Breakwater. A nominal 400 ha of land has been investigated but no specific usage for this land has been identified.

In addition to providing wave protection, Lamma Breakwater will influence water movements; modify siltation rates and patterns; delineate areas available for channels and anchorages; and have ecological, noise and air quality impacts.

All three layouts (Figure 4) considered have only localised effects on water movements and siltation patterns, and all accommodate the channel arrangements which are needed to serve Lantau Port.

The ecological impact of the breakwater will be the loss of the seabed; as such, the impact of each layout is similar. None of the layouts incorporate characteristics that create major differences in potential sources of pollution.

Taking the above into consideration, Layout No. 1 is preferred. Cost estimates indicate that this is the lowest cost solution and, on other aspects, it is equivalent to or marginally superior to the other layouts.

Approach Channels

East Facing Port Options

Two alternative main channel arrangements (Figure 5) have been considered.

Assessment of the capacity of the existing East Lamma Channel indicates that it is possible to consider its sole use to serve Victoria Harbour, Ma Wan Channel through traffic and Lantau Port traffic, at least to the end of the planning period (2011). This has the advantages of requiring limited dredging, of more readily providing full vessel tracking system coverage, and that crossing ferries only have to negotiate a single shipping channel.

The alternative is to construct a new channel immediately to the west of Lamma Island and to create two parallel shipping

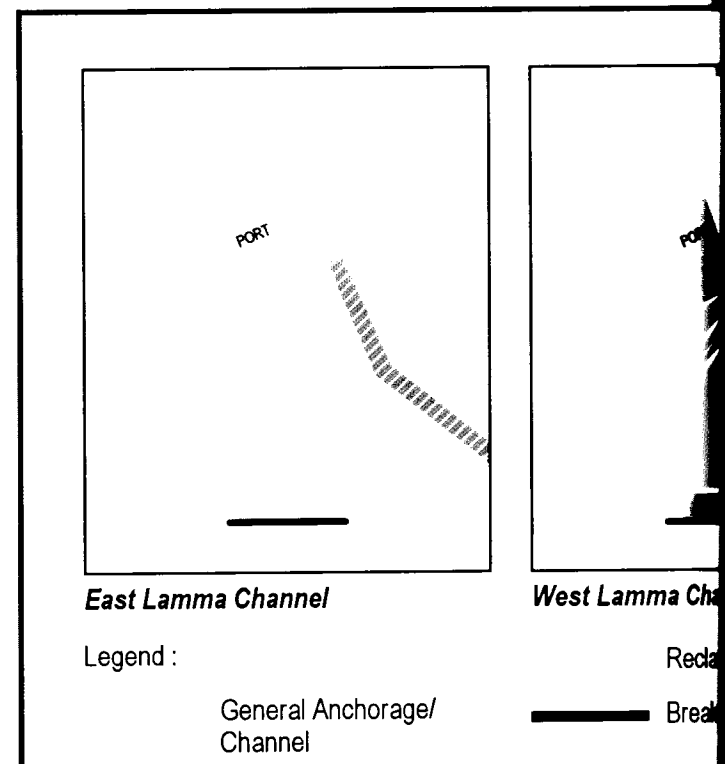


Figure 5 Main Channel Arrangements - East Facing Port

channels in the vicinity of Green Island. In addition to substantial dredging, this would require ferries to cross two shipping channels set some 400 m apart. This has been assessed as generating a significant increase in risk.

The sole use of the East Lamma Channel is the preferred arrangement for east facing port options.

West Facing Port Options

Both channel options (Figure 6) require substantial dredging but they ensure separation of the Lantau Port traffic from the existing and future movements to Victoria Harbour, Kwai Chung and Ma Wan and minimise the risk of collision between ships and ferries.

The East Cheung Chau Channel has been found to be less desirable for navigational reasons and, since other aspects of the two arrangements are similar, the West Lamma Channel is the preferred arrangement for west facing port options.

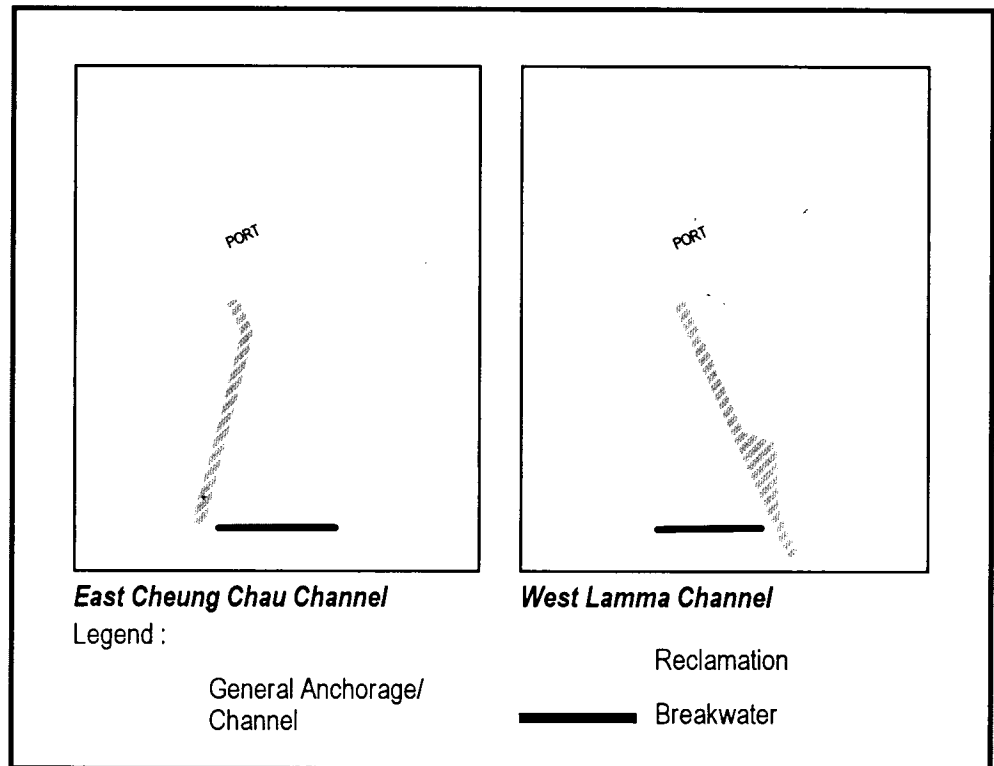


Figure 6 Main Channel Arrangements - West Facing Port

Bay and Peng Chau areas. The Peninsula and Basin concepts do not readily lend themselves to the incorporation of such a feature.

Capital cost estimates have indicated that Island West provides the minimum Phase I cost solution and that its total cost is comparable with other options. A combined technical/cost sensitivity analysis has confirmed the robustness of the preference for the Island West option.

Other Development Components

In parallel with the identification of the preferred plan for Lantau Port and Western Harbour, plans for the remaining development components have been studied to identify preferred solutions. Recommendations, as a result of this work, are :

- The layout of River Trade Transshipment Wharves (RTTW) and the floating docks and related shore facilities on the north shore of Tsing Chau Tsai peninsula (Figure 7).
- To locate the Marine Services Support Area (MSSA) and the ship repair yards on the eastern side of Tsing Chau Tsai peninsula (Figure 8).
- In addition, alternative layouts for a 50 ha typhoon shelter adjacent to Hei Ling Chau were defined and evaluated and a preferred option identified.

Lantau Port & Western Harbour

The five Lantau Port and Western Harbour options which resulted from the selection of preferences for Lamma Breakwater and Western Harbour channels were first comparatively evaluated on technical merit and the resulting ranking was subsequently tested with a combined technical/cost evaluation.

The results of the technical evaluation have indicated a clear and definite preference for the Island West option. The more important discriminators between the various options are given in Table 2.

A special feature of the Island option is its ability to allow tidal flows which, in particular, has a beneficial effect on flushing in the Discovery

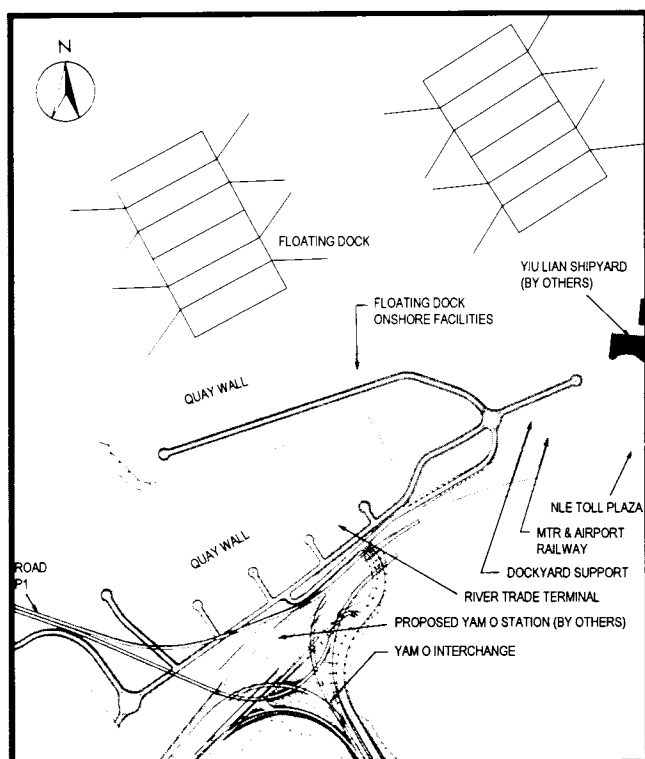


Figure 7 North Shore Development

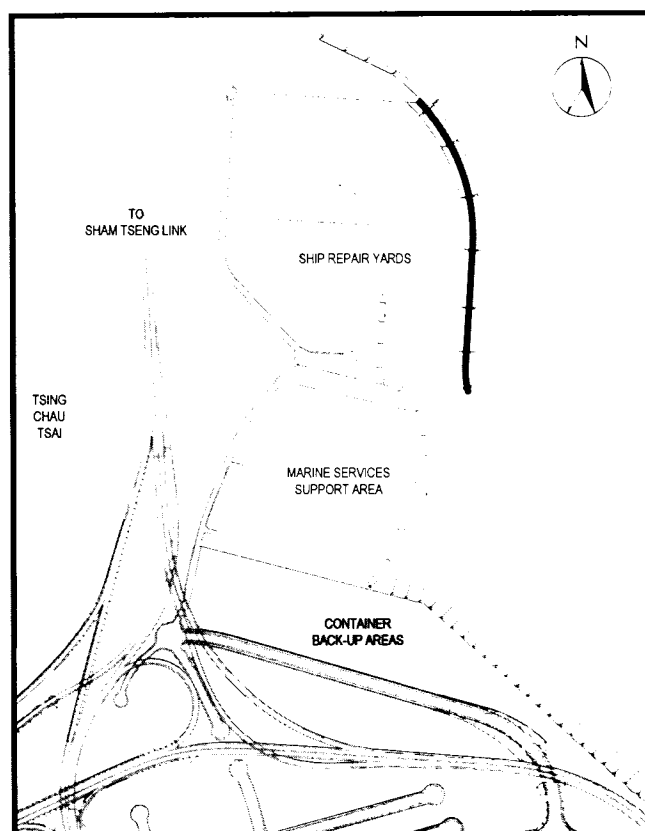


Figure 8 Marine Services Support Area and Ship Repair Yards

CRITERIA CATEGORY	EVALUATION
Port / Harbour	Overall, the Islands are preferred and the Peninsula is least favoured. Basins score well on development flexibility, closely followed by the Islands with the Peninsula scoring lowest. Ultimate development potential is highest for the Islands (24-25 berths) followed by the Basins (20-22 berths). The Peninsula only accommodates 17 berths.
Marine Risk / Navigation	Island West scores highest by virtue of the preferred western approach channel which significantly reduces marine risks and provides good manoeuvring into and out of the port. Ship/ship and ship/ferry encounter risk is lower, typhoon evacuation is faster and traffic control needs are smallest. Basin West also scores high for the same reasons as Island West but manoeuvring into and out of the basin, as well as typhoon evacuation, is inferior.
Environmental	Water quality impacts are least for the Islands. West facing options are superior for air quality, mainly because the Green Island Link is located furthest from Discovery Bay and Peng Chau, the most sensitive areas. Island West is less massive and visually intrusive when seen from the Discovery Bay and Peng Chau areas. East facing options cause less ecological impact because dredging of the western approach channel is not needed; they are also superior on noise, the Green Island Link traffic being assessed as less intrusive than container terminal operations.
Transport / Traffic	No great differences exist for this set of criteria. The Island West and Basins are somewhat superior on direct port access; however, the landforms and port layout associated with the Peninsula is more amenable to the accommodation of the interchanges between the Sham Tseng, Green Island and North Lantau expressways and the freight rail access.
Onshore / Planning	Island West is the preferred option, this being partly due to compatibility with developments on Peng Chau and Discovery Bay, and partly because serviced land supply and land usage efficiency are superior.

Table 2 Summary of Technical Evaluation Discriminators

RECOMMENDED OUTLINE DEVELOPMENT PLAN

The preferred solutions for Lantau Port and Western Harbour, the North Shore Development, the Marine Services Support Area and the Ship Repair Yards, together with the Hei Ling Chau Typhoon Shelter combine to form the Preferred Concept Plan on the basis of which the Recommended Outline Development Plan has been prepared.

The transition from the Preferred Concept Plan to the Recommended Outline Development Plan has been one of refinement in the light of more detailed study and analysis. Finalisation of full details for the first phase of implementation has made an important contribution to this process.

The further evaluation and more extensive modelling of the water quality implications has resulted in a recommendation

that the Recommended Outline Development Plan should be prepared to accommodate the adoption of a bridged section for the northern basin to permit continued water flow through the port peninsula.

Figure 9 identifies the main components of Lantau Port and Figure 10 provides an overview of the Recommended Outline Development Plan.

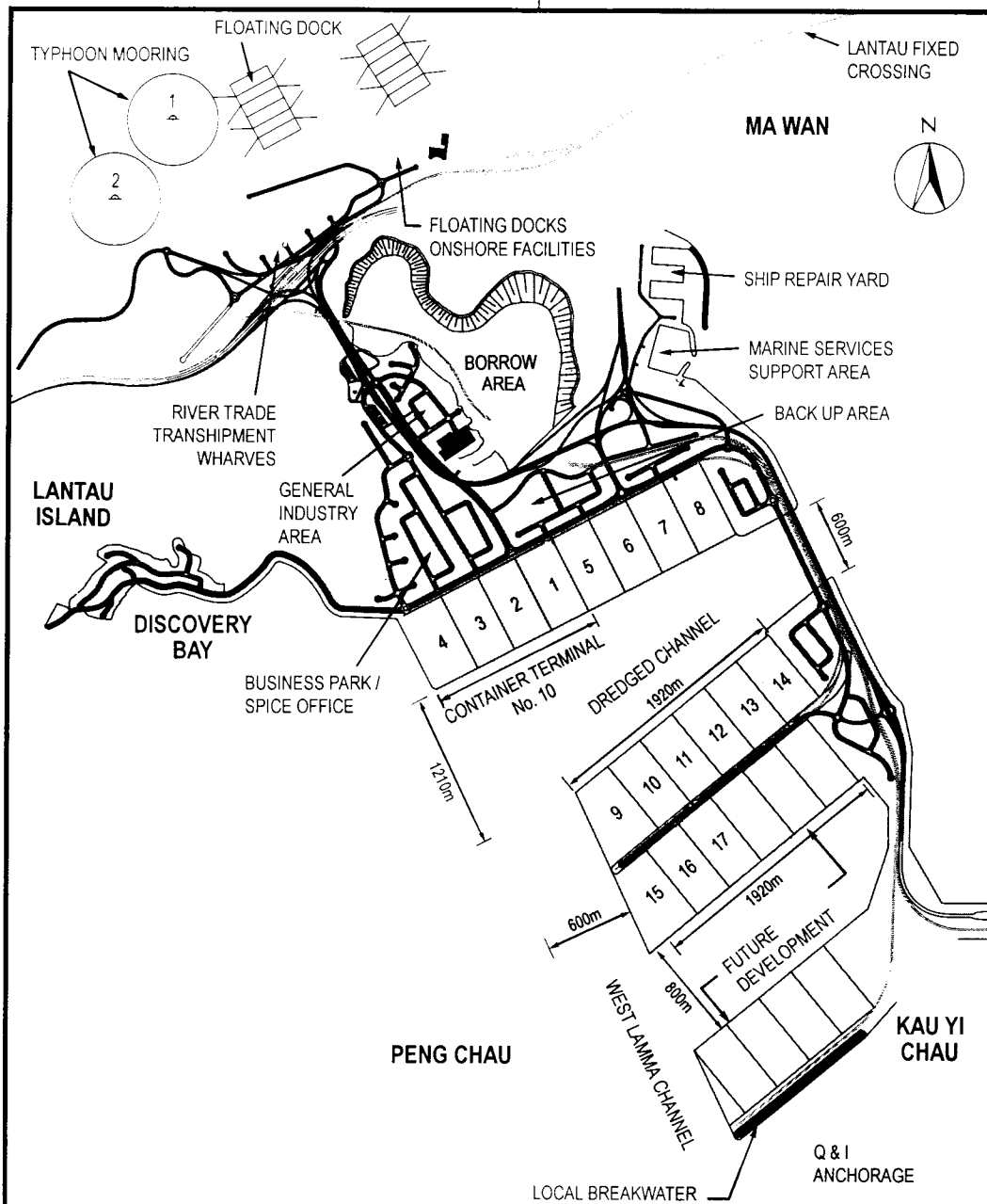


Figure 9 Main Components of Lantau Port

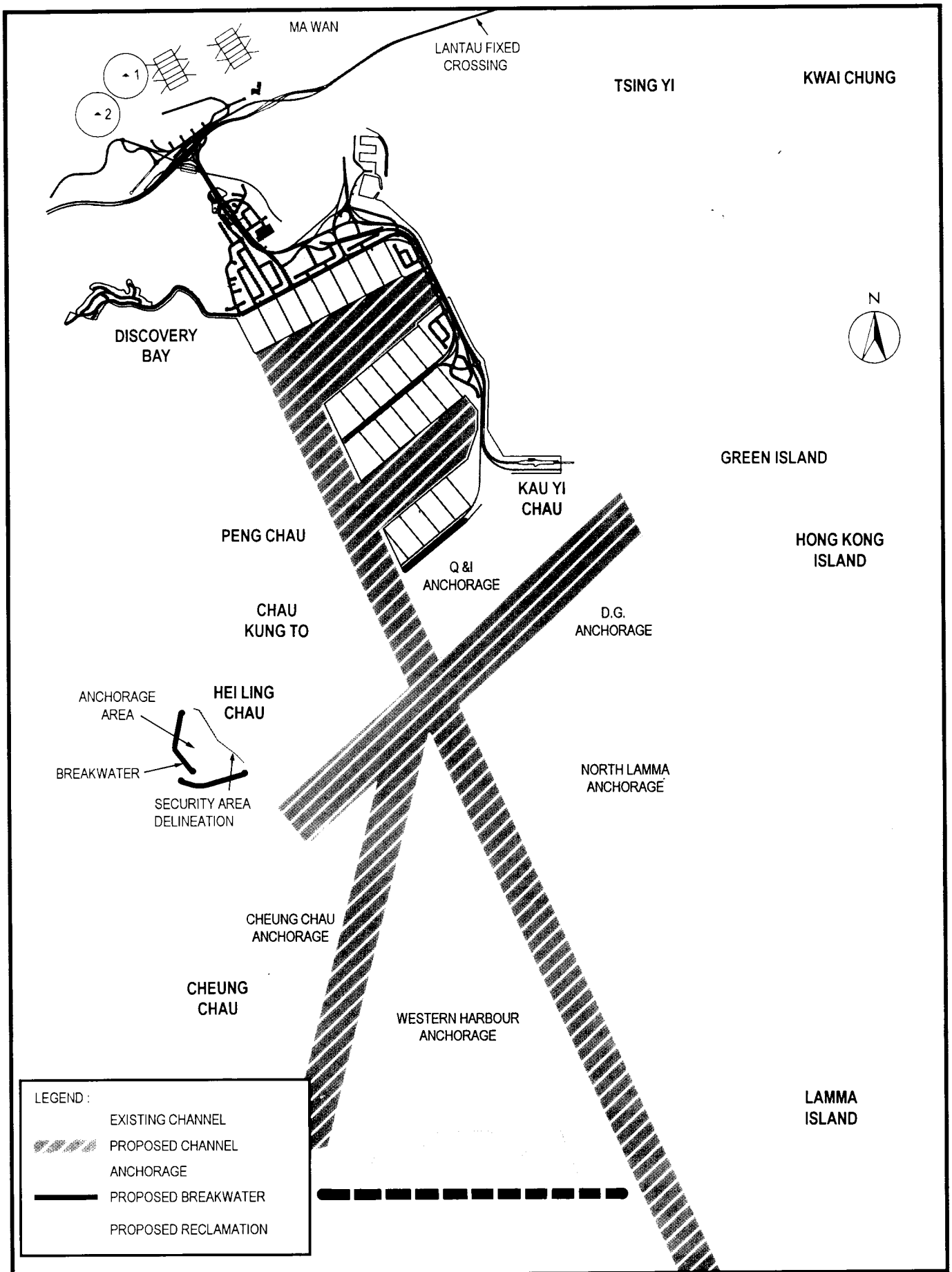


Figure 10 Overview of Recommended Outline Development Plan

KEY FEATURES OF THE PLAN

General

The Recommended Outline Development Plan provides for the majority of Hong Kong's port needs to the year 2011 and beyond. Whilst having container terminal facilities as its main focus, the Plan comprises a composite, integrated development of port and port-related facilities which can be implemented in a flexible manner.

The Plan forms an integral whole with other North Lantau and PADS-related developments. Where appropriate, the plan takes account of Government, Institutional & Community facilities, as well as infrastructure and similar facilities which will be provided under these related developments, either as general or specific provisions, so that adequate, optimum, balanced facilities are attained.

Marine

The container port basins and marine approaches provide unrestricted manoeuvring and access to Lantau Port and rapid evacuation under typhoon conditions. The West Lamma Channel provides a direct straight-line access to and from the open sea.

The marine arrangements separate ocean traffic proceeding to Kwai Chung, Victoria Harbour and Ma Wan from that proceeding to Lantau Port, thereby alleviating congestion in the vicinity of and to the north of Green Island. This will reduce the risks associated with the need for ferry and other local traffic to cross the main ocean traffic routes, and will eliminate potential conflicts between traffic using Lantau Port and the remaining parts of Hong Kong port.

The planned arrangements also provide for the creation of 3,095 ha of anchorage area, which eventually can be provided with protection by construction of the Lamma Breakwater without this having any negative impacts on the approaches to Lantau Port or Lamma power station jetty.

Container Port

The peninsula provides 17 container berths with the potential to develop up to a total of some 24, nearly 50% more than the 2011 projected needs. Each berth has an operating area of 20 ha. This area, which is 30 to 70% more than that provided at Kwai Chung, provides flexibility to adapt to future, changing needs and to accommodate freight rail facilities.

Whilst acknowledging that a recommended layout has been developed for river trade transshipment wharves on the north shore, the flexibility of the peninsula layout would permit the introduction of feeder berths within the container terminals should this be a particular requirement of a terminal operator.

The planned phased development of the container port is shown in Figure 11.

substantial areas of land are provided to accommodate the transport network and reserves for the freight rail link and the Island (MTR) Line extension to Yam O.

Land use interfaces and the requirement to fit proposed land uses into the wider area have contributed to the determination of the selection of appropriate locations.

Container back-up areas are provided at a rate of 10 ha per container berth over and above the operating area. These back-up areas, which are located adjacent to but separate from the berths, provide adequate space to accommodate port-related activities not found on the berths.

The Plan accommodates 71 ha of land for general industry and a Business Park/SPICE office area. The land allocation has been derived by assessing the land needs associated with the port-related activities and users.

An area to accommodate a population of approximately 25,000 is defined in the area between Lantau Port and the already existing and planned (Hong Kong Resorts) Discovery Bay residential areas. This area establishes the appropriate extent of possible further residential development opportunities in the Study Area. Linked to the port and through the port to the airport, the whole of the Discovery Bay residential areas can function as a support community for the port and airport.

Other land use allocations for Government, Institutional & Community, open space, commercial, transportation and possible land reserves have all been identified within the Recommended Outline Development Plan.

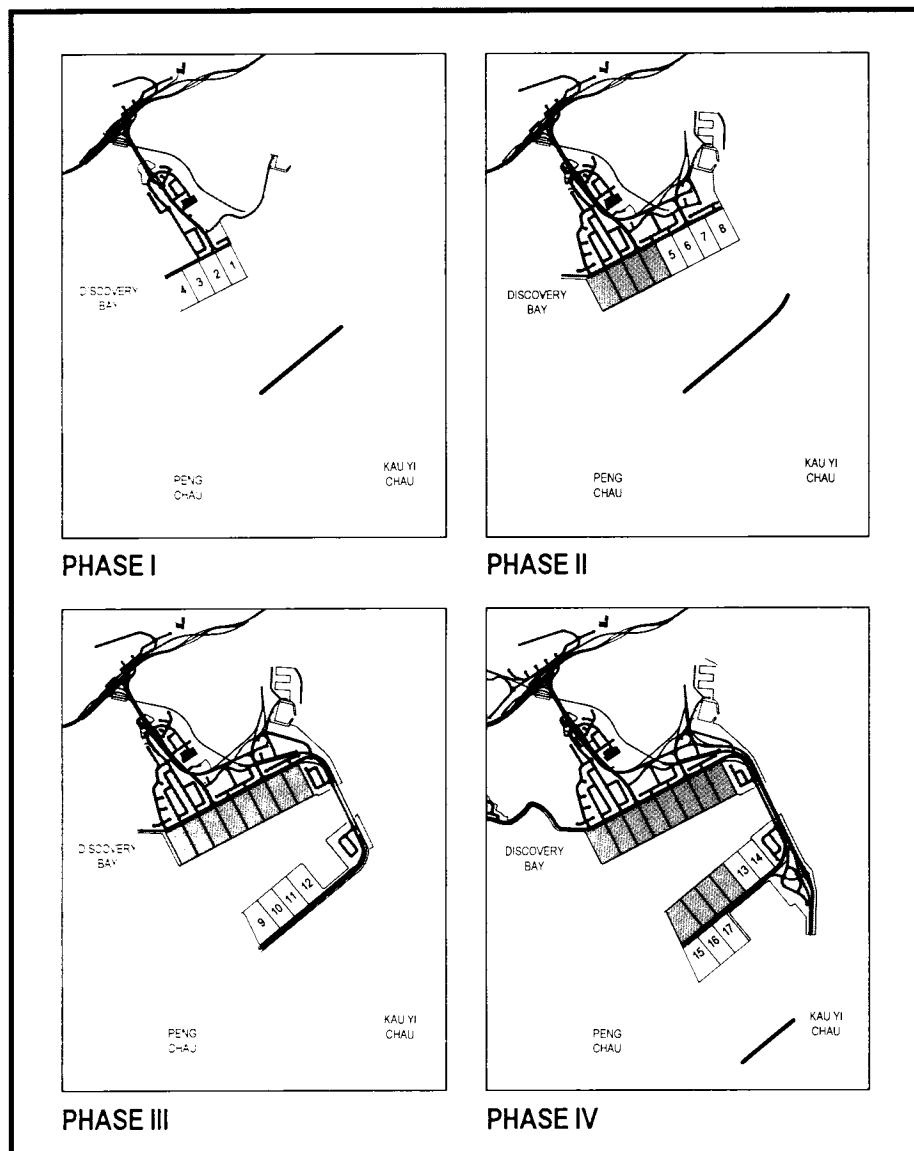


Figure 11 Lantau Port - Phased Development

Land Use Planning

The Plan caters for eight categories of land use: port facility operating areas; container back-up areas; Business Park/SPICE office space; general industry; Government, Institutional & Community facilities; open space; residential; expressway service area and highway maintenance area. In addition,

Transport Infrastructure

The expressway through routes and interchanges associated with the Plan constitute a significant component of land use. These routes comprise Hong Kong strategic links which,

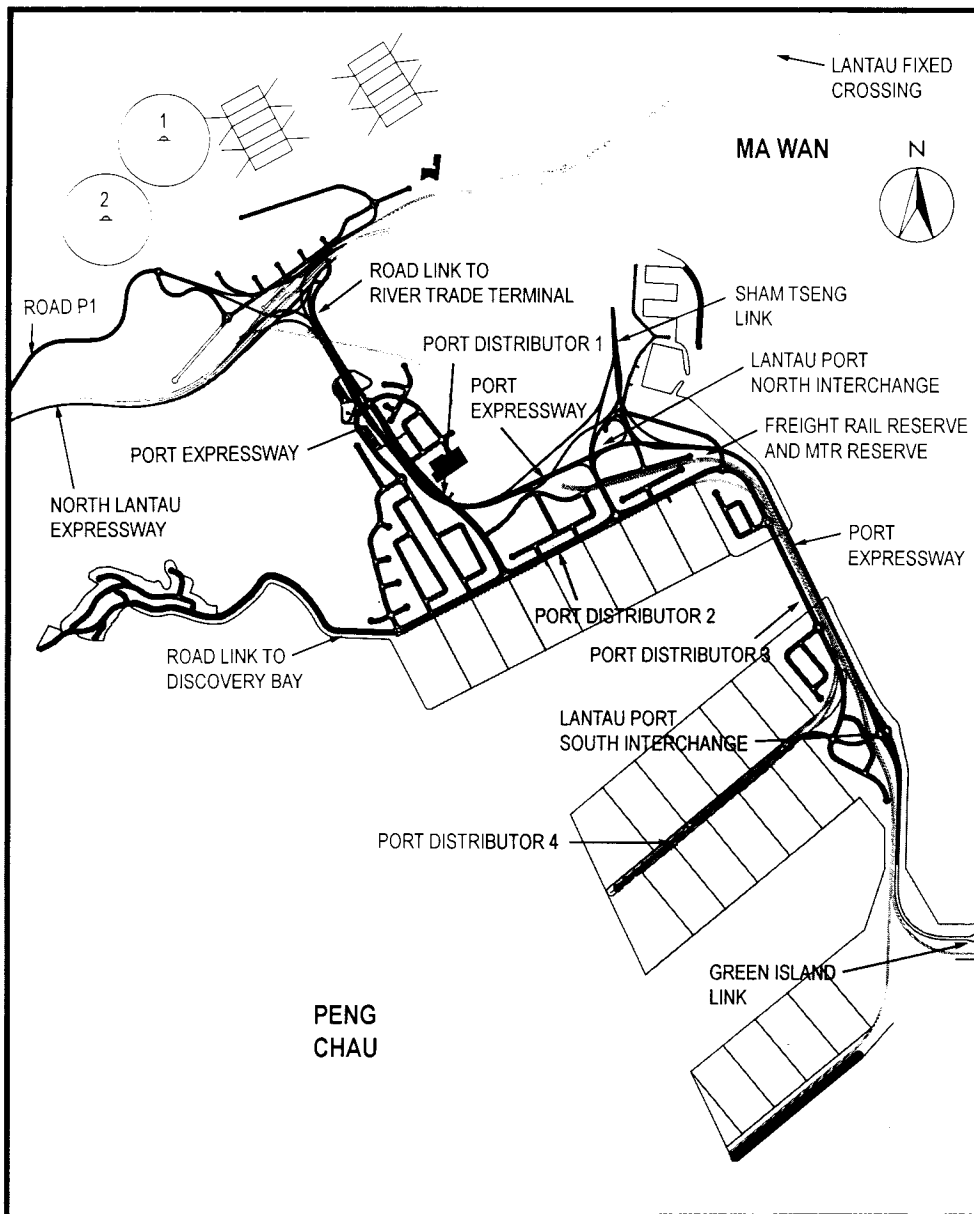


Figure 12 Transport Network

although essential for access to the port, are, by virtue of their strategic role, more extensive than strictly necessary in terms of port-related requirements.

The transport network (Figure 12) provides free flow interchange between the expressways themselves. Thus, traffic using the Lantau Fixed Crossing, the North Lantau Expressway leading towards Chek Lap Kok Airport, the Sham Tseng Link and the Green Island Link can proceed via the Lantau Port Expressway in all directions at will without entering the Lantau Port road system. Interchanges are provided between the Lantau Port Expressway and the Lantau Port road network at three points: the Lantau Port Interchanges - North and South and via the North Lantau Expressway/P1 routes to the north shore area. Once these interchanges have been effected, traffic will be able to circulate freely to all points in the port area.

In addition, the transport infrastructure provides for a link to the Discovery Bay area. Whether this link will be needed or not will depend upon whether alternative access routes to Discovery Bay direct from the North Lantau Expressway are created and upon the degree of economic/work force dependency that the Discovery Bay area develops with Lantau Port.

Further, the transport arrangements make provision for the eventual introduction of a freight rail link to the mainland and an extension of the Island (MTR) Line from Hong Kong Island via Green Island Link through the port peninsula to Yam O.

North Shore Development

Given Lantau Port's position at the mouth of the Pearl River Delta, it is to be anticipated that river and coastal trade will fulfil an increasingly important role in its associated cargo movements.

The river trade transshipment wharves, located on the north shore, will accommodate these movements without placing additional burdens on Hong Kong's marine traffic situation while, at the same time, providing a strategic opportunity to tranship Pearl River cargoes directly to and from the port peninsula container facilities. These facilities, in combination with container freight station and groupage facilities located within the river trade transshipment wharves, the container terminals and/or the adjacent industrial areas, create a multi-modal centre.

The waters of the north shore are one of the few remaining naturally occurring sheltered deep water sites within Hong Kong which can accommodate floating dock facilities together with adjacent shore facilities. Three floating docks are currently located in this area, and shore facilities associated with two

of these are presently under development outside the LAPH Plan areas.

Marine Services Support Area

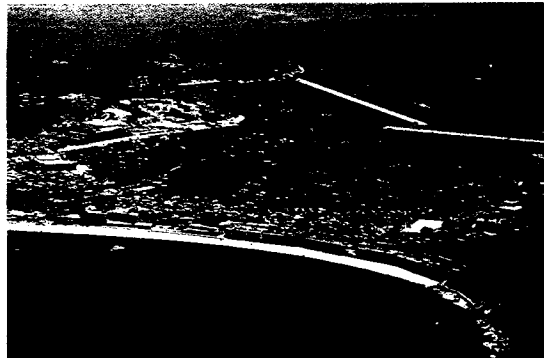
Lantau Port will eventually comprise a major concentration of marine activities and will increase substantially the need for marine services. This will give rise to the need for additional harbour and support facilities for tugs, pilot launches and floating cranes/barges. The site selected for this support area is on the east shore of Tsing Chau Tsai peninsula, compatible with the service needs of the craft which will use it.

Ship Repair Yards

The area adjacent to the marine services support area also offers the opportunity to accommodate ship repair facilities which will predominantly serve shipping operations in Victoria Harbour.

Typhoon Shelters

There is a current shortfall in Hong Kong wide typhoon shelter capacity of some 47ha. The creation of Lantau Port will effectively move the centre of port operations further west, and the provision of an additional typhoon shelter within the Western Harbour, directed towards partially meeting the current shortfall, is considered appropriate. The proposed typhoon shelter at Hei Ling Chau satisfies this requirement without infringing the special security requirements of the island.



Land Formation

Development of the port peninsula involves the formation of some 950 ha of land mainly by reclamation. Primarily to minimise mud disposal needs, but also to minimise fill requirements, the Plan proposes that land formation be

accomplished leaving marine deposits, where possible, in place. This can be accomplished using ground improvement techniques to ensure adequate bearing capacities and to accelerate consolidation so that construction times are achieved that are essentially the same as those when more conventional "remove and fill" techniques are employed.

Using this approach, the disposal of some 120 million cu m of marine deposits can be avoided, and the general fill requirement can be reduced by some 100 million cu m, or 40%.

Tsing Chau Tsai Borrow Area

PADS identified the Tsing Chau Tsai peninsula as a major borrow area to supply construction materials for PADS-related projects. During the currency of the Study, and notwithstanding certain allocations made by the Fill Management Committee (FMC), it was decided by the FMC that this site was now to be earmarked to supply, as far as possible, the construction material needs of the LAPH projects. In compliance with this directive, the Plan defines a Tsing Chau Tsai borrow area intended to fulfil LAPH needs. At the same time, this definition anticipates the creation of land platforms which offer development potential, while at the same time ensuring optimum environmental and landscape solutions for this area.

The precise extent to which this borrow resource will be exploited is, however, open to conjecture on a number of grounds. As a consequence, it is not possible to include the land area so created as a component of the Recommended Outline Development Plan's definitive land budget and this potential must be considered as an unconfirmed reserve development resource.

Re-provisioning and Resumption

The Recommended Outline Development Plan requires the re-provisioning or resumption of the Cheoy Lee Shipyard located in Penny's Bay and re-provisioning of the Pun Shan Dangerous Goods Anchorage and the supply berth associated with China Light & Power's Penny's Bay power station. All of these facilities are affected by the Phase I developments.

There are no other major re-provisionings or resumptions needed for the Plan.

ENVIRONMENTAL ASPECTS

General

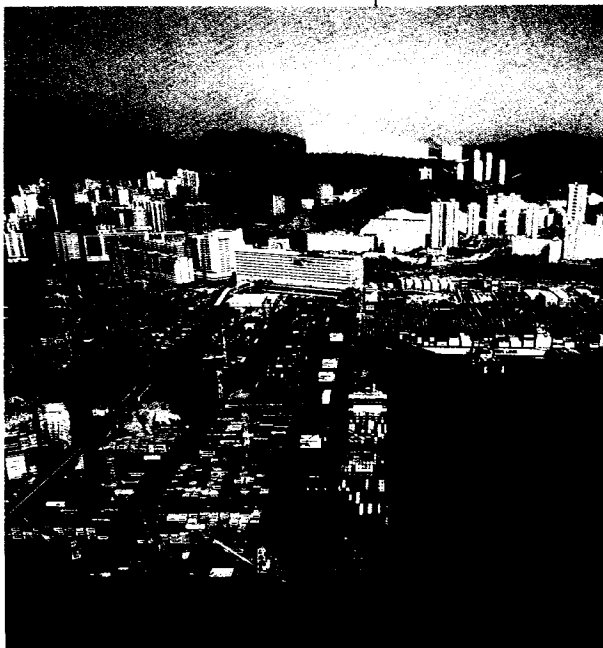
The Recommended Outline Development Plan represents a major port-related industrial development which, in container facility terms alone, is approximately equivalent to a duplication of Kwai Chung facilities once CT8 and CT9 are completed.

Although only a relatively small area of existing land (limited to the Penny's Bay area) will be irrevocably changed by the developments, the port peninsula will ultimately constitute a dominant feature and occupy the greater part of the northern reaches of Western Harbour. Land formation, dredging and other construction activities associated with the implementation of the port peninsula, together with the progressive build-up of port operations and road traffic, constitute the major source of potential impacts, not only for the developments themselves but also for areas within their sphere of influence, most important amongst which are the residential areas of Discovery Bay and Peng Chau.

By comparison, the southern reaches of Western Harbour will remain largely unchanged except for transient impacts from construction of the West Lamma Channel and a substantial increase in marine traffic. Should the Lamma Breakwater be constructed, this will constitute a major further change, albeit in a somewhat remote region of Western Harbour.

A development of the scale and magnitude of Lantau Port will inevitably have substantial impacts, particularly in view of the rural nature of the area in which it is to be implemented. Also and in order to meet projected schedule targets, implementation will result in near-continuous construction activities.

Consequently, despite the incorporation of environmental considerations in the design process and the definition of mitigation measures, there will still be some net impacts.



Water Quality

The proposed developments only give rise to water quality concerns in the Discovery Bay and Peng Chau areas. Potential impact is reduced by the provision of an open end to the northern port basin, which will serve to maintain a significant degree of the natural tidal flushing which the peninsula would otherwise prevent. Provided sewage and other discharges from the present and future populations

in the Discovery Bay and Peng Chau areas are removed and provided potential pollution from Lantau Port and its associated shipping are contained using control procedures, the peninsula will cause little or no deterioration in water quality and possibly an improvement in some parameters. However this area remains sensitive to build up of nutrients and therefore algae.

Land formation with the marine deposits (mud) left in place will avoid the need to dredge and dispose of some 120 million cu m of mud, which will reduce impacts arising from dredging operations. Notwithstanding, this volume of mud will require to be removed, mainly for the formation of the harbour basins and approach channels. This dredging will cause water quality impacts and if these are to be contained mitigation measures will be essential.

Air Quality

Impacts, mainly in the form of dust, will arise from construction activities, notably operation of the Tsing Chau Tsai borrow area but also land formation fill operations. The Air Quality Objectives could be exceeded unless mitigation measures are enforced. The recommendation that reclamation be accomplished with the marine deposits left in place will cut fill quantities by 40%, which will reduce air quality and other impacts from these operations if adopted.

Operational air quality impacts will arise from road traffic and port equipment exhaust emissions. Set back distances have been specified for main arteries to ensure that pollutant concentrations are maintained within permitted limits.

Noise

Noise generated in the flat open spaces of the port peninsula, devoid of natural barriers, will have a wide area of influence. The most sensitive areas will be those around Discovery Bay and Peng Chau. Mitigation measures will be required to contain impacts within current statutory limits, which are related to the existing rural environment and are therefore stringent, given the industrial nature of the proposed developments. The use of specially quietened equipment and purpose built noise barriers will be necessary to keep future port noise within acceptable limits at Discovery Bay and Peng Chau particularly due to night-time operation. The utilisation of quietened equipment is feasible and practicable and is recommended to minimise noise impacts.

Ecology

Apart from a substantial loss and disturbance of sea bed area, the proposed developments will have little or no permanent impact on the sparse marine and terrestrial ecology which exists in the Study Area. Fishing activities in the Western Harbour will, however, be progressively curtailed in the areas occupied by the developments and by the increase in marine activity.

Visual Aspects

Visual impacts will be related to the scale of the developments, the change of the area from undeveloped rural to developed industrial and the need for night-time lighting. The overall visual impacts can be partially mitigated by the use of landscape measures to provide screening and by careful design of flood lighting to minimise glare. However the effectiveness of these measures is limited and visual impact will remain high.

Waste Management

A decision needs to be taken on whether to rely solely on the Chemical Waste Treatment Centre's MARPOL waste barge collection service or to provide storage facilities at the Port.



IMPLEMENTATION

Phasing

The main components of the Recommended Outline Development Plan comprise facilities which will be implemented as private sector enterprises. The implementation process will therefore be driven largely by evolving commercial realities of the markets which each type of facility serves, together with the private sector's interest to undertake the various initiatives.

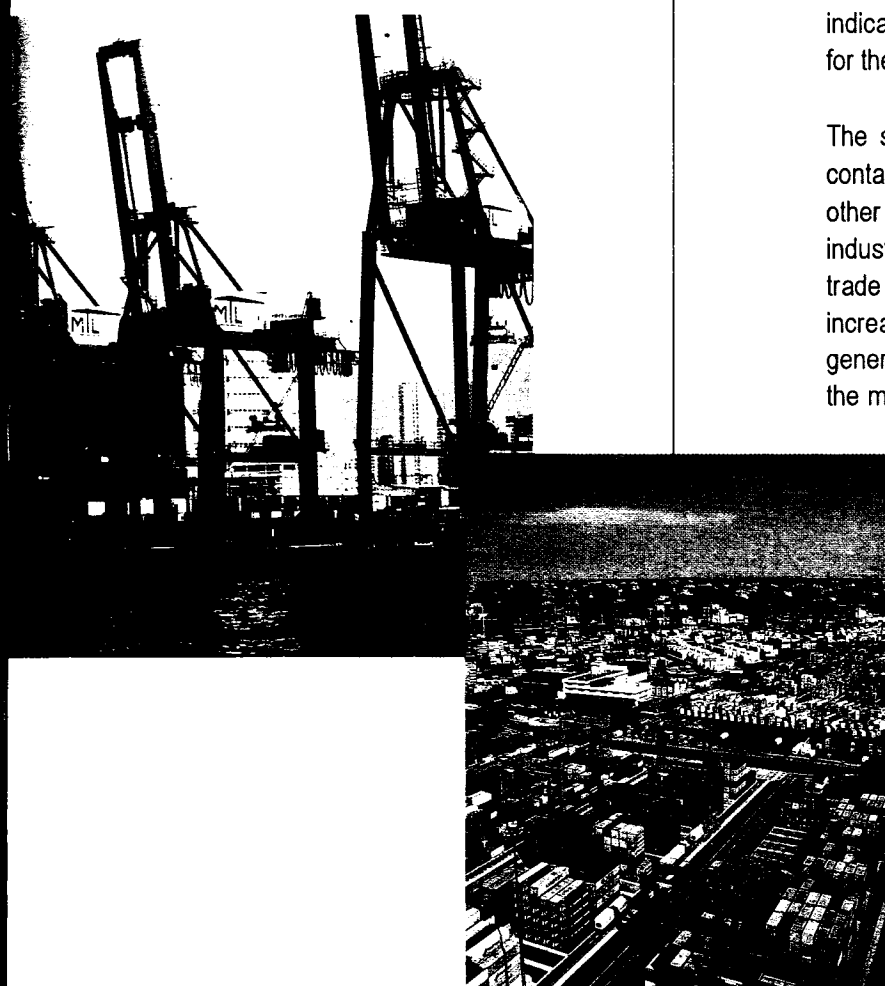
Financial assessments carried out for each private sector component indicate that all will yield a positive return, albeit that this may be below the private sector's perception of an adequate return in some instances, particularly if premiums are to be paid to Government for development rights.

The container terminal facilities will go ahead provided projected demand materialises. Two further considerations indicate that essentially all of the operational facilities will, at one stage or another, be implemented.

The first of these considerations is that Government criteria used for the planning of the floating dock shore facilities and the marine services support area may not be entirely optimum in terms of private sector needs. Some scaling down, while still providing an adequate operational base, may improve the overall economics. In this respect, Government has already indicated that it will undertake a review of the criteria set for the planning of the floating dock shore facilities.

The second consideration is that the development of the container facilities will serve to stimulate the development of other components. This will be particularly so for port-related industrial activities, and will also likely be the case for river trade transshipment wharves. It may also be anticipated that the increased marine activity which the container facilities will generate will, in turn, generate a need and natural focus for the marine services support area, as well as for the marine repair and refit facilities covered by the floating dock and the ship repair yards.

The Plan defines 19 self-contained Work Packages (Table 3) which can be implemented as the need arises or as opportune. These packages comprise four stages of development for the container facilities, the river trade transshipment wharves and serviced land. The floating docks and marine services support area are planned to be developed in two stages, and single packages cover the development of the ship repair yards, the Hei Ling Chau typhoon shelter and, eventually, the Lamma Breakwater.



All packages include not only the main operational components but also all infrastructure, utilities and services needed for their support.

The Plan provides a high degree of flexibility for the manner in which the various components can be implemented according to changing demand forecasts and variations to the desired mix of port developments.

The Plan provides sufficient information to allow progression to detailed planning and design. Outline designs have been prepared for all essential components. The Phase I Development Report sets out full details for the implementation of the first stage of development.

Institutional Arrangements

It is recommended that a modified version of past institutional arrangements be adopted for the implementation of the LAPH developments.

To implement this recommendation, it is proposed that a LAPH Office be set up to establish a distinct focus of policy formulation, commercial evaluation, implementation recommendations and promotion, in order to ensure that the developments go ahead successfully in accordance with Government objectives and consistent with commercial realities. The ability of the LAPH Office to retain a close relationship with the private sector, whilst simultaneously providing confidential advice on port development policy to Government, is considered key to the success of commercial port development and management.

Scheduling

Implementation scheduling has taken all necessary preliminary and Government procedural activities as well as construction activities into consideration, with the necessary distinction being made between Government sponsored developments and private sector undertakings.

OPERATIONAL FACILITY	PACKAGES	COMPONENT	PHASE I 1997-2000	PHASE II 2001-2003	PHASE III 2004-2007	PHASE IV 2008-2011
Container Facilities	A1 - A4	Berths	4	4	4	5
		Operational area (ha)	80	80	40	100
		Back-up area (ha)	40	40	40	50
		Anchorage area (ha)	1,169	810	1,116	
River Trade Transhipment Wharves	B1 - B4	Quay face (m)	400	300	600	700
		Operational area (ha)	7	5	10	12
Floating Docks & Onshore Facilities	C1 & C2	Units (number)	3 (exist)	1 (new)	-	-
		Quay face (m)	1,150	385	-	-
		Operational area (ha)	15	5	-	-
		Typhoon moorings (no.)	6	2	-	-
Marine Services Support Area	D1 & D2	Quay face (m)	400	-	400	-
		Operational area (m)	2	-	2	-
HLC Typhoon Shelter	E	Effective area (ha)	50	-	-	-
Serviced Land	F1 - F4	Business Park/SPICE	10	10	20	-
		Office (ha)				
		General industry (ha)	13	5.1	5.1	7.8
Ship Repair Yards	G	Quay face (m)	-	1,400	-	-
		Operational area (ha)	-	9	-	-
Lamma Breakwater	H	Length (m)	-	-	-	4,300

Note: Phases relate to the period within which facilities need to be in operation

Table 3 Work Packages

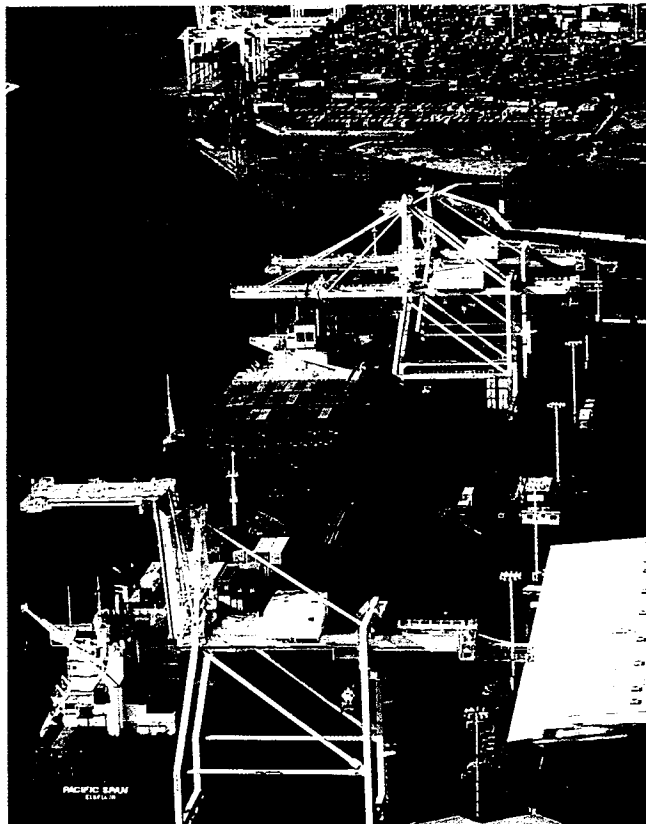
The commencement of the implementation of any Work Package (Table 3) is when Government decides to initiate the preliminary activities related to each package.

Implementation will largely be driven by the development of the container facilities to which the serviced land packages will be closely linked. The remaining packages can be implemented as and when Government decides that this is necessary.

The above leaves the implementation sequence largely open. However, to provide a (notional but definitive) schedule, the following have been allowed for :

- The container facility packages will be implemented such that the first berth goes into operation at the same time as the Lantau Fixed Crossing opens and thereafter berths are to be put into operation such that a total of 8 will be operational by the end of 2003, 12 by the end of 2007 and 17 by the end of 2011.
- The serviced land packages are to be implemented in parallel with the container facility stages and such that all land will be disposed of by the end of the respective phases.
- The Hei Ling Chau typhoon shelter is to be operational by the end of 1996.
- All other packages are to be implemented such that their components will be operational by the end of their respective phases.

A summary of the total implementation schedule is given in Figure 13.



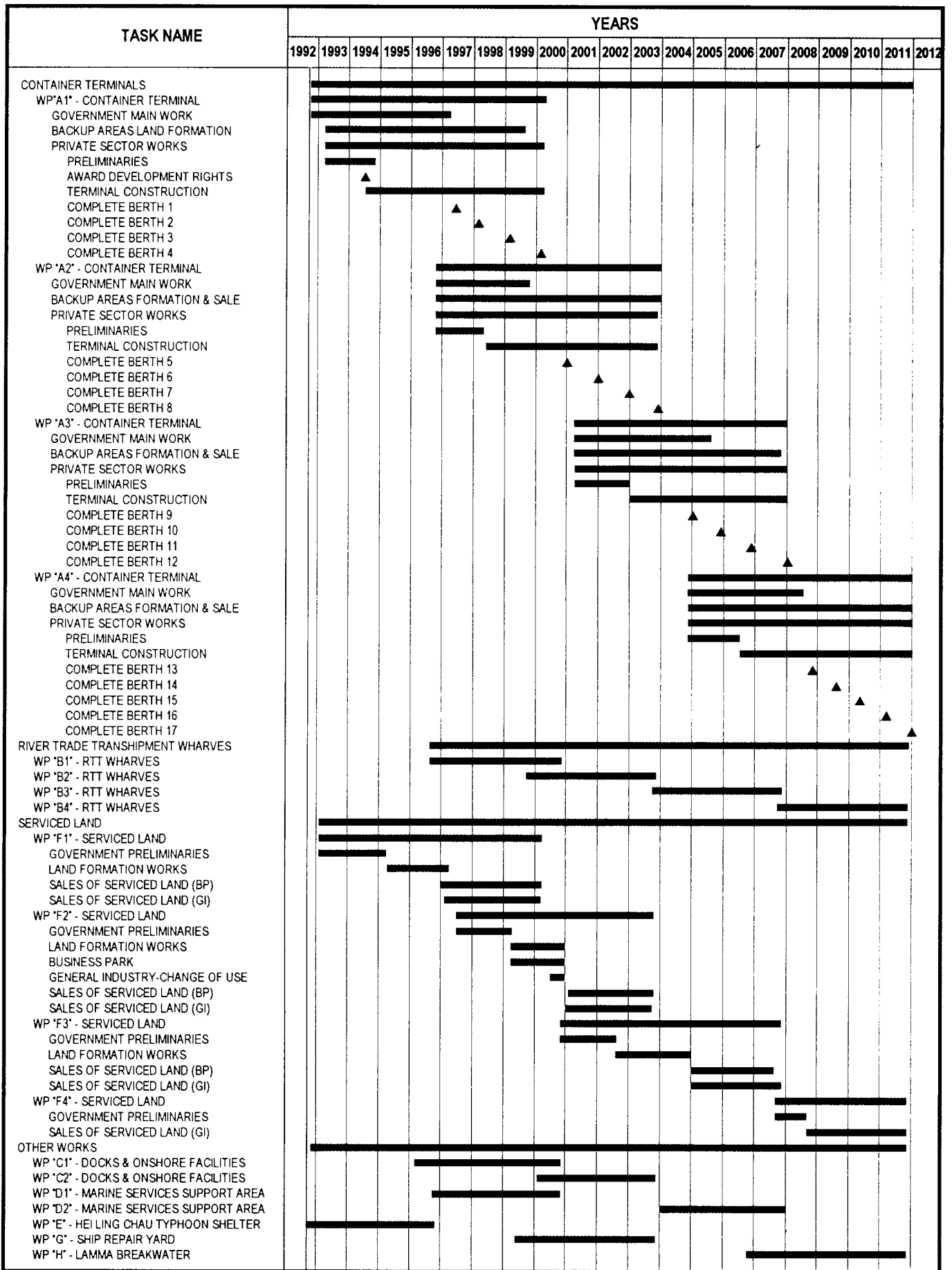


Figure 13 Summary Implementation Schedule

FINANCIAL ASPECTS

Capital Costs

The cost (based on March 1992 Hong Kong prices and including an allowance for contingencies but no allowance for inflation) of the total LAPH developments (Table 4) has been estimated to lie between HK\$ 42.4 billion and HK\$ 61.2 billion, with a March 1992 best estimate of HK\$ 54.2 billion. The container terminal packages, which include container back-up areas and a major part of the transport infrastructure, account for approximately 72% of the total cost.

WORK PACKAGE	LOWER BOUND	BEST ESTIMATE	UPPER BOUND
Container Facilities:			
- Work Package A1	7,347.7	9,329.2	10,329.5
- Work Package A2	6,316.1	8,162.7	8,942.6
- Work Package A3	8,671.8	11,495.3	13,238.6
- Work Package A4	7,815.4	9,952.1	11,193.1
Sub-total	30,151.0	38,939.3	43,703.8
River Trade Transhipment Wharves:			
- Work Package B1	577.1	710.5	795.7
- Work Package B2	471.6	574.5	637.6
- Work Package B3	624.6	732.1	833.4
- Work Package B4	1,218.4	1,436.9	1,562.7
Sub-total	2,891.7	3,454.0	3,829.4
Floating Docks & Onshore Facilities:			
- Work Package C1	2,668.8	3,087.6	3,277.1
- Work Package C2	1,013.7	1,184.2	1,295.7
Sub-total	3,682.5	4,271.8	4,572.8
Marine Services Support Area:			
- Work Package D1	485.3	621.8	743.5
- Work Package D2	179.1	242.8	287.5
Sub-total	664.4	864.6	1,031.0
Hei Ling Chau Typhoon Shelter (E)	348.2	445.1	537.7
Serviced Land:			
- Work Package F1	410.9	547.2	604.5
- Work Package F2	298.3	369.8	399.1
- Work Package F3	317.7	412.4	455.6
- Work Package F4		(nil capital costs)	
Sub-total	1,026.9	1,329.4	1,459.2
Ship Repair Yard (G)	1,771.0	2,374.5	2,765.7
Total	40,535.7	51,678.7	57,899.6
Lamma Breakwater (H)	1,836.0	2,548.3	3,318.2
Total	42,371.7	54,227.0	61,217.8

Table 4 Estimated Capital Costs at March 1992 Prices (HK & millions)

The March 1992 best estimate of Government's share of the total cost is HK\$ 18 billion (35%) or HK\$ 20.6 billion (38%) if the Lamma Breakwater is deemed to be required. The split of March 1992 best estimate costs between Government and the private sector for each Phase is given in Table 5.

Transport infrastructure accounts for 11% of the total costs, of which 88% is provided under the container terminal packages. Other infrastructure, which is mainly breakwaters and dredging, accounts for nearly 14% of the total cost, of which 38% is

attributable to the West Lamma Channel and 35% to the Lamma Breakwater.

Government Revenues

Government revenues (Table 6) from the proposed developments will derive primarily from the granting of development rights (premiums), and from the sale of land.

PHASE		GOVERNMENT	PRIVATE SECTOR
I	to 2000	4,839	9,902
II	2001 - 2003	2,853	9,812
III	2004 - 2007	6,939	5,935
IV	2008 - 2011	3,409	7,980
All Phases		18,040	33,639

Note : The cost of the Lamma Breakwater is not included.

Table 5 Best Estimate Cost per Phase at March 1992 Prices (HK\$ millions)

Income from the granting of development rights has been assessed as HK\$ 10 billion, of which more than 75% derives from the container facilities.

Land sales, covering container back-up, general industry and Business Park areas, are estimated to yield HK\$ 12.5 billion.

WORK PACKAGE	PREMIUMS	LAND SALES	LAND LEASING	DUES
A1 Container Terminal	1,600	1,077	43	49.7
B1 River Trade Transhipment Wharves	-	-	-	0.4
C1 Floating Docks & Onshore Facilities	890	-	-	-
D1 Marine Services Support Area	180	-	-	-
F1 Serviced Land	-	2,150	-	-
Total Phase I	2,670	3,227	43	50.1
A2 Container Terminal	1,600	1,200	-	70.3
B2 River Trade Transhipment Wharves	-	-	-	0.9
C2 Floating Docks & Onshore Facilities	680	-	-	-
G Ship Repair Yards	690	-	-	-
F2 Serviced Land	-	1,750	-	-
Total Phase II	2,970	2,950	-	71.2
A3 Container Terminal	900	1,200	-	80.1
B3 River Trade Transhipment Wharves	-	-	-	1.8
D2 Marine Services Support Area	-	-	-	-
F3 Serviced Land	-	3,250	-	-
Total Phase III	900	4,450	-	81.9
A4 Container Terminal	3,500	1,500	-	155.4
B4 River Trade Transhipment Wharves	-	-	-	2.5
F4 Serviced Land	-	350	-	-
Total Phase IV	3,500	1,850	-	157.9
Total all Phases	10,040	12,477	43	361.1

Table 6 Estimated Government Revenues at March 1992 Prices (HK\$ millions)

Government Cash Flows

A summary of estimated Government expenditures and revenues is given in Table 7 and net annual cash flows in Figure 14.

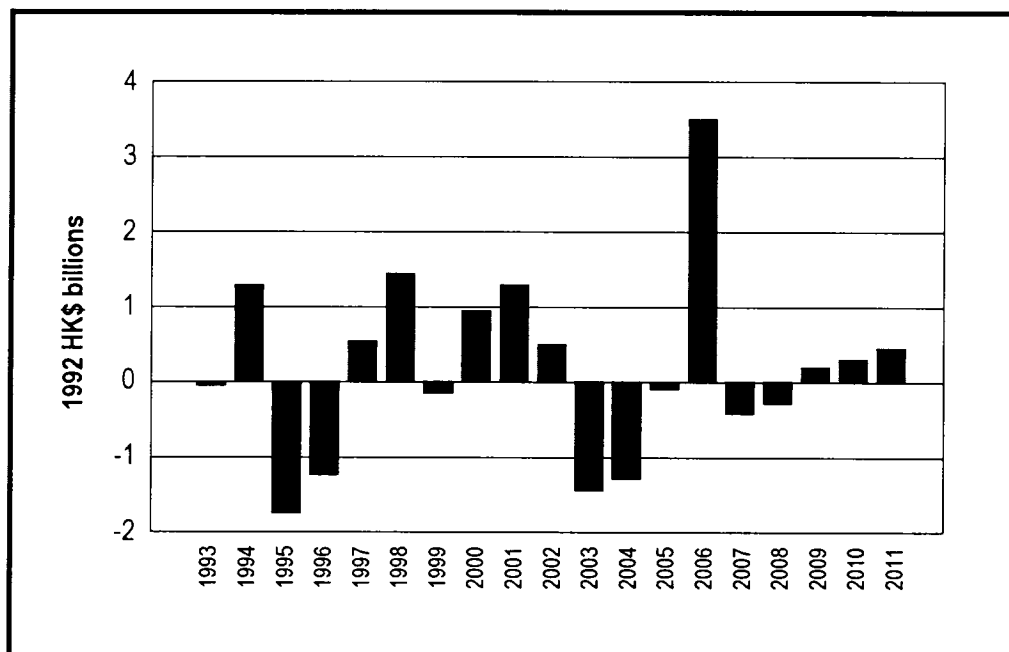


Figure 14
Estimated Government Net Annual Cash Flows

PHASE	EXPENDITURES	REVENUES FROM PREMIUM & LAND SALES	NET
I	(4,839)	5,897	1,058
II	(2,853)	5,920	3,067
III	(6,939)	5,350	(1,589)
IV	(3,409)	5,350	1,941
TOTAL	(18,040)	22,517	4,477

Note : The cost of the Lamma Breakwater is not included.

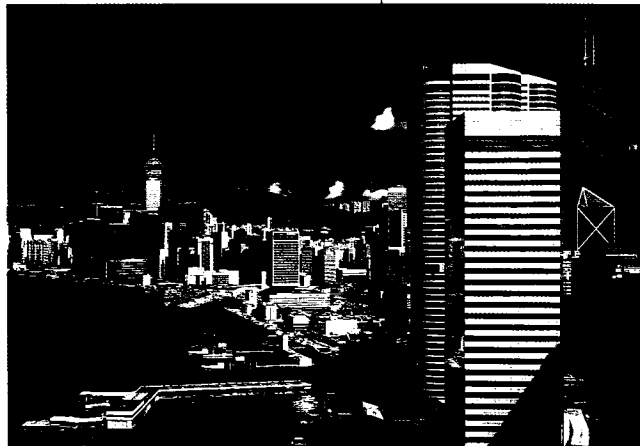
Table 7 **Summary of Estimated Government Expenditures and Revenues at March 1992 Prices (HK\$ millions)**

CONCLUSIONS

In its broadest context, the Recommended Outline Development Plan encompasses a development programme which is unique for Hong Kong port, in as far as :

- It sets out a definitive plan for the next 20 years and more which is capable of efficient, flexible implementation.
- It is an integrated plan for private sector development of extensive, wide ranging and largely interdependent marine-related facilities together with port-related and general industry.
- It represents an extent of development which, if carried out within the projected time frame, necessitates a more or less continuous construction programme, albeit through the implementation of a number of separate packages.
- All of the proposed developments will initially be implemented on a green field site relatively remote from existing urban and industrial development.
- Although the proposed developments encompass a high level of private sector participation, a number need major public sector works to make them possible.

In summary, the LAPH proposals will require implementation using a well-planned and coordinated approach to preserve the identity of the proposals as a single integrated, ongoing project. Of particular importance will be that Government completes the major public works needed to make the private sector initiatives possible in a timely and coordinated manner.



The unique character of the LAPH proposals calls for the adoption of institutional arrangements which are commensurate with its needs. This Report recommends arrangements which, while recognising existing institutional and other constraints, will maximise the chances of success within Government policy objectives and consistent with commercial realities.

