



Hong Kong Government
Environmental Protection
Department

Consultancy Study for Outlying Islands Refuse Transfer Facilities



Initial Environmental
Impact Assessment

September 1993

Aspinwall & company
CONSULTANTS IN ENVIRONMENTAL MANAGEMENT

in association with

SCOTT WILSON KIRKPATRICK

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Consultancy Study for
Outlying Islands Refuse Transfer Facilities Studies

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Impact Assessment

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SUMMARY

The development of the Outlying Island Transfer Facilities (OITFs) forms part of Hong Kong Government's strategy for improved waste management throughout the territory. This involves replacing the existing and outdated waste disposal system with purpose-designed facilities, whereby waste transfer operations will be upgraded to provide an efficient and environmentally acceptable system for final disposal at WENT Landfill. The islands which will be served by the development of the refuse transfer facilities include the following:

- Lantau (facilities at Discovery Bay and Mui Wo);
- Cheung Chau;
- Peng Chau;
- Hei Ling Chau; and
- Lamma (facilities at Sok Kwu Wan and Yung Shue Wan).

This Initial Environmental Impact Assessment (IEIA) has been prepared as part of the Outlying Islands Transfer Facilities Consultancy Agreement No. CE 35/91, and is based on the outline design of the facilities, as described in Working Paper No. 8 which has also been prepared as part of this Consultancy. The IEIA provides an initial assessment and evaluation of the key environmental issues which have been identified, sufficient to set out terms of reference for a detailed Environmental Impact Assessment (EIA) to be conducted by the successful tenderer.

The key issues addressed in this report include:

- Air Quality;
- Water Quality;
- Noise;
- Landscape Visual and Landuse;
- Traffic & Marine Transportation; and
- Bird, Rodent and Insect Control

Where appropriate, the IEIA has recommended mitigation measures which should be incorporated into the design of each transfer facility site in order that no unacceptable impacts occur at identified nearest sensitive receivers.

Recommendations are provided for monitoring and audit requirements for the construction and operational stages of development.

Provided that appropriate mitigation measures are incorporated into the design of the transfer facilities, it is concluded that no unacceptable residual (net) environmental impacts will occur. Furthermore, it is envisaged that the development of the sites will result in an overall environmental improvement in waste transfer arrangements within the Outlying Islands.

1. INTRODUCTION

1.1 This Initial Environmental Impact Assessment (IEIA) has been prepared as part of the Outlying Islands Transfer Facilities Consultancy Agreement No. CE 35/91. Details of the Brief for the IEIA are summarised in Paragraph 1.9 below. The IEIA's primary objective has been to identify the key environmental issues arising out of the development of refuse transfer facilities at seven sites on the Outlying Islands. The IEIA has been based on the outline design of the facilities, as described in Working Paper (WP) No. 8 "Outline Design" (Ref 1.1). It must be recognised however that tenderers are eligible to submit alternative design proposals, in which case further environmental assessment will be needed in the tender stage.

1.2 The IEIA provides an initial assessment and evaluation of the key environmental issues which have been identified, sufficient to set out terms of reference for a detailed Environmental Impact Assessment (EIA) to be conducted by the successful tenderer. Where appropriate, the IEIA has outlined the appropriate mitigation measures which should be incorporated into the design of each transfer facility site in order that no unacceptable impacts will occur at identified sensitive receivers. Recommendations are provided for monitoring and audit requirements for the construction and operational stages of development.

Background

1.3 The development of the Outlying Island Transfer Facilities (OITFs) forms part of Hong Kong Government's strategy for improved waste management within the territory. This involves redeveloping the existing and outdated waste disposal system to purpose-designed facilities, whereby waste transfer will be upgraded to provide an efficient and environmentally acceptable system for final disposal at Hong Kong's new strategic landfills in the New Territories. The islands which will be served by the development of the refuse transfer facilities include the following:

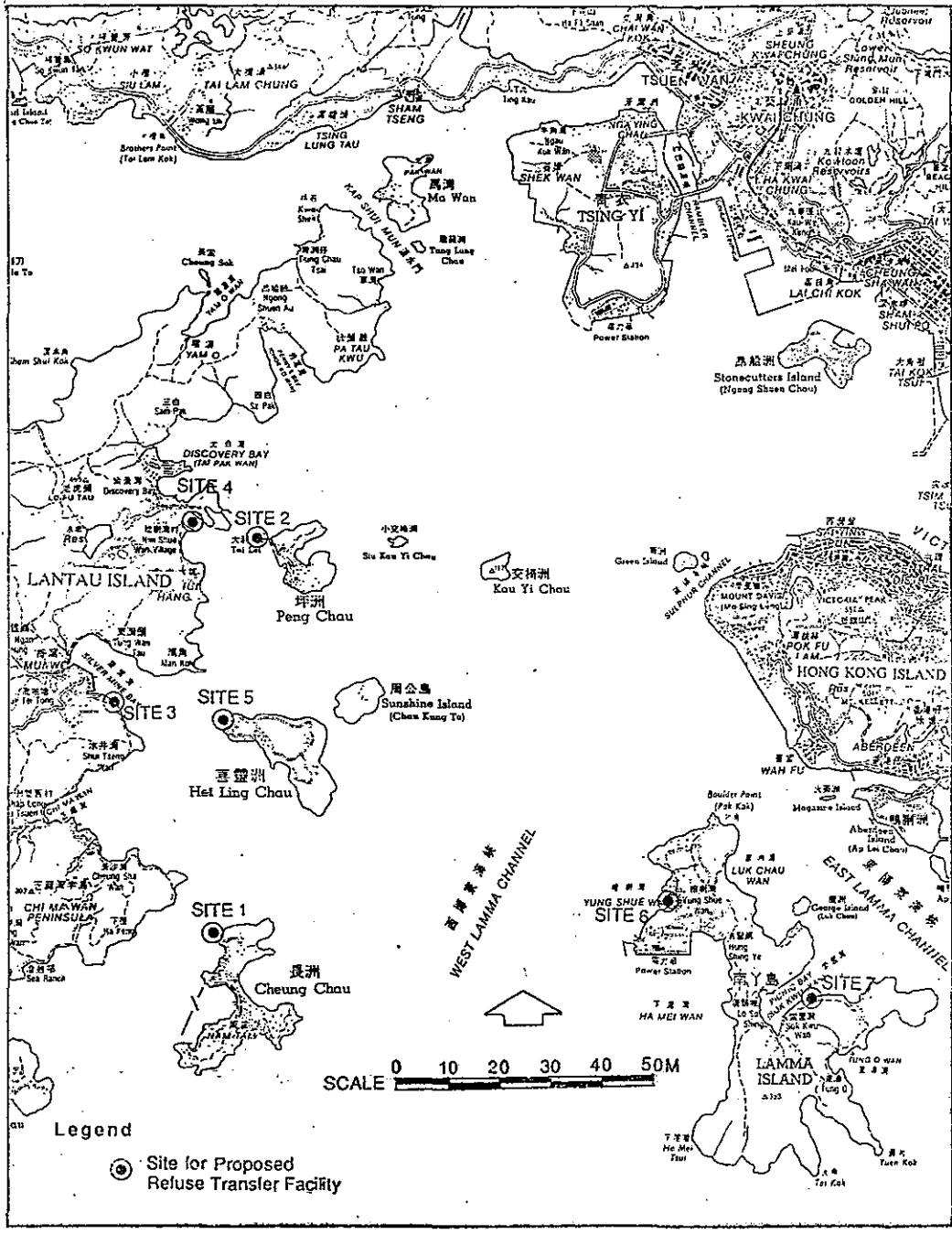
- Lantau (facilities at Discovery Bay and Mui Wo);
- Cheung Chau;
- Peng Chau;
- Hei Ling Chau; and
- Lamma (facilities at Sok Kwu Wan and Yung Shue Wan).

The locations of the proposed transfer facility sites on each of these islands are shown on Figure 1.1.

1.4 The outcome of the Consultancy Study will be to bring waste transfer arrangements on the Outlying Islands in-line with those applying elsewhere in the territory. RSD is currently responsible for both waste collection and waste transfer from eight designated barging points on the islands. RSD will continue barging until the commissioning of the OITF sites, after which the OITF contractor will assume responsibility for waste transfer.

Context of the Initial Environmental Assessment

1.5 It is broadly recognised that the development of the transfer facilities will result in a significant environmental improvement over the existing waste disposal system used in the islands by providing a fully containerised waste transfer operation. However, it is also recognised that the development of the transfer facilities has the potential to cause adverse environmental impacts on the local community as a result of their construction and subsequent operation. As such, Government procedures require that an environmental assessment be conducted to determine the type and severity of the environmental implications of the development proposals.



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FIGURE 1.1 LOCATION OF SITES

1.6 By carrying out an IEIA key environmental issues of concern can be identified at an early stage and essential information supplied to the design process. The incorporation of environmental considerations into the feasibility/planning procedure will allow for the inclusion of suitable mitigation measures in the design, construction, commissioning and operation of the facilities. By doing so, the facilities can be managed within the restraints of Government environmental regulations and guidelines.

1.7 In conducting the assessment reference has been made to all of the relevant Hong Kong Ordinances on the environment, and to the Hong Kong Planning and Standards Guidelines (HKPSG).

Scope of the IEIA

1.8 The IEIA of the transfer facilities has involved a review of all available information on the existing environmental conditions within the study area. This information has been assessed in conjunction with the engineering proposals and outline design for the facilities (Ref 1.1).

1.9 In accordance with the requirements of the brief, the IEIA addresses the following:

- identification of the likely environmental impacts arising from the project;
- initial assessment and evaluation of the residual (net) environmental impacts and cumulative effects of the development in order to identify and quantify those issues of key concern likely to influence recommendations on the outline designs, access arrangements, transfer arrangement and operational constraints and associated control requirements;
- a review of existing environmental monitoring data and recommendations for long-term environmental monitoring and post-implementation audit requirements
- identification of likely mitigation measures (including both conceptual design features and operational controls) and the setting out of Environmental Requirements in quantitative terms such that no unacceptable environmental impacts will result; and
- setting out Terms of Reference for the successful tenderer to undertake a detailed Environmental Impact Assessment of the transfer facilities.

1.10 The IEIA is presented in the following chapters which are numbered below:

- Chapter 2 The Study Area
- Chapter 3 Transfer Facility Operation
- Chapter 4 Scope of Assessment
- Chapter 5 Air Quality
- Chapter 6 Water Quality
- Chapter 7 Noise
- Chapter 8 Landscape, Visual and Landuse Impacts
- Chapter 9 Traffic & Marine Transportation Impacts
- Chapter 10 Bird, Rodent and Insect Control
- Chapter 11 Environmental Performance, Monitoring and Audit
- Chapter 12 Conclusions and Recommendations

References

- 1.1 Environmental Protection Department. Outlying Islands Refuse Transfer Facilities Consultancy Studies. Working Paper No. 8 - Outline Design. June 1993.

2. THE STUDY AREA

Site Description

- 2.1 The locations of the refuse transfer facilities on each of the islands and the surrounding landuses are given in Figures 2.1 to 2.7.
- 2.2 A brief description of each of the proposed refuse transfer facility (RTF) sites and their surroundings is given below and summarised in Table 2.1.

Cheung Chau

- 2.3 The RTF site is 1900 m² in area situated on an existing seawall and quay with 20 m of marine frontage (Figure 2.1). At present the site is used as a temporary stockpiling area for construction wastes. The site is accessed by Cheung Kwai Road, a single carriageway connecting to Praya Street and the built up areas of Cheung Chau. The site is visible from seaward and is located to the forefront of a recreation viewpoint and rest area.

Peng Chau

- 2.4 The RTF site is 1500 m² in area and located on Tai Lei Island at the most westerly point on Peng Chau (Figure 2.2). The site is served by a bridge with a 7.3 metre wide carriageway and has no direct marine frontage, but modification of a seawall to the east may be possible.

Mui Wo

- 2.5 The RTF site is 1700 m² in area and is located near the eastern end of Mui Wo Ferry Pier Road at the southern extremity of Mui Wo's built-up area (Figure 2.3). The site currently comprises the modular incinerator and part of an existing sand depot. There is a 45 m long marine frontage along the northern edge of the site which is currently used as RSD's barging point for waste transfer. The site area includes an area allocated to Drainage Services Department (DSD) for maintenance work, where no significant environmental impacts are envisaged. Sewage sludges from DSD's Mui Wo Sewate Treatment Works (STW) are currently delivered to RSD's barging point and removed by RSD. Water Supplies Department (WSD) currently use Mui Wo Public Pier for off-loading water treatment works chemicals, but have requested to use the marine frontage of Mui Wo RTF in the future.

Discovery Bay

- 2.6 The RTF site is 1000m² in area and is located within Discovery Bay's lease boundary in Area 10B which lies to the north of Nim Shue Wan (Figure 2.4). An area of 230 m² is currently taken up by a central collection facility for waste. This serves the town and is operated by Discovery Bay Management Services Ltd, the management company for the Discovery Bay residential development. The site forms part of a larger service area for Discovery Bay, including a liquid petroleum gas (LPG) storage depot, godowns and a vehicular ferry for service vehicles.

Hei Ling Chau

- 2.7 The RTF site is 1500 m² in area and is located at the western tip of the island adjacent to the cargo handling pier (Figure 2.5). Reclamation and access road construction will be necessary for the development of the facility. The existing ferry pier is used as the barging point for waste and this could continue to be used in the short term as necessary. The island is a restricted area under the control of the Correctional Services Department (CSD).

Yung Shue Wan

- 2.8 The RTF site is 1200 m² in area and is located near Kam Lo Hom and Yung Shue Wan, the most populated settlement on Lamma (Figure 2.6). It is designated as a proposed refuse transfer and waste recycling facility in the latest Layout Plan prepared by the Planning Department and comprises undeveloped foreshore. Reclamation and construction of access road will be necessary for the development of this facility.

Sok Kwu Wan

- 2.9 The RTF site is 1300 m² in area and is located between Sok Kwu Wan and Mot Tat Wan in South Lamma (Figure 2.7a). The proposed site is undeveloped foreshore which comprises an existing platform adjacent to the village access east of a jetty. The platform is currently used as a Government storage area. Reclamation and access road construction will be necessary for the development of this facility.
- 2.10 An alternative site under consideration for the transfer facility is located on the opposite side of a small embayment (Figure 2.7b). An alternative site has been considered in this report because of the environmental sensitivity of the fish culture zone (FCZ) which is in close proximity to the proposed site. Again, reclamation and access road construction will be necessary for the development of this facility.

Environmental Setting and Land Uses

Cheung Chau

- 2.11 The west side of the island, where proposed transfer facility will be sited, is more populated, in contrast to the eastern side which is less developed. The surrounding landuses include the population centres of Tung Wan and Cheung Chau and the small villages of Tai Kwai Wan and San Tseun, although the closest residential development is located over 100 m way from the site boundary (see Table 2.1). The unloading area adjacent to the ferry pier is a particularly busy area with movement of commercial goods.
- 2.12 The site foreshore is highly visible to seaward, and is currently being used for the temporary stockpiling of construction waste. The site is located at the toe of a slope at the top of which is located a recreation viewpoint and rest area. The viewpoint is accessed by footpath and contains a covered area with seating. Apart from a limited number of three-wheeled diesel transport vehicles, there is no motorised traffic on the island.

Peng Chau

- 2.13 The population of Peng Chau is concentrated on the western side of the Island near the ferry pier where low rise residential and shopping developments exist. This is in contrast to the eastern side which is remote from the ferry pier and includes only several village houses at Tung Wan. Peng Chau is a popular recreation destination with weekend visitors from urban Hong Kong. No roads are present on the island for private vehicle use although there is access for service and emergency vehicles.
- 2.14 The site forms part of an area dedicated to public utilities and for storage/maintenance activities. Some low density squatter housing is located about 170 metres away. A sewage treatment works on an adjacent site is currently a proposed development.

Mui Wo

- 2.15 Mui Wo consists of a mixed development comprising residential property, hotels, shops and restaurants. The main residential areas do not front directly onto Mui Wo Bay. The frontage has ferry and bus termini, restaurants, hotels and beach facilities.

- 2.16 The site forms part of an area containing industrial uses and public utilities, including an existing sewage treatment works and is approximately 500 metres distant from Mui Wo. Steep slopes which form a backdrop to the south where individual villages type houses are located on these slopes are some 300 metres distant from the site. The site is currently occupied by a modular incinerator which will require demolition. The proposal for a waste transfer facility is compatible with other existing and planned landuses in the area, given the isolated nature of the area and lack of through traffic past the proposed site. In the context of the surrounding industrial uses, landscape and visual impacts from redeveloping this site will be minimal.

Discovery Bay

- 2.17 Discovery Bay is a self contained residential development consisting of a mixture of low and high rise residential housing focused to overlook the bay, with a population of approximately 8,500. Buses and electric carts are the only forms of transport and the only access to the development is by dedicated ferry. The proposed site is located to the south of the bay on the other side of a promontory facing Nim Shue Wan village.
- 2.18 A road tunnel is proposed connecting the North Lantau Expressway together with a new port facility off Lantau to the north of Discovery Bay, and east of Penny's Bay. According to the approved Masterplan for Discovery Bay, the population will be 20,000 when the area is fully developed. If the Yi Pak Development Plan (including the road tunnel connecting Discovery Bay with the North Lantau Expressway) is approved, the population will increase to 35,550.
- 2.19 This site itself forms part of a larger service area which includes an LPG depot, cargo handling area, vehicular ferry pier and godowns. The site is overlooked by residential blocks, situated on higher ground to the north-east with the nearest 50 metres away.

Hei Ling Chau

- 2.20 The island is a restricted area under the control of the Correctional Services Department (CSD). There are approximately 6,400 residents composed of site staff and Vietnamese Boat People. The island is not accessible to the general public except during designated prison visit periods.
- 2.21 The site is well shielded and distant from existing development, which is in itself low intensity. Adjacent uses comprise barrack accommodation and four story buildings located beyond the cliff face. There is only isolated motorised traffic movement on the island.

Yung Shue Wan

- 2.22 The site forms part of a larger reclamation which has been planned to accommodate industrial and public utility uses, including a proposed sewage works, a dangerous goods store, a building materials depot and rural workshop units. In the longer term the sewage works may be used to provide for the treatment of effluent from the transfer facility. The proposed development, as planned, will require the resumption of the village houses along the existing foreshore. The hillslopes to the South are mostly uninhabited and zoned as a Countryside Conservation area.

Sok Kwu Wan

- 2.23 The site is currently undeveloped foreshore and highly visible, both from land and sea. The development of the site is particularly sensitive due to the proximity of a fish culture zone (FCZ) lying 40 metres offshore. The site is located adjacent to the footpath which connects the villages of Sok Kwu Wan and Mo Tat Wan. Sok Kwu Wan is some 500 metres away to the south-west and Mo Tat Wan is some 900 metres to the east. The site is isolated from residential areas, where the closest residential property is approximately 160 metres to the west.

- 2.24 The alternative site location is less obtrusive than the other site, being located in a sheltered embayment instead of a promontory and is in front of a low cliff face. The alternative site also has the environmental advantage of being twice the distance (i.e. 80m) from the nearest FCZ.

Nearest Sensitive Receivers

- 2.25 Nearest sensitive receivers (NSRs) in the vicinity of the proposed facilities, and proposed developments which are of potential environmental relevance, at each site are summarised in Table 2.1 and Table 2.2 respectively. Receptors which are subject to visual impacts beyond those listed in Table 2.1 are discussed in Chapter 8.

Table 2.1 - Identified Nearest Existing Sensitive Receivers in the Vicinity of the Transfer Facility Sites

Site	NSR	Distance from Site Boundary (m)
Cheung Chau (N808 930 E820680)	Residential Property (N808 845 E820 810)	120
	Residential Development Area (****)	170
Peng Chau (N817 730 E821 490)	Farm Dwellings (N816 720 E821 910)	390
	Residential Property (N816 550 E822 030)	170
Mui Wo (N13 585 E18 640)	Residential Property (N13 525 E18 300)	305
	Heung Yee Yuk Secondary School (N13 805 E18 185)	480
	Round Table Village (N13 720 E18 155)	590
Discovery Bay (N817 180 E820 290)	Jovial Court (N817 205 E820 345)	40
	Haven Court (N817 180 E820 371)	75
	Verdant Court (N817 170 E820 400)	100
	Nim Shue Wan Village (N817 050 E820 000)	330

Table 2.1 - (Contn)

Site	NSR	Distance from Site Boundary (m)	
Hei Ling Chau (N813 050 E 820 840)	Accommodation Block (N813 026 E821 157)	60	
Yung Shue Wan* (N809 550 E829 315)	Children's Play Area (N809 505 E829 442)	90	
	Clinic (N809 505 E829 477)	140	
	Temple (N809 535 E829 483)	140	
	Residential Property (N809 510 E829 450)	110	
Sok Kwu Wan** (N807 650 E 832 010)	FCZ (N807 011 E832 000)	40	
	FCZ (N807 011 E831 800)	120	
	Residential Property (N807 634 E831 882)	160	
	Alternative Site (N807 710 E 831 700)	FCZ (N807 810 E831 800)	95
	FCZ (N807 800 E831 937)	130	
	Residential Property (N807 634 E831 882)	65	

Notes:

1. * *Assumes demolition of the existing squatter settlement*
2. ** *The site is immediately adjacent to a designated Village Development Area, as shown on the Outline Development plan D1/L1/1. The land has been designated to accommodate the expansion needs of the nearby village*

Table 2.2 - Proposed Developments in the Vicinity of the Transfer Facility Sites

Location	Nature of Development	Distance to RTF Site	Timetable for Development	Comments
Cheung Chau	Proposed salt water pumping station	250m	To be confirmed	
	Residential (R3) development	170 m	Site formation work completed end 1993/early 1994	
Peng Chau	Tai Lei Sewage Treatment Works	Adjacent	Operational 1995	
	Residential Area	170m		
Mui Wo	Expansion of Sewage Treatment Works DSD	Adjacent	To be confirmed	Consultancy study to be carried out
	Maintenance Depot	Adjacent	Site to be occupied up to 31.3.96	
Discovery Bay	Redevelopment of Godown within Service Area	50m	Tentative proposal. by HKRC. No date has been fixed for these works	-
Hei Ling Chau	None identified	-	-	-
Yung Shue Wan	Sewage Treatment Works and other uses forming part of reclamation area	Adjacent	Phased in during 1998	-
Sok Kwu Wan	Lamma Quarry Redevelopment	500m	2003-7	Consultancy study being carried out
	Casting basin for emmersed tube tunnels	500m	1995-7	Impacts on water quality are addressed in Consultancy Study
(Alternative site only)	Village Development Area	Adjacent	Unlikely in the near future. Dependent on development pressure	Buffer zone would be incorporated

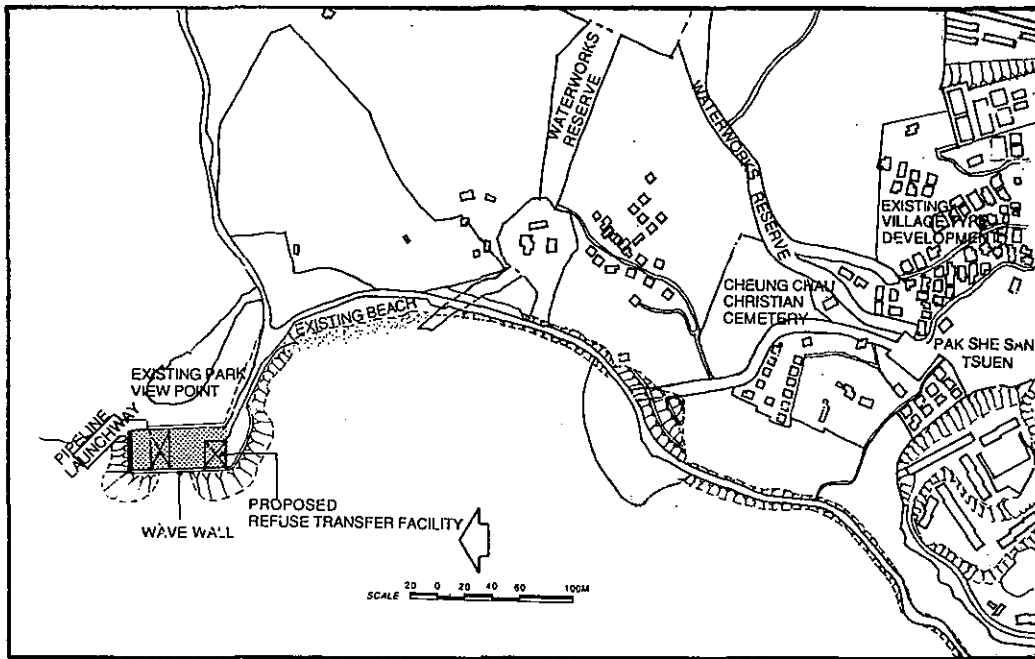


FIGURE 2.1 CHEUNG CHAU TRANSFER FACILITY LOCATION PLAN

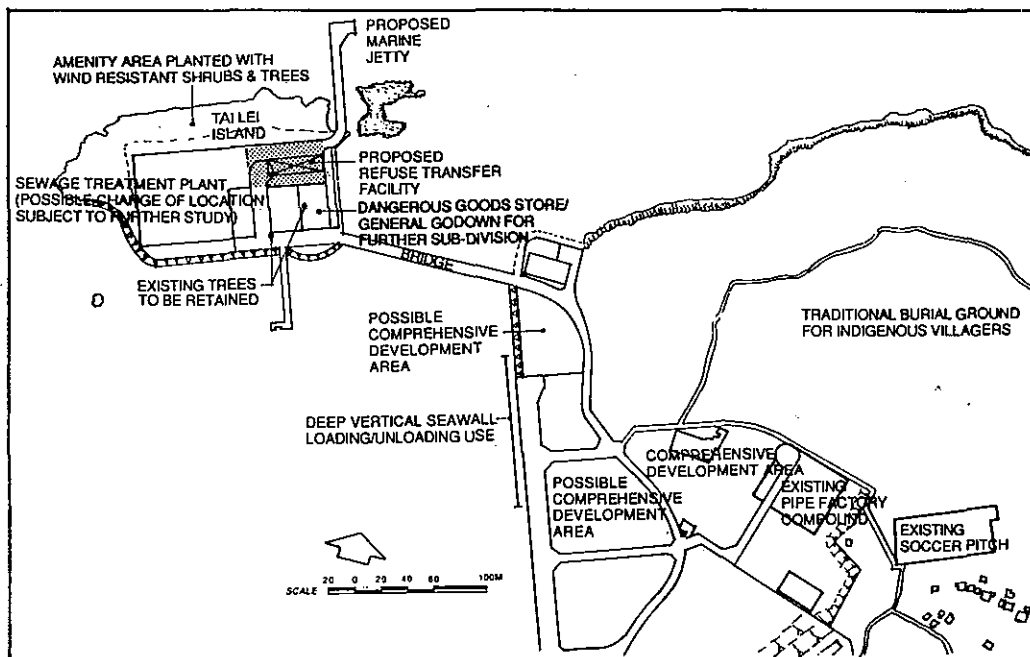


FIGURE 2.2 PENG CHAU TRANSFER FACILITY LOCATION PLAN

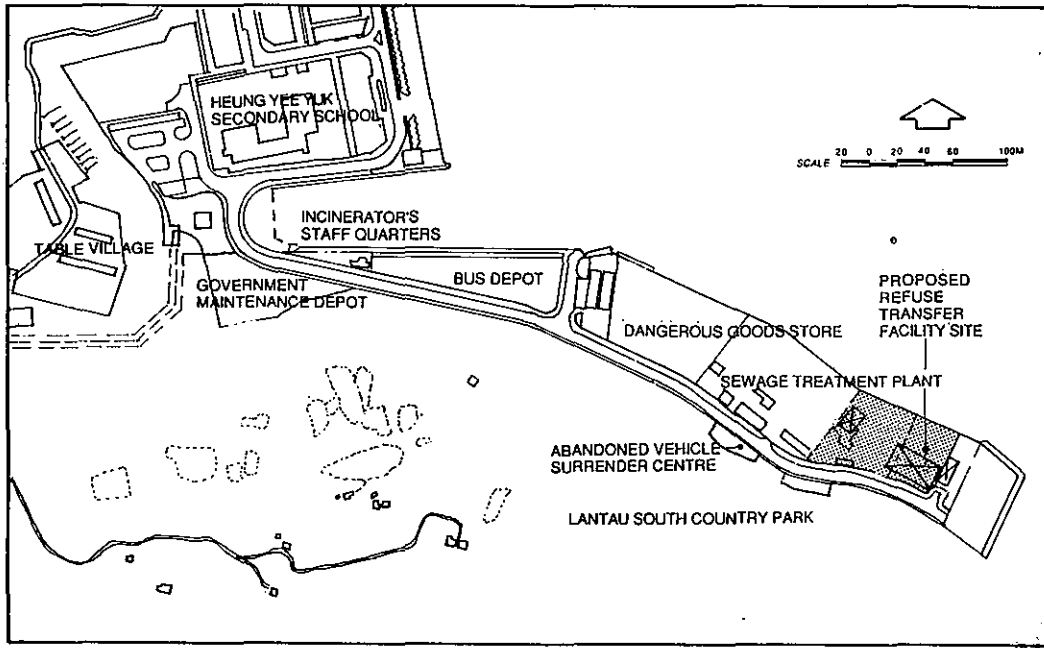


FIGURE 2.3 MUI WO MOTHER SITE TRANSFER FACILITY LOCATION PLAN

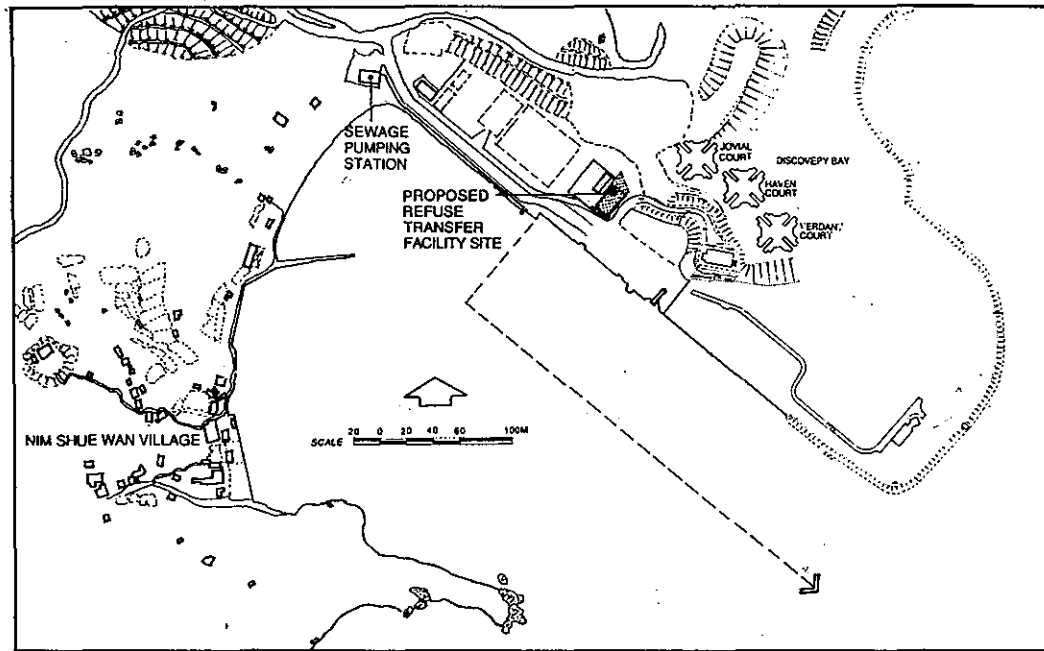


FIGURE 2.4 DISCOVERY BAY TRANSFER FACILITY LOCATION PLAN

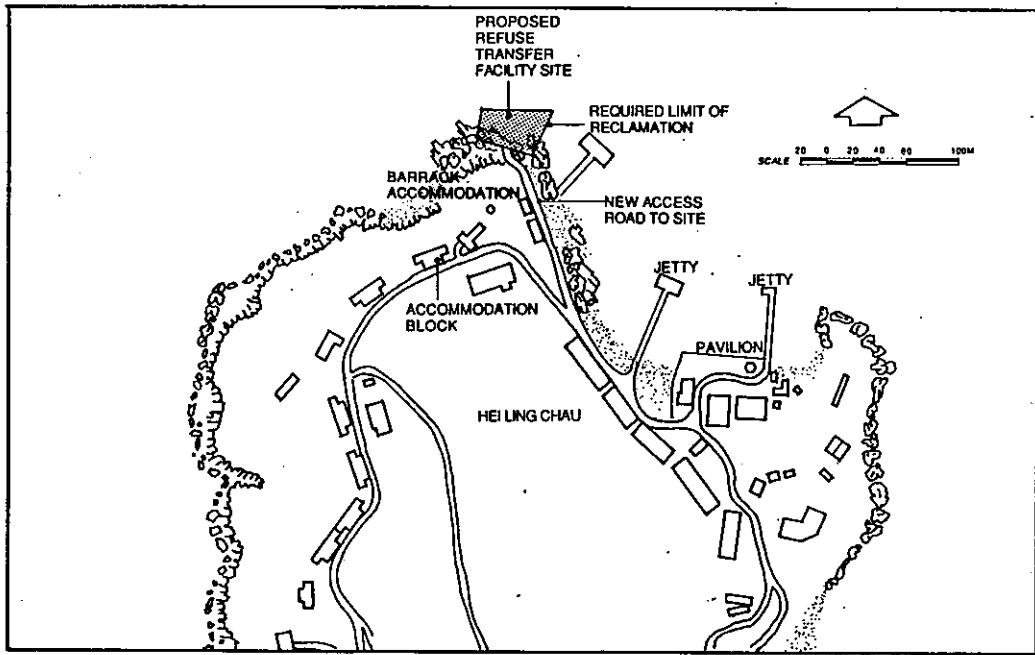


FIGURE 2.5 HEILING CHAU TRANSFER FACILITY LOCATION PLAN

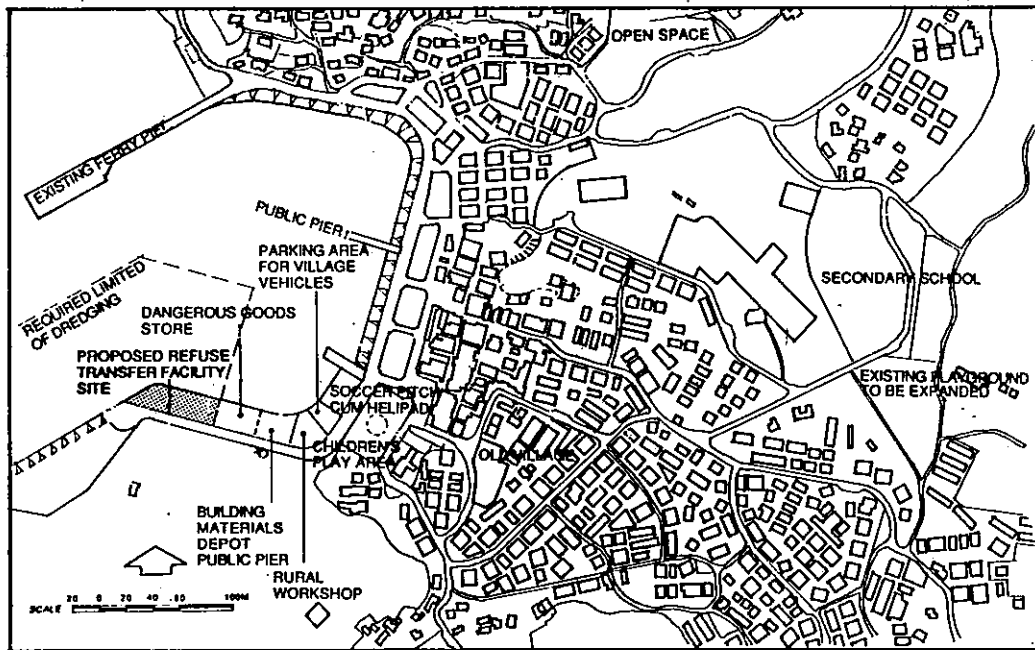


FIGURE 2.6 YUNG SHUE WAN TRANSFER FACILITY LOCATION PLAN

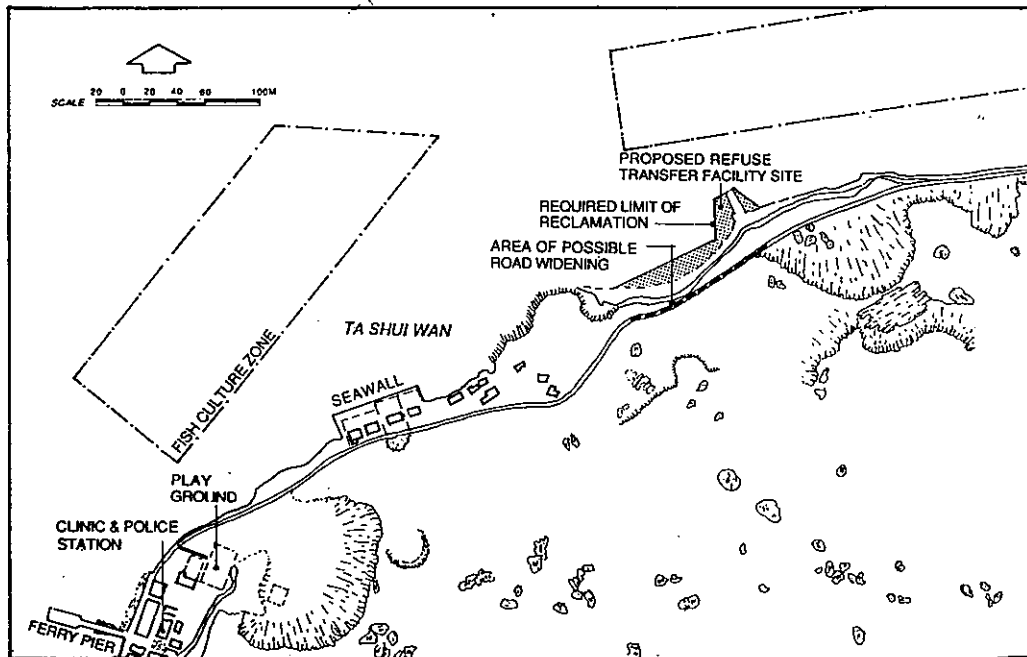


FIGURE 2.7a SOK KWU WAN TRANSFER FACILITY LOCATION PLAN (ORIGINAL LOCATION)

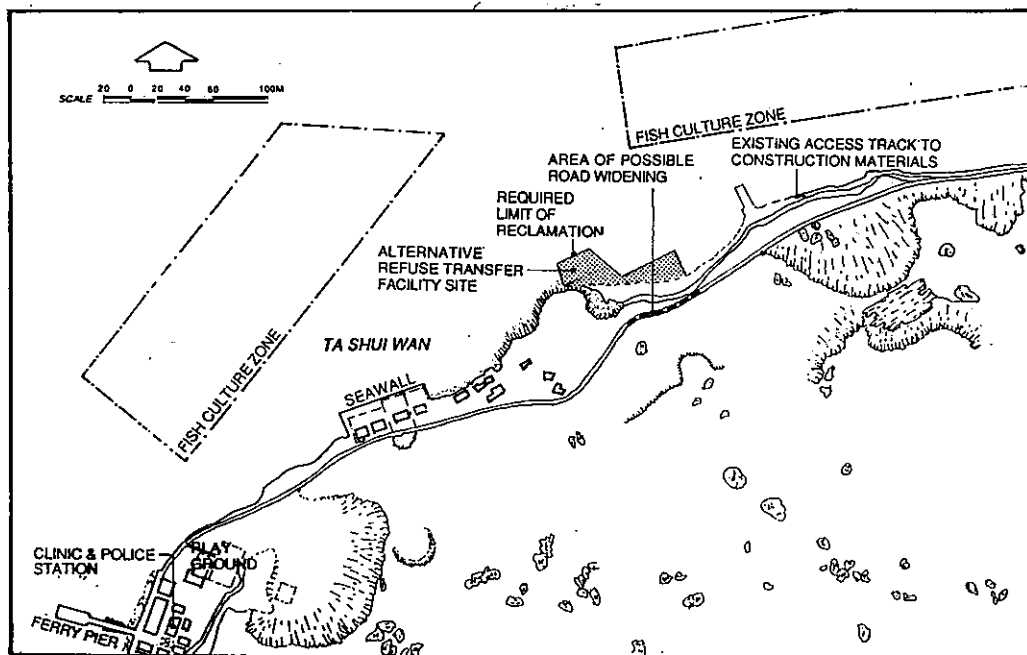


FIGURE 2.7b SOK KWU WAN TRANSFER FACILITY LOCATION PLAN (ALTERNATIVE LOCATION)

3. WASTE TRANSFER OPERATION

Waste Types and Quantities

Current Waste Arisings and Disposal

- 3.1 Currently, waste arisings from the Outlying Islands total 132 tonnes per day of waste which is collected for delivery to an approved disposal point by the Regional Services Department (RSD). The waste arisings vary significantly between different islands and are summarised in Table 3.1 (Ref 3.1). The majority of the waste arisings are dealt with in a small scale localised manner whereby publicly collected domestic and commercial waste is collected in large plastic sacks and transferred to barging points operated by RSD. With the exception of Mui Wo, waste is transferred from public collection points for transfer by hand or motorised carts. Mui Wo wastes are delivered by Refuse Collection Vehicle (RCV). In some cases barging points are located on the existing public ferry pier and close to village centres.
- 3.2 Wooden junks are used to transfer waste to Kwai Chung incinerator for disposal. In addition, there is a small-scale modular incinerator at Mui Wo that treats approximately 8.3 tonnes per day of waste collected from Lantau. The unit is not equipped with a sophisticated pollution control system, and residual ash and incombustible materials are disposed of using the RSD collection system. Consideration has been given by Government to decommission the incinerator in mid-1994.
- 3.3 Sewage sludge arisings from the islands are dewatered and bagged for transfer by Drainage Services Department for final disposal at Tseung Kwan O Landfill. The total volume of sewage sludge arisings currently total approximately 4.25 m³ per day.

Table 3.1 - Current Waste Arisings on the Outlying Islands

Site/Island	Domestic and Commercial Waste (tonnes per day)	Sewage Sludge (m ³ per day)
Cheung Chau	60	1.0
Peng Chau	11	1.3
Mui Wo	28	-
Discovery Bay	12	1.15
Hei Ling Chau	6	0.8
Yung Shue Wan	13	-
Sok Kwu Wan	2	-
Total	132	4.25

- 3.4 At present about 810 cu m per day of thin water treatment works sludge is produced from the Silvermine Bay and Tai O Water Treatment Works and is disposed of to surface water courses.
- 3.5 Small quantities of special waste are produced on the Outlying Islands. These wastes include abattoir waste, animal carcasses and clinical waste. The total quantity is estimated to be less than 1 tonne per day.
- 3.6 Large quantities of construction waste are also generated from the Outlying Islands. The existing arrangement for the transfer of construction waste from the Outlying Islands is confined to Cheung Chau only. An interim measure is in operation, whereby waste is open-barged to Cheung Chau Marine Spoil Ground by the Civil Engineering Department (CED) from Tai Kwai Wan, Cheung Chau.

Future Waste Arisings and Disposal

- 3.7 The development of the transfer facilities will result in an improved system for the removal of wastes from the islands. By securing a suitable disposal outlet for all waste types the illegal tipping of refuse in rural parts of the islands that currently takes place should, hopefully, be discouraged.
- 3.8 Estimates of future waste arisings are given in Table 3.2 (Ref 3.1).

Table 3.2 - Future Waste Arisings on the Outlying Islands

Site/ Island	Domestic and Commercial Waste (tonnes per day)				Sewage Sludge (m ³ per day)
	1996	2001	2006	2011	Estimates for next 15 Years
Cheung Chau	66	74	88	113	2.5
Peng Chau	15	17	21	25	2.6
Mui Wo	33	43	52	65	1.0
Discovery Bay	33	49	59	70	1.2
Hei Ling Chau	5	6	7	8	0.8
Yung Shue Wan	15	56	68	81	-
Sok Kwu Wan	2	2	3	3	-
Total	169	247	298	365	8.1

- 3.9 The future strategy for the transfer and disposal of wastes from the Outlying Islands is through the provision of seven waste transfer facilities at Cheung Chau, Peng Chau, Hei Ling Chau, Mui Wo and Discovery Bay on Lantau, and Yung Shue Wan and Sok Kwu Wan on Lamma. The facilities at each site will be designed to handle all waste types including domestic and commercial wastes (both publicly and privately-collected), construction wastes and those special wastes which may be produced on the Islands.

- 3.10 The transfer facilities will be designed to accommodate the anticipated population and economic growth of each of the Islands over a 15-year period and for the seasonal and daily fluctuations in waste arisings which occur regularly at weekends and at holiday and festival periods. Based on current waste arisings the design capacity of each facility is given in Table 3.3 (Ref 3.1).
- 3.11 The majority of wastes will be transferred by marine transport for disposal at the WENT Landfill site. The overall transport strategy is based on a two stage approach as follows:
- (i) One group of inter-island vessels will collect the containerised waste from Cheung Chau, Hei Ling Chau, Sok Kwu Wan and Yung Shue Wan and deliver it to Mui Wo which will act as a transshipment point or marine berthing facility (MBF);
 - (ii) A second group of larger vessels capable of making the journey to WENT Landfill will transport the waste from Mui Wo, collecting containerised waste from Discovery Bay and Peng Chau en-route.

Table 3.3 - Design Capacity of the Outlying Island Transfer Facilities

Site/Island	Domestic and Commercial Waste (tonnes per day)	Construction Waste (tonnes per day)
Cheung Chau	113	75
Peng Chau	25	17
Mui Wo	65	43
Discovery Bay	70	47
Hei Ling Chau	8	6
Yung Shue Wan	81	54
Sok Kwu Wan	3	2
Total	365	244

Note:

Commercial wastes are assumed to constitute 40 % of total waste arisings

- 3.12 All domestic and commercial wastes delivered to the transfer facilities will be disposed of direct to WENT Landfill. The proposed disposal options for the other wastes types to be handled at the transfer sites are as follows:
- (i) Pre-sorted construction wastes only will be accepted at the transfer facilities and will be transferred to WENT Landfill MBF. Those construction wastes which are permitted at landfill will be disposed at WENT Landfill and inert waste materials suitable for disposal at public dumps will be transported by road to a licensed dump site;
 - (ii) Special wastes will be transported to the proposed Centralised Incineration Facility (CIF) at Tuen Mun by arrangement between the OITF contractor and the CIF contractor;

- (iii) Sewage treatment works sludges from the Mui Wo sewage treatment works will be transferred by the contractor for disposal at WENT Landfill. The OITF contractor should not be required to accept sludge he cannot subsequently dispose of at WENT Landfill.
- (iv) The outline design of the OITFs has been based on the transfer of 30 tonnes per day of waterworks sludge (at Mui Wo) with a solids content of 30% which will be acceptable to WENT Landfill. This capacity accounts for seasonal variation in sludge production and a potential increase in water treatment capacity on Lantau. The actual disposal requirements of Water Supplies Department is subject to further Government study, whereby the management of waterworks sludge is under review.

Transfer Station Operation

3.13 The waste management strategy is characterised as follows:

- Standardisation wherever possible using similar equipment on each site, and plant and containers to designs which have been proven elsewhere.
- Flat slab operational areas to provide flexibility in operation with roofed areas above compactors for wet weather working and to permit separate collection of leachate from the compactor/container areas from rainwater run-off.
- All wastes to be containerised, and no loose handling of materials permitted, to minimise environmental impacts from a variety of causes.
- Craning on all marine vessels to minimise visual impact of the alternative siting of permanent land-to-marine crane installations at each site.
- Daily collections during normal operation, to minimise on site storage of wastes.
- Sealed containers with lightweight covers used as appropriate to minimise vermin, leachate and odour.
- Containers with lightweight covers which do not need to be moved while on site, used at Hei Ling Chau and Sok Kwu Wan to avoid the permanent siting of plant otherwise needed for container manoeuvring.
- Construction wastes, to be handled in 1.25 metre high 6 metre long containers, which will be protected from rain by the use of lightweight covers.
- Special wastes and sludges to be handled in dedicated sealed containers.
- Weighbridges to be installed at all transfer facility, where sites with physical constraints (i.e Discovery Bay, Hei Ling Chau, Sok Kwu Wan and Yung Shue Wan) will have single axle weighbridges installed. All wastes are to be weighed at the landfill and the tonnages will be tracked back to the RTF source by the data management system.

3.14 In the event of non-collection of waste from the sites, (e.g in typhoon conditions), incoming waste will be stored in sealed containers or containers with lids. The design of the facilities allows for one days additional storage of waste, and accumulation beyond this period is not envisaged. No additional environmental impacts are anticipated from this storage.

3.15 The proposed transfer sites will be developed and brought into operation as shown in Table 3.4.

Table 3.4 -Construction and Operational Periods of the Transfer Facility Sites

Site name	Year to be Phased in	Construction Period (Months)	Operating Period (Years)
Cheung Chau	1996	6	15
Peng Chau	1996	6	15
Mui Wo	1996	9	15
Discovery Bay	1996	6	5
Hei Ling Chau*	1997	4	14
Yung Shue Wan*	1998	6	13
Sok Kwu Wan*	1999	6	12

Note

* These sites are likely to be commissioned after the others due to the need to carry out site formation works. Dates used are for costing purposes only.

General Layout of Facilities

3.16 The operational layouts of each OITS, which were included in WP No. 8 (Ref 3.1), are shown in Figures 3.1 to 3.7. The tenderers are likely to propose alternative site layouts for approval, subject to compliance with specified performance requirements. Therefore, the following is a description of one method by which the specification might be complied with, and comprises just one among many options which might be finally adopted.

3.17 Each transfer station will comprise:

- Reception area, at the site entrance. At this location incoming waste will be categorised for waste type and the user will be informed of destination for tipped material (i.e. domestic/commercial, construction waste or special waste containers).
- Marshalling area within site, where users will be required, by the site duty foreman to wait in this area while compaction activities take place, or while container manoeuvring is carried out.
- Hoppers or bins as necessary to allow users, as directed, to tip material during waiting periods (i.e. while compaction activities take place, or while container manoeuvring is carried out).
- Designated areas with containers for domestic/commercial, construction and special wastes.
- Compaction area (roofed) with hopper or elevator fed compactors.
- Container storage areas (including emergency and contingency container storage).
- Marine berth with suitable fenders and moorings.

- Amenities for the contractor, Government contract compliance inspection staff, and users.
- High pressure water lance vehicle washing in a designated area.
- Wastewater segregation, collection and tank storage system with barge transfer to Mui Wo for pre-treatment for all transfer facility effluents.

3.18 Based on the Operational Plans in the Outline Design (WP8), the layout features of each site are summarised:

Cheung Chau

- 3.19 Site modifications are necessary. The existing rubble revetment to the north will be removed to facilitate marine berthing. The existing access road to the site will be widened to 4 to 4.5 metres along its entire length necessitating cut slopes on the landward side.
- 3.20 Two large roofed areas will cover the compacting and container loading operations. Smaller buildings are proposed for site offices. The remaining area will be used for circulation, loading and container storage. No open storage is proposed at this site.

Peng Chau

- 3.21 Developing the existing Refuse Transfer Facility, a single roofed area will be constructed together with small office buildings. The remaining area will be used for loading or container storage. Refuse will be loaded onto marine vessels from a new jetty, to be constructed to the north of the island.

Mui Wo

- 3.22 This is the largest of the Refuse Transfer Facilities. As the "Mother Site", it will receive containers from the other sites. The containers will be stacked along the waterfront before being transferred to the Mother Vessel. Empty containers will be stacked to a maximum of three high. Two large roofed areas will be provided for both the compaction area and for the waste container area, and a new workshop will be provided. The existing office complex will be retained. Open storage of construction waste may also be accommodated on this site together with facilities for leachate storage and treatment.

Discovery Bay

- 3.23 Expanding the existing site, the entire operational area will be covered and enclosed by a single, roofed area. Loaded containers may be stored in the open, along the waterfront which is separated from the building by an access road.

Hei Ling Chau

- 3.24 This site is currently undeveloped therefore reclamation and road construction will be necessary before the facility can be developed. On this island, refuse transfer will be a smaller scale operation with basic site cover and no operational equipment. The reclaimed area will be used to store several (four or five) waste containers. A high level of security will be necessary since it will be operated by the island's correctional institutions.

Yung Shue Wan

- 3.25 The facility will be developed on land reclaimed under a separate contract. It has been suggested that this proposed reclamation is extended an additional 5 metres to more comfortably accommodate operations. If this extension goes ahead, it is likely that it will extend the entire length.
- 3.26 Two separate roofed areas are proposed, separated by a open manoeuvring area. Additional container storage will be provided at the eastern side of the site.

Sok Kwu Wan

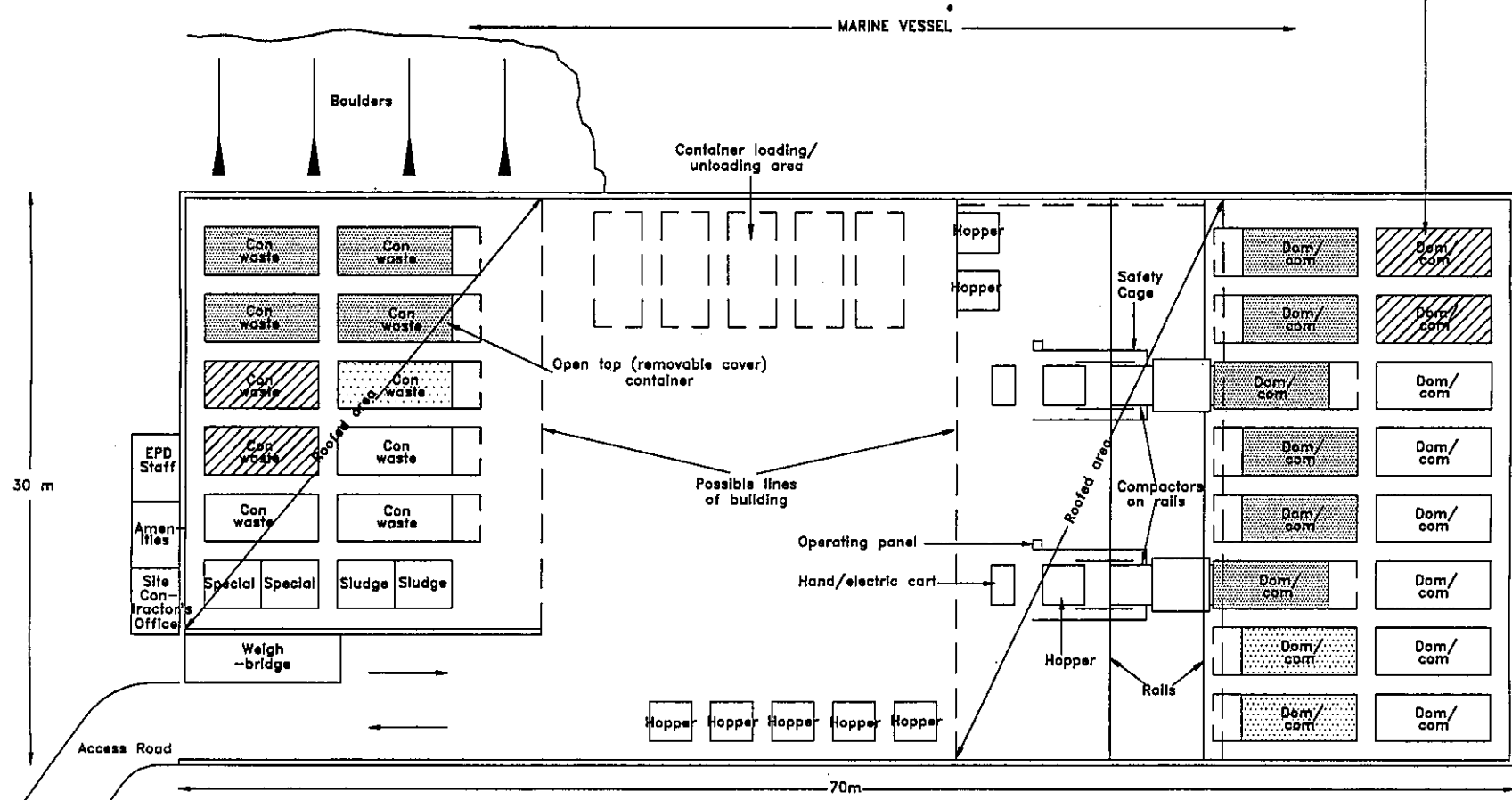
- 3.27 The facility and its access will be constructed on reclaimed land. Two alternative locations have been proposed, within the same area. It will be necessary to widen the existing access track to the site from 2 to 4 metres.
- 3.28 A small scale operation is proposed for this site. No structures will be necessary on this site. The area will be used to store containers. For both options, the design features are the same.

Transfer Operations

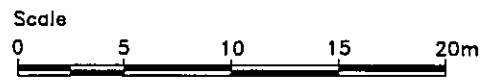
- 3.29 Marine transfer will be carried out by self propelled marine vessels each with a suitable derrick crane for the handling of ISO containers.
- 3.30 The containerisation of wastes will eliminate spillages during barge loading.
- 3.31 The operating hours for marine transfer operations will generally continue beyond normal opening hours for the reception of waste, but will be restricted to comply with environmental (noise) constraints where sites are located close to habitation. Operating hours of the transfer facilities are given in Table 3.5.
- 3.32 Dedicated typhoon moorings will be needed at each end of the route to ensure that the vessel is never more ten nautical miles away from a buoy. This will require a buoy adjacent to the WENT Landfill and a second buoy adjacent to one of the RTF sites. The exact locations of the typhoon moorings will need to be agreed by the successful tenderer. Additional vessels will be available to comply with specified availability requirements.

Domestic and commercial waste compaction containers (6m long ISO containers)

NOTE: All containers are mounted on dollies



All dimensions in metres
 * Berth shared between OITF Contractor and RSD Island delivery vessels



	Containers in normal use from 1996		Containers in normal use from 2011
	Containers in normal use from 2001		Spare containers for use during any service disruption due to storm weather conditions and for emergency storage
	Containers in normal use from 2006		Con waste - Construction waste

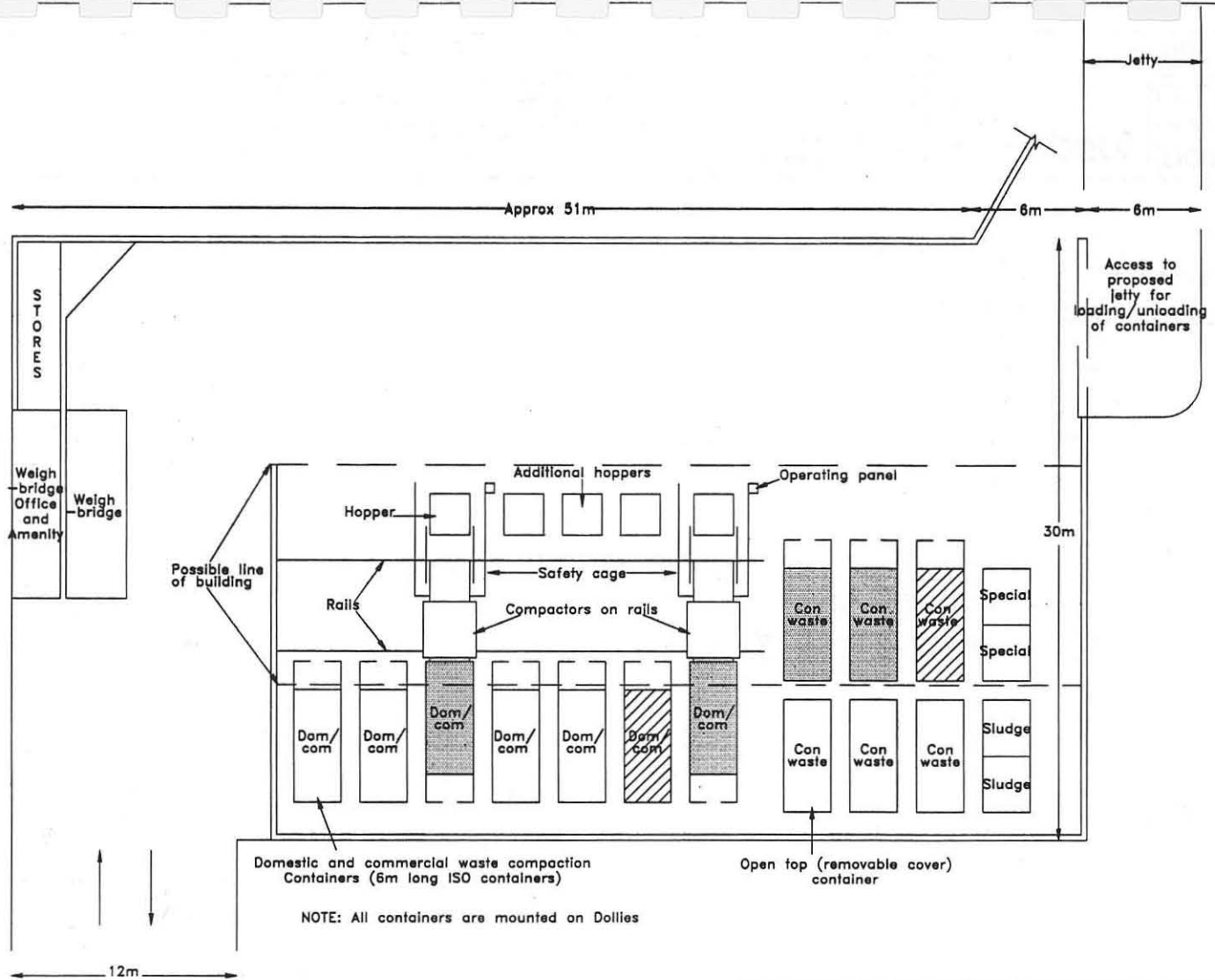
SITE 1	client HONG KONG GOVERNMENT EPD	
	project OUTLYING ISLANDS REFUSE TRANSFER FACILITY	
	drawn BWG	checked SDL
	drafted FPL0423A	

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FIGURE 3.1
CHEUNG CHAU TRANSFER FACILITY
OPERATIONAL PLAN

no. HO1109B	scale	date SEPT 1993
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Access to sewage treatment works

All dimensions are in metres



	Containers in normal use from 1996		Containers in normal use from 2011
	Containers in normal use from 2001		Spare containers for use during any service disruption due to storm weather conditions and for emergency storage
	Containers in normal use from 2006		Con waste - Construction waste

SITE 2

client
HONG KONG GOVERNMENT EPD

project
OUTLYING ISLANDS REFUSE TRANSFER FACILITY

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BWG

drafted
FPL0424A

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SDL

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FIGURE 3.2
PENG CHAU TRANSFER FACILITY
OPERATIONAL PLAN

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scale

date
SEPT 1993

Containers in normal use from 1996 (diagonal lines)

Containers in normal use from 2001 (horizontal lines)

Containers in normal use from 2006 (vertical lines)

Containers in normal use from 2001 (cross-hatch)

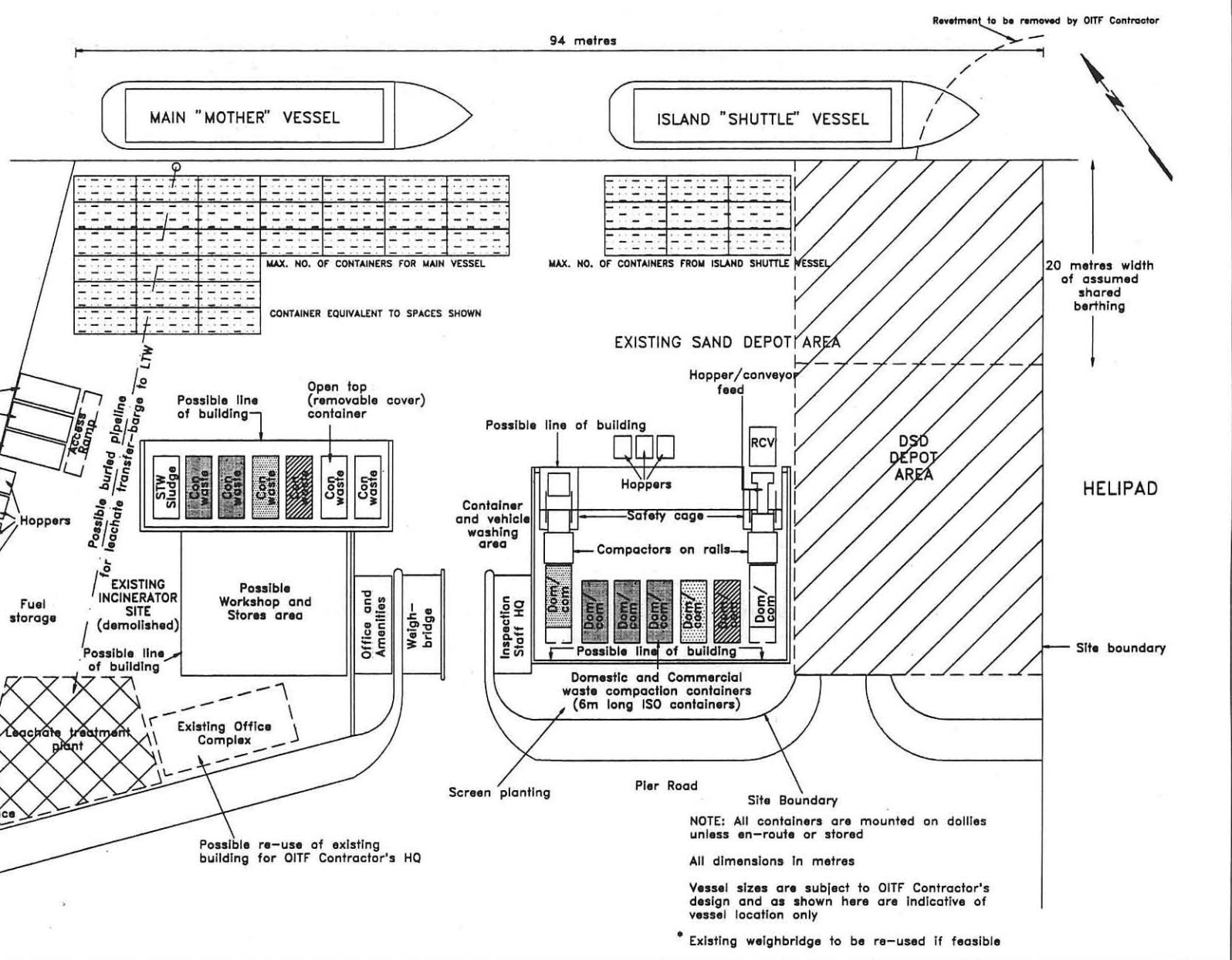
Spare containers for use during service disruption due to weather conditions and for emergency storage (white)

Containers en-route or stored (dashed border)

Dom/com Domestic and Commercial waste

Con Waste Construction waste

Sludge Sewage/Water Treatment Works Sludge (DSD/WSD)



NOTE: All containers are mounted on dollies unless en-route or stored

All dimensions in metres

Vessel sizes are subject to OITF Contractor's design and as shown here are indicative of vessel location only

* Existing weighbridge to be re-used if feasible

Scale
0 5 10 15 20

SITE 3

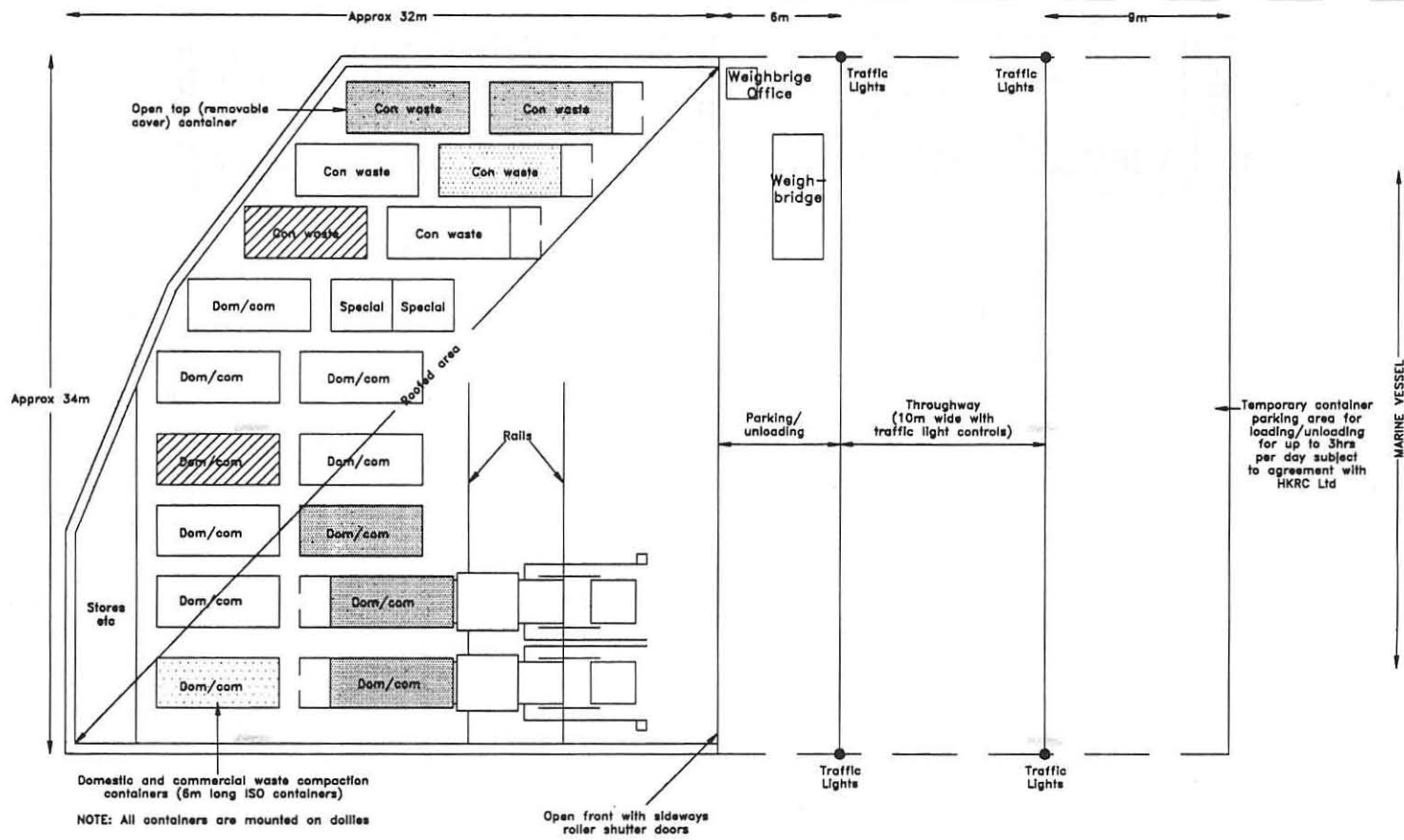
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project	OUTLYING ISLANDS REFUSE TRANSFER FACILITY	
drawn	drafted	checked
BWG	FPL0427A	SDL

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FIGURE 3.3
MUI WO TRANSFER FACILITY
OPERATIONAL PLAN

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HO1109B		SEPT 1993

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Domestic and commercial waste compaction containers (8m long ISO containers)
 NOTE: All containers are mounted on dollies

Open front with sideways roller shutter doors

All dimensions are in metres



	Containers in normal use from 1996		Containers in normal use from 2011
	Containers in normal use from 2001		Spare containers for use during any service disruption due to storm weather conditions and for emergency storage
	Containers in normal use from 2006	Con waste -	Construction waste
		Dom/com -	Domestic and Commercial Waste

SITE 4

client
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 BWG

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 SDL

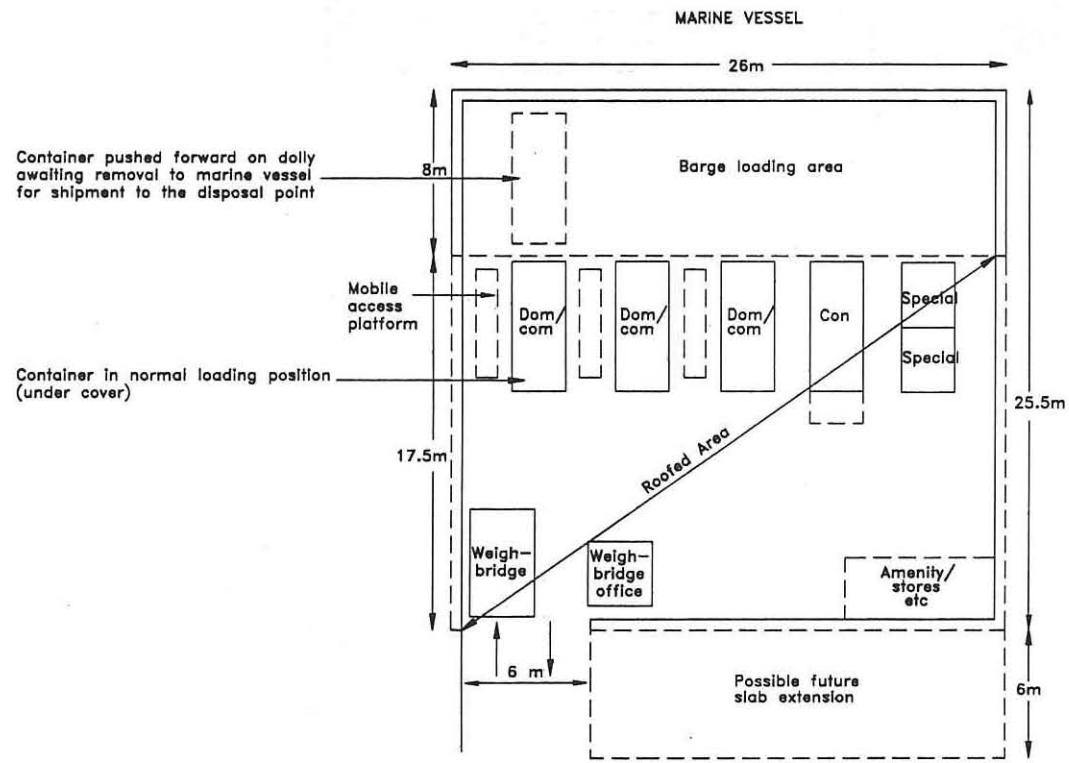
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FIGURE 3.4
DISCOVERY BAY TRANSFER FACILITY
OPERATIONAL PLAN

no.
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date
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One dolly required for each container

Con - Construction Waste
Dom/Com - Domestic and Commercial Waste

All dimensions in metres

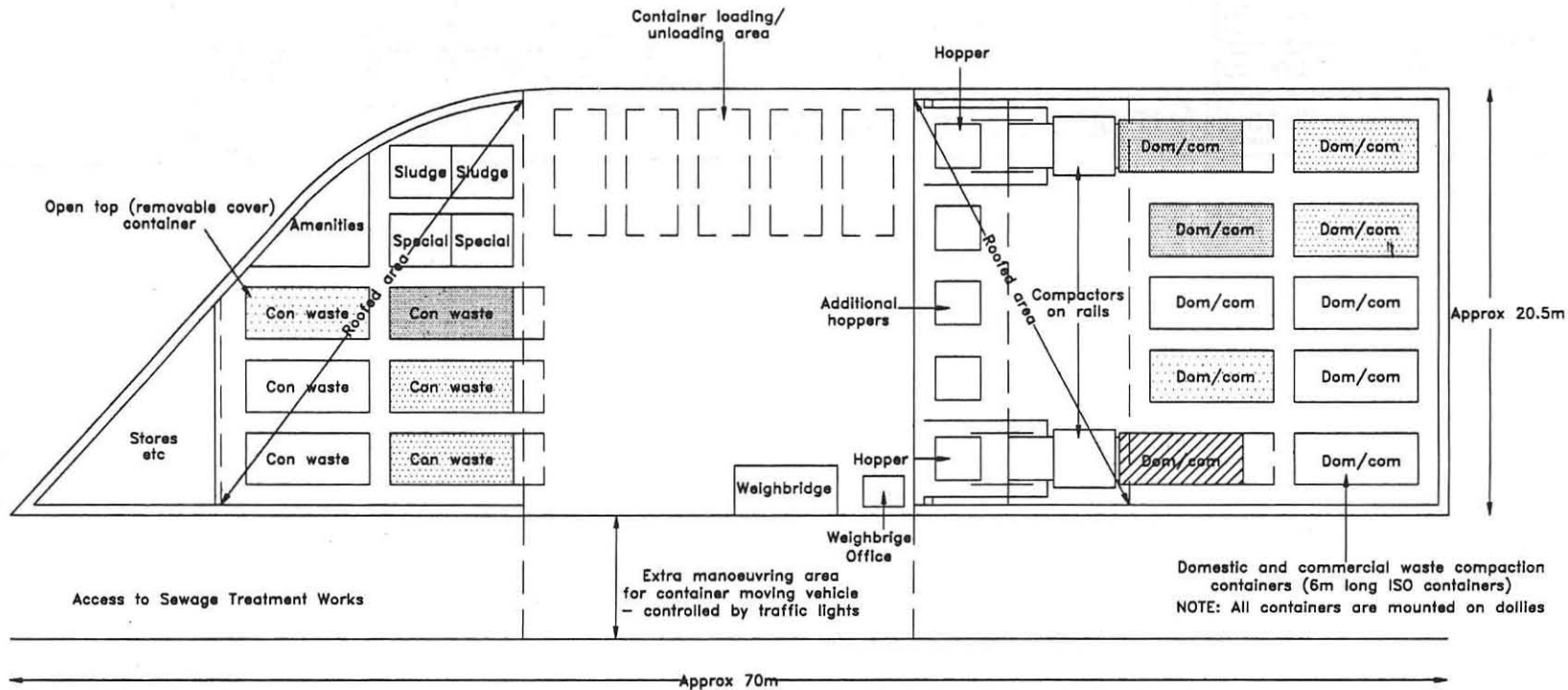


SITE 5

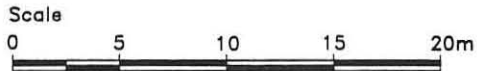
client HONG KONG GOVERNMENT EPD		
project OUTLYING ISLANDS REFUSE TRANSFER FACILITY		
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drawing FIGURE 3.5 HEI LING CHAU TRANSFER FACILITY OPERATIONAL PLAN		
no. HO1109B	scale	date SEPT 1993



All dimensions are in metres



	Containers in normal use from 1996		Containers in normal use from 2011
	Containers in normal use from 2001		Spare containers for use during any service disruption due to storm weather conditions and for emergency storage
	Containers in normal use from 2006		Con waste - Construction waste
			Dom/com - Domestic and Commercial Waste

SITE 6

client
HONG KONG GOVERNMENT EPD

project
OUTLYING ISLANDS REFUSE TRANSFER FACILITY

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BWG

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FPL0426A

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SDL

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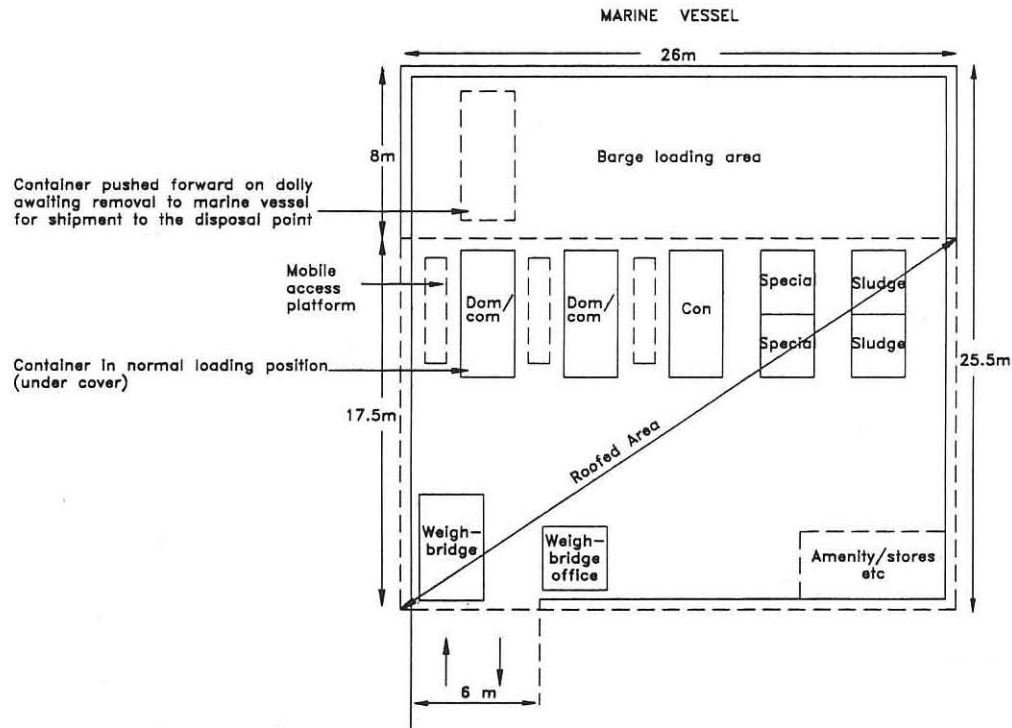
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FIGURE 3.6
YUNG SHUE WAN TRANSFER FACILITY
OPERATIONAL PLAN

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date
SEPT 1993

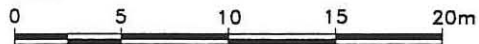


One dolly required for each container

Con - Construction Waste
Dom/Com - Domestic and Commercial Waste

All dimensions in metres

Scale



SITE 7

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project OUTLYING ISLANDS REFUSE TRANSFER FACILITY		
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drawing FIGURE 3.7 SOK KWU WAN TRANSFER FACILITY OPERATIONAL PLAN		
no. HO1109B	scale	date SEPT 1993

Table 3.5 - Site Operating Hours

Site/Island	Operating Hours	
	Waste Reception*	Marine Transfer: Loading and Unloading*
Cheung Chau	07:30 to 23:00 hrs	Unrestricted
Peng Chau	07:30 to 23:00 hrs	Unrestricted
Mui Wo	07:30 to 23:00 hrs	Unrestricted
Discovery Bay	07:30 to 19:00 hrs	07:30 to 20:00 hrs
Hei Ling Chau	As required by CSD	Probably 11.00 to 12.00 noon
Yung Shue Wan	07:30 to 20:00 hrs	07:30 to 20:00 hrs
Sok Kwu Wan	07:30 to 20:00 hrs	Unrestricted
WENT Landfill MBF	08:00 to 20:00 hrs	Unrestricted

Note

** Operating hours are subject to review based on noise assessment conducted as part of the EIA by the successful tenderer.*

Route to WENT Landfill

- 3.33 The contractor will be permitted to choose the most cost effective marine transport route, the number, and size of vessels, subject to compliance with the contract requirements.
- 3.34 The route will be affected by the future development of North Lantau, and the contractor will be required to show that he has considered these factors in the choice of vessel and route.
- 3.35 As stated in Working Paper No. 8 - Outline Design (Ref 3.1), the option of use of Island West Transfer Station as an intermediate transfer point has been rejected, and is not therefore considered further in this report.
- 3.36 The option preferred is the "mother" site option in which Mui Wo would be used as a marine vessel transfer location, with container storage at Mui Wo, as described in Section 3.11 above. Separate vessels would travel between the islands to transfer their containers to larger sea-going vessels which will be designed for the trip to WENT Landfill.

References

- 3.1 Environmental Protection Department. Outlying Islands Refuse Transfer Facilities Consultancy Study. Working Paper No. 8 - Outline Design. June 1993.

4. SCOPE OF ASSESSMENT

- 4.1 This Chapter introduces the general process of environmental assessment and describes the approach used for selecting those issues of concern that have been examined in the IEIA.

The Environmental Assessment Process

- 4.2 Environmental assessment (EA) is a process which seeks to predict the effect that development actions have on the natural and built environment. The general approach involves consultation and scoping followed by baseline studies of the existing environmental conditions, impact prediction, consideration of mitigation measures and the identification of monitoring and audit requirements.
- 4.3 Before potential impacts can be predicted, the existing environmental conditions must be defined. It is then possible to assess any changes which may occur as a result of a development. Environmental conditions may change over time and these must be evaluated as part of the EA process. In assessing the significance of any impact reference should be made to the magnitude and importance of effects, to the environmental sensitivity of nearby receptors, and to quantified thresholds and indicative criteria within government ordinances and policy guidelines. Where quantifiable criteria are not available, best expert judgment must be applied.
- 4.4 Where a proposal is judged to have significant adverse impacts on the environment, it is necessary to identify measures which will reduce or eliminate such impacts. These mitigation measures may involve altering the design or operation of the development, or may require the introduction of particular safeguards in order to ameliorate effects.

Scope of Assessment

Consultation

- 4.5 The scoping exercise conducted as part of the IEIA included early consultation with the Environmental Protection Department, Agriculture and Fisheries Department, District Planning Office and other relevant Government departments where necessary. This consultation process allowed for:
- Acquisition of relevant background information from other consultancy projects and from EPD monitoring programmes;
 - The identification of suitable sensitive receptors for conducting baseline monitoring; and
 - Verification of monitoring protocols;

Review of Background Information

- 4.6 A review of all relevant information on the environment of the Outlying Islands and adjacent developments within the study area has also been undertaken. The main documents reviewed include:
- Lantau Port & Western Harbour Development Studies, III EIA Report. Final Report, March 1993.
 - North Lantau Development, Final Report April 1992.
 - SWNT Development Strategy, Environmental Planning Study: Profiles, Principles and Criteria. Planning Department, May 1991.

- Lantau Port & Western Harbour Development Studies, Environmental Surveys. Data Report, October 1992.
- Lamma Quarry Casting Basin and Moderate Quarry Extension, Environmental Assessment. June 1993.
- Environmental Impact Assessment of Units L7 and L8 Lamma Power Station. Final Initial Assessment Report, May 1992.
- Environmental Impact Assessment (EIA) Study of Units L7 and L8 at Lamma Power Station: Compliance with Effluent Technical Memorandum and Related Water Quality Aspects, 1992.

Issues of Concern

4.7 From the initial appraisal of information and early consultations described above it has been possible to identify those development actions likely to cause environmental effects, and those aspects of the environment most likely to be affected during the construction and operation of the proposed facilities. The likely significant effects of the relate to the following:

- Air quality;
- Noise;
- Water Quality;
- Visual Aesthetic and Land use;
- Traffic & Marine Transportation; and
- Bird, Rodent & Insect Control

4.8 An evaluation of each of these key issues of concern is addressed in the Chapters of the IEIA which follow.

5. AIR QUALITY

Introduction

- 5.1 This Chapter details the environmental standards and guidelines for air quality in the OITF study area and gives an assessment of current air quality and monitoring protocols. Impacts of construction and operation activities associated with the proposed refuse transfer facilities sites are considered. Finally, recommendations are given for further assessment and monitoring.
- 5.2 The absence of large population centres and the relatively few pollution sources in the Outlying Islands ensures that, a good ambient air quality can be expected in most localities. The restriction, or in some cases the complete absence, of motorised traffic on the Outlying Islands means that air pollution impacts from transportation are generally insignificant.
- 5.3 There are no EPD routine air quality monitoring stations located on any of the Outlying Island. Therefore available air quality data is restricted to that collected as a result of previous studies related to specific developments in the area. These include the Port and Airport Development (PADS) and the North Lantau Development Studies, as well as other developments such as the power station and the quarry located on Lamma Island.
- 5.4 The predominant easterly winds in Hong Kong result in western areas being exposed to air pollutants transferred from the industrial and urban centres. The most exposed areas of the Outlying Islands include the northern parts of Lantau. The southern part of Lantau is less exposed due to the shielding effect of the Lantau Peak range, as are the other islands due to their more southerly location. The rugged topography of some of the islands, particularly Lantau and Lamma, acts as a barriers to the dispersal of pollutants within these confined airsheds.

Environmental Quality Objectives, Standards and Guidelines

Statutory Limits

- 5.5 Legislative controls over the emission of pollutants are defined as Air Quality Objectives (AQOs) under the Air Pollution Control Ordinance. The AQOs apply to ambient air and are reproduced in Table 5.1.
- 5.6 The implementation of the Fuel Restriction Regulations in 1990, which limited the sulphur fuel content in fuel oil to 0.5%, has had a significant effect on improving air quality in Hong Kong (Ref 5.1).

Guidelines

- 5.7 Where dust impacts are of short duration during construction activity, an hourly average of total suspended particulates of $500 \mu\text{g m}^{-3}$ is not a statutory limit, but has been applied in Hong Kong to emission sources. This limit typically applies to the site boundary and/or the nearest receiver.
- 5.8 A limit of 2 odour units is recommended by EPD for potentially offensive installations. A limit of 2 odour units at the site boundary corresponds to a concentration of twice the odour detection threshold of known odorous chemicals.

Table 5.1 - Hong Kong Air Quality Objectives

Pollutant	Average Time				
	1 hour	8 hour	24 hour	3 months	1 Year
Sulphur dioxide	800	-	350	-	80
Total Suspended Particulates	-	-	260	-	80
Respirable* Suspended Particulates	-	-	180	-	55
Nitrogen Dioxide	300	-	150	-	80
Carbon Monoxide	30,000	10,000	-	-	-
Photochemical Oxidants (as ozone)	240	-	-	-	-
Lead	-	-	-	1.5	-

Notes:

1. All concentrations in micrograms per cubic metre ($\mu\text{g m}^{-3}$), measured at 298°K (25°C) and 101.325 kPa (one atmosphere).
2. 1 hour concentrations not to be exceeded more than three times per year.
3. 8 and 24 hour concentrations not to be exceeded more than once per year.
4. 3 month and 1 year concentrations are arithmetic means.
5. * Respirable suspended particulates (RSP) means suspended particles in air with a nominal aerodynamic diameter of 10 microns (μm) or less.

Existing Air Quality & Monitoring Protocols

5.9 The seven proposed sites for the refuse transfer facilities fall within the South Hong Kong Island, Lamma and Lantau Air Control Zones. Within these areas meteorological stations are sited at Cheung Chau, Wong Chuk Hang and Chek Lap Kok (see Figure 5.1). Meteorological observations by The Royal Observatory (Ref 5.2) show that prevailing winds at these sites are predominantly easterly. The West Lamma Channel fetch to the north of Cheung Chau contributes to a pronounced northerly wind. The prevailing wind patterns are shown in Figure 5.1. The meteorological data for the area show the typical wind regime of Hong Kong of northeast monsoons in winter and southwest monsoons in the summer. This is most evident for the more exposed Cheung Chau station. At the other two stations, Wong Chuk Hang and Chek Lap Kok, wind regimes are subject to topographical

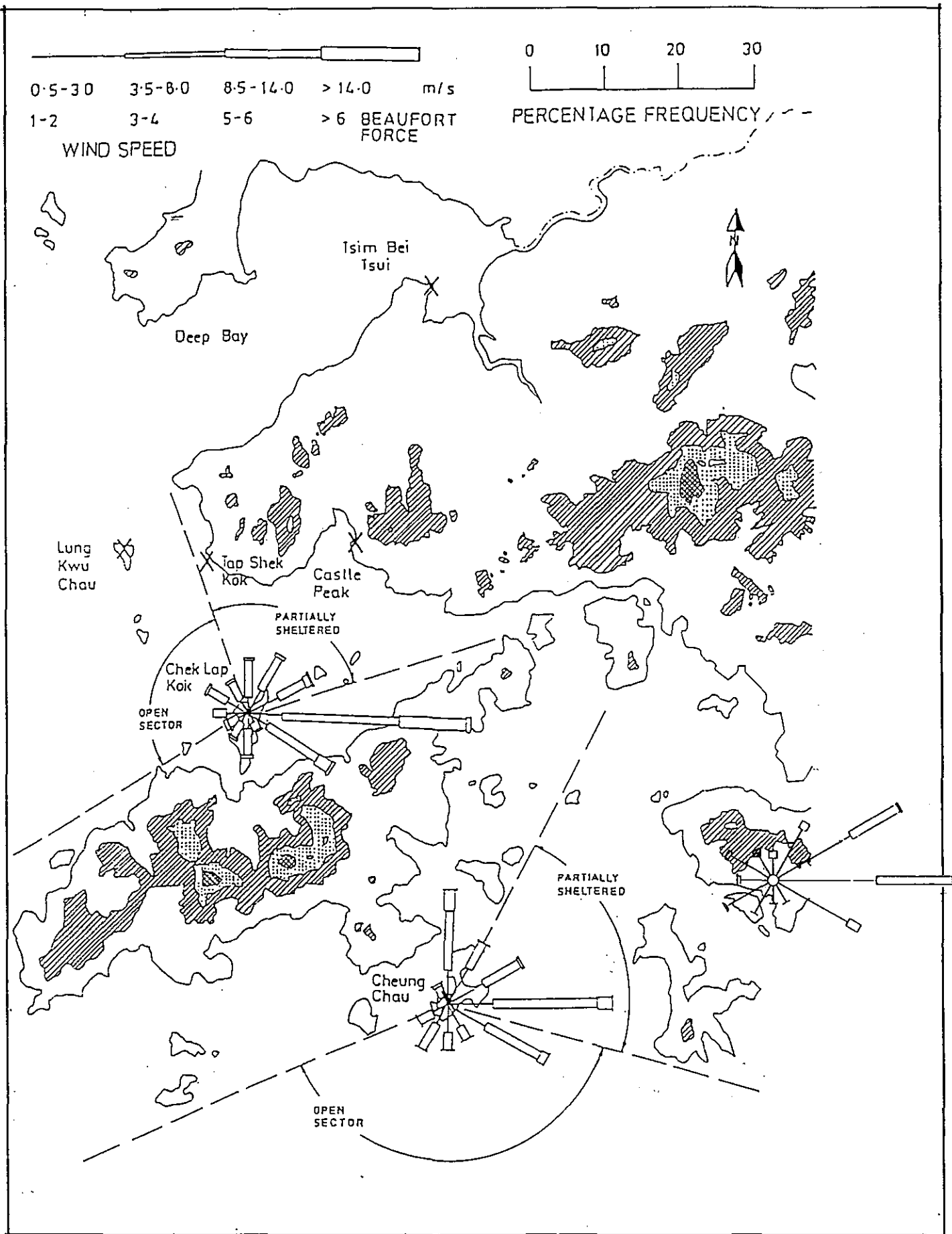


FIGURE 5.1

no. H01109B/8/1	scale 1:100 000	Aspinwall company in association with Scott Wilson Kirkpatrick Shankland Cox Parsons Brinckerhoff (Asia) Peter Fraenkel BMT (Asia)	client HONG KONG GOVERNMENT ENVIRONMENTAL PROTECTION DEPT.
drawn AH	drafted SDL		project OUTLYING ISLANDS. TRANSFER STUDY - STAGE 1
checked JO	date June 1993		drg. Annual Wind Roses, Cheung Chau, Chek Lap Kok and Wong Chuk Hang

influences. Similar wind directions have been noted for the meteorological site at Lamma Island (Ref 5.3).

General Pollution Sources

- 5.10 Air pollution sources affecting air quality in the Outlying Islands area are mainly restricted and localised in terms of environmental impact. Exceptions to this include the coal fired power stations on Lamma Island and the quarrying, construction and infrastructure activities associated with the airport development projects on North Lantau and Chek Lap Kok. The Sok Kwu Wan quarry on Lamma Island is also a potential air pollution source creating significant quantities of dust particulates.
- 5.11 Major polluting sources affecting ambient air quality across the Outlying Islands region include the urban areas to the east and north east from Hong Kong Island to Tseun Wan, the Tuen Mun industrial area in the southern part of the north-west New Territories and the Castle Peak Coal Fired Power Station. This power station, and the station at Lamma Island are likely to be main sources of sulphur dioxide (SO₂) and oxides of nitrogen (NO_x) in the region.
- 5.12 As a result of rapid population growth, construction activities have escalated substantially on the Outlying Islands in recent years. Air quality impacts are mainly related to dust emissions. Sea salt spray may also contribute to particulate levels and some impact on air quality can be expected from marine traffic in the region although these sources.
- 5.13 The EIA for Lantau Port & Western Harbour Development Studies (Ref 5.4) estimated background concentrations of air pollutants in the region of the Outlying Islands for the year 2011 accounting for the container port and other North Lantau developments. Concentrations are not predicted to exceed the AQOs in any instance following the development. With only restricted emissions from both stationary sources (construction sites and industrial processes) and mobile sources (traffic) associated with North Lantau developments at present, the current ambient air quality across the Outlying Island region as a whole is generally expected to be good.
- 5.14 Background dust monitoring is currently being conducted as part of this study to complement the data already available from other studies. Monitoring sites are located on Hei Ling Chau and Lamma, and results will be reported in the Final Report to this Consultancy.

Cheung Chau

- 5.15 No significant air pollution sources exist on Cheung Chau. The island has limited vehicular transport and no significant construction activity at present. A number of small domestic refuse incinerators are present, which result in minor localised pollution impacts. The locations of these incinerators are listed below (Ref 5.5: 1991 source):
- Sai Wan
 - Round Table Village II
 - Tai Kwai Wan
 - Tung Wan (oil-fired)
 - Tung Wan (Open pit) (old)

- 5.16 Other localised emission sources include emissions from marine traffic and the ferries serving the island from Hong Kong, and dust particulates from stored construction waste at the proposed transfer facility site to the north of the ferry terminal. Other potential sources of pollution include the industrial areas of Tseun Wan, Kwai Chung, Tuen Mun, and the power stations at Lamma Island and Castle Peak, although Table 5.2 shows that these sources of pollution are not likely to be significant as the present air quality levels for the island are below recommended AQOs.
- 5.17 Background air quality measurements have been taken at Cheung Chau as part of the Lantau Port & Western Harbour Development Studies (Ref 5.6) in the winter of 1991 and summer of 1992 at Caritas Oi Fai, approximately 3.5 km south east of the proposed transfer facility site. The data are summarised in Table 5.2.

Table 5.2 - Background Air Pollutant Concentrations, Cheung Chau

Pollutant	November 1991			Summer May- June 1991		
	Winter Mean	1-hour max.	24-hour max.	Mean	1-hour max.	24-hour max.
SO ₂	8.0*	90 (800)	28 (350)	10*	132 (800)	48 (350)
NO	3.0*	69	12	18*	123	49
NO ₂	29.0*	129 (300)	51 (80)	31*	104 (300)	104 (80)
TSP	73.0 ⁺	-	119 (260)	30.9 ⁺		59 (260)
RSP	57.6 ⁺	-	99 (180)	22.9*		45 (180)

Notes:

1. * Arithmetic mean
2. + Geometric mean
3. Figures in brackets are relevant AQOs

- 5.18 Compared to the AQOs for Hong Kong (given in Table 5.1) the pollutant concentrations are low, indicative of a rural site. No comparison is possible with annual AQOs due to the limited monitoring period, although annual AQOs are unlikely to exceed standard concentrations.

Peng Chau

- 5.19 There are currently no major air pollution sources on Peng Chau and the proposed site on Tai Lei Island is positioned well away from sensitive receptors such as houses (170m), the nearest of which is located on Peng Chau. On Tai Lei Island, only 0.09 ha are reserved for industrial uses (Peng Chau north Layout Plan No. L/T-PCN/2). Adjoining land uses on the main island (public utilities, storage areas) are also compatible. On Peng Chau itself

industrial uses are allocated on the Layout Plan although these are 500m away from the site. A housing construction development scheme on the marine frontage area adjacent to the ferry terminal is currently a potential source of dust in the area.

- 5.20 General sources of potential air pollution affecting ambient air quality at Peng Chau include the industrial areas of Tsuen Wan, Kwai Chung, Tuen Mun, and the power stations at Lamma Island and Castle Peak.

Hei Ling Chau

- 5.21 There are no significant pollution sources on the island of Hei Ling Chau, where land uses are dedicated to penal detention centres. Pollution sources are limited to exhaust outlets for cooking facilities and the restricted number of vehicles on the island. The isolated and restricted nature of the island results in a good ambient air quality.

Mui Wo

- 5.22 Mui Wo valley is a confined air shed enclosed by steep mountain slopes. Therefore, even though current air pollution sources in the area are few, environmental planning measures are important.
- 5.23 The refuse incineration plant at Mui Wo is, at present, the major local air pollution source located to the south-east of the town adjacent to the Mui Wo sewage treatment works. Recorded air pollution problems caused by the incinerator have included odour emissions from the chimney and refuse storage shed. Incomplete combustion of refuse has also led to dark smoke emissions and air pollutants being emitted (Ref 5.5). The closure of the incineration plant following the development of the transfer facility is expected to result in a significant improvement in local air quality.

Discovery Bay

- 5.24 There are no significant sources of air pollution in Discovery Bay. The limited vehicle access and lack of industrial facilities ensures a good standard of air quality. However, pollutants transported by prevailing winds from the urban and industrial areas of Tsuen Wan, Kwai Chung, Hong Kong and Kowloon may have an influencing factor on the air quality for the area. The central mountain ridge behind the residential development forms a barrier to air dispersal and presents a largely confined airshed. It is understood that odour complaints relating to the existing refuse handling facility have been received.
- 5.25 In December 1991 and June 1992 baseline air quality monitoring was undertaken at Discovery Bay at two monitoring locations for the Lantau Port & Western Harbour Development Study (Ref 5.6). These results are summarised in Table 5.3.
- 5.26 It can be seen from Table 5.3 that all concentrations of measured air pollutants are well below the AQO concentrations (See Table 5.1). SO₂ concentrations are likely to be affected by emissions from Castle Peak and Lamma Power Stations, although the situation is likely to have improved since the introduction of the Fuel Restriction Regulations in 1990 and the burning of low sulphur coal at the stations.
- 5.27 Construction and operational impacts from the proposed extension of the existing residential development, construction of the road tunnel to north Lantau from Discovery Bay beneath the hill of Yi Pak Au, and associated Lantau Port developments are likely to increase air pollution levels, especially dust concentrations.

Table 5.3 - Background Air Pollutant Concentrations, Discovery Bay

Pollutant	Winter	November 1991		Summer	May- June	1991
	Mean	1-hour max.	24-hour max.	Mean	1-hour max.	24-hour max.
SO ₂	10*	129 (800)	22 (350)	10*	118 (800)	54 (350)
NO	3*	52	13	30*	227	56
NO ₂	41*	119 (300)	65 (150)	13*	60 (300)	26 (150)
TSP	90.6 ⁺	-	134 (260)	25.9 ⁺		46 (260)
RSP	75.0 ⁺	-	104 (180)	17.9*		36 (180)

Notes:

1. * Arithmetic mean
2. + Geometric mean

Sok Kwu Wan

5.28 There are no systematic air quality monitoring studies previously undertaken on Lamma Island. However, air quality in terms of dust impacts has previously been quantified at Lamma Quarry by a series of total suspended particulate measurements. Measurements were taken as part of the Environmental Assessment for the Basin and Moderate Quarry Extension (Ref 5.7). Four monitoring sites were established within the quarry boundary and 24-hour concentrations of total suspended particles ranged from 17 to 568 mg m⁻³. Typical ambient TSP levels are likely to be significantly below maximum levels record within the quarry. Predictive modelling studies of TSP in Sok Kwu Wan were found to be within the recommended 24-hour TSP AQOs (Ref 5.7).

5.29 Further air quality monitoring conducted by EPD, at Lamma Quarry for TSP and RSP recorded levels for TSP and RSP of 44-928 μg m⁻³ and 59-874 μg m⁻³ respectively (Ref 5.8).

Yung Shue Wan

5.30 The Hong Kong Electric Company (HEC) has undertaken measurements for suspended particulates within the Lamma Power Station site boundary. No other direct measurements of air quality have been made on Lamma. However, it is to be expected that air quality on

the island is generally good with low levels of the principal gaseous air pollutants, SO₂ and NO_x. HEC operate a series of air monitoring stations on the south of Hong Kong Island which show a range of concentrations of 3-16 µg m⁻³ for SO₂ and 47-72 µg m⁻³ for TSP (1987-1990). NO₂ concentrations averaged over the years 1989-1990 show a range from 27-41 µg m⁻³ (Ref 5.3). These air quality levels are likely to be indicative of concentrations to be found on Lamma Island.

Odour Levels

- 5.31 No data exists on background odour levels for the seven proposed sites, although numerous complaints relating to odour have been received from local residents for the existing waste handling facility at Nim Shu Wan, Discovery Bay (Ref 5.9). Due to the level of complaint, the odour level could well be above the control limit of 2 odour units at the site boundary. The odour level of 2 is assumed to equate to a dilution factor (DF) of 2, which means that the odour must not exceed a level of twice that of its detection threshold (the odour detection threshold is defined as a concentration which can be detected nasally by 50% of the members of an odour assessment panel).
- 5.32 However, in the strict context of the proposed transfer facilities, odour arising specifically and recognisably from decomposing organic waste is the issue of concern, and whilst background levels of odour from different sources may exert additive, synergistic or masking effects, it is unlikely that these will be identical to those emanating from refuse. This issue will be discussed in subsequent sections.

Impacts of Construction

- 5.33 The principal air pollution concern relating to the construction phase of each site will be dust emissions from site formation. Air pollution emissions from plant and motor vehicles are likely to be insignificant, given the scale of construction required.

Dust Emission Sources

- 5.34 The major sources identified are as follows:
- Off-site engineering activities
 - seawall modifications (Cheung Chau)
 - improvement and /or extension of access routes (Cheung Chau, Hei Ling Chau, Yung Shue Wan and Sok Kwu Wan);
 - marine dredging (Sok Kwu Wan, Yung Shue Wan);
 - provision of traffic management schemes (Mui Wo and Yung Shue Wan); and
 - site reclamation activities (Sok Kwu Wan, Yung Shue Wan and Hei Ling Chau)
 - On-site
 - site preparation;

- erosion of stockpiled materials and working areas;
- materials handling and transfer; and
- vehicular and plant engine emissions.

Dust Mitigation Measures

- 5.35 Dust emissions, and hence their degree of impact will be determined by the level of effort placed upon dust control by the contractor. The contractor will be required in the tender documentation to employ the most effective dust suppression methods. These should include, where appropriate:
- Use of regular watering, in dry periods to reduce dust emissions from unpaved areas;
 - The imposition of speed controls for vehicles on unpaved areas;
 - Side enclosures and covering of any aggregate or dusty material storage piles greater than 20m³ to reduce emissions. Where this is not practicable owing to frequent usage during the construction period, watering should be applied to aggregate fines;
 - Vehicles moving waste material on and off-site should be covered and vehicles with an open load carrying area shall have side and tail boards. Material conveyed by marine transport to the proposed sites should be covered. Materials having the potential to create dust should be conveyed with a minimum drop height to reduce potential dust emissions;
 - Establishment and strict use of vehicle wheel and body-washing facilities at the site exit onto public roads;
 - The implementation of a control programme to monitor the construction process in order to enforce controls and modify methods of load work and adjust site plant operations where necessary if dust nuisance conditions arise.
- 5.36 The introduction of these mitigation measures will reduce the potential for dust nuisance. Emissions from vehicular and plant emissions, dredging and traffic management schemes are likely to be localised, temporary and their air quality impact insignificant. Seawall modifications at Cheung Chau will not require blasting activities. Road access improvement schemes are relatively minor for Cheung Chau (widening of road) Hei Ling Chau (road extension of 50m), Yung Shue Wan (widening of access road to allow for a dedicated right turning lane) and Sok Kwu Wan (path widening). Activities will be short-term and employment of the above dust suppression methods will reduce the likelihood of unacceptable dust emissions.
- 5.37 For Hei Ling Chau the proposed siting of the refuse transfer facility at the base of a promontory which is largely screened from the low-rise buildings located on higher ground immediately landward will contribute to the mitigation of reclamation and road construction activities. For Yung Shue Wan the site forms part of a larger reclamation which has been planned to accommodate industrial and public utility uses. The likely resumption of village houses along the existing farshore will increase the distance to nearest sensitive receptors. The reclamation area at Sok Kwu Wan is isolated from existing residential areas.

Dust Emission Predictions

- 5.38 The quantity of dust emissions for the sites requiring reclamation will depend on the size of the area being worked and the level of reclamation activity, specific operations and the prevailing meteorology. Assuming the activities will be similar to construction operations the approximate dust emission factor can be gained from US Environmental Protection Agency AP-42 methods (Ref 5.10) and dust concentrations predicted using the Industrial Source Complex Short-Term (ISCST) model.
- 5.39 Dust emissions from vehicle movements are a function of vehicle speed, vehicle weight, number of wheels per vehicle, surface texture and moisture. Particles are lifted and dropped from rolling wheels, and the road surface is exposed to strong air currents in turbulent shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed.
- 5.40 For unpaved haul roads emission rates can also be calculated using AP-42 methods and predictive concentrations modelled using CALINE-4.
- 5.41 For the purposes of modelling the following assumptions/emission factors were used :
- Particle size : 0-30 μm
 - Density : 2.5 g cm^{-3}
 - Wind speed : 2 m sec^{-1}
 - Wind direction : worst-case wind direction
 - Stability class : D
 - Mixing height : 500 m
 - Temperature : 25 degree Celsius
 - Standard deviation of:
 - horizontal wind direction fluctuations : 10 degree (CALINE4)
 - Gravitational settling velocity : 2.7 cm sec^{-1}
 - Reflection coefficient : 0.68
- 5.42 As previously stated, there are currently no statutory criteria for construction dust. However, a maximum hourly TSP concentration of 500 $\mu\text{g m}^{-3}$ is generally adopted as a guideline for assessment of construction dust. Based on the assumptions given above, dust emissions from the reclamation areas are unlikely to exceed the recommended 1 hour air quality criteria of 500 $\mu\text{g m}^{-3}$. Predicted ground level concentrations at sensitive receivers at Hei Ling Chau and Sok Kwu Wan are approximately 140 $\mu\text{g m}^{-3}$ and 90 $\mu\text{g m}^{-3}$ respectively. For the slightly larger site at Yung Shue Wan predicted concentrations are approximately 200 $\mu\text{g m}^{-3}$. The Yung Shue Wan site will form part of a larger reclamation area of the development which will also be a source of dust emissions. Careful interpretation should be given to the predictions at this stage of the study as assumptions have been made in the absence of detailed reclamation plans. The results given above are also independent of monitored baseline TSP levels. These data are currently being collected and will be made available to EPD as an addendum to this report.
- 5.43 Adoption of the dust control measures outlined in Section 5.35 should prevent dust concentrations at sensitive receivers exceeding recommended air quality criteria.
- 5.44 The limited size of the development sites will limit vehicle movements. Predicted ground level concentrations from vehicle movements are unlikely to be significant compared with dust from reclamation activities. Although emissions of air pollutants from site plant and

vehicle exhaust emissions are likely to be insignificant, the successful contractor should ensure that all plant and vehicles are properly maintained to minimise such emissions.

Impacts of Operation

- 5.45 Potential air pollution emissions from the operation of the transfer facilities are dust and odour from waste handling and storage, and motor vehicle exhausts. The latter are likely to be insignificant due to the restricted size of the proposed operations and the type of waste delivery vehicles.

Dust Emission Sources

- 5.46 Dust emission sources will include:

- deposition of refuse within the refuse transfer facility;
- deposition and resuspension of dust on paved areas;
- the compaction of waste within the compactor;
- the tipping of construction waste not containers; and
- vehicle emissions within the refuse transfer station and on site.

- 5.47 It is generally considered that dust emissions from the above sources will not present a significant concern inside and outside the transfer facilities. It is proposed that, with the exception of Hei Ling Chau and Sok Kwu Wan, each site be provided with roof coverage over plant and operational areas, with full building enclosure being provided at Discovery Bay. The building structure at Discovery Bay will utilise forced ventilation and air filtration systems, thereby containing dust emissions. The semi-enclosed sites will provide a limited degree of dust mitigation, although the scale of operations and remoteness of NSRs is unlikely to result in significant dust impacts. An exposure hood on the compaction hopper and flexible dust curtains will limit dust emissions from the compactors. The sites at Hei Ling Chau and Sok Kwu Wan are considered sufficiently remote and small enough in scale as not to be a cause for concern. The inherent high moisture content of waste in Hong Kong (Ref 5.12) significantly reduces dust problems from tipping and waste transfer operations. The relatively small volumes of waste being deposited at any one time within the proposed transfer facilities will also mitigate against the dispersion of dust.

- 5.48 In order to prevent dust deposited on hard surfaces from being re-suspended it is recommended that regular cleaning and maintenance takes place at each facility.

Odour Emission Sources

- 5.49 Potential sources of odour from transfer facility operational practices are:
- deposition of refuse and refuse liquors in the transfer facility;
 - surfaces contaminated by deposited refuse;
 - waste water collection facilities, and
 - RCV and container vehicles.

- 5.50 The proposed transfer facilities will have a considerably lower throughput of tonnages compared to other transfer facility operating or presently being designed in the urban areas of Hong Kong. The potential for significant odour generation at the Outlying Island facilities will therefore be less. The proximity of residential dwellings to the Discovery Bay facility is of particular concern with respect to odour. However, impacts will be mitigated to a significant extent by the design proposals to enclose the operation within a building structure and to provide force ventilation and air filtration systems (Ref 5.11). The restricted hours of operation will also assist in limiting odour generation.
- 5.51 To limit odour emission it is proposed that waste will be containerised as soon as possible upon delivery to each transfer facility. Waste will be deposited into hopper-feed compactors. Presently waste is manually unloaded from collection trolleys or service vehicles on to nets and then lifted, exposed, into refuse barges. The proposed system will thus remove the potential for refuse and liquor spillage and odour release. The use of an exposure hood on the compaction hopper and flexible dust curtains will also limit the egress of odours. Waste at the non-compactor sites will be stored in containers with lightweight covers. Dedicated containers will be made available for special waste arisings at the Cheung Chau, Peng Chau, Mui Wo, Discovery Bay and Yung Shue Wan transfer facilities.
- 5.52 The provision for hoppers at the sites will minimise the time trolley/carts/vehicles spend on-site and quicken the time from receiving waste to its containerisation, thereby reducing the potential for odour egress. Waste containers and waste carts/trolleys/vehicles will be regularly cleaned to prevent the accumulation of detritus which can lead to odour generation.
- 5.53 Leachate will be containerised and removed from the sites and taken to Mui Wo for treatment prior to disposal to the adjacent sewage works.. As the leachate will be collected and stored in sealed tanks prior to transfer to Mui Wo for treatment, it is unlikely that any odour generation from leachate arisings will occur. The closest NSR to Mui Wo is over 300 m distant. It has been recommended that the wastewater treatment facility at Mui Wo incorporate biological treatment which will result in the metabolism of odour generating organic compounds. Significant odour impact, above that already resulting from the operation of Mui Wo Sewage Treatment Works, is therefore not envisaged. Regular cleansing of contaminated surfaces at each site will also eliminate the generation of odour through spillage.
- 5.54 The transfer facility at Cheung Chau is situated 120 m from any NSR, at Peng Chau 390 m at Mui Wo 305 m, at Hei Ling Chau 60 m and at Sok Kwu Wan 160 m. These sites are unlikely to cause an odour problem due to either:
- the isolated coastal location of the site;
 - the distance to the nearest NSR;
 - the small scale of activity
 - the partial screening of the site; and
 - the compatibility of adjacent landuses.
- 5.55 In general, it is envisaged that proposed waste management practices will be a significant improvement over current practices with respect to odour concerns. However, owing to the sensitivity of odours from the existing site at Discovery Bay it is recommended that following submission of detailed design criteria by the contractor a further study is made

of the effectiveness of odour mitigation measures at Discovery Bay. Further consideration is also recommended for Cheung Chau, where the facility will have the highest throughput of waste of all the proposed facilities and is located 120 m from the nearest residential property, and at Yung Shue Wan where a children's playground is located 90 m distant. It is considered that the scale of operation and their remoteness of the other transfer facilities from NSRs does not warrant further consideration with respect to odour impacts.

Joint User Development

- 5.56 Working Paper No. 6 "Joint and Shared Uses" (Ref 5.13) considered the potential for joint usage of the transfer facilities. The report identifies the principal potential uses being the possible storage of construction materials. It is unlikely that either odour or dust emissions from these uses will cause nuisance to NSRs or the transfer facility operation.

Further Assessment

Construction Phase

- 5.57 Consideration should be given by the contractor to the cumulative effect of dust emissions arising from construction activities in the near vicinity of neighbouring developments at the Yung Shue Wan reclamation site, once the timing of the overall development is known.

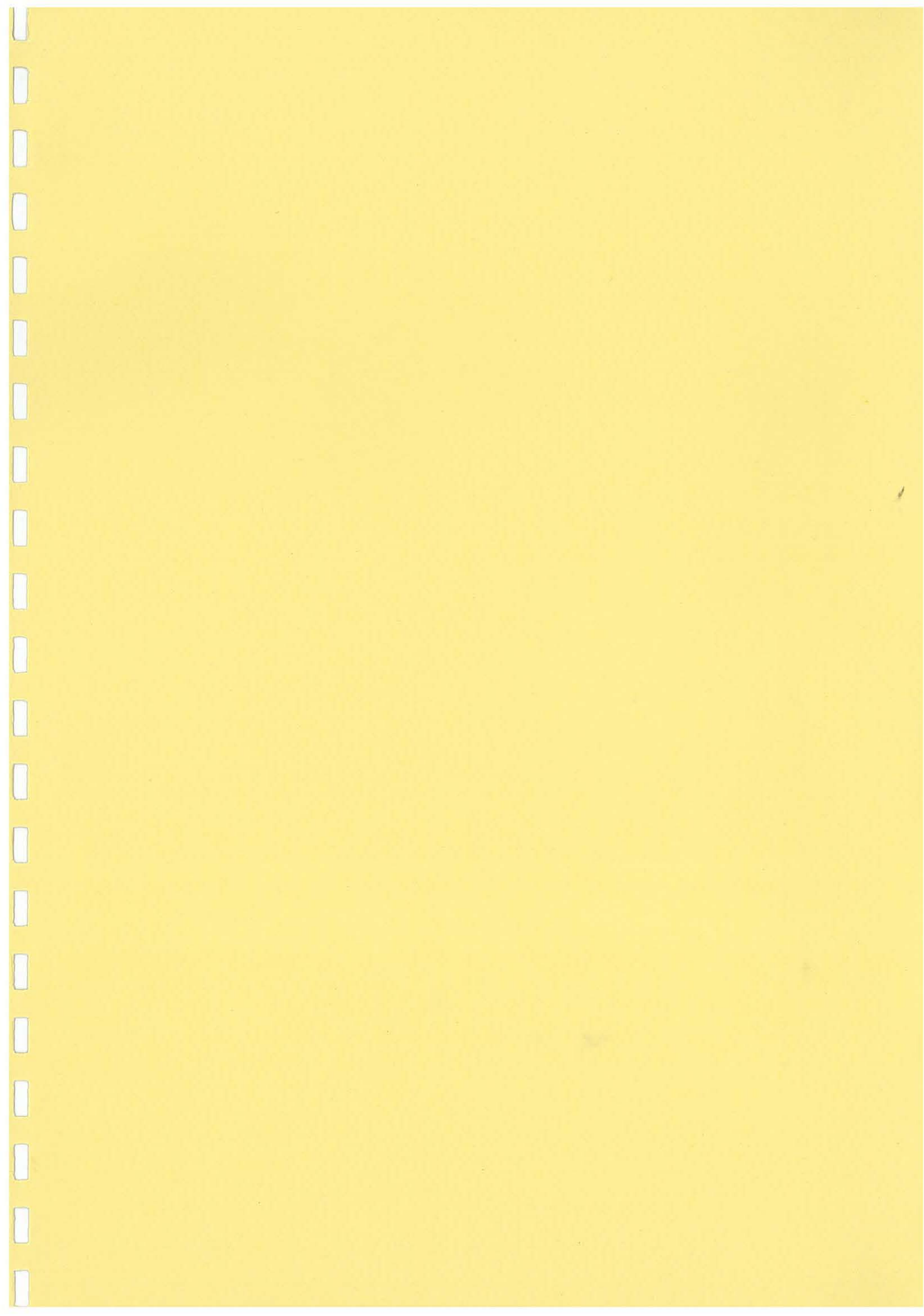
Operational Phase

- 5.58 A detailed assessment should be undertaken by the contractor of the effectiveness of odour control measures from the transfer facility at Discovery Bay, Cheung Chau and Yung Shue Wan to meet EPD site boundary criteria.

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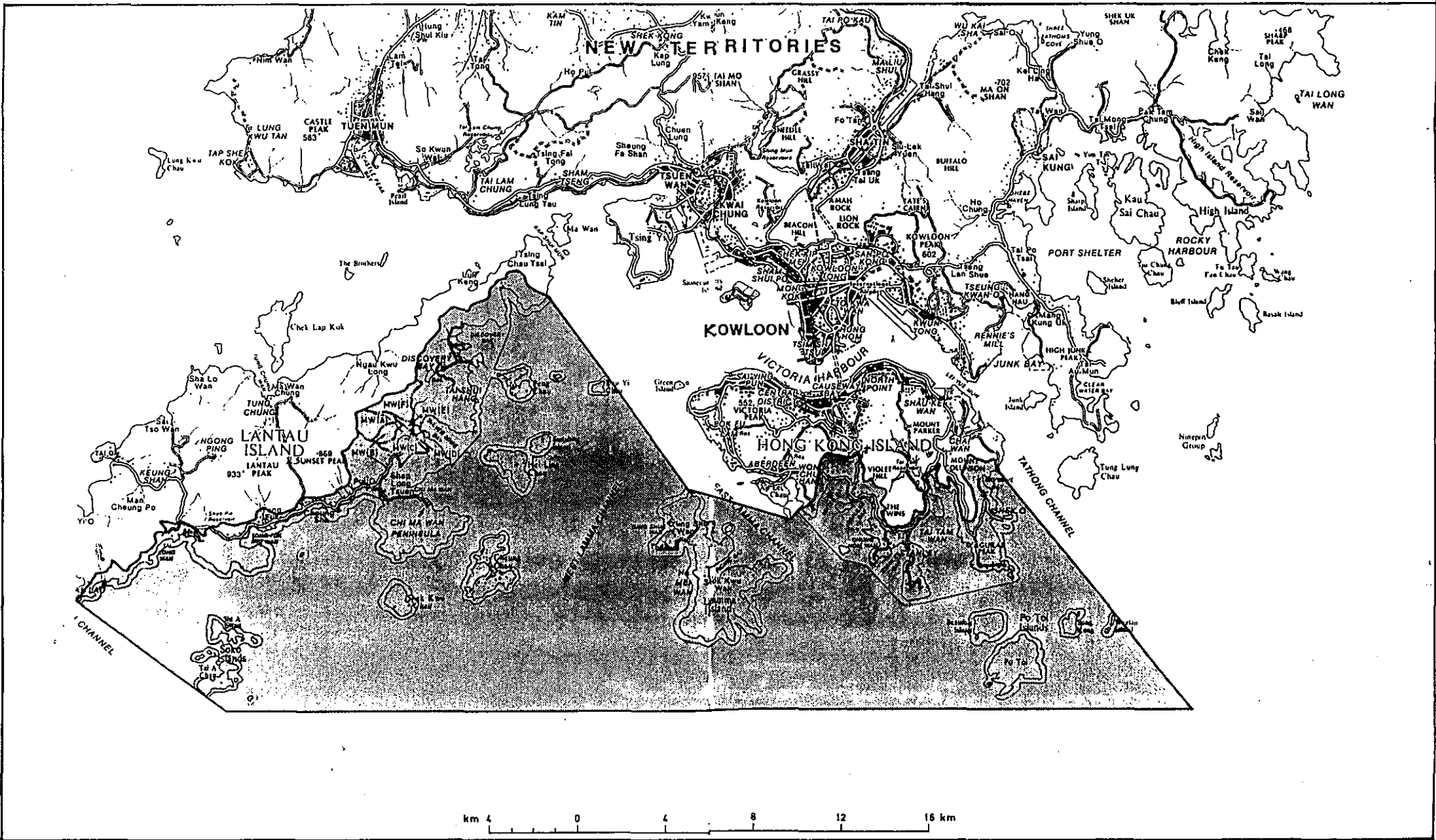
6. WATER QUALITY

Introduction

- 6.1 The waters of the Outlying Islands lie within the an estuarine zone of complex hydrogeography dominated by the impact of the Pearl River delta which drains an area of over 400,000 square kilometres of Southern China (Ref 6.1). Annual flow of the Pearl River is in the order of 300 billion cubic metres, where 80 % of this flow occurs in the summer months. The estuarine waters are heavily laden with suspended matter and deposit an estimated 85.5×10^6 tonnes of sediment and 600,000 tonnes of organic material each year. Fresh water moves in a southerly direction and over flows more saline oceanic water moving north-westerly as a deeper countercurrent, with a halocline forming at about 5 m depth in the summer period. Tidal flows are from the north-west or the southeast on the ebb tide and in the opposite direction on the flood. Waters are stratified during the summer period with a steady flow of surface waters to the south-east. Such waters are characterised by reduced salinity, low dissolved oxygen levels, high turbidity and are high in nutrient and mineral concentrations.
- 6.2 The Pearl River delta is highly populated and pollution is associated with a high degree of agricultural and industrial activity. The main organic pollution is derived from sewage and industrial effluents which lead to high phosphate and nitrate concentrations, with further contamination of marine waters and sediments by heavy metals and organic carbon compounds. Excess nutrient levels result in eutrophication of waters resulting in algal blooms or 'red tides' which adversely affect marine life by the depletion of oxygen and the production of toxins in some cases. The presence of red tides on bathing beaches also constitutes a public nuisance.
- 6.3 Available data for the region (Ref 6.2) indicate the dissolved oxygen target level in the estuarine zone was achieved, but the inorganic nitrogen objective was not met in the western marine area. The less than acceptable compliance in the western marine area results from the substantial nutrient loading of the Pearl River to Hong Kong waters. Sediments in the western estuarine zone are composed of very fine silt and clay (typically less than $63 \mu\text{m}$). Sediments in inner Hong Kong waters are contaminated with heavy metals and organic compounds (PAHs and PCBs) from local industry and have a prominent role in polluting the bottom substrates. In the more open western waters, sediment heavy metal concentrations are more typical of cleaner estuarine conditions.

Environmental Legislation, Standards and Guidelines

- 6.4 Marine water quality in the area of the proposed transfer facility sites is protected from uncontrolled effluent discharges under the Water Pollution Control Ordinance (WPCO), enacted in 1980 and amended in 1990, which provides for declaration of water control zones (WCZs) to cover the whole of Hong Kong. The facility sites lie within the Southern WCZ (Figure 6.1) which was declared in August 1988, with the enforcement actions being implemented in early 1989. The water quality objectives (WQOs) and effluent discharge standards (inshore waters) for the Southern WCZ are given in Tables 6.1 and 6.2 respectively. Prohibited substances which will not be allowed to be discharged into coastal waters during any phase of the developments include the following:
- polychlorinated biphenyls (PCBs)
 - polyaromatic hydrocarbons (PAHs)
 - fumigant, pesticide or toxicant
 - radioactive substances
 - chlorinated hydrocarbons
 - flammable or toxic solvents
 - petroleum oil or tar
 - calcium carbide
 - wastes liable to form scum, deposits or discoloration
 - sludge, floatable substances or solids larger than 10 mm



client HONG KONG GOVERNMENT ENVIRONMENTAL PROTECTION DEPT.		
project OUTLYING ISLANDS REFUSE TRANSFER FACILITIES STUDY		
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client HONG KONG GOVERNMENT ENVIRONMENTAL PROTECTION DEPT.		
project OUTLYING ISLANDS REFUSE TRANSFER FACILITIES STUDY		
drawn SL	drafted AH	checked JLL

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Figure 6.1 Southern Water Control Zone Delineation of Zone and Subzone		
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Table 6.1 - Water Quality Objectives for Southern Water Control Zone

Parameters	Water Quality Objective	Sub-zone
Offensive odour, tints and colour	Not to be present	Whole zone
Visible foam, oil, grease, scum, litter	Not to be present	Whole zone
E. Coli	Not to exceed 610/100 ml calculated as the geometric mean of all samples collected in one calendar year Not to exceed 180/100 ml calculated at the geometric mean of all samples collected from March to October in one calendar year	Secondary Contact, recreation and fish culture subzones Bathing beach subzones
D.O. within 2 m of bottom Depth average D.O.	Not less than 2 mg/l for 90% of samples Not less than 4 mg/L for 90% of samples Not less than 5 mg/l for 90% of samples	Whole zone Whole zone except fish culture zone Fish culture zone
pH	To be in the range 6.5 - 8.5, change due to waste discharge not to exceed 0.2	Whole zone except bathing beaches
Salinity	Change due to waste discharge not to exceed 10% of natural ambient level	Whole zone
Temperature change	Change due to waste discharge not to exceed 2°C	Whole Zone
Suspended solids	Waste discharge not to raise the natural ambient level by 30% nor accumulation of suspended solids	Whole Zone
Toxicants producing significant toxic effects	Not to be present	Whole zone
Ammonia	Annual mean not to exceed 0.021 mg/l calculated as un-ionised form	Whole zone
Nutrients	Quantity shall not cause excessive algal growth Annual mean depth average inorganic nitrogen not to exceed 0.1 mg/l	Whole zone

Table 6.2: Standards for Effluents Discharged into Inshore Waters of Southern WCZ

(All units in mg/l unless otherwise stated; all figures are upper limits unless otherwise indicated)

Determinand	Flow rate			
	m ³ /day	≤ 10	> 10 and ≤ 200	> 200 and ≤ 400
pH (pH units)		6-9	6-9	6-9
Temperature (°C)		40	40	40
Colour (Iovibond units 25 cm cell length)		1	1	1
Suspended solids		50	30	30
BOD		50	20	20
COD		100	80	80
Oil & Grease		30	20	20
Iron		15	10	10
Boron		5	4	3
Barium		5	4	3
Mercury		0.1	0.001	0.001
Cadmium		0.1	0.001	0.001
Other toxic metals individually		1	1	0.8
Total toxic metals		2	2	1.6
Cyanide		0.1	0.1	0.1
Phenols		0.5	0.5	0.5
Sulphide		5	5	5
Total residual chlorine		1	1	1
Total nitrogen		100	100	80
Total phosphorus		10	10	8
Surfactants (total)		20	15	15
E. Coli (count /100ml)		1000	1000	1000

Table 6.3. Classification of Dredged Sediments for Marine Disposal (Ref 6.3)

Class	Heavy Metal (mg/kg)						
	Cd	Cr	Cu	Hg	Ni	Pb	Zn
A	0.0 - 0.9	0 - 49	0 - 54	0.0 - 0.7	0 - 34	0 - 64	0 - 140
B	1.0 - 1.4	50 - 79	55 - 64	0.8 - 0.9	35 - 39	65 - 74	150 - 190
C	1.5 or more	80 or more	65 or more	1.0 or more	40 or more	75 or more	200 or more

Table 6.4: Standards for Effluents Discharged into Foul Sewer Leading into Government Sewage Treatment Plants

(All units in mg/l unless otherwise stated; all figures are upper limits unless otherwise indicated)

Determinand	Flow rate			
	m ³ /day	≤ 10	> 10 and ≤ 100	> 100 and ≤ 200
pH (pH units)		6-10	6-10	6-10
Temperature (°C)		43	43	43
Suspended solids		1200	1000	900
Settleable solids		100	100	100
BOD		1200	1000	900
COD		3000	2500	2200
Oil & Grease		100	100	50
Iron		30	25	25
Boron		8	7	6
Barium		8	7	6
Mercury		0.2	0.15	0.1
Cadmium		0.2	0.15	0.1
Copper		1.5	1	1
Nickel		4	3	3
Chromium		2	2	2
Zinc		5	5	4

Table 6.4 - Contn.

Determinand	Flow rate	≤ 10	≥ 10 and ≤ 100	> 100 and ≤ 200
	m ³ /day			
Silver		4	3	3
Other toxic metals individually		2.5	2.2	2
Total toxic metals		10	10	8
Cyanide		2	2	2
Phenols		1	1	1
Sulphide		10	10	10
Sulphate		1000	1000	1000
Total nitrogen		200	200	200
Total phosphorus		50	50	50
Surfactants (total)		200	150	50

6.5 No specific quality objectives exist for marine sediments under the WCZ designation. However, sediments have been classified for marine disposal from dredging according to heavy metal concentrations (Ref 6.3). The classifications for dredged sediments are given in Table 6.3.

6.6 The outline design of the transfer facilities (Ref 6.4) specifies that leachate arisings and washwaters from each of the transfer facility sites will be collected for transfer to Mui Wo for pre-treatment prior to discharge to the sewage treatment works. Treated effluent from the pre-treatment works, which will comprise primary and secondary biological treatment, will comply with standards for effluent discharged into foul sewers (Table 6.4).

Existing Water and Sediment Quality

General

6.7 Data is available for existing water quality in the Southern WCZ from the routine monitoring programme conducted by EPD for marine waters and sediments. As site-specific information is not available for each of the transfer facility sites, the data collected from EPD's regular marine monitoring programme has been used for the assessment of water quality in the vicinity of the proposed sites. The location of the closest monitoring stations to the facility sites are shown in Figure 6.2. The latest assimilated data available from EPD, which covers the 1991 period, has been used for assessment purposes. Marine water quality data is summarised in Table 6.5 and sediment data in Table 6.6. Further sediment quality data is available for the Outlying Islands District as a whole from the Lantau Port & Western Harbour Development Study Environmental Survey (Ref 6.5) and is summarised in Table 6.7, with monitoring locations given in Figure 6.3. Further data is available for water quality in Discovery Bay, Yung Shue Wan and Sok Kwu Wan from other studies (Refs. 6.6, 6.7 & 6.8), and in the latter case from marine monitoring undertaken by the Agriculture and Fisheries Department.

6.8 For Southern WCZ waters as a whole, the dissolved oxygen WQO was achieved in 1991, whereas the nutrient objective was exceeded at some time during the year for both total inorganic nitrogen and ammonia concentrations. Although there are no significant discharges of

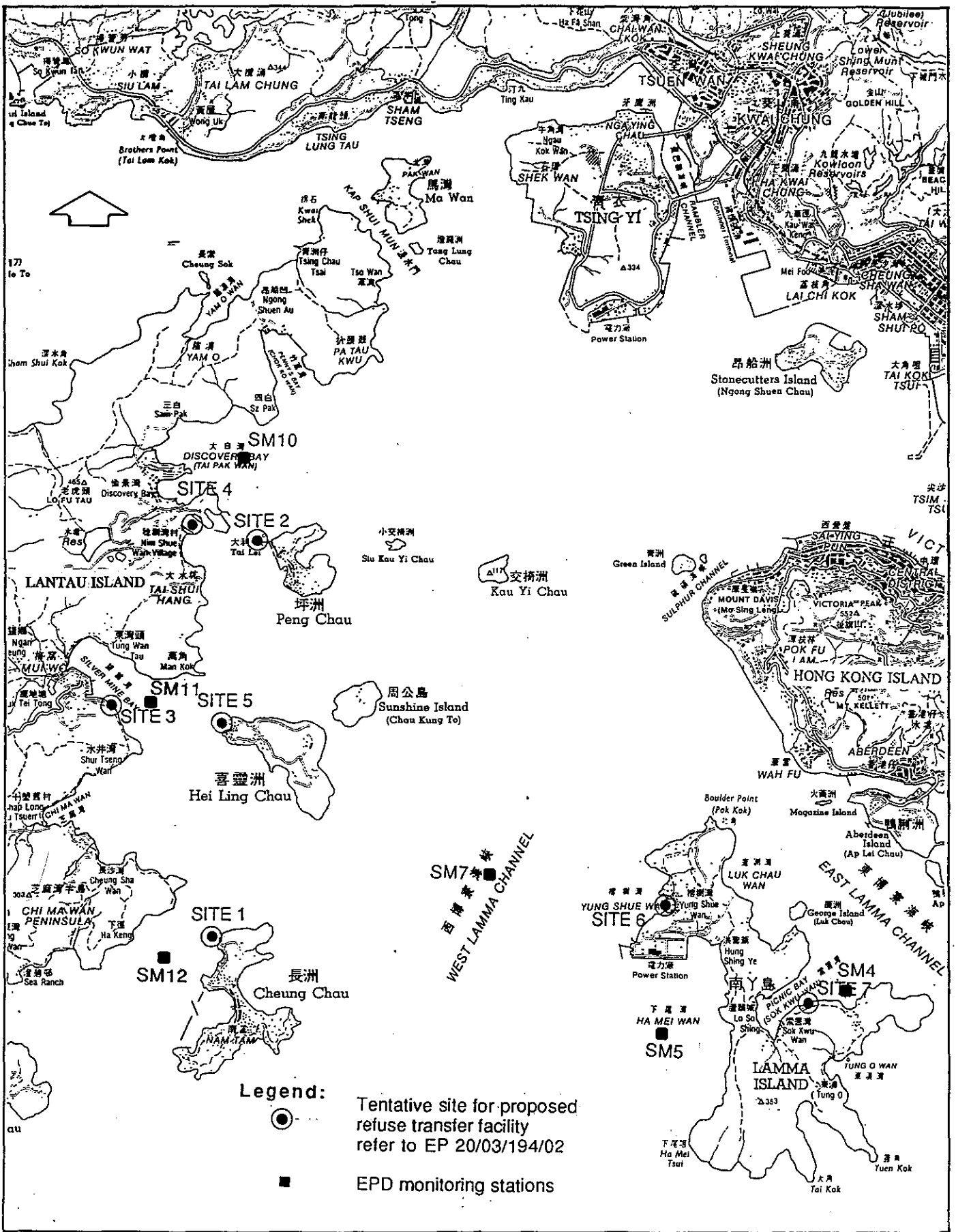


FIGURE 6.2

no.	scale 1:100 000
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drg.	Relevant EPD monitoring stations

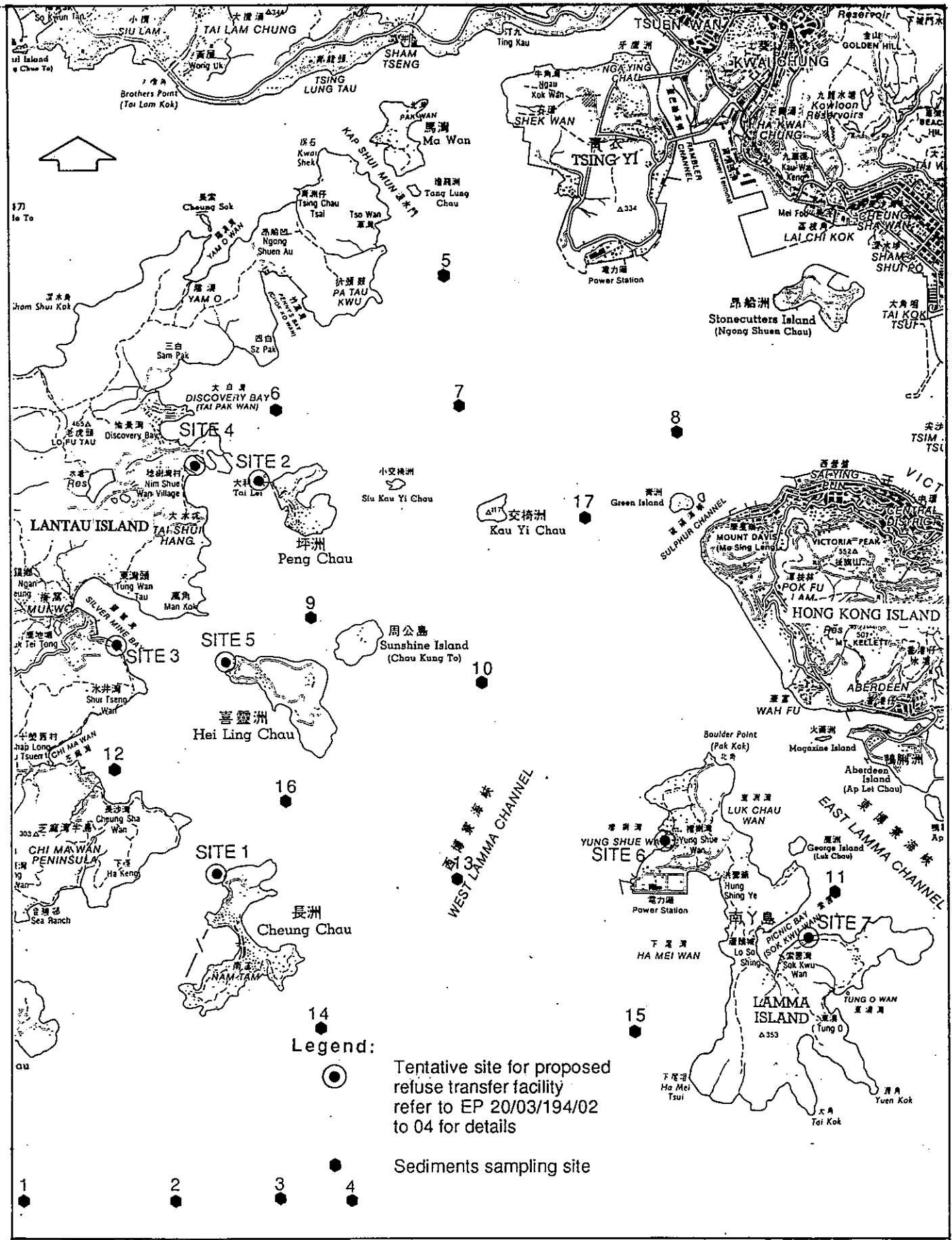


FIGURE 6.3

no.	scale 1:100 000	Aspinwall & company in association with Scott Wilson Kirkpatrick Shankland Cox Parsons Brinckerhoff (Asia) Peter Fraenkel BMT (Asia)	client HONG KONG GOVERNMENT ENVIRONMENTAL PROTECTION DEPT.
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checked JO	date June 1993		drg. Sediment sampling sites (REF. 6.5)

sewage and industrial wastes into this WCZ, the high nutrient loading from the Pearl River Estuary causes this effect. Future wastewater discharges should be carefully controlled to avoid excessive eutrophication of Southern WCZ.

6.9 Concentrations of heavy metals measured in marine sediments under EPD's monitoring programme for stations located at Yung Shue Wan and Sok Kwu Wan, indicate that sediments are relatively uncontaminated for most elements. However, at both locations high concentrations of cadmium were found (Table 6.6), resulting in the lowest classification under dredged sediment standards (Table 6.3). In the case of Sok Kwu Wan, measurements of copper and lead concentrations also exceed slightly the standards for the highest classification of sediments. In contrast, marine sediment samples taken throughout the Outlying Islands region as part of the Environmental Survey for the Lantau Port and Western Harbour Development Study (Ref 6.5) show that sediments are of the highest classification in all cases with the exception of sample locations to the north and south of Kau Yi Chau Island, which exceed copper and mercury levels respectively for class "A" sediments.

Table 6.5 - Relevant EPD Marine Water Monitoring Data - 1991 Period.

Station	Nearest Facility Site	Depth Average DO (mg/l)	pH	Suspended Solids (mg/l)	Ammonia (mg/l)	Inorganic Nitrogen (mg/l)	E. Coli (no./100ml)
SM 4	Sok Kwu Wan	5.50- 11.20	7.76 - 8.65	2.7 - 7.3	0.005 - 0.083	0.04- 0.25 (0.1)	1.6 - 53.3
SM 5	Yung Shue Wan	5.35 - 10.32	8.00 - 8.22	2.0 - 12.3	0.005 - 0.180	0.01- 0.26 (0.1)	2.7 - 68
SM 7	Yung Shue Wan	5.84 - 7.75	8.02 - 8.26	3.8 - 10.5	0.005 - 0.160	0.03- 0.32 (0.1)	1.0 - 10.3
SM 10	Peng Chau Discovery Bay	4.73 - 9.72	8.11 - 8.26	3.75 - 16.3	0.017 - 0.253	0.14 - 0.36 (0.1)	33.5 - 106.7
SM 11	Hei Ling Chau Mui Wo	5.30 - 8.13	8.13 - 8.23	1.8 - 11.3	0.007- 0.263	0.12- 0.37 (0.1)	4.3 - 680
SM 12	Cheung Chau	5.77 - 9.06	8.12 - 8.22	1.8 - 10.3	0.012 - 0.247	0.076- 0.343 (0.1)	0 - 14.6

Notes:

1. Figures in brackets are the relevant WQO for total N

Table 6.6 - Relevant EPD Marine Sediment Monitoring Data - 1991 Period

Location	Heavy Metals (mg/kg)						
	Cd	Cr	Cu	Hg	Ni	Pb	Zn
SM4	9.1	42	56	0.060	20	73	120
SM5	8.9	38	32	0.070	19	71	110

Table 6.7 - Marine Sediment Data, Average of November 1991 and December 1992 (Ref 6.5).

Location*	Heavy Metal (mg/kg)						
	Zn	Cu	Ni	Cr	Pb	Cd	Hg
1	93	24	27	23	39	<0.5	0.09
2	100	46	26	27	43	<0.5	0.57
3	97	32	22	23	41	<0.5	0.23
4	94	25	24	22	37	<0.5	0.30
5	123	71	26	28	42	<0.5	0.29
6	123	34	23	23	52	<0.5	0.30
7	136	72	24	27	59	<0.5	0.57
8	150	35	23	24	32	<0.5	0.25
9	121	35	22	22	48	<0.5	0.31
10	117	54	23	25	48	<0.5	0.82
11	101	23	23	21	39	<0.5	0.23
12	130	37	22	23	50	<0.5	0.30
13	104	42	21	22	45	<0.5	0.44
14	86	24	20	21	33	<0.5	0.32
15	87	15	22	21	36	<0.5	0.25
16	23	23	19	19	46	<0.5	0.41
17	107	46	20	23	36	<0.5	0.30

Note:

1. * Monitoring locations are shown in Figure 6.3.

Cheung Chau

- 6.10 Available EPD monitoring data for a site located approximately 100 m west of the proposed transfer facility site (i.e. SM 12 Table 6.5) show that dissolved oxygen levels are high and that faecal bacteria contamination is low, indicating that organic pollution levels are not excessive. However, during the 1991 monitoring period excessive levels of ammonia and total inorganic nitrogen concentrations were present. Available data indicate that sediment quality in the area is good.
- 6.11 The Cheung Chau Typhoon Shelter is a localised area of poor water quality with minimal exchange of water to the open marine environment. However, monitoring evidence to 1990 showed an improved water quality with increased oxygen levels and reduced in E. Coli levels due to drainage improvements and sewerage provision (Ref 6.2). The Cheung Chau STW provides primary treatment only with a licenced flow rate of 12 000 cu. m per day. The typhoon shelter is over 1 km south east of the proposed site, and as such is not a significant impact on water quality in the near vicinity of the site.

Peng Chau

- 6.12 The waters around Peng Chau are subject to greater tidal and current movement than those within Discovery Bay, thus ensuring more effective flushing and dispersion of contaminants. Currently there are no sewage treatment facilities on Peng Chau. Proposals for a sewage treatment works to be commissioned in 1995, with secondary treatment facilities, will serve the housing estate currently being developed and are likely to result in an overall improvement in water quality in the vicinity.
- 6.13 Available EPD monitoring data in the vicinity of Peng Chau indicates compliance with the Southern WQOs for dissolved oxygen and E. Coli, although nutrient objectives were consistently not achieved for all monitoring occasions for the 1991 period.

Mui Wo

- 6.14 Water quality in the vicinity of the proposed facility will be influenced by sewage discharges from the existing sewage treatment facility and uncontrolled discharges into Silvermine Bay from the village of Mui Wo. As for Discovery Bay, water movement is restricted and the area will be sensitive to the North Lantau developments which have the potential to alter current movements and reduce pollution dispersion.
- 6.15 Available water and sediment quality data is as described for Hei Ling Chau above. The existing STW at Mui Wo provides primary and secondary treatment of effluent, with a licenced flow rate of 3570 cu. m per day. Effluent is discharged to the marine environment from an outlet located 100 m offshore. The provisions for pre-treatment of waste water effluents arising from refuse transfer facility operations prior to discharge to the STW are discussed in Section 6.38.

Discovery Bay

- 6.16 Water movement within Discovery Bay is restricted with the predominant water flow in a southerly water direction across the mouth of the bay (Ref 6.6). The main beach is used by residents and visitors for recreation. There is a sailing club present, and swimming, and windsurfing are popular pastimes. The existing sewerage outlet is designed to produce satisfactory dilution and dispersion of effluent by discharge to the higher velocity currents between Peng Chau and Tai Pak during the flood and ebb tides. The proposed transfer facility site is located in an adjacent bay to the south of Discovery Bay. Water quality is expected to be similar to that of Discovery Bay, although the sites closer proximity to Discovery Bay sewage outlet, combined with sewage from Nim Shue Wan, may result in localised water quality deterioration.

- 6.17 Available monitoring data from the EPD monitoring programme for the 1991 period (location SM 10 Table 6.5) at the mouth of Discovery Bay, indicates general compliance with WQOs for dissolved oxygen and E. coli, although compared to other sites in the Southern WCZ water quality is slightly poorer. Similar to other sites, excessive ammonia and total inorganic nitrogen levels were present during 1991. Available sediment data for the area (Ref 6.5) indicates that heavy metal concentrations are satisfactory.
- 6.18 The development plans for North Lantau and Discovery Bay will result in increased sewage loadings which will require proper treatment and disposal. The Discovery Bay Masterplan Review (Ref 6.6) advocates the diversion of sewage to a new treatment plant on North Lantau to reduce the environmental impact on the bay. However, until the new treatment plant is completed in 1997 additional flows are likely to be diverted to the Discovery Bay Sewage Treatment Works (STW) with necessary modifications to the sewage outfall to ensure adequate dispersion.
- 6.19 The Lantau Port development to the north of Discovery Bay will result in altered water movement in the Western Harbour with the formation of embayments and slack water. This development may have the potential to create a long term deterioration in water quality in the vicinity of Discovery Bay.

Hei Ling Chau

- 6.20 Sewage treatment facilities present on the island serve the Penal Institutions and the Vietnamese Refugee Camp. There are two such facilities, namely:
- A rotary biological contactor for the staff quarters which can serve a population of 600 where daily flow is 177 cu m. per day. Maximum receptive capacity is designed for 885 cu m. per day.
 - An oxidation ditch for prisoners/Vietnamese refugees which caters for a population of 6,400 with a daily flow of 900 cu m. per day.
- 6.21 Tidal currents in the area ensure good dispersion of any sewage or wastewater releases from the island. Limited available data in the vicinity of the island from EPD's monitoring programme (location SM 11 Table 6.5) indicates compliance with the Southern WQOs for dissolved oxygen and E. Coli levels, although as for other monitoring locations, the WQOs are exceeded for nutrient levels. Available sediment data for the area indicate that heavy metal concentrations are satisfactory.

Yung Shue Wan

- 6.22 Available data for Yung Shue Wan from the EPD monitoring programme (locations SM 5 and SM 7, Table 6.5) indicate that WQOs and E.coli levels were achieved throughout the 1991 monitoring period. In common with other monitoring sites within the Southern WCZ the nutrient objectives were not achieved throughout the monitoring period.
- 6.23 Lamma Power Station releases discharges of heated water from the condensers off the north-west seawall of the site along the Po Lo Tsui Headland (Ref 6.7). The thermal discharge undergoes dispersion in the surrounding water body, depending on the prevailing hydrographic condition. Surveys indicate that the thermal plume is dissipated within 1 km of the power station and does not exceed the WQO of not causing more than a 2°C increase in water temperature.
- 6.24 Localised discharges from residential dwellings and restaurants located along the shoreline of Yung Shue Wan are currently impacting on water quality, but this will improve with the development of a sewage treatment works on the reclamation site encompassing the transfer facility.

Sok Kwu Wan

- 6.25 Water quality at Sok Kwu Wan is a particularly sensitive issue due to the proximity of two recently gazetted Fish Culture Zones to the proposed facility site. Fish farming in Sok Kwu Wan commenced in the 1960's and fish culture zones were created following the implementation of the Marine Fish Culture Ordinance. Water quality monitoring is conducted both by EPD and AFD in the area. EPD monitoring data (location SM 4, Table 6.5) show compliance with the Southern Water WQOs for dissolved oxygen and *E. Coli* concentrations, although nutrient objectives were not achieved on all occasions during the 1991 period. Available EPD sediment data in the proximity of the proposed facility site (location SM 4, Table 6.5) show evidence of cadmium contamination.
- 6.26 The available AFD monitoring data for monitoring sites located inside and outside the fish culture zone located to the south west of the proposed site, at a distance of approximately 400 m away (Figure 6.4), is given in Table 6.8.
- 6.27 AFD data indicate that for the majority of sample occasions Southern Water WQOs were achieved for dissolved oxygen levels. However data available for the summer of 1992 indicates that the dissolved oxygen level was below the WQO of 5 mg/l within the FCZ. In common with other locations within the Southern WCZ high levels of ammonia were recorded. These data are supported by monitoring conducted under a separate study (Ref 6.8). It is likely that organic loadings from feed pellets and fish excreta are responsible for the elevated ammonia levels and for the depleted summer oxygen levels recorded in the vicinity.
- 6.28 Other sources of marine pollution in the area include human sources at Sok Kwu Wan and quarrying activity on the opposite side of Picnic Bay. The proposed construction and operation of a concrete casting basin and quarry extension has the potential to impact water quality in the vicinity of the FCZs. Specific mitigation measures and monitoring have been recommended (Ref 6.8) and these should ensure that impacts are acceptable and do not effect the FCZs or result in an aesthetic deterioration of the bay.

Construction Impacts

- 6.29 Water quality impacts associated with construction activities will be derived from uncontrolled discharges offsite and dredging and reclamation activity for new site formation works. Dredging and reclamation will be required at several locations i.e. Discovery Bay, Yung Shue Wan, Sok Kwu Wan, and Hei Ling Chau.
- 6.30 Dredging activity will require the disposal of potentially contaminated marine sediments and has the potential to introduce contaminants and suspended particulate material into the water column. Resuspension of organic material increases microbial activity resulting in oxygen depletion and the release of inorganic nutrients. The placement of reclamation material and site formation works has the potential to result in increase suspended particulate concentrations. Of the sites requiring these works, the most sensitive location is Sok Kwu Wan because of the close proximity of the FCZ. Fish are particularly sensitive to changes in water quality and fish kills can result as a consequence of excessive disturbance, toxification, clogging of gill structures with suspended matter and oxygen depletion.
- 6.31 The relatively small area required for reclamation at Yung Shue Wan, Hei Ling Chau and Sok Kwu Wan will mean that water quality impacts are limited in extent and will be of short duration. A number of mitigation measures are also available for reducing the impact of dredging activity to acceptable levels. These measures include:
- The use of mechanical grabs designed to avoid spillage and to seal tightly when lifted from the seabed;

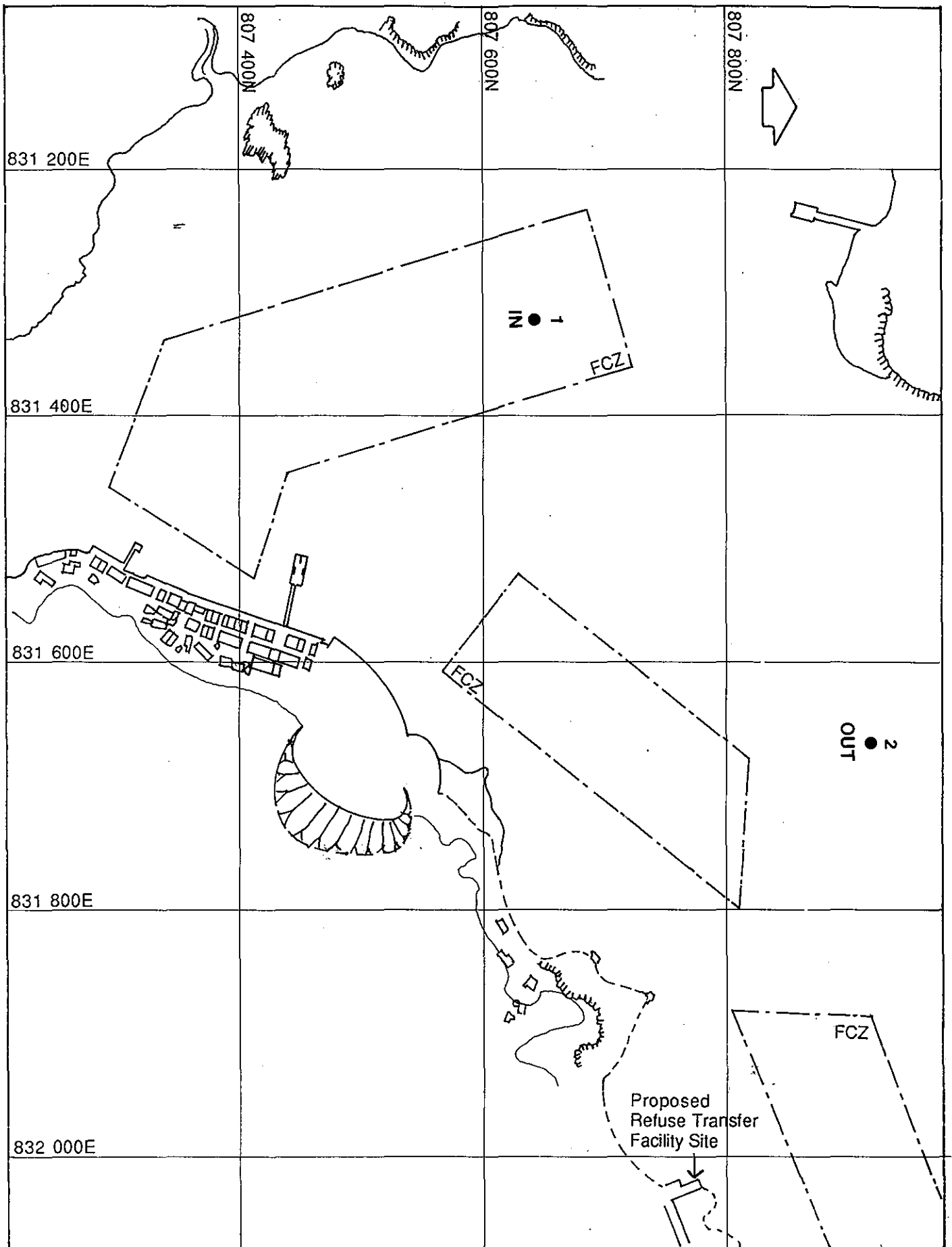


Figure 6.4

no.	scale Approx 1:2000	Aspinwall & company in association with Scott Wilson Kirkpatrick Shankland Cox Parsons Brinckerhoff (Asia) Peter Fraenkel BMT (Asia)	client HONG KONG GOVERNMENT ENVIRONMENTAL PROTECTION DEPT.
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checked JO	date June 1993		drg. AFD Monitoring Locations Sok Kwu Wan

Table 6.8 - AFD monitoring of Inner and Outer FCZ Water Quality Monitoring Data at Sok Kwu Wan.

Date of Monitoring	Temp. °C	Dissolved Oxygen (mg/l)	BOD ₅ (mg/l)	NH ₃ -N µg/l	Turbidity (NTU)	Suspended Solids (mg/l)
2/4/93						
(in) 0-10 m	20.0 - 20.5	4.86 - 6.38 (> 5.0)	1.3 - 1.6	124 - 162 (<21)	1.8 - 2.7	1.1 - 7.0
(out) 0-12 m	20.1 - 20.7	6.40 - 6.63 (>4.0)	1.3 - 1.5	96 - 113 (<21)	1.7 - 2.9	1.0 - 5.0
18/1/93						
(in) 0-4 m	28.3 - 29.5	6.68 - 8.83 (> 5.0)	0.64 - 0.66	35 - 41 (<21)	1.4 - 1.8	1.5 - 6.0
(out) 0-10 m	25.7 - 29.0	4.37 - 8.62 (>4.0)	0.55 - 0.73	159 - 189 (<21)	1.2 - 1.3	0.2 - 0.8
25/6/92						
(in) 0-4 m	29.3 - 29.5	6.68 - 8.83 (> 5.0)	1.33 - 1.44	70 - 96 (<21)	0.8 - 1.2	-
(out) 0-10 m	25.7 - 29.8	4.37 - 8.62 (> 4.0)	1.99 - 2.07	100 - 105 (<21)	1.4 - 2.1	-
25/11/92						
(In) 0-8 m	21.5 - 21.6	6.68 - 8.83 (> 5.0)	0.54 - 0.78	115 - 173 (<21)	8.12 - 8.16	-
(out) 0-11 m	21.4 - 21.5	4.37 - 8.62 (> 4.0)	0.50 - 1.16	89 - 97 (<21)	8.23 - 8.24	-
29/9/92						
(in) 0-8.5 m	28.2 - 29.0	6.68 - 8.83 (> 5.0)	0.92 - 1.02	61 - 190 (<21)	-	-
(out) 0-12 m	28.1 - 29.0	4.37 - 8.62 (> 4.0)	0.66 - 1.94	43 - 202 (<21)	-	-
31/8/92						
(in) 0-8 m	27.9 - 28.5	3.50 - 4.10 (> 5.0)	0.7 - 1.01	35 - 56 (<21)	-	-
(out) 0-11 m	27.4 - 28.2	3.36 - 4.12 (> 4.0)	0.71 - 1.9	19 - 99 (<21)	-	-

Notes:

1. *Figures in brackets are Water Quality Objectives (WQOs)*
2. *Figures in bold indicate WQOs have been exceeded. Ammonia levels are for ionized and unionised levels, where the WQO relates to unionised ammonia only.*

- The avoidance of overflow, overloading and lean mixture overboard systems on the dredging vessel;
 - The use of suitable sized vessels to ensure adequate clearance from the seabed to avoid undue turbulence and turbidity from vessel movement and propeller wash;
 - The use of barges and hopper dredgers with tight fitting seals to their bottom openings to prevent leakage of material;
 - The use of silt curtains or steel sheeting to prevent migration of suspended solids; and
 - The restriction of dredging activity to tidal periods when current flow will minimise or avoid impact of suspended particulates on the FCZ.
- 6.32 The deployment of these measures combined with an appropriately designed monitoring programme are likely to reduce dredging impacts on water quality to acceptable levels. Details of a suitable monitoring programme are given in Chapter 11.
- 6.33 Other construction impacts are associated with site formation works and building development. The most significant impacts will be associated with discharges with high suspended solid concentrations as a result of the erosion of exposed ground and loose material. The contractor should ensure that no oil, fuel or solvents are permitted to leak offsite.
- 6.34 The risk of large particulate loadings to marine waters during construction can be considerably reduced by good management practices. These include the storage of earth and other loose material away from marine frontage areas, avoiding the long term exposure of exposed surfaces, the diversion of surface drainage waters away from site and the use of silt/oil traps prior to any marine discharges. Arrangements should also be made by the contractor for the proper disposal of sewage generated from messing facilities associated with construction works. The use of such management practices should be enforced through regular daily on-site inspections for potential fugitive discharge sources.

Operational Impacts

- 6.35 Operational impacts associated with the facilities will be limited as the effluent and drainage design of the sites will prevent fugitive marine discharges (Ref 6.4). Leachate derived from delivered wastes will be collected for subsequent transport and disposal at the Mui Wo pre-treatment works prior to discharge to the STW. Vehicle washdown waters, sewage, and stormwater from site will be directed to sewer, where connections are available (i.e Cheung Chau, Peng Chau, Discovery Bay, and Mui Wo) and only if wastewater quality complies with WPCO standards. Where sewer connections are not available (i.e Hei Ling Chau, Yung Shue Wan, and Sok Kwu Wan) vehicle washwaters, sewage and the initial flush of storm water will be collected for pre-treatment at Mui Wo RTF, together with leachate arisings. The volume of the initial flush of stormwater to be collected, where required, should be determined by the successful tenderer as part of the finalised design for each site.
- 6.36 All sewer discharges must be approved by Drainage Services Department (DSD), and the OITF contractor will be obliged to perform with all relevant regulations and performance standards imposed by DSD. In the event of sewer discharges not being acceptable to DSD, then the OITF contractor will be obliged to collect wastewaters for pre-treatment at Mui Wo. Clean surface drainage waters will be segregated from contaminated waters and will be discharged to marine waters after passing through a settlement and oil interceptor tank to prevent any fugitive emissions.
- 6.37 Collection tanks for the storage of leachate and other wastewaters at each site should be above ground, where leachate was pumped from the drainage collection system. Above ground tanks would aid inspection for leakage, where tanks should be double skinned to minimise the risk of a leakage event. In the event of spillage in the filling or emptying of collection tanks the area

beneath the tank should be suitably banded to contain the wastewater. In the event of a spillage a clean-up programme and disposal procedure should be implemented to prevent any discharge from site.

- 6.38 Similarly, spillage prevention measures should be incorporated into the design on the wastewater tank on the waste transfer vessel, which should be secure enough to contain the wastewater in the event of the tank being lost at sea. Inspection of the wastewater transfer operation should be conducted regularly to ensure the operation is being carried out effectively.
- 6.39 Estimated quantities of wastewater arisings which will require pre-treatment at Mui Wo prior to discharge for further treatment at Mui Wo STW are given in Tables 6.9. These figures represent maximum loadings based on the maximum waste throughput of waste at the RTFs over a 15 year operational period, and are considered 'worst case' as they assume that all wastewater arisings are collected for pre-treatment and are of a similar quality to leachate arisings. In reality, the bulk volume of the arisings will be vehicle washdown waters of considerably higher quality. Estimations of wastewater arisings and pollution loadings presented in Table 6.9 are indicative only, and the successful tenderer will need to liaise with DSD to determine actual loadings on the Mui Wo STW as part of the detailed EIA.
- 6.40 Based on estimated wastewater arisings, the total wastewater arising is estimated at approximately 60 cu. m per day compared to the total influent to the STW of 3570 cu. m per day. Wastewaters will receive primary settlement and secondary biological treatment at the pre-treatment works, and effluent to Mui Wo STW will not exceed permissible standards for effluents, as given in Table 6.4. Achievable treatment standards and estimated dry flow loadings of effluents and estimated loadings at Mui Wo STW are given in Table 6.10.
- 6.41 Currently, Mui Wo STW has a BOD capacity of approximately 330 kg/day, whereby the load from the pre-treatment facility is estimated at approximately 30 kg/day maximum, or 9 % of capacity. Furthermore, it is understood from DSD that the Mui Wo STW will be extended to achieve a target BOD capacity of 660 kg/day, thereby reducing the load from the pre-treatment facility to 4.5 % of capacity. The time table for completion of the Mui Wo STW extension is uncertain, but is targeted for around 1996. In the event of the extension not being complete, then the effluent from the pre-treatment facility will be discharged to the existing STW. However, the loading in the initial years of operation of the RTFs will be significantly lower than the maximum throughput capacity and hence wastewater arisings will be less. Using available waste throughput data (see Table 3.2) the wastewater arisings in the initial years of RTF operation have been estimated at approximately 40 m³ in total. Therefore estimated BOD loading on the Mui Wo STW, in the absence of the extension, is estimated at 18 kg/day or 5.5% of capacity. In reality, it is expected that the actual loading will be significantly less due to the diversion of non-leachate wastewaters to sewer and the higher wastewater quality of wastewater arising than used for the purposes of estimation, as presented in this report.
- 6.42 The successful tenderer will be required to liaise with DSD to ensure that all required effluent standards and regulations of effluent flow to the Mui Wo STW can be achieved. In the event of DSD being dissatisfied with effluent loadings prior to, or following the STW extension, the OITF contractor will be obliged to upgrade the treatment facility to achieve a higher effluent standard or make alternative arrangements for the disposal of pre-treatment facility effluents. It is considered, that on the basis of estimations presented in this report that the pre-treatment of leachate derived wastewaters and sewage will ensure that excessive loadings are not placed on the works and that water quality in the area will be maintained.
- 6.43 Wastewater storage tanks should be of a sufficient capacity to retain excess wastewaters in the event of the waste transfer vessel failing to visit the site due to typhoon or accident. Beyond an additional 24 hour storage capacity, arrangements should be made for an alternative disposal route or collection vessel to be used. In the event of typhoon, it is likely that the refuse collection service on the Outlying Islands would also be disrupted, thereby alleviating the burden on the transfer facility site. In the event of continued collection of waste at each facility in adverse weather conditions, alternative disposal to nearby existing sewage works may be required. Where no sewage treatment facilities are likely to exist upon commissioning of the transfer facility

sites, further storage arrangements should be provided (i.e. at Sok Kwu Wan and Yung Shue Wan). In no event should untreated wastewaters be allowed to discharge directly to sea..

Table 6.9 - Wastewater Arisings from the Transfer Facilities

Site	Total Wastewater Arisings* (m ³ per day)
Cheung Chau	16.7
Peng Chau	7.2
Mui Wo	11.0
Discovery Bay	14.7
Hei Ling Chau	2.3
Yung Shue Wan	11.3
Sok Kwu Wan	2.8
Total	66

Note:

1. * Arisings include leachates, washwaters, initial flush of stormwater and sewage

Table 6.10 Estimated Contaminant Loadings of Wastewaters to Mui Wo Pre-treatment Facility.

Determinand	Effluent Standard Following Pre-treatment (mg/l)	Estimated Daily Dry Weather Flow Loading (kg/day)
BOD ₅	450	29.7
COD	1400	92.4
Suspended Solids	650	42.9
Ammoniacal nitrogen	250	16.5

Joint User Development

- 6.44 It is understood that joint user development will be restricted to the storage of construction materials at one or more of the transfer sites.
- 6.45 These joint-usage will have limited potential to cause significant marine water quality impact. However, it is recommended that storage sites should form part of the overall effluent and drainage design to prevent fugitive discharges off-site. For the storage of loose building materials (e.g. sand) areas should be covered to prevent rainfall erosion and release of discharges with high suspended solid concentrations. Any hazardous construction chemicals stored on site (e.g. solvents, oils, creosote) should be kept in secure receptacles with spillage containment provisions.

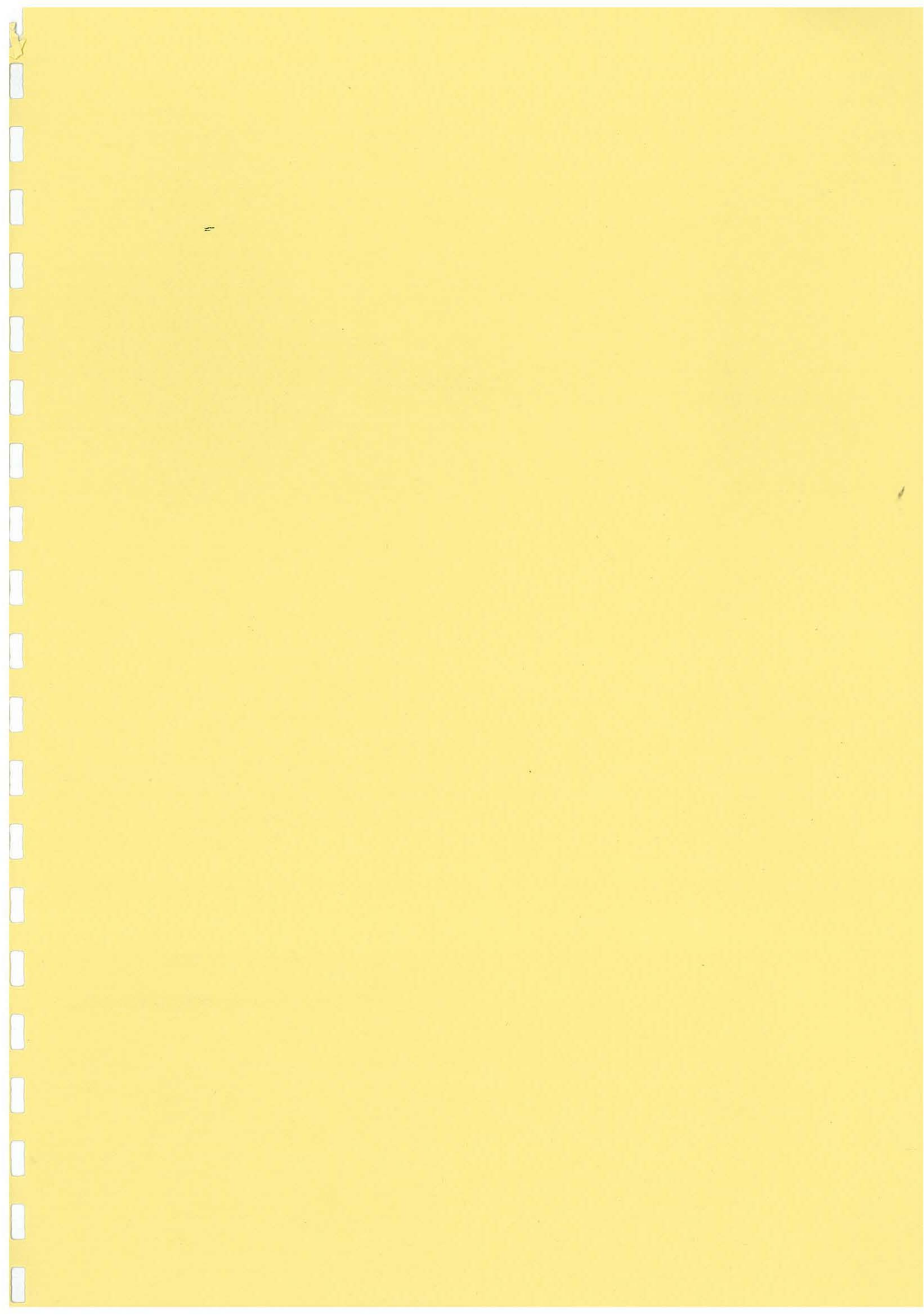
Further Assessment

6.46 With respect to water quality impacts, it is recommended that the following tasks be conducted by the successful tenderer;

- To conduct predictive modelling of impacts for a range of water quality parameters (e.g suspended solids, dissolved oxygen) on the FCZ at Sok Kwu Wan over a range of tidal and operating conditions to determine the optimum time and method for works to be conducted, subject to contractual responsibilities for the works.
- An assessment of the impact on the Mui Wo STW of receiving wastewaters directly from the facilities in the event of failure of the pre-treatment facility.
- Baseline, construction water quality monitoring for dredging and reclamation works needed for the development of the transfer facilities, subject to contractual responsibilities for the works.

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- 6.1 Morton, B. Pollution of the Coastal Waters in Hong Kong. Marine Pollution Bulletin, Volume 20, pp 310-318, 1989.
- 6.2 Marine Water Quality in Hong Kong. Results from the EPD Marine Water Quality Monitoring Programme for 1989. Environmental Protection Department. 1990.
- 6.3 Technical Circular No. (TC) No 1-1-92 Classification of Dredged Sediments for Marine Disposal. Environmental Protection Department. November 1992.
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- 6.5 Lantau Port & Western Harbour Development Studies. Environmental Surveys Data Report. Civil Engineering Department, Port Development Office. October 1992.
- 6.6 Discovery Bay Master Plan Review: A Support Community for PADS. Environmental Review. Hong Kong Resort Company Ltd. August 1992.
- 6.7 Environmental Impact Assessment of Units L7 & L8 Lamma Power Station, Final Initial Assessment Report. The Hong Kong Electric Company Ltd. May 1992.
- 6.8 Lamma Quarry Casting Basin and Moderate Basin Extension, Environmental Assessment. June 1993.



7. Noise

Introduction

- 7.1 This Chapter of the IEIA evaluates noise impacts associated with the proposed refuse transfer facilities for each of the sites with respect to the construction and operational phases of development. Available data from previous studies is reviewed to assess baseline noise levels and this is supported by field monitoring data collected as part of this study. Mitigation measures for the control of noise levels at identified sensitive receptors are discussed and consideration is given to potential joint user development of the transfer facilities and areas for further assessment by the successful tenderer.

Environmental Quality Objectives, Standards and Guidelines

- 7.2 The Noise Control Ordinance 1988 (NCO) was implemented in Hong Kong in 1988 and provides a framework on which specific Regulations, Guidelines and Technical Memoranda have been produced. Of particular relevance to this study are the following documents produced by EPD:
- The Hong Kong Planning and Standards Guidelines. Environmental Guidelines for Planning in Hong Kong (Ref 7.1);
 - Technical Memorandum on Noise from Construction Work other than Percussive Piling (Ref 7.2);
 - Technical Memorandum on Noise from Percussive Piling (Ref 7.3); and
 - Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites (Ref 7.4).
- 7.3 The objective of this guidance and legislation is to prevent noise problems arising, through careful planning, and to provide statutory control over activities which generate noise.

Construction Impacts

- 7.4 Under the NCO, the acceptable noise levels (ANLs) for construction work, with the exception of percussive piling, are specified in the Technical Memorandum on Noise from Construction Work other than Percussive Piling (Ref 7.2). For the purposes of assessment all the proposed refuse transfer facilities sites have been given the highest area sensitivity rating. The acceptable noise levels (ANLs) at noise sensitive receivers (NSRs) are presented in Table 7.1. There are no controls for general construction work during normal day time hours (0700 to 1900) on the normal working days (Monday - Saturday), but specific controls are effective during evenings, night-time and public holidays (including Sundays). A Construction Noise Permit will be required for any work undertaken during the hours for which ANLs are specified.
- 7.5 Although a daytime construction noise level is not specified under the NCO, it is proposed that in order to provide a degree of protection to the public a guide limit at the facade of any NSR of 70 dB(A) L_{eq} (30 mins) should be adopted by the successful tenderer, thereby reflecting the semi-rural setting of the sites.
- 7.6 For construction work involving percussive piling provision is made for noise control under the NCO. Assuming that NSRs at the transfer facility sites are in the most sensitive category specified in the Technical Memoranda, the ANL is

85 dB(A) with the permitted hours of operation given in Table 7.2. These are based on the extent to which the Corrected Noise Level (CNL) at the NSR exceeds the ANL.

Table 7.1 - Acceptable Noise Levels for Construction Works

Time Period	ANL (dB(A)) Area Sensitivity Rating: A
All days during the evening (1900-2300 hours), and holidays (including Sundays) during the day-time and evening (0700-2300 hours)	60
All days during the night-time (2300-0700) hours)	50

Table 7.2 - Permitted Hours of Operation for Percussive Piling

Amount by which CNL exceeds 85 dB (A) at the NSR	Permitted hours of operation on any day not being a general holiday
More than 10 dB(A)	0800 to 0900 1230 to 1330 1700 to 1800
Between 1 dB(A) and 10 dB(A)	0800 to 0930 1200 to 1400 1630 to 1800
No exceedance	0700 to 1900

Operational Impacts

- 7.7 The NCO gives statutory provision on which noise from specific sources may be controlled in the Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites. Giving the NSRs in the vicinity of the proposed transfer facilities the highest sensitivity rating, the ANLs are shown in Table 7.3.
- 7.8 The Hong Kong Planning and Standards Guidelines (HKPSG) states that in order to plan for a better environment a new noise source should be located and designed so that the noise level at the NSR should be at least 5 dB(A) below the ANL presented in Table 6.3 or no higher than the background noise level if the latter is not less than 5 dB(A) below the ANL. In no case should operational noise exceed 60 dB(A) during the day and 50 dB(A) L_{eq} (30 mins) at night.

Table 7.3. Acceptable Noise Levels for NSRs of the Highest Sensitivity Rating

Time Period	ANL (dB(A)) Area Sensitivity Rating: A
Day (0700 to 1900 hours)	60
Evening (1900 to 2300 hours)	60
Night (2300 to 0700 hours)	50

Road Traffic Noise

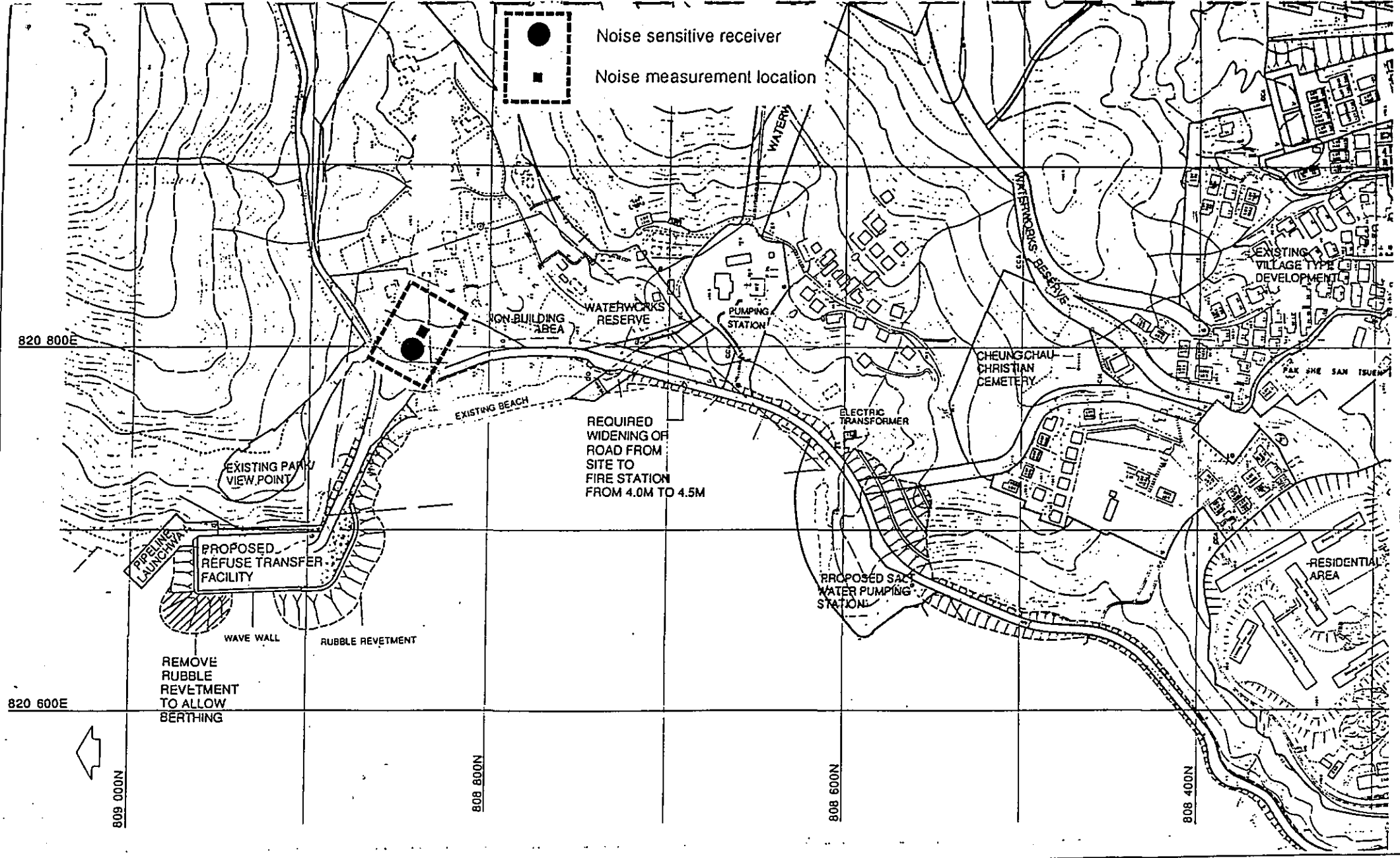
7.9 The HKPSG road traffic noise standard is a peak hour of 70 dB(A) L₁₀ (1 hour) at the facade of residential buildings. Criteria are more stringent for educational establishments and places of worship at 65 dB(A) and medical institutions at 55 dB(A).

Existing Baseline Conditions

7.10 Data on ambient noise levels in the vicinity of the transfer facility sites is available from previous studies in the Outlying Islands region and from field monitoring conducted as part of this consultancy.

7.11 The noise environment for the island sites, in general, are representative of quiet rural areas due to their remote locations and lack of large scale industrial and transport infrastructure developments. As such, the sites are sensitive to any increase in noise levels although in most cases this is limited due to the distance of NSRs from the sites.

7.12 The measured noise levels recorded for each of the sites under this consultancy are given in Table 7.4 and the locations used for monitoring are shown on Figure 7.1 - 7.7. Each of the NSRs used for measuring purposes are residential dwellings (except Yung Shue Wan which is a clinic) and measurement times coincided with the expected time of arrival of the waste transfer vessels as given in WP 5 "Access, Land and Marine Transport and Berthing Facilities" (Ref 7.5). A precision integrating sound level Type 1 meter was used to measure the ambient noise levels. The microphone was placed at a position of 1m from the exterior of building facades and pointed towards the proposed site. Measurements of equivalent continuous sound pressure level in terms of the A weighting, LA_{eq}, were carried out for 30 minutes at each location. The meter was calibrated and checked immediately prior to and after noise measurements.



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NOTES 1. THIS DRAWING IS BASED ON CHEUNG CHAU NORTH LAYOUT PLAN. PLAN NO. LI-CCN/1A

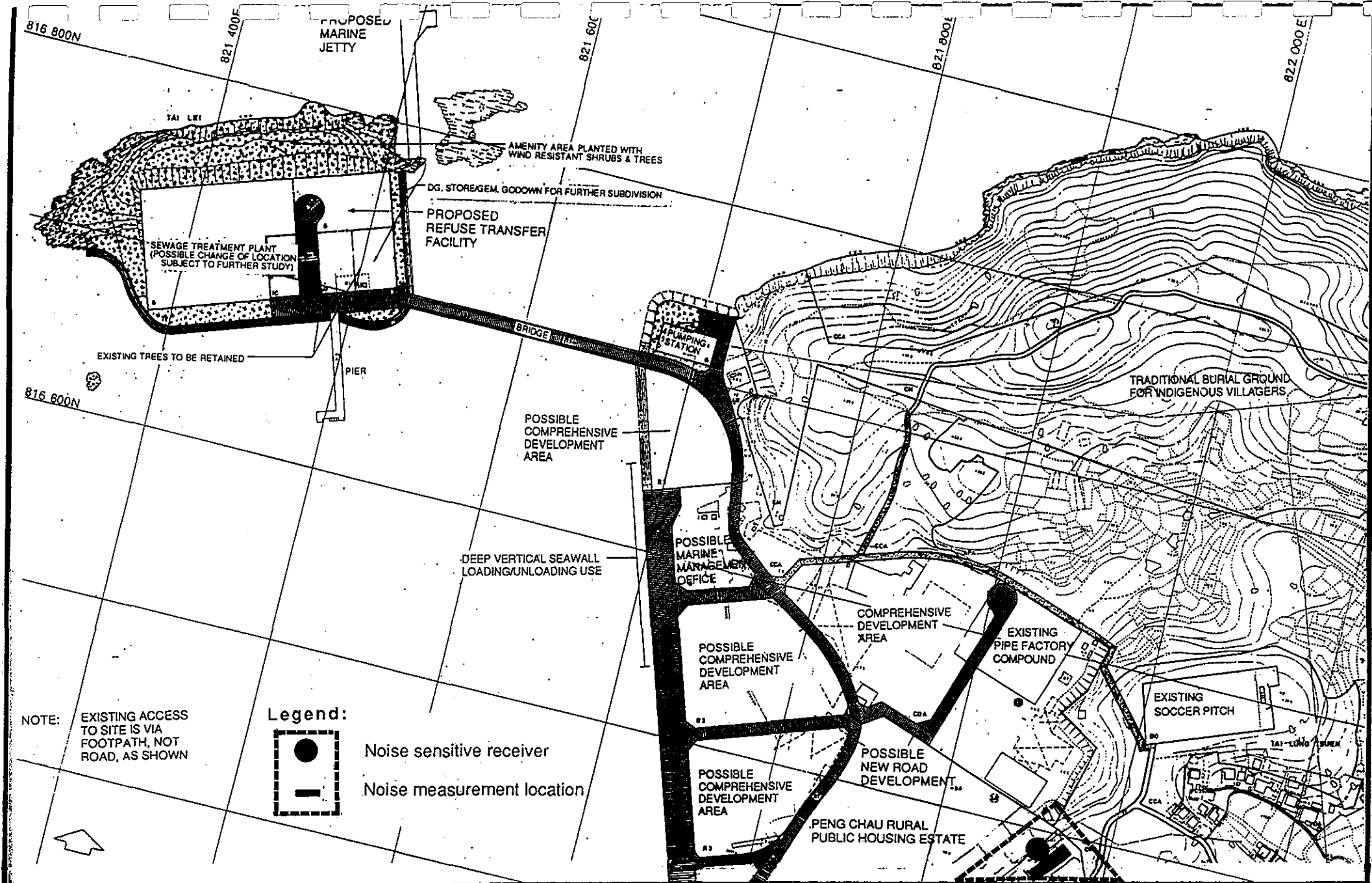
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FIG 7.1
 The Location of Noise Measurement at CHEUNG CHAU

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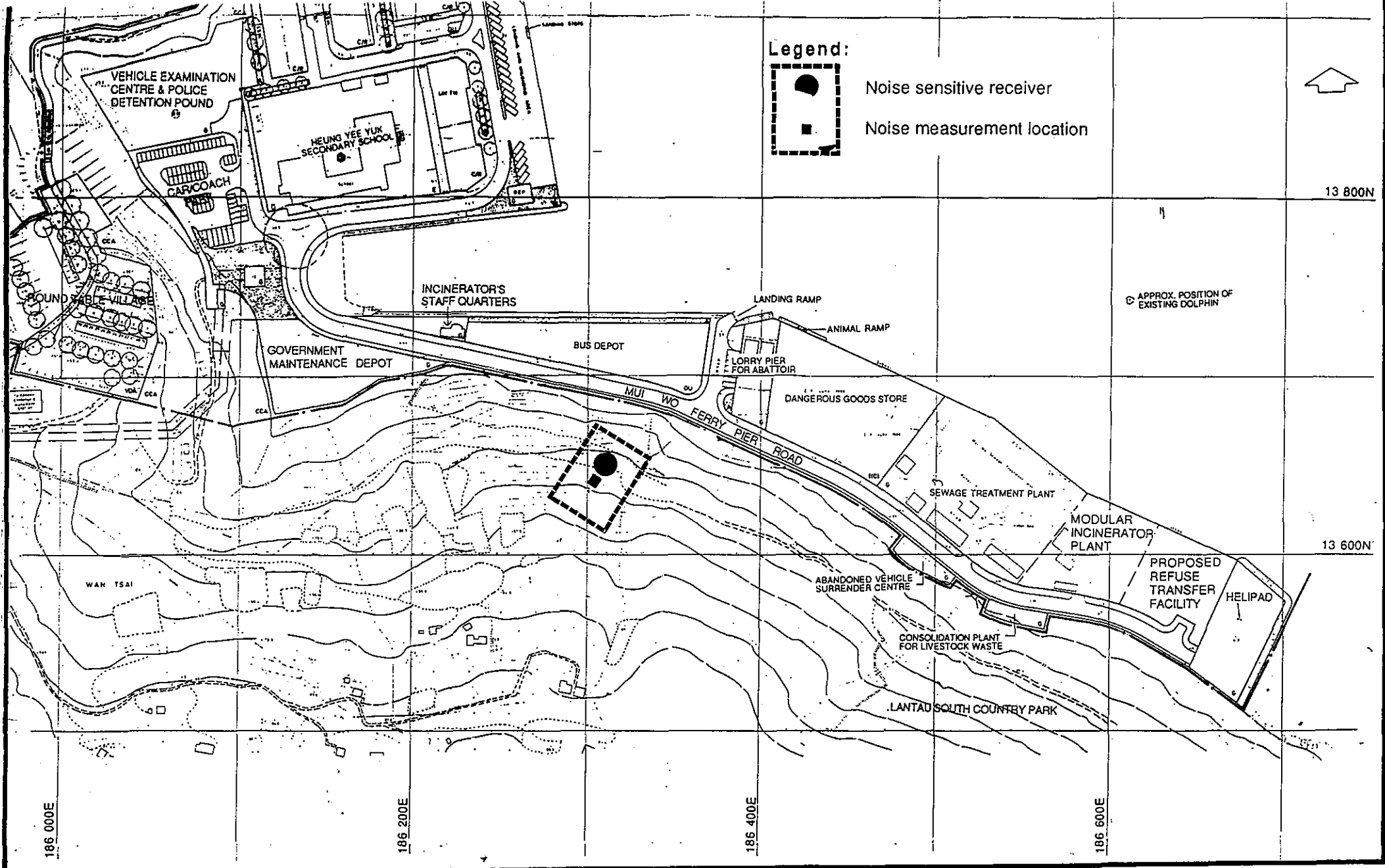
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FIG 7.2: The Location of Noise Measurement at Peng Chau

no.	scale Approx 1:3000	date JUNE 1993
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Legend:



Noise sensitive receiver

Noise measurement location



13 800N

13 600N

186 000E

186 200E

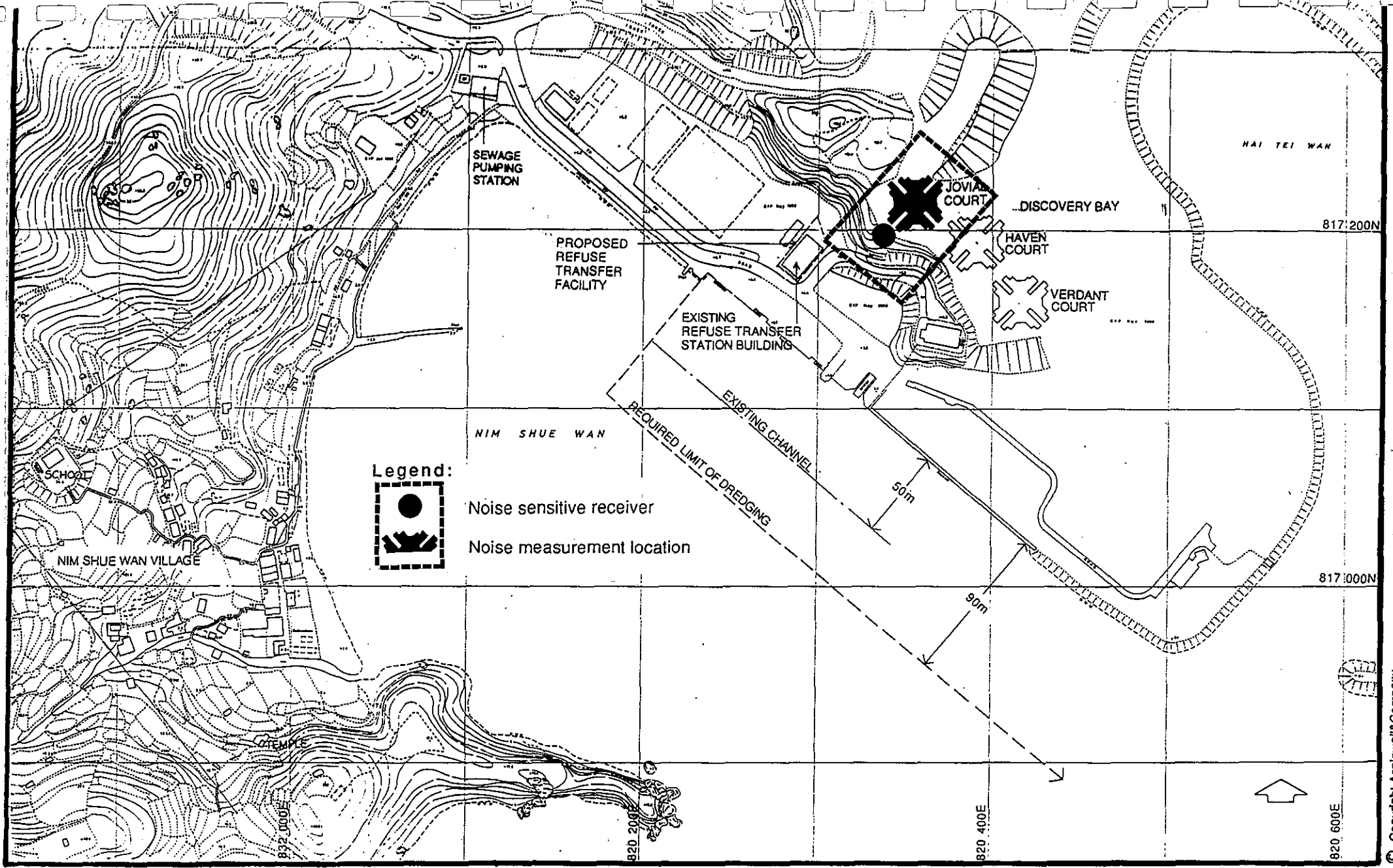
186 400E

186 600E

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FIG 7.3:		The Location of Noise Measurement at Mui Wo	
no.	scale	date	
	Approx 1:3000	JUNE 1993	



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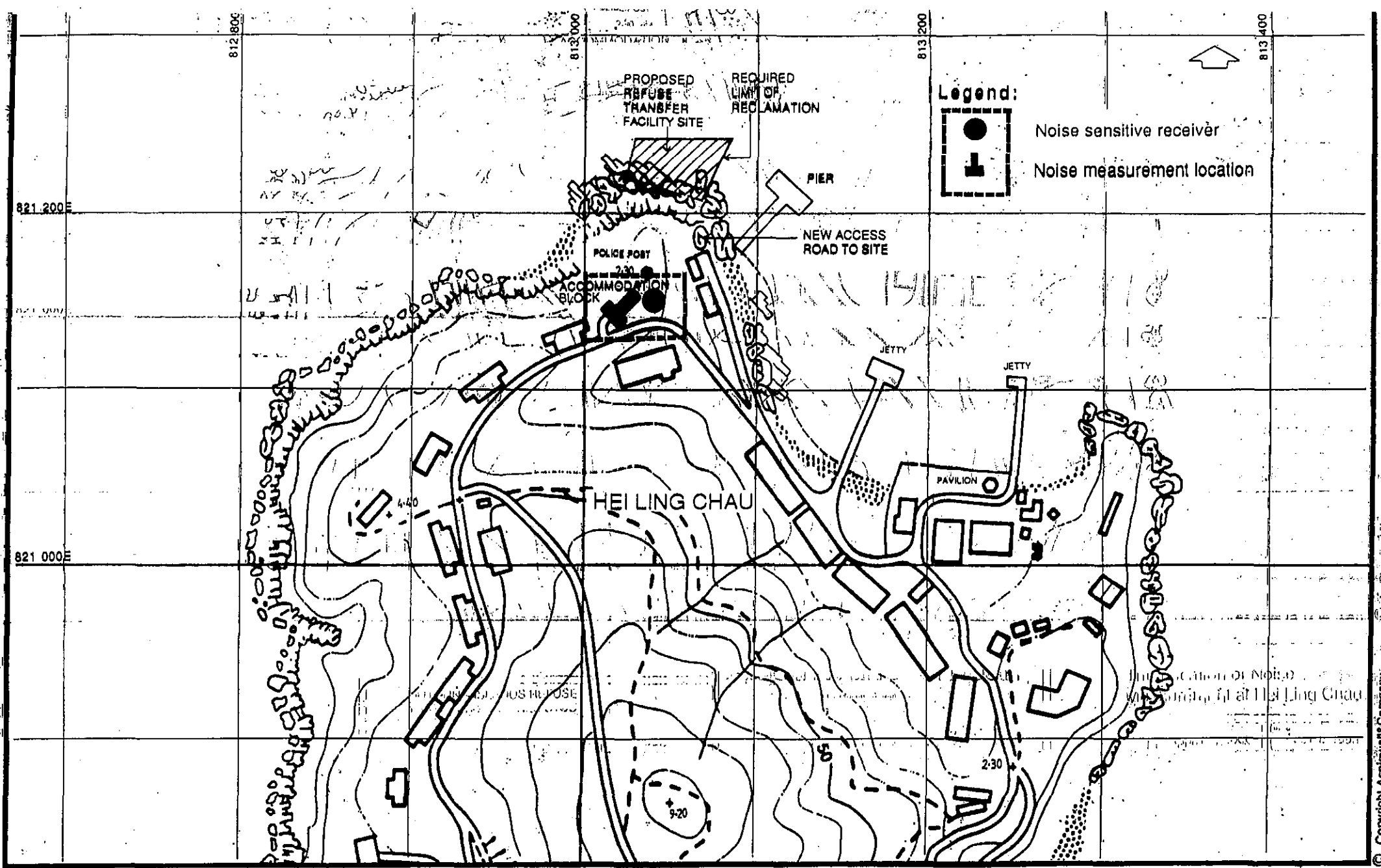
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FIG 7.4:
The Location of Noise
Measurement at Discovery Bay

no.	scale Approx 1:3000	date JUNE 1993
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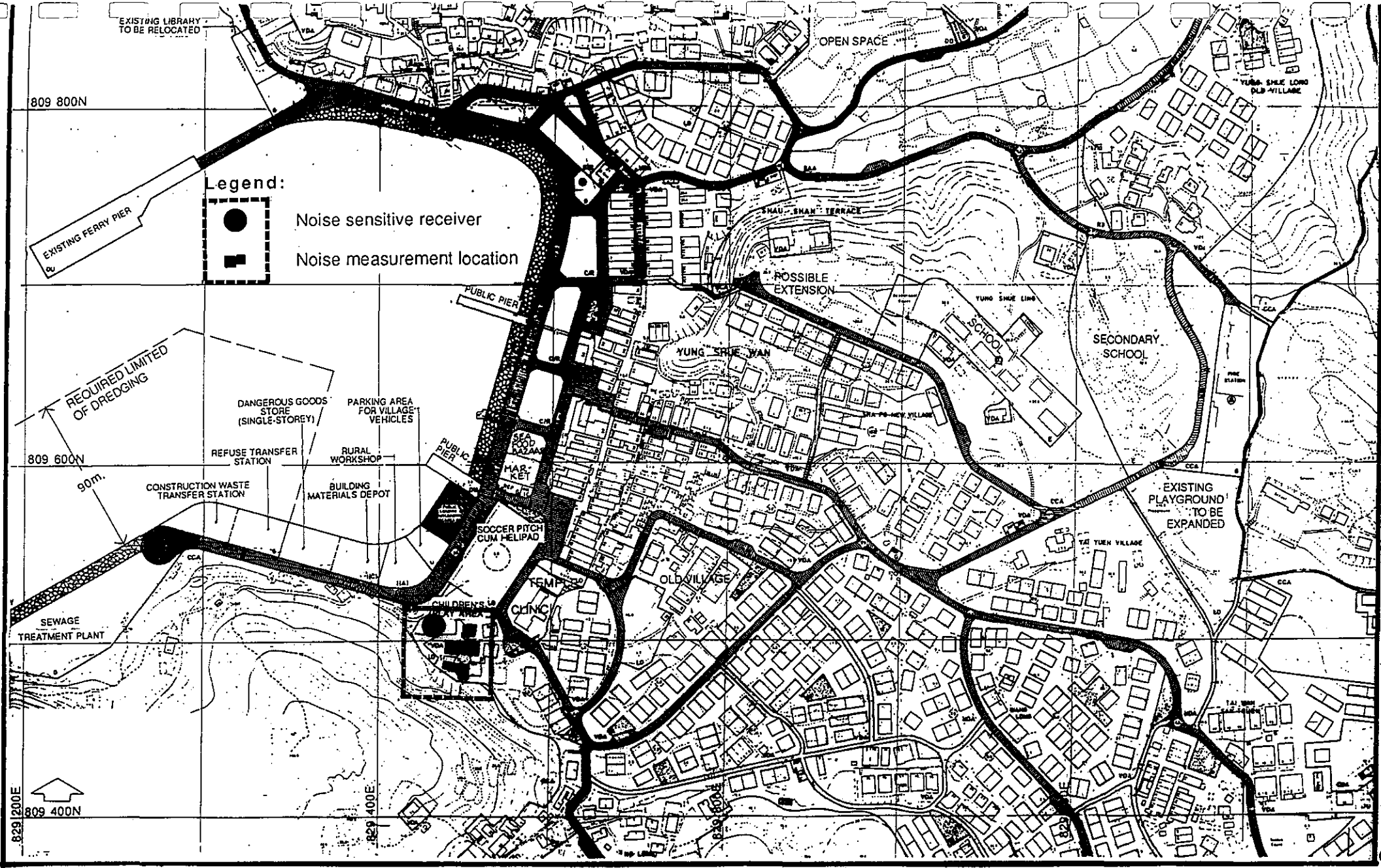


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FIG 7.5: The Location of Noise Measurement at Hei Ling Chau		
no.	scale Approx 1:3000	date JUNE 1993



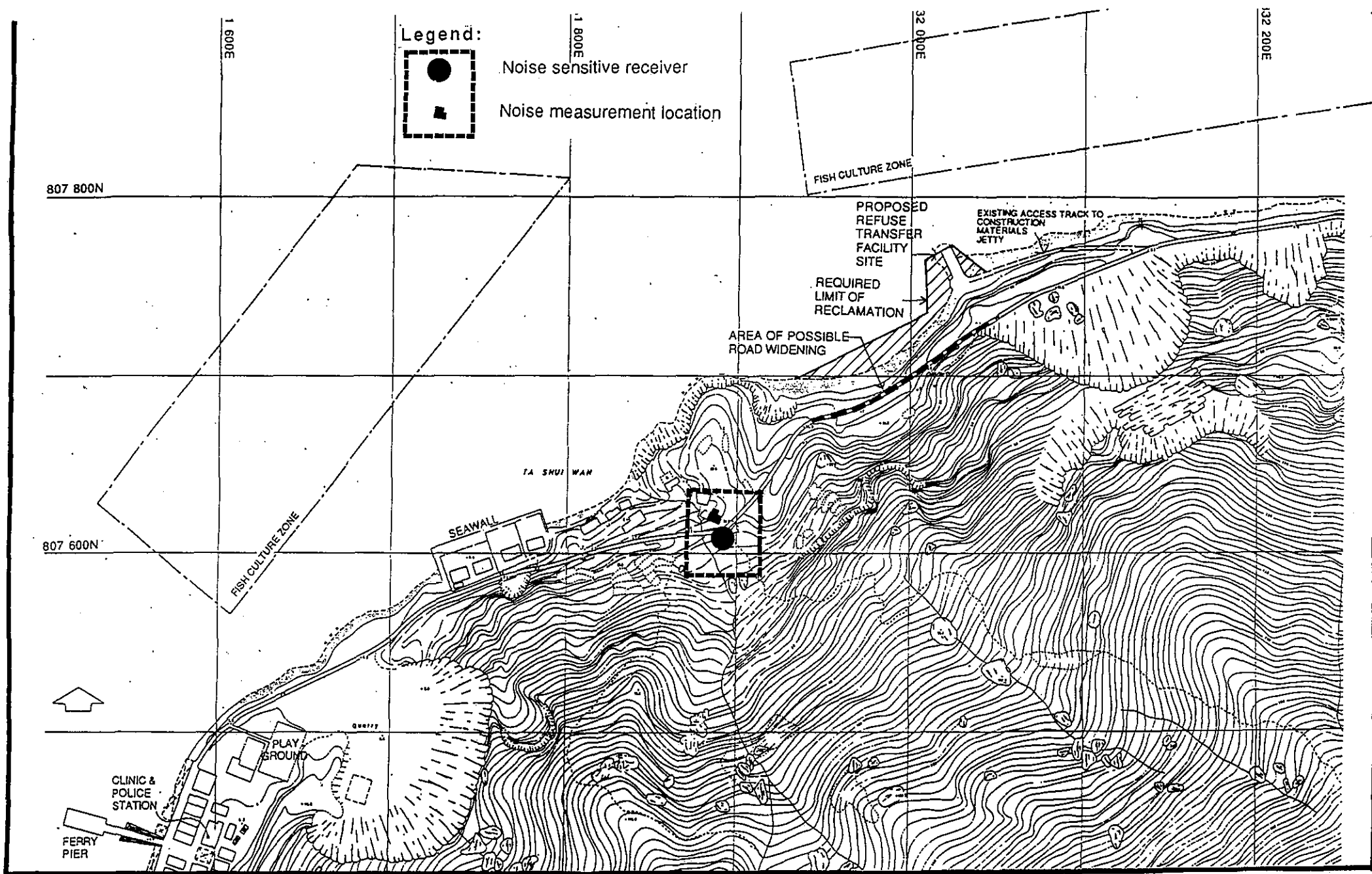
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FIG 7.6: The Location of Noise Measurement at Yung Shui Wan

no.	scale Approx: 1:3000	date JUNE 1993
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Legend:
 ● Noise sensitive receiver
 □ Noise measurement location

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FIG 7.7:
 The Location of Noise
 Measurement at Sok Kwu Wan

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Table 7.4 - Ambient Noise Levels for NSRs at the Outlying Islands Refuse Transfer Facility Sites

Location	Proposed period for 30min. measurement	Actual measurement time & date	L_{eq} (30 min)	L_{90} (30 min)	Remarks
Cheung Chau	0800 - 0900	0804 - 0834 (2/6/93)	77.3	74.3	a
Peng Chau	1000 - 1100	1032 - 1102 (2/6/93)	62.9	52.3	c
Hei Ling Chau	0700 - 0800	1050 - 1120 1120 - 1150 (7/6/93)	53.4 55.1	49.3 50.8	e, f e, g
Mui Wo	1615 - 1715	1617 - 1647 (7/6/65)	59.6	53.3	h
Discovery Bay	1130 - 1230	1200 - 1230	60.3	50.8	c
Sok Kwu Wan	1400 - 1500	1400 - 1430 (2/6/93)	61.0	53.3	a
Yung Shue Wan	1130 - 1230	1130-1200 (2/6/65)	57.2	53.8	b

Remarks:

- a) *The result was disturbed by insects.*
- b) *The site was disturbed by aeroplane noise.*
- c) *The site was disturbed by an adjacent construction site.*
- d) *The site was disturbed by helicopters, ships and insects.*
- e) *The site was disturbed by helicopters and ships.*
- f) *The result was collected with no ship berthing at the pier*
- g) *The result was collected with a ship berthing at the pier.*
- h) *The site was disturbed by helicopters, ships and heavy vehicles.*

Cheung Chau

- 7.13 The western side of the island is subject to ferry noise, unloading operations and noise from other human activity at Cheung Chau Wan. However, noise impact from these sources will be limited in the vicinity of the proposed transfer facility site which is over 1 km distant from the settlement. There are a limited number of three-wheeled diesel vehicles transporting soils/building materials around the island which represent the only form of transport noise.
- 7.14 Field measurements were taken at the facade of a residential dwelling located 120 m from the proposed site boundary. The L_{eq} (30 min) noise level of 77.3 dB(A)

exceeded ANLs for NSRs both for construction and fixed source operational noise due to the presence of Cicadas. Likely species generating the noise include the Large Brown Cicada (*Cryptotympana mimica*) or the Red-nosed Cicada (*Scieroptera sanguinea*) which sing from May to end of July and June to September respectively.

- 7.15 Noise data available for the Cheung Chau is restricted to that from measurements taken on the east side of the island (Ref 7.6) which in contrast to the western side is much quieter and less developed than the western side. The noise survey was carried out at Tung Wang Beach over a 24 hour period in October and December 1991, on a typical weekday. The results are given in Table 7.5.

Table 7.5 - Background Noise Levels - Cheung Chau Eastern Side (L₉₀ dB(A)) (Ref 7.6).

Monitoring Locations	L ₉₀ dB(A)		
	Day 0700 - 1900 hrs	Evening 1900 - 2300 hrs	Night 2300 - 0700 hrs
Tung Wan Beach - North	56.4 - 63.3	56.5 - 57.0	55.3 - 58.2
Tung Wan Beach - South	48.5 - 55.1	46.5 - 49.2	44.3 - 47.2

- 7.16 Background noise levels are typical of a rural locality with minimum noise disturbance and are considered representative of the area surrounding the proposed transfer facility site in the absence of summer Cicada activity and are the more appropriate data to use for design/assessment purposes.

Peng Chau

- 7.17 The concentration of existing shops and people around the ferry pier are the main contributors to the background noise levels. Possible future development along the marine frontage to the south east of the proposed transfer facility site can be expected to increase ambient noise levels in the area. Traffic noise is restricted to service and emergency vehicles only. The eastern side of the island is remote from the ferry pier and less populated, and is significantly quieter than the western side.
- 7.18 Field measurements were taken at the facade of a residential dwelling located 500 m from the proposed site boundary. The site was disturbed by aeroplane noise, which can be considered as part of the background noise for the duration of use of Kai Tak Airport. Leq (30 min) measurements marginally exceed the 60 dB(A) standard for construction and fixed source operational noise. The L₉₀ (30 min) noise level of 52.3 dB(A) is representative of the general background noise level in the area.
- 7.19 Other noise data are available for Peng Chau was taken from monitoring conducted at two locations, one site in direct line of view to the harbour/breakwater to the north of the island and a more southerly site where there was a direct line of site to the typhoon shelter. The noise survey was carried out over a 24 hour period in

November 1991, on a typical weekday (Ref 7.6). The results are given in Table 7.6.

Table 7.6 Background Noise Levels - Cheung Chau Eastern Side (L₉₀ dB(A)).

Monitoring Locations	L ₉₀ dB(A)		
	Day 0700 - 1900 Hrs	Evening 1900 - 2300 Hrs	Night 2300 - 0700 Hrs
Peng Chau North	50.1 - 54.9	48.2 - 52.8	42.8 - 49.0
Peng Chau South	52.3 - 56.7	46.3 - 52.3	43.1 - 50.8

7.20 Noise levels are typical of a semi-rural locality and are not expected to be exceeded in the vicinity of the proposed transfer facility site.

Mui Wo

7.21 Existing noise sources are limited to activity around the ferry pier at Mui Wo and the adjacent developments including the sewage treatment plant and bus depot.

7.22 Field measurements were taken at the facade of an isolated residential dwelling located 310 m away from the proposed site boundary. The noise environment was disturbed by passing helicopters, ships and heavy goods vehicles using the existing road access and are considered to be representative of normal conditions. L_{eq} (30 min) measurements were just below the 60 dB(A) standard for construction and fixed source operational noise. The L₉₀ (30 min) noise level of 53.3 dB(A) is representative of background noise in the area.

7.23 Noise data from a previous study is available for a monitoring location at Silvermine Beach, on the opposite side of Silvermine Bay to the proposed site at a distance of approximately 1 km away (Ref 7.6). The noise survey was carried out over a 24 hour period in December 1991, on a typical weekday. Results are given in Table 7.7.

7.24 The beach and seafront are popular with visitors and are a holiday recreation area. As such, noise levels at Silvermine Beach are expected to be similar or slightly higher than those prevailing in the vicinity of the proposed transfer facility site.

Table 7.7 Background Noise Levels - Silvermine Bay, Lantau (L₉₀ dB(A)).

Monitoring Locations	L ₉₀ dB(A)		
	Day 0700 - 1900 hrs	Evening 1900 - 2300 hrs	Night 2300 - 0700 hrs
Silvermine Beach	58.2 - 61.5	61.6 - 63.5	58.2 - 63.4

Discovery Bay

- 7.25 Noise sources in the area include vessel and vehicle movements from the port-side service area for Discovery Bay, including an liquid petroleum gas (LPG) storage depot, godowns and a vehicular ferry for service vehicles. Other impacts can be expected to be intermittent and due to aircraft, buses and ferry movements. Background noise is likely to increase when construction work for the Lantau Port project commences, once reclamation starts south east of Penny's Bay headland (Ref 7.7).
- 7.26 Field measurements were taken at the ground-level facade of the high rise residential block "Jovial Court" located 40 m from the proposed site boundary. The noise environment was disturbed by construction activity from an adjacent site. On the basis of the survey, L_{eq} (30 min) measurements of 60.3 dB(A) indicate that noise levels for construction are only marginally exceeded and the L₉₀ (30 min) level of 50.8 dB(A) is representative of the prevailing background noise level in the area.
- 7.27 Previous monitoring data is available for two monitoring sites at Discovery Bay (Ref 7.6):
- A three storey house balcony situated east of the proposed transfer facility site on Headland Drive, where no significant noise sources are located;
 - A four storey block south of the proposed site on the opposite side of the bay, where background noise is affected by ferries.
- 7.28 The noise survey was carried out over a 24 hour period in November 1991, on a typical weekday. Results are given in Table 7.8.
- 7.29 Noise levels recorded at the two monitoring locations are low, as may be expected in a low density residential area with no major traffic sources. They are considered representative of the area surrounding the proposed transfer facility site.

Table 7.8 - Background Noise Levels - Discovery Bay (L₉₀ dB(A)).

Monitoring Locations	L ₉₀ dB(A)		
	Day 0700 - 1900 hrs	Evening 1900 - 2300 hrs	Night 2300 - 0700 hrs
Discovery Bay - North	45.0 - 49.8	45.5 - 46.7	39.8 - 44.8
Discovery Bay - South	50.4 - 58.0	47.5 - 51.1	35.2 - 48.0

Hei Ling Chau

- 7.30 Background noise levels are already low although they are increased intermittently by noise from aircraft, ferries and isolated vehicles movements.
- 7.31 Field measurements were taken at the facade of the accommodation block located 60 m away from the proposed site boundary. It was not possible to take measurements at the proposed time of waste transfer vessel arrival at the transfer facility due to limitations of public transport to the site. Two sets of measurements were taken at the NSR, with and without a berthing of a supplies vessel to the Penal Institution on the island. Leq (30 min) noise levels were slightly increased in the presence of the vessel (55.1 dB(A) compared to 53.4 dB(A)), but in either case did not exceed ANLs for construction or fixed source operational noise. The L₉₀ (30 min) measurements of 49.3 and 50.8 dB(A) are indicative of background noise levels in the area.
- 7.32 Previous noise monitoring data are available for two sites on the island at residential blocks to the north and south east of the proposed transfer facility site (Ref 7.6). The noise survey was carried out over a 24 hour period in November 1991, on a typical weekday. Results are given in Table 7.9.

Table 7.9 Background Noise Levels - Hei Ling Chau (L₉₀ dB (A)).

Monitoring Locations	L ₉₀ dB (A)		
	Day 0700 - 1900 Hrs	Evening 1900 - 2300 Hrs	Night 2300 - 0700 Hrs
Hei Ling Chau - North	46.2 - 49.3	44.9 - 45.9	42.3 - 45.7
Hei Ling Chau - South	48.8 - 53.3	47.4 - 48.8	43.1 - 47.2

- 7.33 Noise levels are low and typical of a semi-rural locality with no dominating noise sources and are considered representative of the area surrounding the proposed site.

Yung Shue Wan

- 7.34 The existing noise environment is dominated by human activity associated with the shops and residences of the village. Intermittent noise impacts are a result of the ferry operations and marine traffic serving the island community. The only significant source of industrial noise in the area is the power station where there are noise contributions from coal unloading, mobile plant movement, construction activities and shipping. However, background noise levels have been consistently reduced over the last decade and are now typically in the range of 42-47 dB(A) (L₉₀ (30 min)) in the vicinity of the station (Ref 7.8) due to a decline in construction activity. There are no significant sources of traffic noise on the island.
- 7.35 Field measurements were taken at the facade of a residential dwelling located adjacent to an existing children's playground 90 m away from the boundary of the proposed facility. The noise environment was disturbed by aircraft but is considered representative of normal conditions for the duration of use of Kai Tak airport. L_{eq} (30 min) noise level of 57.2 dB(A) was below standards for construction and fixed source operational noise. The L₉₀ (30 min) noise level of 53.8 dB(A) is representative of background noise levels in the area.
- 7.36 Noise data from previous monitoring studies in the area are available for two sites (Ref 7.6). The northern site was a residential dwelling overlooking the ferry pier; the southern site was also at a residential dwelling located at Hung Si Ye Beach, south of the power station. The noise survey was carried out over a 24 hour period in November-December 1991, on a typical weekday. Results are given in Table 7.10.

Table 7.10 Background Noise Levels - Yung Shue Wan (L₉₀dB(A)).

Location	Day 0700 -1900 hrs	Evening 1900 - 2300 hrs	Night 2300 - 0700 hrs
Yung Shue Wan	55.0 - 58.4	54.7 - 55.1	53.3 - 57.4
Hung Sing Ye Beach	41.8 - 50.0	39.5 - 41.9	37.3 - 42.4

- 7.37 Noise measurements for these monitoring locations are consistent with field measurements obtained under this study. They are considered representative of levels in the vicinity of the proposed transfer facility.

Sok Kwu Wan

- 7.38 Field measurements were taken at the facade of an isolated residential dwelling located 170 m away from the proposed site boundary and 80 m away from the alternative site boundary. The noise environment was disturbed by Cicadas, where the L_{eq} (30 min) noise level of 61.0 dB(A) exceeded construction and fixed source

operational noise standards only marginally. The L₉₀ (30 min) noise level of 53.3 dB(A) is representative of prevailing background noise in the area.

- 7.39 The usual dominant noise source in the area is Lamma Quarry. The quarry has been operating for in excess of 10 years and currently operates a number of processes that generate noise including drills, crushers, graders. A possible extension to the quarry with the formation of a casting basin and associated increase in the number of concrete mixing trucks and power generators can be expected to increase the background noise level in the future (Ref 7.9). Crushers are the predominant noise source, where vehicles are not normally audible on opposite side of Picnic Bay while crushers are in operation. Vehicle reversing alarms may, however, be audible above noise generated from crushers.
- 7.40 The impact of quarry noise on Sok Kwu Wan, and the smaller settlement of Lo So Shing (which includes a school), is dependent on the prevailing wave action and meteorological conditions. Intermittent noise impacts are associated with visitor arrival on the ferry to use the local restaurants.
- 7.41 A noise survey was conducted in January 1993 (Ref 7.9) at sensitive receivers located at Sok Kwu Wan and Lo So Shing over a 24 hr sample period during typical weather conditions i.e. fine weather and a slight breeze. Measurements at Sok Kwu Wan indicated the lowest noise level was approximately 50 dB (A). During quarry operation hours the noise level was 52 to 60 dB(A). Noise generation was also associated with activity from the restaurants and the Fish Culture Zone (FCZ). Noise from the quarry operation was found not to influence the L₉₀ dB(A) noise level at Lo So Shing (measured at 48 dB(A)), where other noise sources were predominant. In no circumstance was operational noise more than 5 dB(A) above the background noise level.

Construction Impacts

- 7.42 Construction noise impacts will depend on whether reclamation works are required, the scale and duration of development, the prevailing noise environment, the proximity of sensitive receptors and the type of plant used on site. Although there is no noise limit specified in the NCO or guidelines in the HKPSG, it is recommended that a limit of 70 dB LAeq (1 hour) at the facade of an NSR should be adopted. A construction noise permit will be required if construction work takes place outside the hours of 0700 to 1900 (Monday to Saturday) and if any percussive piling work is required.
- 7.43 Noise predictions at NSRs have been calculated using methodology given in "Technical Memorandum on Noise from Construction Work other than Percussive Piling" (Ref 7.2). Estimates of types and numbers of construction plant used at each of the transfer facility sites, together with corresponding power levels are given in Table 7.11. Predicted noise levels at the facade of NSRs arising from construction plant noise are given in Table 7.12.

Table 7.11 - Construction Plant and Sound Power Levels

Plant	Sound Power Level dB(A)	Percentage use	Residual level dB(A)	Number of items of Plant	Combined Power Level dB(A)
Excavator /loader	112	50	109	1 (1)	109 (109)
Air compressor	109	100	109	1 (1)	109 (109)
Concrete lorry mixer	109	50	106	1 (2)	106 (109)
Crane	112	50	109	1 (1)	109 (109)
Poker vibrator	113	25	107	1 (1)	107 (107)
Lorry	112	50	109	2 (3)	112 (114)
Roller (vibratory)	112	50	109	1 (1)	109 (109)
Winch	95	25	89	1 (1)	89 (89)
Bulldozer	115	50	112	1 (1)	112 (112)
				Total	118.6 (119.3)

Note:

1. Figures in brackets refer to Discovery Bay.

- 7.44 Noise calculations indicate that at Discovery Bay noise levels at NSRs exceed the recommended target of 70 dB(A), even with the provision of screening which can be expected to provide up to a 10dB (A) attenuation. To achieve the target it will be necessary to adopt further mitigation measures to avoid unacceptable noise impacts at this site sites. Guidance on noise control is provided in the Practical Guide for the Reduction of Noise from Construction Works, produced by EPD (Ref 7.10). A number of measures are available for controlling noise generation and preventing levels exceeding 70 dB(A) at NSRs. These include the specification of quiet construction plant and scheduling of work.
- 7.45 Predicted noise levels do not include noise generated from dredging activity required at Yung Shue Wan, Sok Kwu Wan , Discovery Bay and Hei Ling Chau. However, it is considered that noise levels from land-based construction activity will be the dominant source of noise and that noise generated from marine activities will not significantly contribute to the total noise level.
- 7.46 Where road access development or widening is required, namely at Cheung Chau, Hei Ling Chau, Yung Shue Wan and Sok Kwu Wan further mitigation may be required to protect NSRs located along the route from construction impacts.

Table 7.12 - Calculated Noise Levels from Construction Plant at NSRs

Transfer Facility Site	Distance from NSR (metres)*	Calculated noise level - no mitigation	Calculated noise level - with mitigation (Screening)
Cheung Chau	120	71	61
Peng Chau	390	61	51
Mui Wo	305	63	53
Discovery Bay	40	81	71
Hei Ling Chau	60	77	67
Yung Shue Wan	90	75	65
Sok Kwu Wan	160	70	60

* All NSRs are residential with the exception of Yung Shue Wan which is a clinic.

Operational Impacts

- 7.47 The operational noise of the transfer facilities should not result in noise levels at NSRs at least 5 dB(A) below the ANL given in Table 6.3 or no higher than the background noise level if this is not less than 5 dB(A) below the ANL.
- 7.48 Calculations of operational noise levels were conducted using similar methodology to those for construction, as above. Power levels of different plant are given in Table 7.13 and predicted noise levels at NSRs for each of the facility sites in Table 7.14.

Table 7.13 - Operational Plant and Sound Power Levels

Plant	Sound Power Level dB(A)
Compactor	85
Handler & Accessories	85
Container Handler Units	90
Exhaust Fan	112
Marine Vessel Crane	112

- 7.49 Noise predictions indicate that operational noise, not accounting for noise from crane operations on the marine vessel, will not be significant at any of the sites, where predicted levels at NSRs are less than measured ambient background levels (Table 7.14). The possible exception is at Discovery Bay, where noise levels are more than 5 dB(A) less than the standard requirement for day and evening periods

of operation (i.e. 60 dB(A)), but slightly higher than the background noise level of 50.8 dB(A) (measured as L₉₀ (30 min)). However, it is considered that with further insulation of operational plant, compliance with relevant standards and guidelines can be achieved at the sensitive facade of "Jovial Court" at Discovery Bay. At Cheung Chau, the planned residential development at Tai Kwai Wan Bay, at a distance of 170 m from the RTF is not expected to receive unacceptable noise impacts on the basis of noise level estimates based on an NSR at 120 m distance, as given in this Chapter.

Table 7.14 - Calculated Noise Levels from Operational Plant at NSRs

Site	Plant Requirement*	Total Sound Power Level dB(A)	Reduction due to Enclosure dB(A)	Distance to NSR (metres) **	Noise-Distance Correction dB(A)**	Resultant Noise Level dB(A)**
Cheung Chau	3 x (1) 1 x (2)	91 (112)	15	120 (165)	51 (49)	28 (66)
Peng Chau	2 x (1) 1x (1)	90 (112)	15	390 (430)	61 (58)	17 (57)
Mui Wo	2 x (1) 2 x (2) 2 x (3)	115 (112)	15	305 (340)	58 (55)	45 (60)
Discovery Bay	1 x (1) 1 x (2) 1 x (4)	90 (112)	25	40 (90)	41 (44)	52 (71)
Hei Ling Chau	0	- (112)	0	60 (90)	- (44)	- (71)
Yung Shue Wan	2 x (1) 2 x (2)	91 (112)	15	90 (120)	47 (47)	32 (68)
Sok Kwu Wan	0	- (112)	0	160 (180)	- (49)	- (66)

Notes:

- * Construction plant type is referred to in brackets, where (1) is compactors, (2) is handlers & accessories, (3) is container handling units and (4) is exhaust fans. All sites will be subject to crane noise from the marine transfer vessel during refuse loading operations.
- ** Figures in brackets are inclusive of noise levels from the marine vessel crane and include a 10dB(A) reduction due to site screening.
- Resultant noise levels include an additional 3 dB(A) for building reflection correction.

7.50 When taking into account the operational noise from the marine vessel crane, the noise levels at NSRs are significantly elevated at all sites and are generally above background noise levels. This is due to the proximity of the crane to NSRs and the need for the operation to be outside, where only a deduction of 10 dB(A) has been

given for noise attenuation from site screening. In practice, further mitigation can be provided by the design of purpose built screening around the cranes as necessary to mitigate noise generation from the marine transfer vessel. As the crane is not a fixed noise source and the period of operation is limited to a short time period, it is considered that the noise impact will be within acceptable levels.

7.51 In addition to operational plant, noise will be generated from various other sources on site including:

- Movement of lightweight waste delivery vehicles at all sites with the exception of Mui Wo which will include motorised RCV movements.
- Vehicle/container and site cleansing activities;
- Movement of waste hoppers;
- Movement of containers; and
- Vehicle audible alarms.

7.52 Apart from vehicle movements, the noise impact from other operational sources are expected to be intermittent and only of marginal significance. Equipment and operational procedures should be adopted to minimise noise from shock and jolt noise from container movement, particularly empty containers. Mobile plant used on site should have audible reversing alarms set at a loudness and tone that is not intrusive at NSRs. This is particularly applicable at the Discovery Bay and Yung Shue Wan sites.

7.53 Restriction of operating and loading hours at Yung Shue Wan and Discovery Bay (Ref 7.11) will limit the duration of operational noise impacts at adjacent residential properties. Restrictions imposed on facility operation at Hei Ling Chau, for security reasons, will have a similar effect for accommodation blocks and staff quarters located nearby.

7.54 Noise impacts at NSRs have been predicted using methodology in the British Standard 5228:1984, as follows:

$$LA_{eq} = LWA - 33 + 10\log_{10}Q - 10\log_{10}V - 10\log_{10}d$$

Where

- Lwa is the sound power level of the vehicle (dB(A))
- Q is the number of vehicle movements per hour
- V is the average speed (kph) and
- d is the distance to NSRs

7.55 Motorised vehicle types include RCVs with a 4 tonne payload and carts of 0.2 tonne payload; average vehicle speed on site has been assumed to be 10 kph and 5 kph respectively; and sound power levels have been assumed as 122 dB(A) and 110 dB(A) respectively.

7.56 Estimated vehicle types and movements, together with predicted noise levels at NSRs for each of the transfer facility sites are given in Table 7.15.

7.57 Noise calculations indicate that noise from on-site traffic will not result in significant impacts at any of the sites, where all calculated levels are greater than 5 dB(A) less than the measured ambient levels given in Table 7.4. The exceptions to this are Discovery Bay and Hei Ling Chau where the proximity of the NSRs results in noise levels similar to ambient conditions. However, noise levels presented in Table 7.15 do not account for the presence of site screening, which is estimated to provide at least a 5 dB(A) attenuation. Noise levels are also indicative of peak delivery rates and are therefore expected to occur for only short time periods

during the daily operation of the facilities. Overall therefore, noise impacts from on-site traffic movements on site at each of the transfer facilities is considered to be acceptable.

- 7.58 It is recommended that the tenderer specify sound power levels of refuse vehicles that are proposed and provide evidence that their use will not result in unacceptable impacts either from use onsite or in the site vicinity. Further assessment will be required to determine whether mitigation measures are sufficient, or if further measures, such as further screening or porous road surfacing are necessary.

Table 7.15 - Calculated Noise Levels from Operational Traffic at NSRs

Site	Vehicle Type	Vehicle Movements per hour*	Distance from NSR (metres)**	Calculated Noise Level dB(A)***
Cheung Chau	RCV	8	140	50
Peng Chau	Cart	20	430	35
Mui Wo	RCV	4	325	43
Discovery Bay	RCV	4	45	52
Hei Ling Chau	RCV	4	68	50
Yung Shue Wan	RCV	4	90	47
Sok Kwu Wan	RCV	4	160	33

Notes

1. * Vehicle Flow rates are based on information given in Table 9.2 and represent peak flow of vehicles, assumed at twice average flow rate over the operational period.
2. ** Distances to NSRs are based on estimates from a point within the site boundary.
3. *** Noise levels include a correction for an angle of view of 20o (minus 9.5 dB(A)) and for facade reflection (plus 3dB(A))

Joint User Development

- 7.59 The potential use of the sites for storage of construction materials poses no restrictions for joint usage in terms of noise impact. Noise generation from such a storage facility will be intermittent and considering the large displacement at most of the sites from NSRs operational noise is not considered to be a significant constraint.

Further Assessment

- 7.60 Tenderers should be required to provide sound power levels of construction and operational equipment specified and be able to demonstrate that their use will not result in unacceptable noise impacts at NSRs. Particular consideration is required with respect to refuse vehicles to ensure that unacceptable noise impacts associated

with their passage to and from the proposed sites, and their movements on site do not result in excessive noise impact at NSRs.

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- 7.3 Environmental Protection Department. Technical Memorandum on Noise from Construction Work other than Percussive Piling. January 1989.
- 7.4 Environmental Protection Department. Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites. July 1991.
- 7.5 Environmental Protection Department. Consultancy Study for Outlying Islands Refuse Transfer Facilities. Working Paper No. 5, Access Land and Marine Transport, and Berthing Facilities. March 1993.
- 7.6 Civil Engineering Department, Port Development Office. Lantau Port & Western Harbour Development Studies. Data Report, Environmental Surveys. October 1992.
- 7.7 Hong Kong Resort Company Limited. Discovery Bay Masterplan Review: A support community for PADS. Environmental Review. August 1992.
- 7.8 The Hong Kong Electric Company Limited. Environmental Impact Assessment of Units L7 and L8 Lamma Power Station. Final Initial Assessment Report. May 1992.
- 7.9 Lamma Quarry, Casting Basin & Moderayte Quarry Extension, Environmental Impact Assessment. June 1993.
- 7.10 Environmental Protection Department. A Practical guide for the Reduction of Noise from Construction Works. July 1990.
- 7.11 Environmental Protection Department. Consultancy Study for Outlying Islands Refuse Transfer Facilities. Working Paper 8, Outline Design. June 1993.

8. LANDSCAPE, VISUAL AND LAND USE IMPACTS

Introduction

- 8.1 This chapter assesses the landscape, visual and land use impacts of the proposed refuse transfer facilities in relation to their proposed locations.
- 8.2 The existing landscape and visual context of each site is outlined in order to establish baseline conditions against which the impacts of the transfer facility developments can be assessed. The general design features of the facilities are described to determine the nature of their development. Design features are based on the Outline Design (Ref 8.1) and described in more detail in Chapter 3 of this report.
- 8.3 Based on this, landscape and visual impacts are examined. Joint user developments, involving the storage of building materials, are being considered for the larger Refuse Transfer Facilities. This would not have a significant, additional impact and is therefore not considered further in this chapter.
- 8.4 Conclusions and recommendations propose landscape and visual mitigation measures. Areas for further assessment are identified.

Environmental standards and Legislation

- 8.5 At present, there is no legislation governing the landscape or visual impact of development. EPD have published an advice note that offers guidelines on the environmental impact process for major private sector projects. This recognises visual impact as an issue of concern. The Government White Paper on "Pollution in Hong Kong - A Time to Act" offers overall policy objectives that are applicable to landscape and visual impacts as well as more specific environmental issues. This states that new environmental problems should be avoided by considering the impacts of development in site selection, planning and design. In addition, opportunities for environmental improvement should be seized.
- 8.6 The approach adopted in this report is to examine the existing context of the proposed Refuse Transfer Facility sites and identify sensitive receivers. Landscape and visual impacts of the facility's development are assessed and mitigation methods proposed in order to minimise adverse impacts.

Assessment Methodology

- 8.7 Landscape and visual assessment are inter-related, however, for the purpose of this assessment they are, as far as possible, considered separately. In addition, both types of assessment are based on subjective judgements. For this report, these assessments are based on professional experience, using the following criteria:
- 8.8 Landscape assessment is based on the physical components of the landscape such as topography, vegetation and buildings. The sensitivity of the landscape is based on its degree of naturalness.
- 8.9 In summary, landscape assessment is based on an evaluation of:
- Character and quality of the existing landscape (influenced by the degree of naturalness),

- Nature of the impacts to the natural landscape, either:
 - positive* due to the inclusion of natural landscape features or
 - negative* due to the imposition of built structures,
 - Ability of the landscape to accommodate change.
- 8.10 Visual assessment is based on identification of key viewpoints (receptors) to the development. The viewpoints are considered to have varying degrees of sensitivity; views from residential areas and schools, for example, are highly sensitive. Views from commercial developments and public open spaces are considered to be moderately sensitive. Industrial and transport corridor viewpoints are considered to have low sensitivity. The sensitivity of these views to new development is assessed.
- 8.11 In summary, visual assessment is based on evaluation of:
- Existing visual quality (influenced by the degree of man-made development),
 - Visual sensitivity of the area (influenced by the distance between the sensitive receptor and the development as well as the land use at the view point),
 - Nature and extent of change caused by the development to the existing visual quality,
 - Alternative views from the sensitive view points i.e. the relative significance of the development within the viewshed.

Landscape and Visual Context

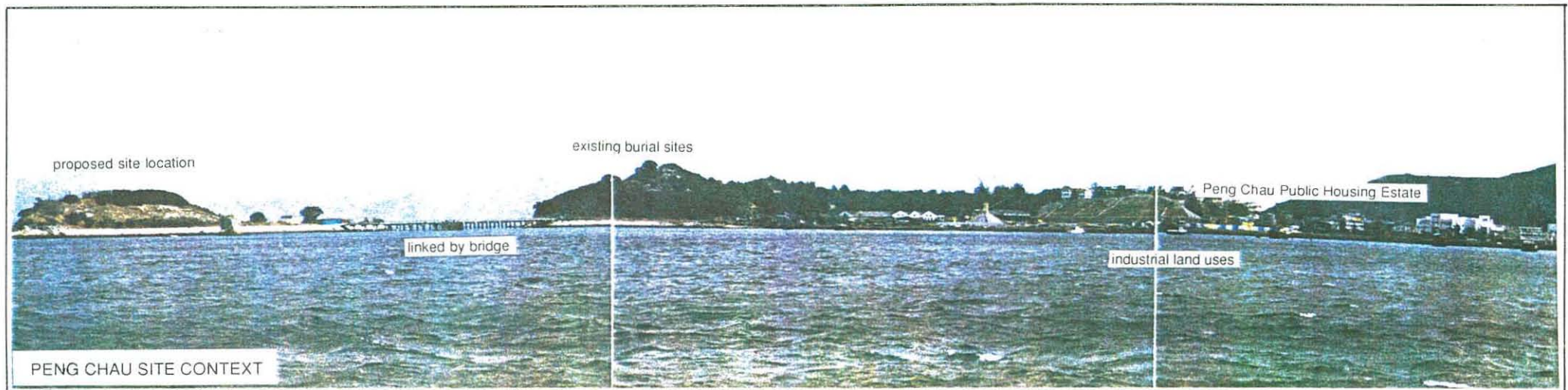
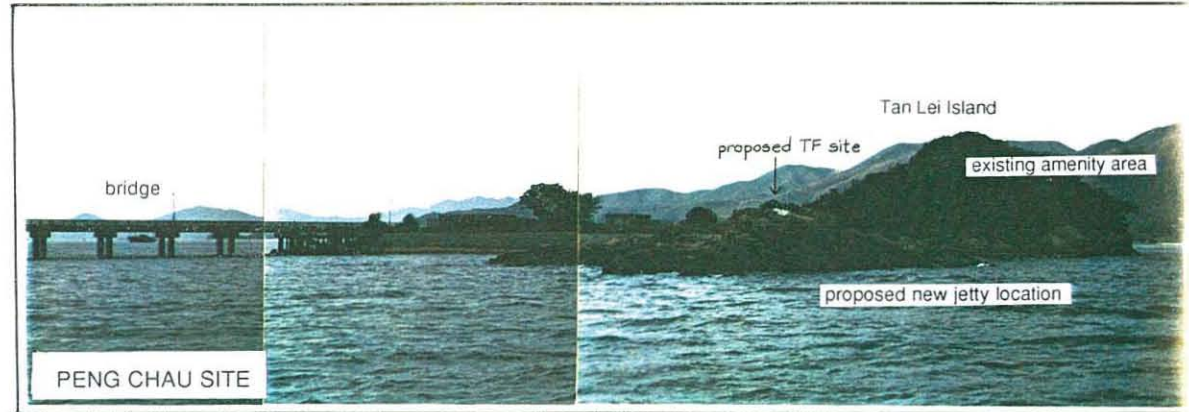
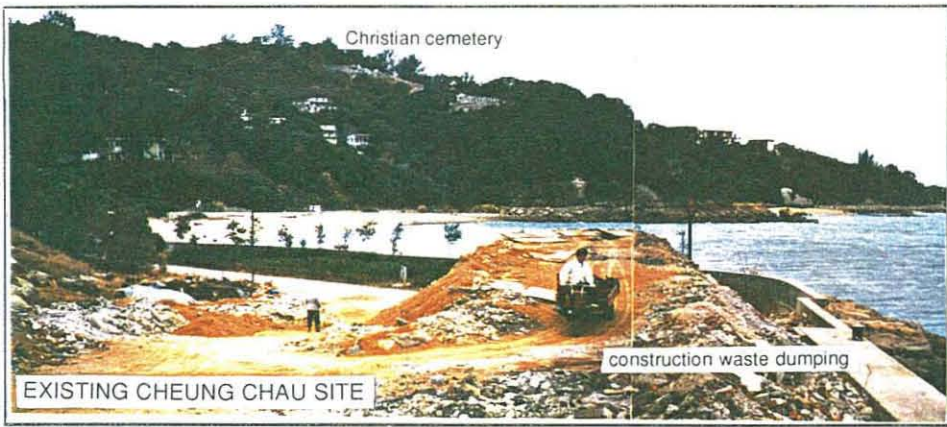
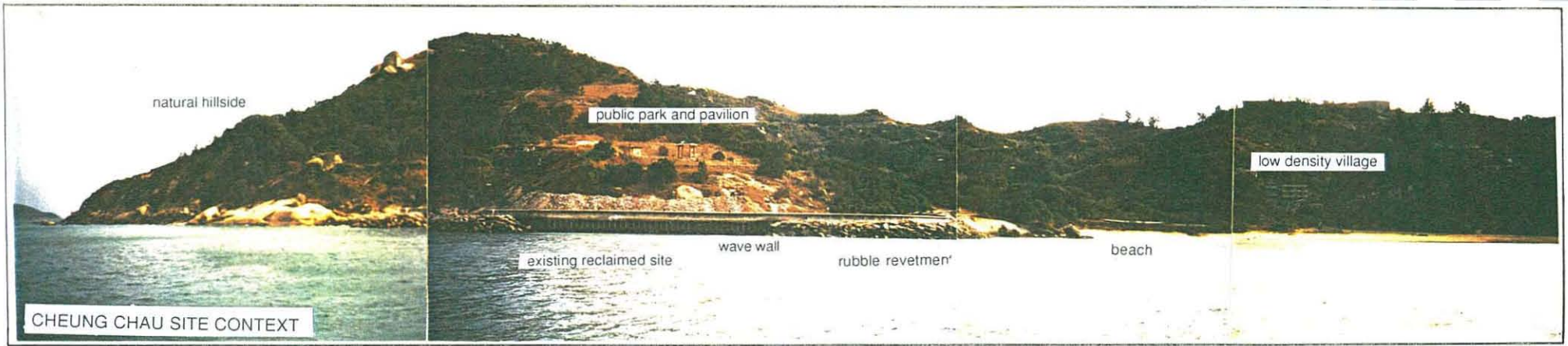
- 8.12 The Refuse Transfer Facility sites and their settings are described in Chapter 2 of this Report. In this chapter the existing landscape and visual context of the sites is described. Views of the proposed sites are shown in Plates 8.1 to 8.3.

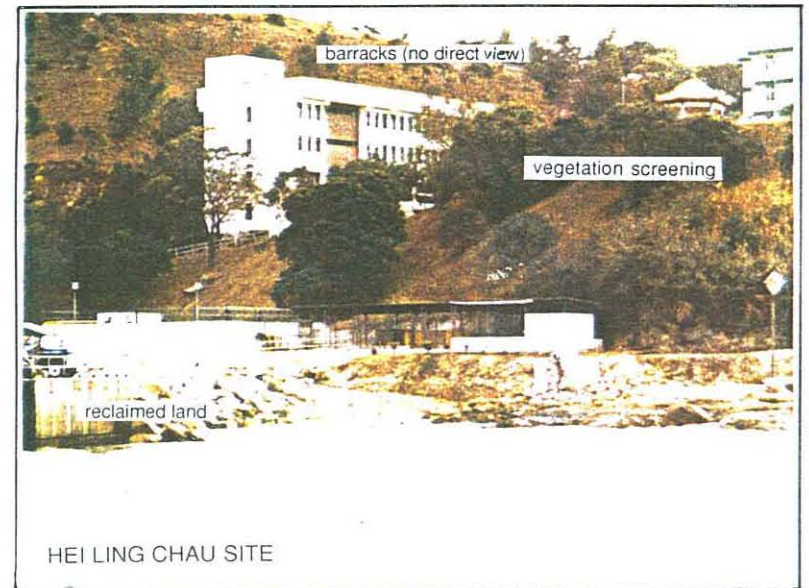
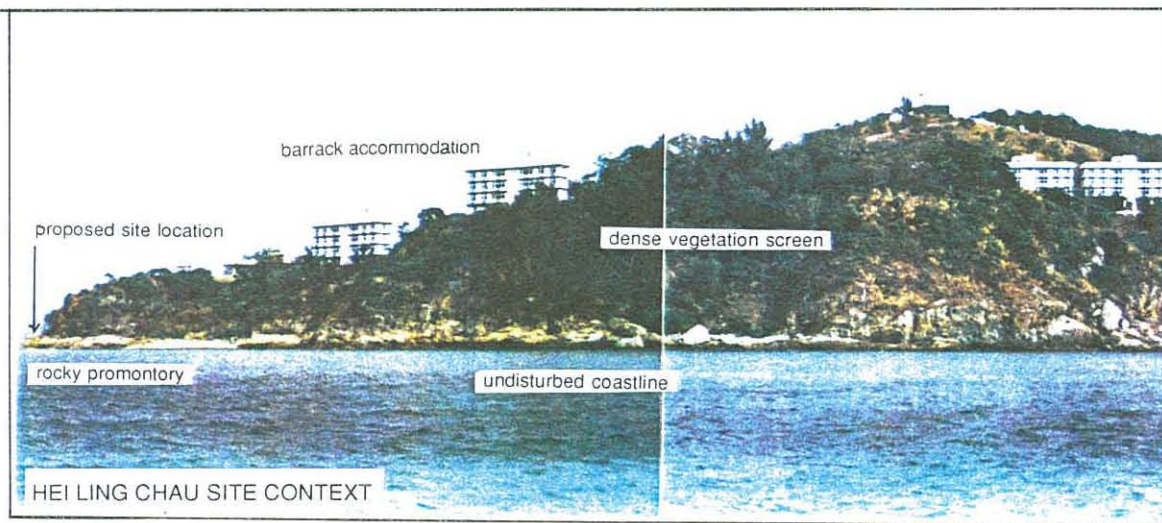
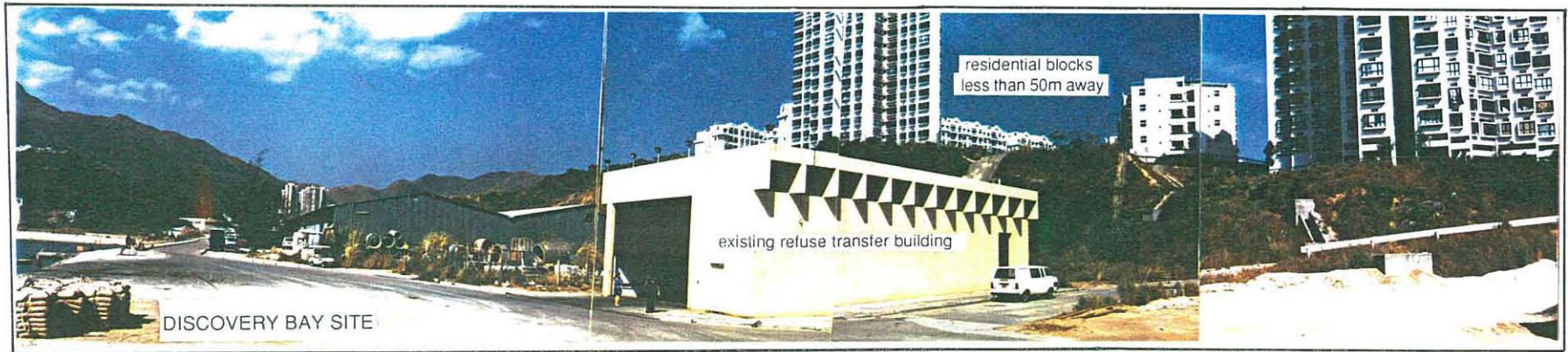
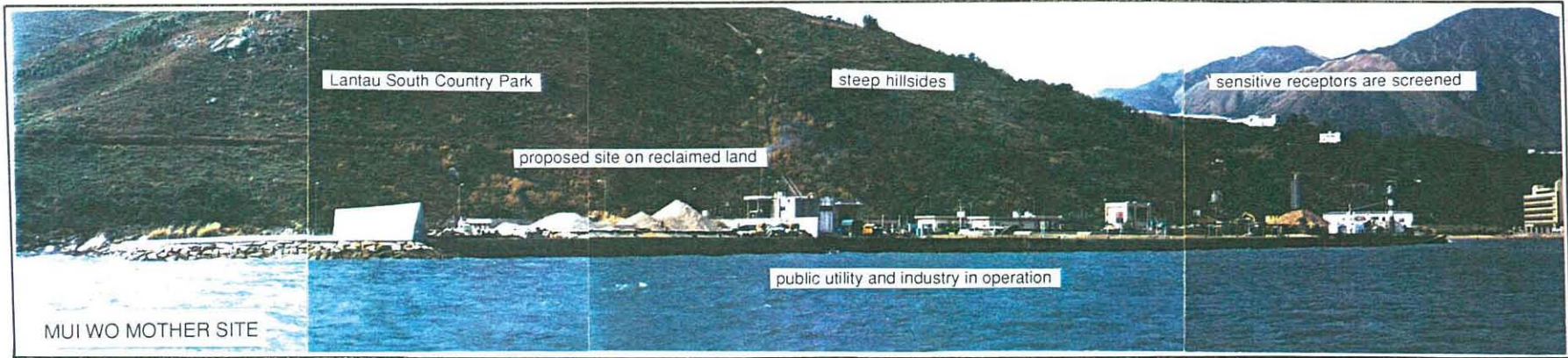
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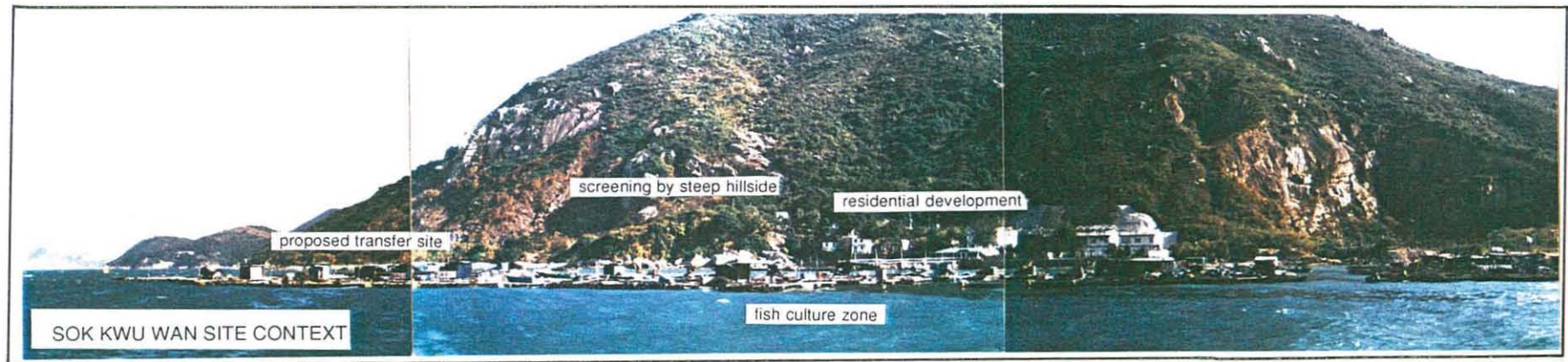
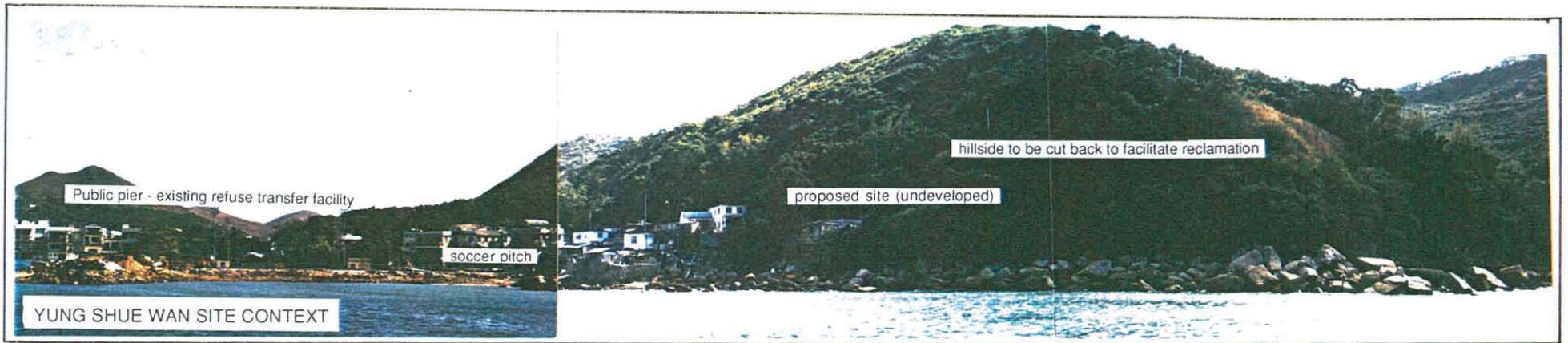
- 8.13 Due to the nature of the proposed refuse transfer operations, each site occupies an accessible and prominent waterfront location. All are highly visible from seaward. By operational necessity, the facilities are to be developed on flat land, adjacent or accessible to the waterfront.
- 8.14 In all cases except Peng Chau, the sites are set against a hillside backdrop. Where access to these hillsides is possible, the sites are highly visible from these higher levels.
- 8.15 Four of the proposed transfer facility sites are existing sites, currently in use, or planned to be used, for refuse transfer facilities. Three sites are to be developed on new land, reclaimed from the sea on previously undisturbed foreshore.
- 8.16 The specific context of each site is considered below:

Cheung Chau

- 8.17 The Cheung Chau site is located on an existing reclaimed promontory at the base of a steeply sloping, natural hillside. The reclamation is contained by a rubble wall. A rocky shoreline adjoins to the north, with a sandy beach in Tai Kwai Wan to the south. This reclaimed platform forms an unnatural landscape element along this shoreline.







- 8.18 Overall, the existing landscape quality of the site is medium to low.
- 8.19 The site is visible, at more than 250 metres distance from the main ferry route into Cheung Chau Harbour. It is, however, dominated by its natural backdrop.
- 8.20 The site is directly overlooked by a small public park (Local Open Space) with a Chinese-style pavilion, providing panoramic seaviews. The park is considered to be a moderately sensitive viewpoint.
- 8.21 The site is also visible across the bay from Tai Kwai Wan San Tsuen, a small, low density village with about 30 dwellings. The sensitivity of this residential viewpoint is reduced by its distance of 350 metres from the site. While the site occupies a prominent location on a headland, the site has relatively low significance within the viewshed which is dominated by an expansive seaview.
- 8.22 From the Cheung Chau Christian Cemetery, 400 metres away, the site will also be visible. This would not be considered a sensitive viewpoint due to distance and the low number of people visiting this area.
- 8.23 Currently, the Cheung Chau site is operated as a "tolerated" dump for construction waste. The stockpile of rubble and other construction waste has a low visual quality.

Peng Chau

- 8.24 Located on Tai Lei island off the west coast of Peng Chau, the site is physically isolated from the main island; connected only by a narrow bridge. The island is currently developed for public utility uses. This has involved cutting the natural landform to create a flat platform. The existing landscape quality is low to medium. The natural ridgeline has, however, been retained and creates a screen from Lantau (Discovery Bay) to the north as well as a natural backdrop to the proposed site.
- 8.25 The proposed Refuse Transfer Facility is located at the bottom of this ridgeline, behind a proposed dangerous goods store which will assist in screening the site and the activities within.
- 8.26 The site is visible from the new Peng Chau Public Housing Estate and the existing village houses located on the ridge above this estate. From these residential areas, the site is more than 400 metres away with a predominant and uninterrupted seaview.
- 8.27 Closer to the site, the land uses are currently public utilities of low visual sensitivity. Obsolete industrial and boatyard area have been rezoned. It is proposed that this area and the reclaimed area to the west will become a possible Comprehensive Development Areas (CDAs), as in the Peng Chau North Layout Plan No. L/T-PCN/2. It is likely that development would be predominantly residential with one site within 100 metres of the proposed Refuse Transfer Facility. Most of the development sites are 300 metres or more away and with predominant seaviews.
- 8.28 A ridge line screens the view of the site from Tai Lung Tsuen village.
- 8.29 In response to the main island's topography, most of the burial sites on the nearby hillsides are orientated away from Tai Lei island. It is likely that new burial sites will be concentrated on the north and northwest facing slopes, visitors to which will have uninterrupted sea views.
- 8.30 In conclusion, Peng Chau is not a visually sensitive site.

Mui Wo (Silvermine Bay)

- 8.31 The proposed Refuse Transfer Facility site is located on flat, reclaimed land forming a continuation of the reclaimed waterfront to the northwest. It is located at the base of the steep, natural slopes of the Lantau South Country Park. This proposed site forms part of an area devoted to public utility and industrial uses and is, at present, dominated by a visually intrusive modular incinerator, which emits smoke contributing to the industrial appearance of the area. As the site is man-made and unnatural, within an industrial area, it has inherent low landscape quality. This is somewhat offset by the scale and dominance of its dramatic, natural setting.
- 8.32 The site is screened from the nearest sensitive receptors, the Round Table Village and Heung Yee Yuk Primary School, by the steep hillsides which form part of the Lantau South Country Park. These hillsides form a natural backdrop when viewed from the sea. Village houses dot the higher slopes but they are orientated in a northerly direction, towards Mui Wo.
- 8.33 The site is overlooked from the Country Park which creates a valuable and significant visual backdrop as well as a passive recreation area. Footpaths meander across the hillside, some of which form the final stages of the Lantau Trail.
- 8.34 The site is visible on the seaward side from the main ferry into Silvermine Bay.
- 8.35 Overall, this site has low visual sensitivity.

Discovery Bay

- 8.36 The site is located on existing reclamation, bisecting Nim Shue Wan bay. It forms a relatively small component of the larger, designated service area for the large and landscape dominating, Discovery Bay development. This service area is physically separated from the rest of the Discovery Bay community by steep, cut slopes which define and separate this area from the rest of the development.
- 8.37 The proposed site is already functioning as a Refuse Transfer Facility forming part of an area characterised by its industrial appearance. The waterfront is frequently utilised for the transportation of building materials. To the south and east of this area, the landscape is extremely and increasingly developed.
- 8.38 In contrast, the northern side of Nim Shue Wan bay remains relatively natural and unspoiled.
- 8.39 The Discovery Bay site, therefore, has low landscape quality.
- 8.40 The transfer facility site is overlooked by the north facing flats of the nearby residential towers, only 50 metres away. These are highly sensitive viewpoints. The towers are located on a platform, fifteen metres above the site, separated by steep slopes. These slopes and the covering vegetation offer some degree of screening from the lowest floors however, above this, views of the service area are more dominant. From the upper floors, views of the surrounding hillsides dominate.
- 8.41 The site is also visible across the bay, from Nim Shue Wan village, more than 350 metres away as well as the burial sites on the south facing hillsides which form the natural backdrop to Nim Shue Wan bay, approximately 300 metres from the site. The view from both these directions is, however, dominated by the high-rise, residential blocks and large waterfront godowns which are more visually dominant than the Refuse Transfer Facility site.

- 8.42 The site has high visual sensitivity due to its proximity to the residential towers although suitable mitigation measures should reduce this impact to an acceptable level.

Hei Ling Chau

- 8.43 At present, the proposed Refuse Transfer Station site is an undeveloped, rocky promontory which slopes steeply down to the sea. The landform of Hei Ling Chau island rises steeply up from this natural coastline. To the south, the coastline remains undisturbed while in the bay to the north, piers and jetties have been built to facilitate access to the institutions developed on the island. The island has low density development and remains predominantly undisturbed. Based on its naturalness, the Hei Ling Chau site has high landscape quality.

- 8.44 The Hei Ling Chau site will be highly visible from the sea. The site is screened from most of the low level development on the island but will be visible from the existing barrack accommodation and four-storey buildings located beyond the cliff face, less than 50 metres away. The site is therefore highly visually sensitive.

Yung Shue Wan

- 8.45 The transfer facility will be located on a strip of reclaimed land at the base of the existing rocky shoreline. This southern shore of the bay is currently the only undeveloped section of the coast in this area. The reclamation, formed to accommodate this and other public utility uses, will be undertaken as part of a separate contract. The impact of the reclamation will, therefore, not be fully evaluated in this report.

- 8.46 The reclaimed site is set against a steeply sloping natural hillside. The lower slopes will, however, be cut as part of the reclamation work. This vegetated landform physically defines the eastern side of the harbour.

- 8.47 At present, the site location has high landscape quality although once the shoreline is disturbed by the reclamation, the landscape quality will be reduced.

- 8.48 Currently, refuse transfer takes place from the highly visible public pier in the middle of the bay. The proposed site will be also visible to seaward and across the harbour. The site is elevated just above sea level and set against the visual backdrop of a 50 metre high hill which will dominate these more distant views together with the chimneys of the Lamma Power Station. The site will be visible from the footpath leading to the top of the hill.

- 8.49 The proposed site may be obliquely visible from the nearby Village Development Area and childrens' play ground. The reclamation will result in the cutting back of the hillside which currently screens this location. Depending on the size of structures associated with the adjacent developments on the new reclamation, the site will be visible from the soccer pitch which is just over 100 metres away.

- 8.50 The existing squatter houses which occupy the slopes directly overlooking the future site, are to be relocated.

- 8.51 The Yung Shue Wan site has medium visual sensitivity.

Sok Kwu Wan

- 8.52 The proposed and alternative sites for the Sok Kwu Wan transfer facility are located at either end of a small, natural bay with a narrow beach. To the west, this bay is separated from Ta Shui Wan and a small reclaimed platform with houses, by a low rocky headland. To the east, a small construction materials jetty and access path has been constructed. The shoreline in this area is predominantly undeveloped. The steep sided natural slopes, forming the backdrop to the site, are the dominant landform. These hillsides are, nevertheless, disturbed by quarrying operations in this area. The disturbed landform of Lamma Quarry dominates.
- 8.53 This site currently has high landscape quality.
- 8.54 The Sok Kwu Wan sites are set against the visual backdrop of a steep hillside, rising to more than 200 metres, which dominates the view from across the bay. Sok Kwu Wan bay is however dominated by the scar of Lamma Quarry.
- 8.55 The site is visually isolated from the main village and the topography screens the beach from the few houses on the fringes of the community, 200 metres from the site. The site will be highly visible from the footpath leading to Mo Tat Wan village which is regularly used by hikers and residents.
- 8.56 Since the majority of the sensitive viewpoints are some distance away, the visual sensitivity of the proposed and alternative sites are medium to low.

Design Features

- 8.57 The design features of the Refuse Transfer Facilities are based on the Operational Plans in the Outline Design (WP8), and are described in Chapter 3 of this Report.
- 8.58 For operational necessity, all the transfer facilities will occupy flat sites with waterfront locations. Clear access will be necessary for marine berthing and loading.
- 8.59 Wastes will be delivered to the facilities and stored in covered containers. Their size will vary according to their content:
- | | |
|---------------------|-------------------|
| Domestic containers | 6.0 x 2.5 x 2.5 m |
| Construction waste | 6.0 x 2.5 x 1.5 m |
| Sewage sludge | 3.0 x 2.5 x 2.5 m |
- 8.60 The containers will be stored close to the seawall to be collected by a marine vessel and exchanged for empty containers. These containers, stored close to the visible sea frontage, will become a visually dominant feature of the transfer facilities.
- 8.61 As containers will be open during the filling operations, all the sites except Hei Ling Chau and Sok Kwu Wan will have buildings or rain canopies to protect waste handling equipment and operations. These structures would be single storey, with a minimum internal height clearance for plant operation of 4 to 6 metres. These light weight structures would be constructed from reinforced concrete or steel and clad with profiled steel or aluminium sheeting.
- 8.62 The storage of non-containerised wastes will be allowed in some of the facilities. This will be minimised and limited to bulky and construction wastes only.
- 8.63 All the sites, except Hei Ling Chau and Sok Kwu Wan require additional buildings and machinery. These are described on a site by site basis.

- 8.64 The Refuse Transfer Facilities will be surrounded preferably by a screening wall, 1.8 to 2.4 metres high. The sites and their access roads will be paved with concrete.
- 8.65 Refuse transfer will take place from 07.30 until, in most cases, 23.30. Operating hours are restricted at Discovery Bay and Lamma, where operations will cease at 19.00 and 20.00 respectively. Lighting of the sites will be provided and high pressure sodium (SON) has been proposed.

Landscape and Visual Impacts

- 8.66 General comments are made on the anticipated landscape and visual impacts of the transfer facility developments with specific comments for each site where necessary.
- 8.67 The significance of negative landscape and visual impacts will depend on the number of sensitive receivers affected and the sensitivity of the site to change.

General

- 8.68 At all the refuse transfer facilities, the containers stored along the waterfront will have a negative landscape and visual impact. Container storage will be a new feature within the rural, Outlying Islands landscape. Container storage is usually associated with undeveloped areas within the New Territories and generally has negative impact on landscape quality. Typically, containers, and all operational equipment associated with refuse transfer, are brightly coloured. While appropriate in busy and highly developed urban areas for safety reasons, these colours will make the containers particularly conspicuous in the, still relatively natural and undeveloped, context of the Outlying Islands. As proposed in the Outline Design, it is recommended that container colours will be selected to blend with the environment.
- 8.69 The large roofed areas, while minimising the visual impact of the operations within the facility, will have an inherent landscape and visual impact. The landscape impact will be relative to presence and scale of other developments within the site area. Visual impact will be relative to the visibility of the development from the surrounding sensitive viewpoints. As proposed in the Outline Design, it is recommended that the design of the structures will respond to their setting in order to be as unobtrusive as possible.
- 8.70 Where a site is currently undeveloped, the Refuse Transfer Facilities will have a visual impact at night from operational lighting. This impact will be reduced at Discovery Bay and on Lamma, due to restricted operating hours and presumably, restricted hours of lighting. This night time view will affect relatively few receivers in most cases. Such lighting will also have a negative impact on the landscape character, emphasising the change from natural to developed.
- 8.71 The sodium lighting proposed will contribute to these impacts. This type of light source renders a yellow glow which will be magnified by reflections in the water, and be visible from a considerable area. This light source characterises urban areas and is less appropriate on the Outlying Islands, which still remain relatively rural in character.

Cheung Chau

- 8.72 The development of this site as a refuse transfer facility will, to some extent, have a positive visual impact when compared with the sites current appearance as a construction waste dump. This will be especially significant when viewed from the public park, above. The introduction of large, roofed structures in an undeveloped

and predominantly natural setting will, however, have a negative impact on the landscape and visual quality of the area. Due to the sites prominence, the structures will be clearly visible from the sensitive viewpoints across the bay.

- 8.73 Widening of the access road to the facility, will create an unnatural cut edge to the existing path. The relatively minor widening will have a minimal impact on the character of the path.

Peng Chau

- 8.74 As this site is surrounded by similar public utility uses, the redevelopment will have a minimal landscape and visual impact. The new roofed structures will be visible from the sensitive viewpoints in the area however these will be viewed against the existing natural ridgeline forming the backdrop to the site.

- 8.75 The construction of the new jetty and the associated access road will have a significant negative impact on the natural landscape character of the north side of the island. The significance is, however, reduced by the low number of sensitive viewpoints in the area. The construction of the jetty will necessitate cutting back the existing ridgeline. This will also have a negative visual impact as this landform has an important role in visual mitigation of activities on Tai Lei island, both from Peng Chau and distant views from Discovery Bay.

Mui Wo

- 8.76 The redevelopment and extension of the existing site for the new refuse transfer facility, will include the demolition of the existing modular incinerator plant. Demolition of this industrial-looking structure, and the associated emissions, will be of benefit to the landscape and visual character of the area.

- 8.77 More and larger buildings are proposed, to be located within the site. If they are designed to blend into the surroundings, it is anticipated that their landscape and visual impact will be insignificant within this, already developed, setting.

- 8.78 The containers stored along the waterfront, will be the most dominant visual element within this facility. Stacked three high, in some cases, they will rise to 7.5 metres (higher than the buildings) and effectively create a "wall" along the waterfront. This large bank of containers will give a more industrial character to the area, and have a negative impact on the landscape character of the area. Due to their scale and mass, the containers will also have a significant, negative visual impact.

Discovery Bay

- 8.79 The landscape and visual impact of the existing service area is currently significant, especially from the nearby sensitive, residential viewpoints. The existing refuse transfer facility, while forming a relatively small component within this service area, is directly overlooked by the residential towers. The extended and redeveloped transfer facility, as well as the associated operations, will take place within a building. It is, therefore, considered that the new building will have a minimal additional visual impact.

- 8.80 The containers stored along the waterfront edge will create a new and different element within the landscape, lowering the overall landscape and visual quality of the area. As the service area already has an industrial-type quality, it is anticipated that the impact will be less significant than in a less developed setting.

Hei Ling Chau

- 8.81 Development of this facility and its access road, on a natural promontory of a relatively undeveloped island, will have a significant, negative impact on both the landscape and visual quality of the area. All previous development has been confined within the small bay to the north. The proposed transfer facility extends development outside this bay, onto a prominent, natural foreshore, creating an especially significant impact.

Yung Shue Wan

- 8.82 On a currently undeveloped shoreline, the development of the transfer facility will have a negative impact on the landscape quality of the area. However, when this is assessed in the context of the larger public utility development planned for the reclaimed shoreline, and as an extension of an already highly developed waterfront, the impact is less significant.
- 8.83 The proposed structures will be relatively large in relation to the scale of the built context. This will have a negative visual impact however this is reduced within the context of the development around the bay.
- 8.84 From the nearby sensitive viewpoints, the proposed transfer facility will be screened by buildings constructed on adjacent sites on the reclamation, closer to these viewpoints.
- 8.85 This report will not consider the landscape or visual impacts of the required reclamation work and it is anticipated that extending the line of reclamation by five metres will not have a significantly greater landscape or visual impact.

Sok Kwu Wan

- 8.86 Both the proposed and alternative transfer facility sites will have a negative landscape and visual impact. The significance of the visual, and to a less extent the landscape, impact is reduced due to the low number of sensitive viewpoints overlooking the site and the existing disturbance of the natural landscape in the surrounding area. Both proposed and alternative sites will effectively destroy the landscape character of the existing undisturbed bay.
- 8.87 The alternative site, fits better into the exiting landform and therefore its landscape and visual impacts are reduced. The small rocky headland to the west will assist in screening this site from the sensitive viewpoints west of the headland. As an extension of the headland, the reclamation could create a more natural landform.

Land Use Impacts

- 8.88 Land use impacts in the context of this report refer to the transfer facility interface with adjacent and surrounding land uses. Although the design and operation of RTS's conform to strict environmental standards, it is nevertheless preferable to locate such uses away from non-compatible land uses (including residential areas, active recreational areas and areas of outstanding natural beauty) to minimise disturbance from traffic, noise and potential odour problems.
- 8.89 It is also advantageous to group together service and utility uses, (as well as possible light industrial activities and storage uses), on discrete sites away from residential and sensitive environmental areas. This is to avoid the spread of non-compatible uses and to control traffic generated by such uses. This is especially beneficial in the case of the smaller of the Outlying Islands where scenic and residential areas are

set in a confined area and where the dispersal of "bad neighbour", service and industrial uses would detract from both the urban and natural environment.

- 8.90 This section therefore assesses land use interface issues for each of the proposed sites.

Cheung Chau

- 8.91 This site is isolated from sensitive receptors, with the main residential areas being located at Tai Kwai Wan San Tsuen, a small village some 300 metres to the south of the site. An isolated property and residential development area are located about 120 and 170 m away respectively (see Table 2.1). The surrounding area consists of the sea to the west and south and a cliff face to the north and east. As such there are no land use interface problems on the site and no significant impacts are envisaged.

Peng Chau

- 8.92 Being located on Tai Lei island, where several Government utility uses are accommodated, the proposed transfer facility poses little land use interface problems. The island itself is isolated from residential and other sensitive areas while existing and committed uses on Tai Lei island, including an electricity sub-station, sewage treatment plant, storage and industrial uses, are compatible with the use of a refuse transfer facility.

Mui Wo

- 8.93 The site at Mui Wo is similarly set amidst public utility and industrial uses at the western end of Mui Wo Ferry Pier Road. An existing sewage treatment works to the west and a works area and storage compound (operated by Highways NT Dpt) and maintenance works area (operated by DSD) to the east of the site are compatible uses. The sea to the north and steep slopes to the south similarly present no interface problems.

Discovery Bay

- 8.94 The transfer facility would be located on a site occupied by a temporary refuse collection centre and within a service area of about 5 ha (Area 10B). Other uses include a godown and LPG storage facility. Residential uses are partially shielded by steep slopes to the north of the site. Being within a service area, there are no planning interface problems associated with the site.

Hei Ling Chau

- 8.95 Located on a reclaimed site, isolated from other uses operated by CSD, and screened by a cliff face to the east, the site presents no land use interface problems. The proposed Typhoon Shelter at Hei ling Chau, planned under the Lantau Port and Western Harbour Development Studies, would not conflict with the proposed transfer facility.

Yung Shue Wan

- 8.96 The site is proposed as part of a wider service and industrial area including a sewage treatment works, dangerous goods store and building materials depot. It is part of a proposed reclamation which would form a strip of land south of the ferry pier of Yung Shue Wan. As such the transfer facility would be compatible to adjacent uses, while the harbour to the north and hillslopes to the south, mostly uninhabited and

zoned as a Countryside Conservation Area should ensure that the site is isolated from sensitive receptors.

Sok Kwu Wan

- 8.97 Two possible sites are proposed for this facility. The first site considered is located on a presently undeveloped foreshore between Sok Kwu Wan and Mo Tat Wan on the southern shoreline of Sok Kwu Wan Bay. Although located some 500m and 900m from the villages of Sok Kwu Wan and Mo Tat Wan respectively, this site is in close proximity to a Fish Culture Zone (lying some 40m offshore).
- 8.98 Accordingly an alternative site, also on reclamation, is proposed on a sheltered embankment further west, closer to Sok Kwu Wan. This development does present some interface issues.
- 8.99 Firstly, although still isolated from the present built-up envelope of Sok Kwu Wan, the proposed site would be adjacent to a Village Development Area (VDA) immediately to the west, designated under the Lamma Island Outline Development Plan. Although there is no programme for the preparation of the Sok Kwu Wan Layout Plan in the short term, it is recommended that any planning of the VDA should include a suitable buffer distance between the transfer facility and proposed village houses. This buffer area could be taken up by landscaping and/or utility uses such as an electricity sub station. Other surrounding areas to the south, zoned as a Countryside Conversation Area (CCA) do not present interface problems.
- 8.100 Secondly the access to the proposed transfer (to both possible locations) would require widening of the existing access track from 2 to 4 metres. This would moreover depart from the present alignment of the track, and encroach within the VDA. As such the future layout of the village would have to reflect this road alignment.
- 8.101 Conclusions and recommendations from the assessment are given in Chapter 12.

Areas for Further Assessment

- 8.102 The successful tenderer should undertake a detailed landscape and visual assessment as part of the EIA, once the operational and detailed design is finalised. Particular attention should be given to areas where the detailed design varies from the proposed Outline Design. The mitigation recommendations should be incorporated into the final scheme.
- 8.103 This report has highlighted the importance of the colour of the containers, buildings and operating plant in the landscape. As part of the detailed design and EIA, a colour assessment of the existing sites should be undertaken and the findings incorporated into the design.

References

- 8.1 Environment Protection Department. Outlying Islands Refuse Transfer Facilities Consultancy Study. Working Paper No. 8 "Outline Design". June 1993.

9. TRAFFIC & MARINE TRANSPORTATION IMPACT

Introduction

- 9.1 This Chapter provides an initial assessment and evaluation of the traffic impacts associated with the construction and operation of the refuse transfer facility sites, and the marine transportation of waste from the facilities to the WENT Landfill. Mitigation measures and requirements to reduce impacts to acceptable levels have been identified, and responsibilities of the contractor which should be specified in the Outlying Island Transfer Facilities (OITF) tender documents are outlined.

Environmental Objectives, Standards and Guidelines

- 9.2 The major objective is to avoid undue traffic congestion and risk to safety. Other related impacts concern excessive dust and poor water quality during construction and exhaust fumes and noise during operation, which have been dealt with in previous sections.
- 9.3 Road access design is governed by the requirements of the Transport Planning Design Manual and other Government department requirements. The engineering works required to achieve the necessary standards for road access have been presented in WP No. 8 "Outline Design" (Ref 9.1). In order to present realistic evidence on traffic congestion, it has been necessary to make assumptions on the type of collection vehicles that will be used by Regional Services Department for domestic/commercial waste deliveries and by private collectors for construction waste deliveries.
- 9.4 For road traffic capacities, it is assumed that; at Cheung Chau, the existing 4.0 m wide Cheung Kwai Road will be widened to 4.5 m; at Peng Chau, the existing 2.0 m wide footpath will be upgraded to a minimum of 4.5 m wide emergency vehicular access road as shown on Layout Plan No. L/I - PCN/2; and at Sok Kwu Wan, the existing 2.0 m wide footpath will be upgraded to a 3.5 m - 4.5 m wide single track access road.
- 9.5 Transport, Fire Services, and Marine Departments have provided comments on WP No. 5 "Access, Land and Marine Transport, and Berthing Facilities" (Ref 9.2) which elaborated more on particular requirements and guidelines for access to and from the sites. These are considered in this Chapter.
- 9.6 In recent years much work has been carried out with regard to the environmental impact of ports and shipping operations. Guidelines and reference material have been prepared by the following organisations with specific reference to these topics:
- International Maritime Organisation;
 - International Chamber of Shipping;
 - Oil Companies International Marine Forum;
 - International Association of Ports at Harbours; and
 - The World Bank
- 9.7 Appendix 1 lists key International Maritime Organisation (IMO) conventions and codes relevant to the protection of the marine environment.

Impacts of Construction Traffic

- 9.8 The main construction activities required for development of the sites as refuse transfer facilities are shown in Table 9.1.

Table 9.1 - Construction Activities and Duration for the Transfer Facility Sites

Site	Main activities	Estimated duration (months)
Cheung Chau	- Removal of rubble-mound spur (2,000 m ³)	2
	- Strengthening works (tie anchors)	1
	- Buildings construction (19 m x 23 m and 14 m x 30 m)	5
	- Roadworks @ site entrance	1
	- Pavement slab (70 m x 30 m) = 2,100 m ³	3
	- Cheung Kwai Road widening (700 m x 0.5 m)	6
Peng Chau	- Jetty construction	
	• decking (80 m x 8 m)	4
	• piling	2
	- Building construction (14 m x 47 m)	6
	- Pavement slab (57 m x 30 m) = 1,700 m ²	2
-Emergency vehicular access road construction (150 m x 4.5 m)	6	
Mui Wo	- Seawall strengthening	2
	- Buildings construction (18 m x 24m), (24 m x 8 m), (18 m x 12 m)	9
	- Roadworks @ site entrance	1
	- Pavement slab (100 m x 50 m) = 5,000 m ²	4
Discovery Bay	- Demolition	1
	- Building construction (33 m x 32 m)	6
	- Dredging* (350 x 50 x 0.2 m) + (350 x 40 x 1.2 m) = 20,300 m ³	2
	- Traffic control system	1

Table 9.1 - Contn.

Site	Main activities	Estimated duration (months)
Hei Ling Chau	- Reclamation** (40 m x 25 m x 5 m) + (40 m x 10 m x 5 m) = 7,000 m ³ and seawall (40 m)	4
	- Road access (50 m)	2
	- Relocation of CSD service building (4 m x 3 m)	3
	- Pavement slab (40 m x 25 m) = 1,000 m ³	1
Yung Shue Wan	- Dredging**(*) (90 m x 150 m x 1.5 m) = 20,000 m ³	2
	- Reclamation**(*) (25 x 60 m x 5 m) = 7,500 m ³ and seawall (80 m)	5
	- Buildings construction (10 m x 20 m), (15 m x 18 m)	4
	- Pavement slab (60 m x 20 m) = 1,200 m ²	1
	- Access road construction (200 m)	6
	- Traffic control system	1
Sok Kwu Wan	- Dredging** (90 m x 200 m x 2 m) = 36,000 m ³	3
	- Reclamation** (40 m x 30 m + 40 m x 10 m) x 5 m = 8,000 m ² and seawall (40 m)	6
	- Road access (50 m)	2
	- Pavement slab (40 m x 25 m) = 1,000 m ²	1
	- Single track access road construction (*) (500 m x 4.0 m average)	6

Notes:

- * for large dumb-lighter access
- ** by barge with grab
- (*) constructed by others

9.9 In addition to impacts associated with land-based traffic there will be potential marine construction impacts on air, noise and water quality. These issues have been addressed in the appropriate Chapters of this report.

9.10 The potential impacts of land-based construction traffic and appropriate mitigation measures are described below.

Cheung Chau

9.11 The majority of the work will be carried out on site and as the site has marine frontage, deliver and removal of plant and materials should be by sea. The road widening work is a result of the Fire Services Department requirement for a 4.5 m wide emergency vehicular access from the fire station to the site. The viability and implementation of carrying out his work are matters which are considered to be the responsibility of a Government works agency and outside the scope of this project.

9.12 Nevertheless, it would be preferable that any work carried out on the Cheung Kwai Road was complete before commissioning of the refuse transfer facility, which is currently programmed for 1 January 1996.

Peng Chau

9.13 Again the transportation of plant and materials should be specified to be by sea to avoid using the footpath through a small village area just before the Tai Lei link bridge.

Mui Wo

9.14 The roadworks required to create a new entrance and the traffic of construction plant and materials should not effect any users of the 6.0 m wide Ferry Pier Road and therefore should be permitted.

Discovery Bay

9.15 The dredging required to allow large dumb-lighter access to the quayside serving the site is work that must be carried out with the consent of Hong Kong Resort Company (HKRC). Although the impact of a dredging vessel on the minimal amount of marine traffic using the Area 10B quayside is small, agreement must be reached on any working limits to be imposed on the successful tenderer if he is to carry out the work. It is more likely that construction materials and plant would be transported by barge in the absence of suitable sources from within or adjacent to Discovery Bay.

Hei Ling Chau

9.16 Correctional Services Department (CSD) have provided outline details to allow requirements to be specified in the OITF tender documents for the construction and operation of the facility. It is anticipated that limited use of the new cargo handling pier would be required by the OITF contractor and this should be subject to agreement by the contractor and CSD.

Yung Shue Wan

9.17 The majority of construction traffic impact will be related to the dredging and reclamation works required for the site formation as shown on Layout Plan No. LI-YSW/D and is outside the scope of this project.

Sok Kwu Wan

- 9.18 The marine construction traffic impacts on the Fish Culture Zones (FCZ) can be partly mitigated by the development of the alternative site as it is 80 m away from the FCZ compared 45 m for the original site,. Construction method controls and monitoring programmes should be used, as discussed in Chapters 6 and 11 respectively.

Impacts of Operational Traffic

Waste Delivery

- 9.19 The waste arisings projections presented in Working Paper No. 4 are given in Table 9.2 and have been used to estimate the traffic flows for waste deliveries to the refuse transfer facilities as shown in Table 9.3. By inspection, the road capacities are sufficient given the provisions in Section 9.4. These works should be carried out by the appropriate Government works agency.

Table 9.2: Phased Increase in Waste Throughput (tonnes per day)

Site	1996			2001			2006			2011		
	D/C	Con	Tot-al	D/C	Con	Tot-al	D/C	Con	Tot-al	D/C	Con	Tot-al
Cheung Chau	66	44	110	74	49	123	88	59	147	113	75	188
Peng Chau	15	10	25	17	28	45	21	14	35	25	17	42
Mui Wo	33	22	55	43	29	72	52	35	87	65	43	108
Discovery Bay	33	22	55	49	33	82	59	39	98	70	47	117
Hei Ling Chau	5	3	8	6	4	10	7	5	12	8	5	13
Yung Shue Wan	15	10	25	56	33	89	68	45	113	81	54	135
Sok Kwu Wan	2	1	3	2	1	3	3	2	5	3	2	5

Notes:

1. *D/C means domestic and commercial waste.*
2. *Con. means construction waste., which is assumed to constitute 40 % of total waste arisings*

- 9.20 Table 9.3 shows that there is nearly as much private vehicular traffic delivering waste to the refuse transfer facilities as there is for Regional Services Department (RSD) deliveries. It is not possible to predict the likely traffic flow patterns within any given day, but as it is likely that there may be peak flows for vehicles during the day a possible measure to reduce the impact of congestion and queuing would be to regulate the times when privately-delivered construction waste is accepted.

Table 9.3: Phased Increase in Vehicle Deliveries Per Day at Transfer Facility Sites

Site	1996			2001			2006			2011		
	D/C	Con	Total	D/C	Con	Total	D/C	Con	Total	D/C	Con	Total
Cheung Chau	17	15	32	19	16	35	22	20	42	29	25	54
Peng Chau	75	20	95	5	7	12	6	5	11	9	6	15
Mui Wo	9	8	17	11	10	21	13	12	25	17	15	32
Discovery Bay	9	8	17	-	-	-	-	-	-	-	-	-
Hei Ling Chau	2	1	3	2	1	3	2	2	4	2	2	4
Yung Shue Wan	4	4	8	14	11	25	17	15	32	18	15	33
Sok Kwu Wan	10	5	15	10	4	14	15	10	25	10	4	14

Notes:

1. Assumed that refuse collection vehicles for commercial & domestic waste for all sites except Peng Chau initially and Sok Kwu Wan have payloads of 4 tonnes.
2. Assumed that Peng Chau initially and Sok Kwu Wan are served by motorised carts for domestic & commercial waste with 0.2t payload.
3. Assumed that private deliveries of construction waste for all sites except Peng Chau initially and Sok Kwu Wan have payloads of 3 tonnes.
4. Assumed that private deliveries of construction waste for Peng Chau initially and Sok Kwu Wan have payloads of 0.5 tonne.
5. Assumed that existing footpath at Peng Chau will be upgraded to an emergency vehicular road by 2001.
6. Assumed that Discovery Bay waste is handled at YI Pak and disposed of at North Lantau Transfer Station from 2001.

9.21 Government policy for disposal of construction waste and the impacts on the OITF contract were described in WP No. 8 "Outline Design" (Sections 3.18 to 3.31) (Ref 9.1). It was suggested therein that controls could be imposed to regulate volumes and similar controls could regulate the timing of deliveries, either as specified in the OITF contract or via the Buildings Ordinance Office approval system or both.

9.22 Transport Department have advised that a "Closed Road Permit" may be required for use of the roads on the Outlying Islands. The OITF contractor should not require regular use of the islands' road network but, nevertheless, will be advised of this requirements in the tender documents.

- 9.23 Traffic light control systems are needed at the Discover Bay and Yung Shue Wan site entrances on account of the close proximity of refuse transfer operational areas to access roads which are used by others. Future discussions with HKRC will address this matter, and Territory Development Department should be requested to provide EPD with an engineering layout plan of the transfer facility site and access arrangements for their comment at the appropriate time.

Marine Transport

- 9.24 Environmental impacts associated with the transfer of waste to the marine transfer vessel with respect to noise, water and air quality have been addressed under the appropriate Chapters of this report.
- 9.25 With respect to the operation and maintenance of the waste transfer vessels, a source of potential pollution is the discharge of contaminated ballast from bilges, liquid and solid wastes, or waste oils and greases. This can be avoided by equipping vessels with dedicated ballast tanks and by providing facilities for their collection and safe disposal.
- 9.26 The potential problems of cargo spillage will be avoided as a result of the use of sealed containers, thereby avoiding the loss of liquids or solids into the vessel bilges or to sea during loading, transportation in unloading. Containers should be appropriately designed to contain waste in the event of loss at sea.
- 9.27 Disturbances brought about by propeller scour or ship waste will not have significant physical effects on adjacent waterfront areas at any of the sites. Concern has been expressed by EPD with regard to the potential effects of ship waste or propeller disturbance on the inshore fish culture zones at Sok Kwu Wan and an alternative site has been examined. It is considered unlikely that any additional impacts will result from waste transfer vessel operations in addition to those currently arising from existing ferry movements adjacent to the FCZs.
- 9.28 Navigation issues and the safety of maritime operations have been discussed in WP No. 5 " Access, Land and Marine Transport, and Berthing Facilities" (Ref 9.2) of the study. The recommendations contained within these reports reflect the specifications of the marine transfer vessels required for the transportation of wastes from the facilities and their operating characteristics. Particular attention has been given to the safety and reliability of vessel transits around Ma Wan and across the East Lamma Channel Traffic Separation Scheme.
- 9.29 In order to ensure proper implementation of the project it will be necessary to include vessel operational requirements in the performance specification for the system and to include appropriate aids to navigation at the berms and maneuvering areas. These aspects will apply at all sites.

WENT Landfill Berthing Facility

- 9.30 The berthing area at the WENT Landfill site will be capable of accommodating barges and will provide storage and unloading facilities for containerised waste transported from Mui Wo RTF, as well as transfer stations located in the urban of Hong Kong.
- 9.31 It is recommended that the allocated area for the receipt of containerised waste from Mui Wo RTF is paved and provided with a suitable surface water drainage system to segregate clean and contaminated waters.
- 9.32 NSRs in the vicinity of the WENT berthing facility are fewer and more distant than at the RTF sites and therefore, noise should be sufficiently attenuated. However, consideration will be required in the detailed EIA of the cumulative impacts

arising from the operation of all of the berthing facilities at the WENT Landfill site. Restrictions on working hours may be required to ensure compliance with relevant noise standards and guidelines.

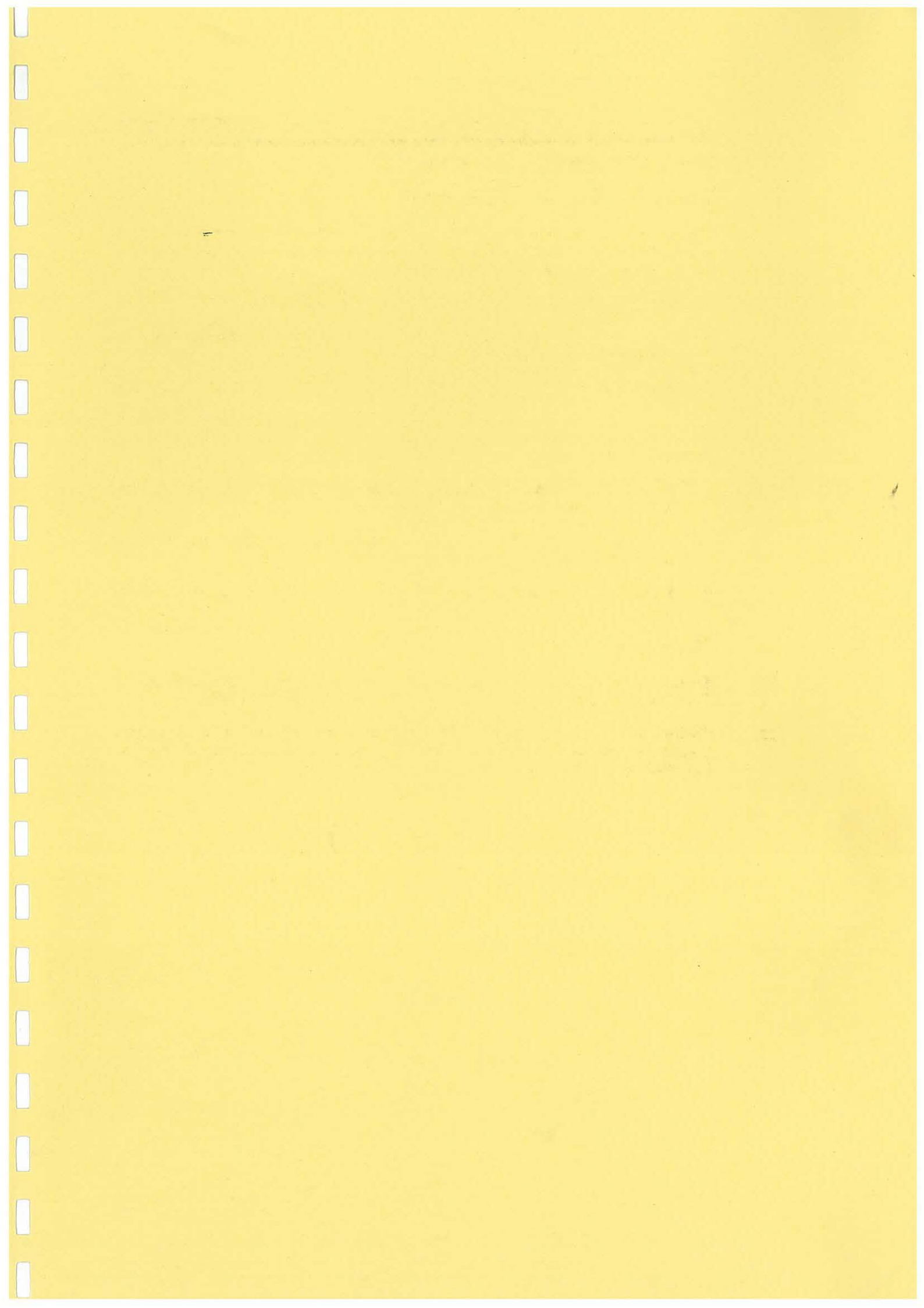
Areas for Further Assessment

9.33 = The following actions are required to facilitate dealing with the mitigation of possible traffic impacts during the OITF contract and may require further assessment by the successful tenderer:

- Cheung Kwai Road widening by Government works agency;
- Peng Chau footpath upgrade to emergency vehicular access road by the Government works agency;
- Government to agree on appropriate approach for handling Discovery Bay waste;
- Consultants to discuss Discover Bay requirements with HKRC to provide appropriate specifications in OITF tender document;
- Territory Development Department to liaise with EPD in developing the Yung Shue Wan access road design adjacent to the site; and
- Government to consider implementing a mechanism for regulating construction waste deliveries at OITF sites.
- Consideration of cumulative impacts associated with the operation of WENT Landfill.

References

- 9.1 Environmental Protection Department. Outlying Islands Refuse Transfer Facilities Consultancy Study. Working Paper No. 8 - Outline Design. June 1993.
- 9.2 Environmental Protection Department. Outlying Islands Refuse Transfer Facilities Consultancy Study. Working Paper No. 5 - Access, Land and Marine Transport, and Berthing Facilities. March 1993.



10. BIRD, RODENT AND INSECT CONTROL

Bird Control

- 10.1 Refuse is often attractive to birds which if allowed to gather in large number can become a source of nuisance. With the exception of Discovery Bay which will be fully enclosed, the operational areas of the remaining refuse transfer facilities are either open (as at Sok Kwu Wan and Hei Ling Chau) or semi-enclosed (i.e. Cheung Chau, Peng Chau, Mui Wo and Yuen Shu Wan). It therefore not possible to totally restrict access by birds. Nevertheless, where structures are proposed, certain design measures can be effectively incorporated into the design of the transfer facilities to discourage bird from feeding and nesting at the sites. These measures include the use of corrugated roofing, smooth rounded corners on buildings or coverings, and the use of rainwater guttering protected with 45° inclined plates. These features have been incorporated into the Kowloon Bay and Island East Transfer Stations and can readily be applied to the smaller scale structures proposed for the Outlying Island transfer facility sites. In the use of the Discovery Bay transfer facility it is also recommended that all ventilation inlets and outlets should be covered with 5 mm mesh to prevent bird access.
- 10.2 The presence of staff on the sites and the constant movement of plant will prevent significant gatherings of birds at the transfer facilities. It is also unlikely that the marine loading berths will offer any significant attraction.
- 10.3 In addition to the above design features, the following operational controls procedures should be adopted to prevent excessive bird attraction to the sites:
- maintenance of a clean, odour free site;
 - prevention of refuse accumulation or littering;
 - effective spillage containment and clean up procedures;
 - regular cleaning of all contaminated surfaces;
 - regular cleaning of all waste delivery vehicles and on-site plant; and
 - regular inspection of the site for nests,

Rodent Control

- 10.4 Refuse odour will attract rodents which may cause a nuisance or hazard. At the Discovery Bay site where the operation will be entirely enclosed, the building should be designed to be rodent-proof as far as possible. Measures that could be adopted include the sealing of spaces around pipes and the use of 20 mm mesh on vents.
- 10.5 For semi-enclosed sites and open sites the total exclusion of rodents will be more difficult to achieve. However, the adoption of operational procedures listed in Section 10.3 above will reduce the attractiveness of sites to rodents.
- 10.6 Rodent control can be effectively carried out at all sites using approved poison and traps by suitably trained personnel. Inspection of the buildings and removal of rodent carcasses should be conducted on a regular basis.

Insect Control

- 10.7 The small scale of the operation and throughput of waste at the majority of the transfer facilities will result in the minimum exposure of refuse, thereby limiting potential insect infestation. Odour mitigation measures, as described in Chapter 5, will also effectively limit the attractiveness of the sites to insects.
- 10.8 The design of the sites and adoption of suitable operational procedures will avoid the presence of standing pools of water which are attractive to mosquitoes, and all leachate arisings will be collected and contained prior to disposal. Insecticide spraying is likely to be required to control cockroaches and this should be carried out by suitably trained personnel outside normal operating hours. During the spraying, full protective clothing should be worn by the operator, and site personnel should be prohibited to enter the site for a minimum residual period. The contractor should use fast acting insecticides of low toxicity to human beings. Spraying should be conducted in a manner so as not to contaminate any clean surface drainage on site or adjacent watercourses.

11. ENVIRONMENTAL PERFORMANCE, MONITORING AND AUDIT

Monitoring and Audit Requirements

- 11.1 The contractor for the Outlying Islands Transfer Facilities (OITF) should be responsible for monitoring the environmental performance of the construction and operation of the facilities. The contractor should also be responsible for further collection of baseline monitoring data, as detailed in this Chapter.
- 11.2 Auditing of monitoring results will be required to ensure that the construction and operation of the facilities are compliant with environmental standards and guidelines, and performance criteria specified in this chapter. The roles of monitoring and auditing are distinct, and responsibilities are therefore clearly established in this Chapter.
- 11.3 The environmental monitoring programme should have the following characteristics:
- (i) It must provide continuity of environmental management throughout the baseline, construction and operational monitoring phases of the developments.
 - (ii) It should provide high quality information which can be utilised via a feedback loop to assess compliance with legislative standards, appropriate guidelines and performance criteria.
- 11.4 In addition to the environmental monitoring role, which should be the responsibility of the site contractor, there is a need for an independent audit of the contractor environmental performance. The key requirements of the auditing role are as follows:
- (i) It should be independent of the site contractor.
 - (ii) It should provide regular and independent reports on the standard of performance of the transfer facility contractor, and forward these to the contractor as well as to EPD.
 - (iii) The cost of the auditing role should be met by the site contractor on terms established by Government and set out in the tender document.
- 11.5 The tender document for the design, construction and operation of the facilities should include a specification and programme for the environmental monitoring and audit role. Details of monitoring regimes and monitoring and audit responsibilities should be set out in a site operations manual prepared by the contractor.
- 11.6 The role of the independent auditor should be as follows:
- (i) To establish the degree of compliance of each facility with legislative standards, appropriate guidelines and environmental performance criteria.
 - (ii) To review changes in measured parameters to detect any deterioration in environmental conditions associated with the construction and operation of the facilities.
 - (iii) To review management practices critical to the environmental integrity of the site.
 - (iv) To recommend improvements to the management practices and specify mitigation measures to reduce adverse environmental impacts to acceptable levels.
 - (v) To conduct review meetings with the site contractor and EPD representatives to consider environmental performance and to provide feedback into the facilities' environmental performance.

- 11.7 Audits should be conducted on a regular and frequent basis during site construction by an independent consultant. This will be particularly important at Sok Kwu Wan in relation to water quality monitoring conducted in the vicinity of the FCZ during construction, and at Discovery Bay and Yung Shue Wan due to their proximity to residential properties. Audits should be conducted six months and one year after commissioning of the facilities. Further audits should be conducted at frequency and scope determined on the basis of findings of the initial audits, but should not be less than on an annual basis.

Baseline Monitoring

- 11.8 The purpose of baseline monitoring is to establish the ambient environmental level of a specified parameter (e.g. noise) prior to development in order to assess the magnitude of predicted impacts as a result of the construction and operation of the transfer facilities. Baseline monitoring also permits the determination of environmental performance criteria for the operation of the transfer facilities.

Air

- 11.9 The key impact during the construction of the transfer facilities is likely to be dust. It is considered that the existing available data from previous monitoring studies and field measurements taken as part of this consultancy are sufficient for determining ambient dust levels at each of the sites and no further monitoring is recommended.

Water

- 11.10 Water quality impacts will be associated with sites requiring reclamation activity (i.e. Yung Shue Wan, Hei Ling Chau and Sok Kwu Wan). There is also the potential for significant impact at Discovery Bay where dredging is required to deepen the existing marine channel.
- 11.11 No significant water quality impacts are associated with the operation of the transfer facilities. Data are available for marine water quality from previous consultancy studies in the Outlying Islands Region and from the regular EPD monitoring programme. For Sok Kwu Wan additional data are available for water quality within and without the FCZ from the AFD monitoring programme.
- 11.12 Data is considered sufficient for assessing baseline conditions at transfer facility sites not requiring reclamation, but further more detailed monitoring is recommended prior to the commencement of dredging and reclamation activity at Peng Chau, Discovery Bay, Hei Ling Chau, Yung Shue Wan and Sok Kwu Wan. The requirement for the contractor to carry out this monitoring will depend on Government contractual arrangements for the dredging and reclamation activity. In the event that a contract is awarded for required works to an independent contractor, then the requirement for water quality baseline and construction monitoring associated with marine works should be the responsibility of this contractor rather than the OITF contractor.
- 11.13 Water quality monitoring should be conducted at four monitoring locations and two control sites for each of the sites on three sampling days per week for a four week period at mid-ebb and mid-flood prior to the commencement of dredging. Measurements should be taken in situ, with the exception of suspended solids, at three depths, namely, 1m below the surface, midwater, and 1 m above the sea bed. Measurements of the following parameter should be taken:
- Turbidity;
 - Dissolved oxygen concentration (DO in mg/l);
 - Dissolved oxygen concentration (DO in %); and

- Suspended solids (mg/l).

11.14 Measurements should be taken by suitably qualified technicians and arrangements should be made for the proper storage and preservation of samples for determination of suspended solid concentrations at a suitably accredited laboratory. At Sok Kwu Wan, monitoring locations should be spaced to detect any gradient effect in parameters towards the FCZ, and should include a monitoring location within the FCZ itself.

11.15 Sediment samples should also be taken at four locations within the proposed area of dredging and two control locations at each of the two sites using an appropriate 'grab' sample device for sampling surface sediments. Samples should be analysed for the following parameters:

- Particle size distribution; total organic carbon; chemical oxygen demand (COD); total kjeldahl nitrogen; total sulphide; total PCB in < 63µm fraction; metals (Cd, Cr, Cu, Hg, Ni, Pb, Zn).

11.16 Analysis of sediments will allow determination as to whether sediments are classed as contaminated according to EPD Technical Circular No. 1-1-92 (Ref 11.1), and whether procedures for disposal of contaminated sediments according to Technical Circular No. 22/92 (Ref 11.2) need to be carried out.

Noise

11.17 The noise environment has been sufficiently documented for each of the proposed transfer facility sites by undertaking field measurements as part of this study. Data has also been supported from that available from other consultancy studies on the Outlying Islands Region. Further baseline monitoring prior to the commencement of construction is not therefore recommended.

Construction Monitoring

11.18 The purpose of construction monitoring is to detect any unacceptable environmental impacts according to legislative standards, appropriate guidelines and established environmental performance criteria. Noise and dust are likely to be the key issues of concern during the construction of the transfer facilities. In the case of Yung Shue Wan and Sok Kwu Wan, water quality impacts associated with dredging and reclamation activity will require comprehensive monitoring, the requirements of which should be specified in the contract.

Air

11.19 Site boundary measurements of 24 hour average total and respirable suspended particulates should be taken on a weekly basis at the nearest sensitive receiver to ensure compliance with the AQOs. Measurements should also be taken on a weekly basis at the site boundary to ensure compliance with the guideline of 500 µg m⁻³. Monitoring should be conducted according to EPD guidelines (Ref 11.3).

11.20 Monitoring is only considered necessary at sites in close proximity to sensitive receivers and should be limited to Discovery Bay and Yung Shue Wan. In addition monitoring should be conducted at the site boundary only at Sok Kwu Wan where reclamation is required.

Noise

11.21 Daytime LAeq (30 min.) measurements should be taken on a weekly basis at the nearest sensitive receptor to ensure compliance with the target noise level of 75 dB (A) during construction activity. In the event of construction work taking place outside normal daytime hours monitoring should be conducted to ensure compliance with relevant Noise Control Ordinance standards.

Water

- 11.22 During the course of dredging and reclamation activity monitoring should be undertaken as specified in Sections 11.13 to 11.14, but at two day intervals. The interval between each series (mid-ebb and mid-flood) of samplings shall not be less than 36 hours. For in-situ measurements, two readings at each depth should be taken and where the difference between the first and second value is greater than 25% then the readings should be discarded and re-taken. It is recommended that monitoring be undertaken daily at Sok Kwu Wan due to the close proximity of the activity to the FCZ.

Operational Monitoring

- 11.23 The purpose of operational monitoring is to detect any long-term unacceptable impacts according to legislative standards, appropriate guidelines and environmental performance criteria. The key impacts of concern associated with the operation of the transfer facilities are likely to be dust, odour and noise generation. Where any deterioration in environmental parameters measured is detected a review of operational procedures will be required in the first instance, followed by remedial action in further cases of non-compliance.
- 11.24 It is considered that the nature and scale of operation of the RTFs will not result in any significant littering and in this respect the development of the RTFs will result in an improvement of the current waste disposal practice. In the unlikely event of littering, litter will be most likely trapped by the perimeter boundary and removed as part of a regular daily site inspection programme. Any spillage of refuse should be cleared immediately.

Air

- 11.25 Dust measurements should be taken for TSP and RSP at the nearest sensitive receptors at Discovery Bay and Yung Shue Wan on a quarterly basis to determine 24 hour concentrations and compliance with the AQOs. Monitoring should be conducted according to EPD guidelines (Ref 11.3).
- 11.26 Odour monitoring, should be undertaken by non-site personnel along the boundary of the transfer facility sites at all sites on a twice monthly basis and on a more frequent basis at times when complaints are received. An action plan for when odour levels exceed the recommended level should be prepared as part of the detailed EIA to be completed by the successful tenderer.

Water

- 11.27 No significant water quality impacts are envisaged during the operational phase of the transfer facilities. However, due to the sensitivity of the FCZ at Sok Kwu Wan monitoring is recommended to ensure that environmental conditions are unaffected by the facility operation. Monitoring should be conducted as specified in Sections 11.13 to 11.14, but on a monthly basis for three months upon the commencement of operation and on a quarterly basis thereafter. Other sites should be monitored at the commencement of the operation and six monthly thereafter. This monitoring will allow the detection of the remote possibility of long-term deterioration in water quality associated with disturbance of base sediments by the waste transfer vessel or fugitive discharges from site. In the event of adverse effects being detected remedial action will need to be taken to protect the environmental integrity of the FCZ. Other sites should be similarly monitored, but on a six monthly basis.

Noise

- 11.28 Noise monitoring (LA_{eq} (30 min.)) should be undertaken for all sites at NSRs once normal operation has resumed for the daytime period, and for the nighttime period where applicable. Monitoring should be conducted around each waste transfer vessel berthing and container

transfer operation when noise generation is likely to be greatest. For sensitive sites including Discovery Bay and Yung Shue Wan daytime monitoring is recommended on a quarterly basis and, where appropriate, on a twice annual basis for the night time period. For other sites, monitoring should be conducted on a six monthly basis for daytime measurements and annually for nighttime measurements.

Standards, Guidelines and Environmental Performance Criteria

- 11.29 Relevant environmental standards and guidelines for construction and operational phases of the development were given in the appropriate Chapters of this report. Environmental performance criteria, where no appropriate standards or guidelines exist, are based on previous experience and assessments contained in this report. Relevant objectives for each phase of the development are summarised in Tables 11.1 and 11.2.

References

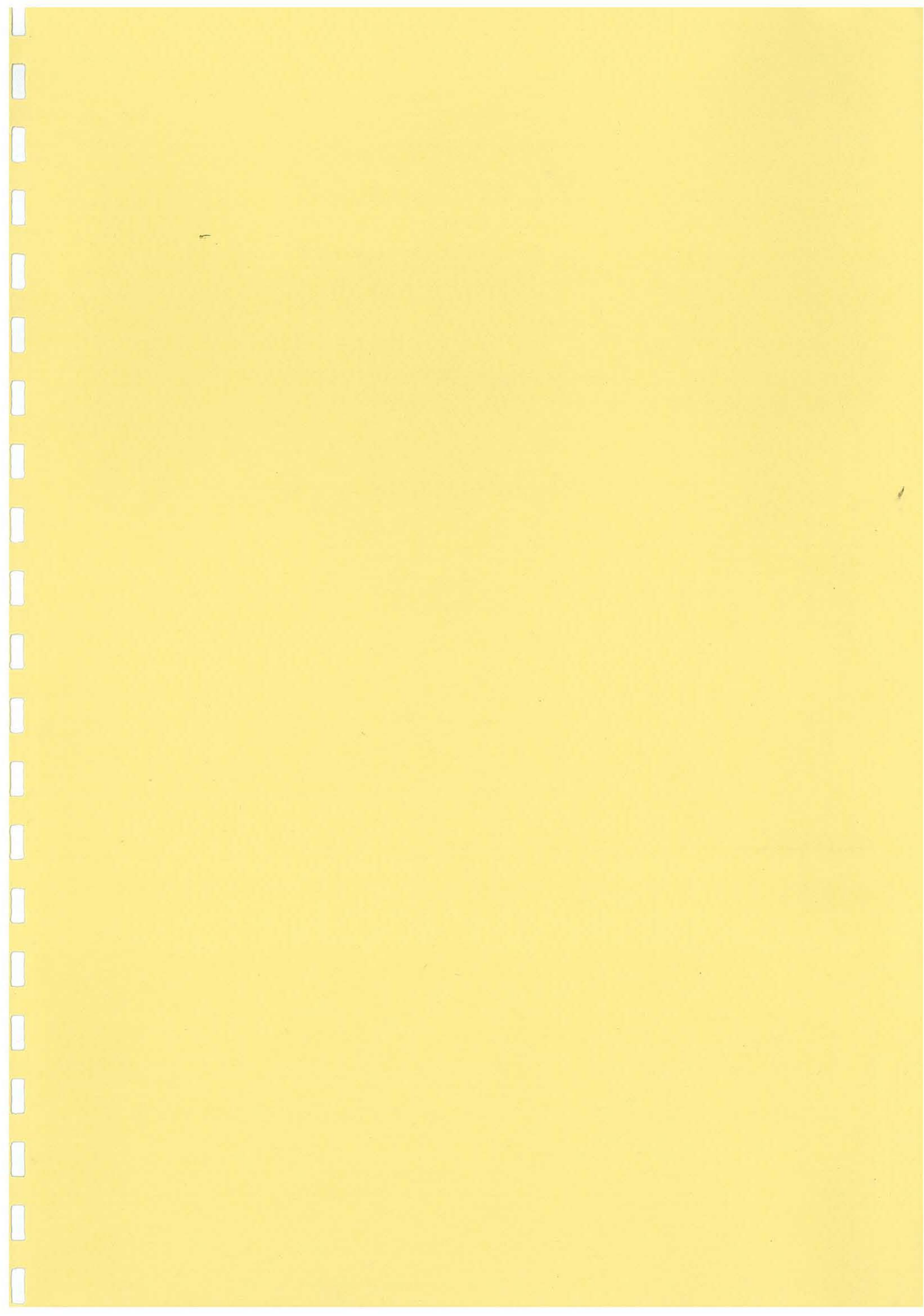
- 11.1 Environmental Protection department. Classification of dredged Marine sediments for Marine Disposal. Technical Circular No. (TC) 1-1-92. November 1992.
- 11.2 Hong Kong Government. Works Branch, Marine Disposal of Dredged Mud. Technical Circular No. 22/92. 1992.
- 11.3 Environmental Protection Department. Environmental monitoring and Audit - Guidelines for Dust Monitoring. 1993.

Table 11.1 Summary of Standards, Guidelines and Performance Criteria for Construction Monitoring.

Parameter	Location	Frequency	Compliance Objective
Air			
TSP	Site Boundary of Discovery Bay, Sok Kwu Wan and Yung Shue Wan.	Weekly.	Hourly average concentration not to exceed $500 \mu\text{g m}^{-3}$.
TSP & RSP	NSRs at Discovery Bay and Yung Shue Wan.	Weekly.	24 hr. average concentrations not to exceed $0.18 \mu\text{g m}^{-3}$ for RSP and $0.26 \mu\text{g m}^{-3}$ TSP.
Noise	NSRs at Discovery Bay, Yung Shue Wan and Hei Ling Chau.	Weekly.	Noise levels not to exceed: 75 dB (A) 0700 - 1900 60 dB (A) 1900 - 2300 (0700-2300 hols.) 45 dB (A) 2300-0700
Water	Six monitoring locations at Peng Chau, Discovery Bay, Hei Ling Chau, Yung Shue Wan and Sok Kwu Wan.	Two day interval at Peng Chau, Discovery Bay, Hei Ling Chau, Yung Shue Wan Daily at Sok Kwu Wan.	DO - minimum value 70% of ambient at both surface and bottom. No permitted impact within FCZ at Sok Kwu Wan. Turbidity - Maximum value 30 % above ambient at all monitoring sites more than 100 m from dredger. No detectable impact within FCZ at Sok Kwu Wan. Suspended solids- Maximum value of 30 % above ambient value at monitoring sites more than 100 m from the site, with a maximum of 150 mg/l at a radius greater than 100 m from the dredger. No detectable impact within FCZ at Sok Kwu Wan.

Table 11.2 Summary of Standards, Guidelines and Performance Criteria for Operational Monitoring.

Parameter	Location	Frequency	Compliance Objective
Air TSP & RSP	NSRs at Discovery Bay and Yung Shue Wan.	Quarterly.	24 hr average concentration not to exceed 0.26 $\mu\text{g m}^{-3}$ for TSP and 0.18 $\mu\text{g m}^{-3}$ for RSP.
Odour	Site boundary at Discovery Bay, Yung Shue Wan and Hei Ling Chau.	Twice weekly or more frequently on receipt of complaint.	2 odour units (100 % compliance requirement). In practice this is impractical to apply. No detection of odour at the site boundary is a reasonable alternative compliance objective.
Noise	NSRs at Discovery Bay and Yung Shue Wan. Other sites	Quarterly during daytime period (to be conducted during berthing and transfer operation) Twice annually at night. Six monthly during daytime period Annually nighttime period	Fixed Noise at least: 55 dB(A) - 0700 - 1900 55 dB (A) - 1900-2300 45 dB (A) - 2300-0700 Or lower depending on ambient noise levels. Traffic impacts: 70 dB (A) - residential 65 dB (A) - schools 55 dB (A) - clinics etc.
Water	6 monitoring locations at Sok Kwu Wan. 4 monitoring stations at other sites	Monthly for first quarter, quarterly thereafter. Commencement of operation and six monthly thereafter.	DO - no detectable impact Turbidity - no detectable impact Suspended solids - no detectable impact



12. CONCLUSIONS AND RECOMMENDATIONS

Introduction

- 12.1 The development of the Outlying Island Transfer Facilities (OITFs) forms part of Hong Kong Government's strategy for improved waste management within the territory. This involves replacing the existing and outdated waste disposal system with purpose-designed facilities which will allow for the efficient and environmentally acceptable transfer of waste for final disposal at the new strategic WENT Landfill in the New Territories.
- 12.2 The primary objective of the IEIA has been to provide an initial assessment of the key environmental issues relating to the development and operation of seven refuse transfer facilities located on five of the Outlying Islands. The replacement of the existing waste disposal system will result in several immediate environmental benefits, including the closure of the Mui Wo incineration plant and the removal of refuse storage at several public ferry piers. While it is broadly recognised that the development of the transfer facilities will result in a significant environmental improvement over the existing waste disposal system used in the islands, the developments have the potential to cause adverse environmental impacts on the local community as a result of their construction and subsequent operation.
- 12.3 By carrying out an IEIA key environmental issues of concern can be identified at an early stage so that appropriate mitigation controls can be incorporated into the design of the facilities to reduce impacts to acceptable levels. A monitoring and auditing programme, based on suitably collected baseline data, will ensure that residual (net) impacts arising from the construction and operation of the transfer facilities comply with relevant environmental standards, guidelines and performance criteria, and that nearest sensitive receivers (NSRs) are suitably protected.
- 12.4 The key issues identified for assessment within the IEIA included the following:
- Air Quality, including Odour;
 - Water Quality;
 - Noise;
 - Landscape, Visual and Land Use;
 - Traffic and Marine Transportation; and
 - Bird, Insect and Rodent Control.
- 12.5 Areas for further assessment have been identified which form the basis of the Terms of Reference for a detailed EIA to be conducted by the successful tenderer. Recommendations for further baseline monitoring together with construction and operational monitoring/audit requirements were specified in Chapter 11 and these should be included within the contractual responsibilities of the successful tenderer.
- 12.6 The conclusions and recommendations for each of the key issues are given below. A discussion of potential cumulative impacts arising from the concurrent construction and operation of adjacent developments to the transfer facility sites is given at the end of this Chapter.

Air Quality

- 12.7 The Outlying Islands are characterised by areas of low population and few significant industrial or vehicular emission sources. Existing air quality problems are therefore localised. Available data from previous studies indicate that current air quality objectives (AQOs) specified under the Air Pollution Control Ordinance are not generally exceeded and that air quality across the Outlying Islands region is good. Further dust monitoring is being conducted as part of this study

to provide additional information on ambient air quality, the results of which will be submitted in the Final Report to this Consultancy.

- 12.8 The principal air quality impact resulting from the construction of the transfer facilities and access roads relate to dust emissions associated with site formation works and vehicle movements. Predictions of dust emissions were conducted for the sites requiring reclamation activity i.e. Hei Ling Chau, Yung Shue Wan and Sok Kwu Wan. Modelling indicated that dust levels would not exceed the accepted guideline value of $500 \mu\text{g m}^{-3}$ at the construction site boundary. Appropriate mitigation controls have also been specified to ensure compliance with relevant AQOs at NSRs. It is recommended that these measures be adopted by the successful tenderer.
- 12.9 Air quality impacts associated with the operation of the transfer facilities relate principally to dust and odour emissions. It was concluded that the potential for dust generation at the sites was limited and that dust impacts at semi-enclosed sites (i.e. Cheung Chau, Peng Chau, Mui Wo and Yung Shue Wan) would be insignificant given certain control measures are incorporated into the hopper/compactor operation. This was also the case for open facility sites (i.e. Hei Ling Chau and Sok Kwu Wan), where the sites will be of a sufficiently small scale and distant from NSRs to prevent any unacceptable impacts. At Discovery Bay, dust impacts will be mitigated by the enclosure of the operation within a building incorporating forced ventilation and air extraction systems.
- 12.10 It is concluded that the potential for odour generation during operational activity will be limited due to the small scale of waste transfer operations, the distance from NSRs and the mitigation measures recommended for the control of leachate and refuse spillage. The proposed leachate treatment process at Mui Wo will result in the removal of odorous compounds, and given the remote location of the NSRs (over 300 m) the process should not result in unacceptable impact. At Discovery Bay, the enclosure of the operation within a building with appropriate air control systems should ensure compliance with the AQO of 2 odour units at the site boundary, although difficulties in assessing odour impacts are recognised.
- 12.11 It is recommended that monitoring and audit requirements in relation to air quality, specified in Chapter 11, be adopted by the successful tenderer.

Water Quality

- 12.12 Data on water quality in the Southern Water Control Zone (WCZ) was available from previous studies, the regular EPD monitoring programme and from AFD monitoring of fish culture zones (FCZs) at Sok Kwu Wan. Although there are no significant discharges of contaminated water in the vicinity of any of the proposed facility sites, it is apparent that the Southern WCZ is influenced by nutrient and contaminant loadings from the Pearl River Delta. Data sources indicated that Water Quality Objectives (WQOs) were found to be exceeded for total nitrogen and ammonia levels. The importance of protecting water quality during the construction and operation of the transfer facilities was recognised, particularly at Sok Kwu Wan where an alternative site has been proposed because of the close proximity of the original site to the FCZ.
- 12.13 During construction, the potential for significant impacts will be limited to those sites requiring dredging and reclamation activity i.e. Peng Chau, Discovery Bay, Hei Ling Chau, Yung Shue Wan and Sok Kwu Wan. Recommendations have been given for further marine water analyses to establish baseline conditions in close proximity to these sites and for monitoring of sediment quality to allow classification according to Government disposal criteria. It is recommended that mitigation measures, as specified in Chapter 6, to control unacceptable water quality impacts be adopted by the successful tenderer, subject to contractual responsibilities for dredging and reclamation works being clarified with Government. The extent of dredging will be determined in the detailed design, to be completed by the successful tenderer.

- 12.14 The alternative site at Sok Kwu Wan is recommended for development on the basis of its greater distance from the FCZ and lesser potential for water quality impacts during construction and operation of the transfer facility.
- 12.15 The outline design of the transfer facilities provides for the collection and segregation of leachates, vehicle and site washwaters and sewage from clean surface waters. As such, operational impacts associated with discharges from the transfer facility sites are considered to be insignificant. Primary and secondary biological pre-treatment facilities to be provided at Mui Wo and will ensure that treated leachates meet relevant effluent standards for discharge to sewer prior to further treatment at the Mui Wo Sewage Treatment Works. It is recommended that design criteria and spillage prevention measures be adopted by the successful tenderer to prevent any loss of leachate from storage tanks either on-site or on the marine transfer vessel.

Noise

- 12.16 Ambient noise conditions have been described based on available data from previous studies, together with monitoring data collected for each of the proposed transfer facility sites collected under this study. There are few significant noise sources within the Outlying Islands region and, apart from seasonal Cicada noise at some of the monitoring locations, NSRs were not significantly affected by existing noise sources. With the exception of the Discovery Bay site the proposed transfer facilities are not located in highly urbanised areas, it is therefore appropriate for construction and operational noise be reduced to acceptable noise levels in keeping with a rural semi-rural setting.
- 12.17 Construction noise will be associated with the use of mechanical plant and vehicles and will be dependent on the scale, duration and type of equipment used as well as proximity of the construction site to NSRs. Predictive calculations for construction noise were based on estimates of construction plant required and their sound power levels, with a day-time target objective of 70 dB(A) at a sensitive facade. Predicted levels at all sites complied with this objective with suitable mitigation controls, except Discovery Bay which exceeded the objective by 1 dB(A). It is recommended that further mitigation controls are adopted by the successful tenderer including the specification of quiet plant to reduce, as far as possible, impacts from construction noise.
- 12.18 Operational noise from the transfer facilities is associated with mechanical equipment, crane operation of the marine transfer vessel and waste delivery vehicle movements. Predictive calculations from mechanical equipment showed that noise impacts at NSRs will be well within acceptable limits, with the exception of Discovery Bay where predicted noise levels were slightly higher than the prevailing background noise levels. It is recommended that further insulation of mechanical plant be undertaken to reduce noise levels to below background levels at Discovery Bay.
- 12.19 It has been concluded that the crane operation on the marine transfer vessel is likely to be a significantly source of noise during operation of the transfer facilities and will result in the exceedance of noise standards in several cases. Although this noise source will be of limited duration at each of the sites, it is recommended that further sound insulation measures be implemented by the successful tenderer to reduce noise generation further on the crane. It is concluded on the basis of predictive calculations using estimates of vehicle delivery patterns and types, that noise impact from waste delivery vehicle traffic on-site will be insignificant.
- 12.20 It is concluded that joint usage of sites designated for storage of construction materials will be insignificant in terms of noise impact.
- 12.21 It is recommended that tenderers provide information on the types, quantities and sound power levels of construction and operational equipment to be used at each transfer facility.

Landscape, Visual and Land Use Impacts

- 12.22 The transfer facilities affect relatively few NSRs and where impacts occur these are largely mitigated by their distance from NSRs. Nevertheless, the landscape and visual character of the Outlying Islands remains relatively rural and undeveloped and, in every case, development takes place against a predominant backdrop of the surrounding natural hillsides. Careful consideration will therefore be required to reduce the visual impact of these facilities, wherever possible.
- 12.23 It is recommended that containers and roof structures are painted in suitable shades to reduce visible intrusiveness and where the sites are clearly visible, it is recommended that facilities should be screened from view by a wall. In naturalistic settings this would be faced in stone whereas in more developed areas a rendered external finish may be more appropriate. Where possible container stacking should be limited to two high, although stacking to three high may be required in certain cases.
- 12.24 Wherever possible, planting of trees and shrubs is also recommended to screen the facilities as well as soften and break up their appearance. This will be particularly effective in mitigating the visual impacts from more distant viewpoints. Wherever possible, planting should be incorporated outside the perimeter fencing/wall, and to shield stacked containers. In some cases, the most effective screening would be achieved by planting on adjacent land. Planting should be conducted by the successful tenderer. Reinstatement of any vegetation damaged by construction work is strongly recommended. Planting of native trees and shrubs should also be carried out on cut slopes where roads and footpaths are widened.
- 12.25 In order to retain the rural character of the Outlying Islands at night, it is recommended that light sources with a more natural colour rendering should be used, for example, metal halide or mercury vapour lights in preference to high pressure sodium lighting as specified in WP No; 8 'Outline Design' (Ref 12.1)
- 12.26 Specific additional recommendations for each site are as follows:
- Cheung Chau
 - Reinstatement and supplement existing planting adjacent to the access road to the south of the site;
 - Plant the slopes behind the site with trees and shrubs, to break up the view from the public park; and
 - Stone facing to the sea wall to blend with the rubble revetment.
 - Peng Chau
 - Provide perimeter walls to reduce visual impact;
 - Reinstatement and supplement planting around the site; and
 - Construction of the jetty to have minimal impact on the surroundings.
 - Mui Wo
 - Provide a screening wall along the property boundary and plant a screen of native trees and shrubs to improve the appearance of the road frontage;
 - The colour of the containers will be particularly important in mitigating their visual impact; and
 - Where practicable, consider the possibility of container storage at a maximum of two high, with a total height similar to the buildings.

- Discovery Bay
 - Supplement planting at the top of the slope behind the facility to assist in screening from the lower floors of the residential towers, especially Jovial Court.
- Hei Ling Chau
 - Moving the site to the north, further into the existing developed bay would assist in mitigating the landscape and visual impacts of the proposed location;
 - Design the non-operational edges of the reclamation to have a more natural form. The edges of the reclamation should be formed from natural rock to blend into the natural shoreline;
 - Chain link fencing, which will not be visible when viewed from a distance, should be considered for this site provided adequate security is ensured; and
 - Planting above the foreshore in front of the buildings, to screen the facility and operations below.
- Yung Shue Wan
 - Reinstate and supplement planting on the adjacent cut slopes.
- Sok Kwu Wan
 - Adopt the alternative location where landscape and visual impacts are less; and
 - Give attention to the form of the reclamation in order to minimise its area. The non-operational shoreline should adopt a natural form, reflecting the natural landscape. The reclamation should be retained by local rock rubble.

12.27 With respect to landuse impacts, no significant interface problems are envisaged at Cheung Chau, Peng Chau, Mui Wo, Discovery Bay, Hei Ling Chau, and Yung Shue Wan. At Sok Kwu Wan, a Village Development Area (VDA) is located immediately to the west adjacent to the alternative site location in the Lamma Island Outline Development Plan. Although there is no programme for the development of the VDA in the short term, it is recommended that the planning of the VDA include a suitable buffer distance to the transfer facility and should account for necessary road widening and alignment requirements.

Traffic and Marine Transportation

- 12.28 Construction activities and estimates of their duration for each site were given in Chapter 9. Where possible, it was recommended that construction plant be transported to site directly by sea to avoid any overland haulage and disturbance to local villages.
- 12.29 Estimates of waste throughput and vehicle requirements have been given over a 15 year operational period. It is recognised that regulation of privately delivered construction waste may be required to avoid congestion and queuing at the sites. It is also recognised that relevant permits may be required from Transport Department for the use of roads on the Outlying Islands, although road usage will be limited in its scope.
- 12.30 Traffic control systems are recommended at Discovery Bay and Yung Shue Wan as they share access roads with other users.

- 12.31 Issues related to the use of marine transport vessels addressed in the chapters on noise and water quality. Recommendations have also been provided in relation to containment and disposal of contaminated bilge waters and wastes arising from vessel operation and maintenance. Overall, disturbance arising from vessel movements in the vicinity of FCZs at Sok Kwu Wan were considered unlikely to result in impacts any greater than those already experienced due to ferry and other shipping movements.
- 12.32 It was recommended that marine transfer vessel specifications and operational requirements be included in the tender submissions.

Bird, Insect and Rodent Control

- 12.33 The containerisation of waste, combined with effective measures for controlling refuse spillage and odour generation will minimise the potential for nuisance from birds, insects and rodents. The open or semi-enclosed nature of the sites, with the exception of Discovery Bay, will mean that total exclusion of pests will not be possible, although design criteria have been recommended to limit the attractiveness of the sites. In the event of infestation, pest control measures are recommended involving the use of pesticides and traps by trained personnel.

Terms of Reference

- 12.34 In addition to this IEIA, it will be necessary for the successful tenderer to conduct a detailed EIA to further assess environmental issues related to the construction and operation of the transfer facilities. This must be conducted with respect to final design proposals incorporating, where appropriate, the recommendations on mitigation control and monitoring/audit requirements provided in the IEIA. The detailed EIA should quantify residual (net) impacts arising from the development and ensure necessary environmental standards, guidelines and performance criteria are complied with.
- 12.35 The terms of reference for the detailed EIA which require further assessment have been identified as part of the initial assessment process and are as follows.

Air Quality

- 12.36 Areas for further assessment in relation to air quality to be included in the detailed EIA are:
- Assessment of the cumulative effect of dust emissions arising from construction activities in the vicinity of neighbouring developments at Yung Shue Wan;
 - Assessment of odour control measures from the transfer facilities at Discovery Bay, Cheung Chau and Yung Shue Wan. Preparation of an action plan for when odour levels exceed the recommended limit; and
 - Assessment of monitoring requirements with respect to adjacent developments, and contractual responsibilities, if any, for dredging and reclamation works.

Water Quality

- 12.37 Areas for further assessment in relation to water quality to be included in the detailed EIA are:
- ☆ ~~Predictive modelling of suspended solid impacts on the FCZ at Sok Kwu Wan over a range of tidal and operating conditions to determine the optimum time and method for construction works to be conducted, subject to contractual responsibilities for such works;~~
 - Assessment of the impact on the Mui Wo STW of receiving untreated leachate in the event of failure of the pre-treatment facility; and

- Conduct baseline and construction monitoring (marine water and sediments) for dredging and reclamation works needed for the development of the facilities, subject to contractual responsibilities for such works.

Noise

- 12.38 Areas for further assessment in relation to noise quality to be included in the detailed EIA are:
- Assessment of noise levels at NSRs for proposed construction and operational equipment used in the final design; and
 - Assessment of noise impact on NSRs associated with passage of waste delivery vehicles to and from the transfer facility sites.

Landscape, Visual and Land Use

- 12.39 The detailed EIA should incorporate a full assessment of the landscape, landuse and visual aspects of the transfer facilities with appropriate mitigation measures, once the operational and detailed design is finalised. This should include a tree survey and appropriate liaison with Government departments regarding any tree felling required.
- 12.40 A colour assessment should also be incorporated into the EIA to ensure that containers, buildings and operating plant are not unacceptably intrusive into the environment.
- 12.41 Consideration of the landscape, visual and land use impacts associated with the 'Residential 3' development area located 170 m south east of the RTF site on Cheung Chau.

Traffic and Marine Transportation

- 12.42 Further consideration is required in the EIA in relation to several traffic issues. These include:
- Cheung Kwai Road widening by the Government works agency. Road widening works are required for Cheung Chau (widening of Cheung Kwai Road by 0.5m for 700m length from Fire Station), Peng Chau (footpath over Tai Lei Link Bridge from village needs replacing with a road) and Sok Kwu Wan (footpath from village cargo area needs an accompanying single track access road);
 - Peng Chau footpath upgrade to emergency vehicular access road by the Government works agency;
 - Identification of appropriate specifications in OITF tender document for Discovery Bay in association with Hong Kong Resort Company;
 - Planning issues associated with the development of Yung Shue Wan access road adjacent to the site; and
 - Liaison with Government on implementing a mechanism for regulating construction waste deliveries at OITF sites.

Bird, Rodent and Insect Control

- 12.43 Further assessment should be provided in the EIA on pest control beyond recommendations given in the IEIA, if the design of the facilities differs significantly from that proposed in the outline design prepared as part of this Consultancy Study.

Cumulative Impacts

- 12.44 The nature and magnitude of potential cumulative impact arising out of the construction and operation of the transfer facilities is dependent on two issues:
- The proximity and timing of other development proposals with respect to proposed transfer sites; and,
 - The scale of anticipated residual impacts of the facilities themselves.
- 12.45 There is a degree of uncertainty attached the programming of many of the developments which are provisionally planned take place within the general vicinity of the transfer sites (see Table 2.2). In some cases consultancy studies are currently underway which will quantify the impacts of these developments, the proposed rehabilitation of Lamma Quarry, for example, requires a full EIA to be carried out. In other cases little or no information is currently available. It is therefore recommended that at the time of preparing the EIA the successful consultant should give further consideration to all available reports and studies and identify and assess potential cumulative impacts related to other nearby developments. In particular, consideration should be given to:
- The development of the Sewage Treatment Works and Comprehensive Development Areas on Peng Chau;
 - The extension of the Mui Wo Sewage Treatment Works; and
 - The development of adjacent landuses on the reclamation area at Yung Shue Wan .
- 12.46 Provided that the design features and environmental control measures recommended in this report are adopted, the residual impacts from the relatively small-scale facilities being proposed are likely have minimal adverse effects. This in turn will limit the potential for the transfer facilities to contribute to wider cumulative impacts.
- 12.47 Overall, the development of the sites will result in an environmental improvement in waste transfer and disposal within the Outlying Islands.

Reference

- 12.1 Environmental Protection Department. Outlying Islands Refuse Transfer Facilities. Working Paper 8, Outline Design. June 1993.

Appendix 1 - Relevant Environmental Maritime Legislation

IMO conventions, codes and recommendations relevant to the protection of the marine environment and liability and compensation for pollution damage:

- International Convention for the Prevention of Pollution from Ships, 1973.
- 1978 Protocol relating to the International Convention for the Prevention of Pollution from Ships, 1973 (MARPOL PROT 1978)
- International Convention for the Prevention of Pollution of the Sea by Oil, 1954
- Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972
- International Convention relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, 1969 (INTERVENTION)
- International Convention on Civil Liability for Oil Pollution Damage, 1969 (CLC)
- International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1971 (FUND)
- Guidelines on the Provision of Adequate Reception Facilities in Ports.
- IMO/UNEP Guidelines on Oil Spill Dispersant Application and Environmental Considerations.
- Manual on Chemical Pollution
- Manual on Oil Pollution
- Oily Waste Separators and Monitoring Equipment
- Proceedings of the IMO/UNDP International Seminar on Reception Facilities for Wastes
- Proceedings of the International Symposium on Reception Facilities for Noxious Liquid Substances
- Provisions concerning the Reports on Incidents Involving Harmful Substances under MARPOL 73/78
- Recommendation on International Effluent Standards and Guidelines for Performance Tests for Sewage Treatment Plants
- Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk — Annex II, MARPOL 73/78
- Regulations for the Prevention of Pollution by Oil — Annex I, MARPOL 73/78
- Report from the Symposium on Prevention of Marine Pollution from Ships
- Control of Ships and Discharges
- Crude Oil Washing Systems
- Dedicated Clean Ballast Tanks
- Facilities in Ports for the Reception of Oil Residues
- Facilities in Ports for the Reception of Oily Wastes
- Guidelines for Surveys under Annex I of MARPOL 73/78
- Guidelines for Surveys under Annex II of MARPOL 73/78
- Code for Existing Ships Carrying Liquefied Gases in Bulk
- Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (BCH Code)
- Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk
- Code of Safety for Special Purpose Ships
- Index of Dangerous Chemicals Carried in Bulk
- Inert Gas Systems
- International Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk (IBC Code)
- International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code)
- International Maritime Dangerous Goods Code (IMDG Code)