Section 11

11 WASTE MANAGEMENT

11.1 INTRODUCTION

The LAPH Development comprises a number of elements (Table 2.1), each of which may give rise to wastes both during their construction and operation. Many of the elements are to be developed on a phased basis, giving rise to corresponding phases of construction waste production and a progressive increase in the amount of waste from operations.

This Section identifies and (where possible) estimates the wastes arising for each element of the LAPH development, firstly in relation to construction and then to operation. Options for collection, storage, treatment and disposal are discussed for all waste types however emphasis has been placed on operational wastes due to the extent and nature of arisings. For these wastes, the phased build up of waste is presented both for each phase, and for the development as a whole.

11.2 METHODOLOGY

11.2.1 Prediction of Waste Arisings

Table 11.1 sets out the anticipated types of waste arising from each of the elements of the LAPH development. These wastes have been identified according to both construction and operational phases as follows:

Construction Phase

For marine mud, quantities have been derived from site investigations and engineering calculations. However, further work would be needed at the detailed design stage to define exact quantities of contaminated mud.

For excavation waste, quantities are available from engineering calculations. However, as disposal problems are not anticipated, quantities are not regarded as critical. Waste vegetation from ground clearance is unquantified but it is anticipated to be relatively minor.

For building and general construction type waste, no estimate of waste arising has yet been made. It may be possible to formulate estimates based upon waste production at previous sites where similar buildings and structures have been constructed.

Operational Phase

For land based industrial and commercial activities, arisings have been based on estimates provided in the Waste Disposal Plan for Hong Kong (EPD, 1989) for arisings per employee. This provides a projection derived from a past increase of 5.8% per annum. It is considered that there is no reason to anticipate an increase in this growth rate for employees in the port related industries and in the relatively high-tech business park activities. Estimates for the year 2011 have been based on the 1997 figure, taking upper and lower bounds of 5.8% and 0% increase per annum respectively.

For difficult wastes derived from ship repair and marine support operations, figures have been obtained by investigation of similar existing activities in Hong Kong.

For ships wastes, guidance has been taken from International Maritime Organisation (IMO) Guidelines (IMO, 1976, 1986, 1988) and from an IMO Conference on Reception Facilities for Wastes (IMO, 1984).

11.2.2 Selection of Disposal Options

Rather than carry out an exhaustive review of all possible disposal options, due regard has been given to the Waste Disposal Plan for Hong Kong, which sets out a strategy for waste management until the year 2001, and also considers the position beyond that date. It is also noted that the Consultants for the North Lantau Development Study have given preliminary consideration to the integration of disposal of wastes from LAPH into a system for the NLD.

The NLD Design Memorandum DM2 which gives an outline design of the waste transfer station and waste disposal arrangement has made provision for notional amounts of waste arising from the LAPH development. A detailed consultancy study for the North Lantau refuse transfer station is scheduled to be commissioned by EPD in April 1993. This study will consider waste transfer requirements from other likely sources such as the LAPH development. It is also noted that a consultancy study to evaluate the management of wastes from the Outlying Islands is under way. This study should include consideration and recommendation for disposal methods and extent of integration with the North Lantau Development (NLD)/LAPH waste management system.

TABLE 11.1

SUMMARY OF WASTE ARISINGS FOR
THE LAPH DEVELOPMENT

DEVELOPMENT ELEMENT	CONSTRUCTION PHASE			OPERATIONAL PHASE		
	MM	EX	CW	GR	D	S
Container Terminal 10	X	-	X	X	X	X
River Trade Transhipment Areas	X	-	X	X	X	X
Floating Docks and Shore	X	-	X	X	X	X
Backup	X	X	X	X	X	X
Marine Services Support Area	X	-	-	-	-	-
Dredged Channels	X	-	X	-	-	-
Typhoon Shelter	X	-	-	-	-	-
Lamma Breakwater	X	-	-	-	-	-
Lamma Breakwater Reclamation	X	-	X	X	X	X
Freight Rail Terminal	-	X	X	X	-	-
Roads/Utilities/Services	-	X	X	X	X	X
Port Industry	-	X	X	X	-	X
Business Park	-	X	X	X	X	X
G/IC	-	-	-	X	-	-
Open Space	-	-	-	-	-	-
Navigational Aids	-	X	-	-	-	-
TCT Borrow Area Platforms	-	X	-	-	-	-

Key:

X	Some waste anticipated to arise.
-	No waste anticipated
MM	DREDGED MARINE MUD
EX	EXCAVATION WASTE (clean rock and soil from site formation and excavation.)
CW	BUILDING AND GENERAL CONSTRUCTION WASTE (may contain considerable quantities of non-inert items such as paint tins, cement sacks, bitumen, bamboo scaffold, etc.) Some difficult wastes may arise should the redevelopment of existing works take place e.g. Cheoy Lee shipyard (Penny's Bay).
GR	GENERAL REFUSE (including biodegradable materials and comprising paper, plastic, textiles, metals, timber, sawdust, food scraps, etc.)
D	DIFFICULT WASTES (those wastes presenting greater difficulty in handling or disposal than GR, such as chemical wastes, solvents and oils, MARPOL Annex I and II ship's waste.)
S	SEWAGE

11.3 DISPOSAL OPTIONS

11.3.1 Marine Mud

The Waste Disposal Plan recognised that dredged material should continue to be disposed of at sea, and recommends the identification of new dumping grounds. Studies as part of the marine ecology baseline survey have revealed that some of the samples taken fall within spoil categories 'A' and 'B' for contamination. These will require special consideration and disposal arrangements (See Section 6 for details).

For a number of reasons including cost of removal, difficulty of disposal, and cost of replacement fill, it is proposed to leave as much marine mud as possible in-situ. This approach which minimises the disturbance of marine mud is environmentally favoured. Any mud which is dredged from channels, berths, quay and breakwater foundations is likely to be disposed of by marine dumping.

11.3.2 Clean Excavation Wastes

The Waste Disposal Plan recognises marine dumping and land reclamation as the preferred disposal option for these wastes. As the LAPH development involves large areas of phased reclamation, it is therefore possible that these wastes could be disposed of in the reclamation.

11.3.3 Construction Wastes

The Waste Disposal Plan recommends segregation at source of undesirable materials (i.e. materials which are potential sources of water contamination or landfill gas due to decomposition) such as paper, timber and plastic, allowing the use of the remainder, such as concrete and rubble, for reclamations; this is considered to be the most desirable option. To preserve landfill capacities, the new strategic landfills (WENT, SENT and NENT) will not accept wastes with more than 20% inert content by volume, such as concrete. Reinforcing wire, paper, timber, etc., are not considered to be inert. It is understood that government contracts, for example for NLD projects, may require contractors to implement segregation systems to reduce landfilling of construction waste.

Much of the LAPH construction waste will be from formation of structures such as quays and roads, in which contaminants should be minimal. Should contaminated waste arise from the redevelopment of existing works, this would require landfill disposal. Timber and vegetation from initial site clearance will also need to be either landfilled or shredded.

11.3.4 General Refuse

At the present time, municipal solid waste from Lantau is disposed of at the Mui Wo Modular incinerator which is expected to be phased out. Waste from Discovery Bay is collected separately and taken to Kwai Chung by a contracted barge service. The Waste Disposal Plan discussed a new landfill site for Lantau, however this concept has been discarded in favour of transfer of Lantau waste to the WENT Landfill site. Two new transfer stations are to be provided at Mui Wo and Nim Shue Wan. The consultants for the North Lantau Development have proposed a further transfer station to serve the airport and the North Lantau Development (NLDS Working Paper 5), and have given preliminary consideration to the acceptance of the LAPH waste at that transfer station. Given the decision not to develop new landfill capacity on Lantau, the disposal options are reduced to disposing of waste to WENT either via the NLD transfer station or directly, with the exact manner of collection and transportation to be decided (this will be included in the Outlying Islands Refuse Transfer Facilities Consultancy Study).

11.3.5 Difficult Wastes

Chemical Wastes, as defined in the Waste Disposal (Chemical Waste) (General) Regulation 1992, can only be disposed of at a facility licensed by EPD. If there is no suitable site in Hong Kong alternative arrangements must be made to the satisfaction of EPD requirements. MARPOL wastes discharged to facilities within the Lantau Port are not subject to the Chemical Waste Regulations but are controlled under the Merchant and Shipping Ordinance.

A chemical waste treatment centre (CWTC) is under construction on Tsing Yi, and will be commissioned early in 1993. The treatment centre will include facilities for neutralisation, physio-chemical treatment, oil-water separation, high temperature incineration and solidification. The centre was designed on the basis of a 1987 survey of chemical waste arisings, however allowance has been made for future increased arisings. The facility also includes for 5000 tonnes of storage capacity for the reception of MARPOL Annex I wastes. However little data is available on MARPOL arisings, and it is conceivable that the

facility may prove inadequate in terms of capacity.

Options for chemical waste disposal are therefore the use of CWTC and/or the provision of some treatment, pretreatment or storage on site. Some wastes, notably asbestos, will continue to go to landfill.

For small arisings of clinical wastes from the proposed health clinic, disposal by incineration is desirable. A centralised incineration facility (CIF) is currently proposed at Tuen Mun for clinical wastes. The proposed plant should be commissioned by about 1996. If this is not available, other arrangements will be required, for example possible use of a hospital incinerator.

11.3.6 Sewage

The Preferred Concept Plan Report suggested three options for sewage treatment:

- transfer to, and treatment at the new works at Siu Ho Wan STW servicing the airport and NLD, some upgrading of the works would be necessary to accommodate this additional flow;

- treatment at a purpose built local discrete or centralised facility at or near works for the LAPH development; and

- via a connection to the SSDS system;

The Phase I Development Report proposed pumping stations at the Container Terminal and North Shore Development, to dispose of sewage to the proposed Siu Ho Wan sewage treatment works (Section 2). The environmental impact of this works and the disposal of sludge and screenings would therefore fall outside the scope of this Study.

11.4 CONSTRUCTION WASTES - ARISINGS AND DISPOSAL

11.4.1 Waste Arisings

Estimated volumes of dredged marine mud and excavation waste resulting from construction activities are presented in Table 2.2 and 2.3 of Section 2. The majority of dredged marine mud will arise from the Container Port during Phase III of the LAPH developments. More than 50% (approximately 1.1Mm^3) of the excavated material will be required for the Container Port, with 0.98Mm^3 required for Links/Utilities and 0.1Mm^3 for the MSSA. At this stage of the LAPH development it has not been possible to quantify building and general construction waste. However, it is anticipated that quantities would be small.

11.4.2 Waste Disposal

Marine Mud

Although consideration has been given to the use of marine mud for reclamation utilising a dewatering technique, this has been rejected, and the current intent is to dispose of the mud at a marine dumping ground. It will be necessary to determine the quantity of contaminated mud for disposal (as special disposal arrangements are required) and also the disposal requirement on a phased basis.

Excavation Waste

It is anticipated that excavation waste will all be disposed of within reclamation or embankments.

Building and General Construction Waste

Government policy is to encourage segregation of non-inert and inert components of construction wastes with the use of inert components in fill and reclamation. Non-inert components will therefore become a part of general refuse, adding to the quantities of refuse for disposal at the phases of building construction.

The development of Serviced Land entails the redevelopment of Cheoy Lee Shipyard (Penny's Bay). It is possible that this site may be contaminated from ship building and repair activities carried out there over the past 18 yrs. Potential contaminants include asbestos, resins, solvents, oil and grease, metal dusts and anti-fouling chemicals. Polychlorinated biphenyls (PCBs) may also be present if larger vessels with transformers have been worked on. Part of this site is proposed for development and some excavation may be necessary. Extensive excavation and removal may be required should there be a risk to health of construction workers or building occupants, for example by emission of flammable or toxic gases. Further studies are therefore recommended to determine the nature and extent of any contamination.

11.5 OPERATIONAL WASTES ARISINGS

11.5.1 Container Port

It is anticipated that 'stuffing' and 'breaking' of containers would take place at the RTTWs and waste from this activity is considered in Section 11.5.2. The main activity associated with the Container Port is therefore the reception, storage and movement of containers, with some back-up and repair facilities and office and control activities.

General Refuse On-Shore

The handling of containers only gives rise to small quantities of waste. Kosmatos (1984) suggests 1t of waste for every 25,000t of container cargo. On that basis, the arisings of general refuse have been calculated and are presented for all phases in Table 11.2.

In addition to waste arising from the container cargo there will also be wastes arising from the back-up areas. Using the methodology for shore-based wastes, (as above) quantities of waste from back-up areas have been estimated and are similarly presented in Table 11.2.

TABLE 11.2

CONTAINER PORT
GENERAL REFUSE ARISINGS
ON-SHORE

Waste type	YEAR			
	2000	2003	2007	2011
Cargo Waste /Tonnage (million tonnes)	12.8	25.6	38.4	54.4
Waste @ 1t/125,000t (tonnes/annum)	102	205	307	435
No. of employees	1,400	2,800	4,200	5,950
Back-up Waste @ 5.8% pa increase (tonnes/annum)	1,507	3,569	6,709	11,909
Back-up Waste @2kg/emp/day (tonnes/annum)	1,022	2,044	3,066	4,344
Spillage & Interceptors	*	*	*	*

Note : * unquantified but anticipated to be small.

Difficult Wastes On-Shore

Some containers are expected to contain Dangerous Goods (DG), both on arrival and departure. International studies have shown that a significantly high proportion of such loads are not safely packed (see Section 12). Experience at Kwai Chung has shown that attention to minor leakages of chemicals in containers is necessary, resulting in the (occasional) production of waste chemicals on absorptive media. A purpose designed bay for leaking containers will be required to deal with such incidents. A drainage system with interceptors is proposed to mitigate any water pollution from spillages, in particular of oil and grease from vehicles and cranes. The resultant interceptor pit residues will require disposal.

Ship Wastes

The MARPOL convention requires provision of reception facilities at ports for oily wastes (MARPOL Annex I), noxious liquids (MARPOL Annex II) and garbage (MARPOL Annex V). The Container Port is not expected to receive oil or chemical tankers and the main ships waste arisings will therefore be other oily wastes (i.e. other than oil tank washings/ballast) and general refuse.

General Refuse - Offshore

Apart from certain designated 'Special Areas' which do not include Hong Kong), MARPOL (Annex V) only bars the disposal at sea of plastic waste. Other refuse may be disposed of provided it is a specified distance from shore. The International Maritime Organisation (IMO, 1988) advocates the installation of communitors for food wastes on ships which operate primarily beyond three miles from land, before allowing discharge to sea. Otherwise, IMO suggests that although certain non-plastic refuse may be disposed of at sea, it is preferable for reception facilities to be provided at ports.

Kosmatos (1984), suggests the following waste production figures as guidance for ships at sea:

- food waste 1.4 - 2.4kg/person/day;
- refuse 0.5 - 1.5kg/person/day; and
- maintenance waste 20kg/day.

The latter category includes metal shavings, soot, scraped paint, rust sweepings etc. On the basis that this would be appropriate for co-disposal rather

than chemical treatment, it is categorised as general refuse for the purposes of this Report. Table 11.3 sets out the ships refuse arisings on the basis of :

- an average crew of 20 per container vessel;
- that maintenance waste is produced throughout the year; and
- that one third of the waste per annum is landed in Hong Kong.

TABLE 11.3

CONTAINER PORT
GENERAL REFUSE ARISINGS
- OFFSHORE (SHIPS REFUSE)

	YEAR			
	2001	2003	2007	2011
No. of ship visits	2,190	4,380	6,570	9,308
Refuse & food waste (tonnes/ annum)	1,000-2,000	20,000-41,500	30,000-62,000	40,000-83,000
Maintenance waste (tonnes/ annum)	5,000	11,000	16,000	23,000

Note: The tonnages in the Table have been rounded to the nearest thousand.

Difficult Wastes - Offshore

The main oily wastes from ships other than oil tankers are sludge from on-board processing of fuel oil, oily bilge water and ballast water from bunker fuel tanks. International Maritime Organisation (IMO, 1986) suggests that :

- facilities should be provided at a port to promptly relieve ships of at least 10t of sludge;
- that ports 'handling ocean tonnage' should be able to accept up to 100t of oily bilge water at any one time; and
- that 'much more' than 500t of bunker fuel tank ballast at any time should be catered for at deep sea container ports.

This guidance provides no figures for the amount of waste per ship, however, the total suggested (some 600t of oily water) is the equivalent of approximately 30 large road-tankers, consequently this is considered to be a very significant issue and will have landuse implications.

11.5.2 North Shore - RTTWs

It is anticipated that ships arriving at the RTTWs will be in break-bulk cargoes, and that these will then transfer to containers at RTTWs. Similarly container loads will be broken down for transport up river to the PRC in break-bulk cargoes. In the future it is expected that more direct transhipment of containers will occur.

General Refuse - On-shore

General refuse will derive from the wastage of cargo during breaking and bulking. Kosmatos (1984) suggests 1t of wastage for every 123t of break-bulk cargo. Given the likely scale of activity, it is felt prudent to allow for general refuse arising per employee on the same basis as described in subsection 11.2.1 above. Estimates for general refuse arisings are presented in Table 11.4.

TABLE 11.4

NORTH SHORE
GENERAL REFUSE ARISINGS
- RTTWs

	YEAR			
	2001	2003	2007	2011
Tonnes of cargo *	280,000	560,000	800,000	1,479,000
Tonnes of waste/annum	2,276	4,553	6,504	12,024
Number of employees	400	650	1,300	2,000
Tonnes/annum of waste @2kg/person/day	292	475	949	1,460

Note: * Source WP No. 29 - Table 2.3.

General Refuse - Offshore

In addition to general refuse will be refuse arising from ships. This has not been quantified, however it is considered that the quantity will not be large as most vessels will be on short trips within the Pearl River estuary.

Difficult Wastes

It is anticipated that the majority of vessels calling at the RTTWs will be based in the PRC, operating in the Pearl River estuary area and will therefore be within 1-2 days sailing of the LAPH facilities. In general, it is therefore expected that demand for MARPOL Annex I and II facilities will be reduced. Minor quantities of chemicals from spillages, and interceptor wastes may also arise.

11.5.3 North Shore Floating Docks and Back-up Facilities

Difficult Wastes

The primary activity to be carried out at the floating docks would be ship repair and refurbishment. It is anticipated that the arrival of vessels for repair would be known in advance, and arrangements made for the emptying of any cargo or ballast tanks either elsewhere or on an ad-hoc basis. It is therefore unlikely that permanent MARPOL reception facilities would be required for this area. A variety of difficult and chemical wastes could be produced, for example, asbestos from insulation and PCBs from ships transformers. Waste solvents, foundry wastes and dusts containing tri-butyl tin (TBT's are a toxic constituent of anti fouling paints) could all arise from the ship repair activities. These can be quantified only by comparison with existing operations elsewhere. It is recommended that the operators of the floating docks and back-up areas are required to ensure that no micro-contaminants or other difficult wastes are discharged to the marine environment. These requirements could be incorporated into the lease conditions.

11.5.4 Marine Services Support Area (MSSA) and Ship Repair and Dockyard

This MSSA would comprise a base for tugs, pilot boats, floating crane barges and launches, with additional on-shore buildings for office and repair activities.

General Refuse

General refuse arisings have been estimated on the basis of employee numbers and are presented in Table 11.5.

Difficult Wastes

Similar wastes to those described in 11.5.3 above would arise, although it is anticipated in much smaller quantities.

TABLE 11.5

MSSA, SHIP REPAIR YARD GENERAL REFUSE ARISINGS

Year	No. of employees	Waste (@ 2kg/person/day) (tonnes/annum)
2001	300	219
2004	1,200	876
2007	1,500	1,095
2011	1,500	1,095

The ship repair yard which was originally proposed for the North Shore, will be located adjacent to the MSSA (to the northeast of the container terminal). Similar considerations would apply to this area as for the North Shore. It has also been proposed that Cheoy Lee Shipyard in Penny's Bay be relocated although the whereabouts of the new site has yet to be confirmed. The yard is primarily engaged in the construction of smaller craft, and wastes are likely to include solvents and resins from the use of glass reinforced plastic and plastics in construction. It is possible that small quantities of low level radioactive sources may be used (for example for weld testing) and will therefore occasionally arise for disposal. It is recommended that the operators of the MSSA and the Ship Repair and Dockyards are required to ensure that no micro-contaminants or other difficult wastes are discharged to the marine environment. These requirements could be incorporated into the lease conditions.

General Refuse

General refuse would include general maintenance wastes such as paint scrapings and rust and wastes from refurbishment which might include large amounts of timber and metal. General domestic and office type wastes will also arise. These wastes arisings have been calculated on the basis of employment levels and are presented in (Table 11.6).

11.5.5 Business Park, General/Industrial, Commercial Retail

The business park would mainly comprise non-

TABLE 11.6

NORTH SHORE
GENERAL REFUSE ARISINGS -
FLOATING DOCKS, BACKUP

Year	No. of employees	Waste (@ 2kg/person/day) (tonnes/annum)
2001	1,800	1,314
2004	2,400	1,752
2007	2,400	1,752
2011	2,400	1,752

polluting industries, offices and ancillary warehousing for such activities as high technology product manufacture, laboratory-testing, research & development, design, data processing, training, marketing and sales.

The industrial land would be used for port-related activities, in particular warehousing and storage. The above two uses would be supported by a service centre including shops, restaurants and banking and by a health centre, police, fire and ambulance services.

General Refuse

Manufacture at the business park will be high-tech and the industrial land will be mainly storage and distribution. Wastes should therefore comprise mainly packaging and damaged or reject products. Wastes from the local service centre would be mainly office and domestic type wastes including food residues. Potential arisings have been calculated using employment figures and shown in Table 11.7.

Difficult Wastes

At this stage of the LAPH development it is not possible to determine the exact nature of difficult waste arisings. Wastes from the business park may include small quantities of laboratory chemicals, solvents, printing inks, resins etc. Arisings from the industrial land would mainly comprise spillages of stored materials and small quantities of clinical wastes from the health centre (particularly used dressings and sharps). The health centre would provide services for workers rather than residents and is likely to treat mainly minor injuries and

TABLE 11.7

BUSINESS PARK, INDUSTRY
GENERAL REFUSE ARISINGS

Year	No. of employees	Waste (@ 2kg/person/day) tonnes/annum
2001	3,444	2,514
2004	6,615	4,829
2007	12,786	9,334
2011	13,054	9,529

ilments. It is possible that low level radioactive sources might be used for quality control purpose and occasionally require disposal.

11.5.6 Lamma Breakwater Reclamation and Tsing Chau Tsai Mega Borrow Area

These areas both have the potential for industrial or residential development. Until the exact areas and type of development have been defined, it is not possible to reliably assess waste types. Proposals for the Lamma Breakwater are for some 400ha of reclamation, compared with approximately 45ha for the Lantau Port Development (some 23ha in Phase I). Clearly future development behind the Breakwater could have a major impact for future waste arisings. In particular, given its remote location, PHI's and industries unsuitable for urban locations may be sited there.

11.5.7 Miscellaneous Operational Wastes

It is likely that small operational waste arisings will occur from:

- the freight rail terminus;
- highway maintenance (i.e. sweeping, gully emptying);
- the typhoon shelter; and
- spent batteries from navigation aids.

These wastes however are unlikely to significantly affect the overall arisings in terms of collection and disposal.

11.5.8 Overall Generation of General Refuse

Overall general refuse arisings as set out in the

preceding Sections, are summarised below in Table 11.8. In addition allowance has been made for ships refuse from the RTTWs and miscellaneous wastes as set out in Section 11.5.7. Total refuse figures have therefore been increased as indicated in the Table 11.8.

TABLE 11.8

SUMMARY OF GENERAL REFUSE ARISINGS FOR LANTAU PORT

ELEMENT	YEAR (tonnes/annum)			
	2001	2004	2007	2011
Container Port Cargo	102	205	307	435
Container Port Backup	1,022	2,044	3,066	4,344
Container Port MARPOL Garbage	5,329	10,658	15,987	22,648
Container Port Maintenance	5,329	10,658	15,987	22,648
RTTW Cargo	2,276	4,553	6,504	12,024
RTTW Back-up	292	475	949	1,460
Floating Docks	1,314	1,752	1,752	1,752
MSSA	219	876	1,095	1,095
Serviced land	584	584	584	584
Total	16,467	31,805	46,231	66,990
Tonnes/Day (365 days/year)	45	87	127	184
Tonnes/Day plus ship's refuse (RTTWs) and miscellaneous waste	60	90	130	190
Tonnes/Day plus additional 10% contingency	66	99	143	209

11.5.9 Overall Production of Difficult Wastes

The production of difficult wastes in terms of type of waste and source is summarised in Table 11.9.

TABLE 11.9

SUMMARY OF DIFFICULT WASTE ARISINGS FOR LANTAU PORT

ITEM		WASTE ARISINGS
Container Port	-	wastes from leaking containers,
	-	wastes from interception pits,
	-	sludge from on-board processing of fuel oil,
	-	oily bilge water,
	-	bunker fuel tank ballast.
RTTWs	-	oily bilge water,
	-	wastes from leaking containers,
	-	wastes from interception pits.
Floating Docks/Ship Repair	-	possible one-off chemical wastes,
	-	asbestos, PCBs, foundry sand,
	-	grit/paint containing TBT, resins,
	-	solvents,
	-	Radioactive sources.
MSSA	-	similar to FD/SR,
Serviced land	-	laboratory chemicals, solvents, inks, resins, clinical wastes, possible low level radioactive sources.
Navigation Aids	-	Spent batteries.

Note: Only the oily wastes would be expected to arise in significant quantities, although it is likely that the Lamma Breakwater Reclamation if developed would give rise to significant difficult waste arisings.

11.6 OPERATIONAL WASTES - COLLECTION AND DISPOSAL

11.6.1 General Refuse

Overall arisings of general refuse were predicted in Section 11.5.8 and are anticipated to increase from 66t/d in 2001 to 209t/d in 2011. These wastes will arise over a total development area of 692ha.

Given that the LAPH development will contain a variety of small land parcels for container back-up, industrial/business use, and offices etc, the most appropriate collection system would be based on skips for individual premises, perhaps with packers at the larger waste producers such as container freight stations.

The Waste Disposal Plan for Hong Kong (1989) encourages waste minimisation and waste recovery. It is therefore likely that the overall quantities set out above may be reduced and it is possible that an organised separate collection system for recoverables such as paper and metals will be required.

It is proposed that the waste will be disposed of at the strategic landfill facility at WENT. In order to ensure that the waste is handled adequately on route to WENT, a number of waste collection and transportation options have been identified and evaluated, including the following:

i) Direct delivery to a proposed Refuse Transfer Station (RTS), outside the development, probably at Siu Ho Wan but possibly at Nim Shue Wan;

ii) a RTS for LAPH linked to the barging system for the Outlying Islands Refuse Transfer collection system; and

iii) a RTS for LAPH with transhipment of loaded containers to Siu Ho Wan for barging to WENT.

The selection of options for handling containerised wastes for marine transport will be based upon capital costs, road-transport logistics and policy considerations.

Given the extensive nature of the development, a transfer station might ideally be situated centrally, in or near the Serviced Land. However, this would dictate a need to road haul the loaded containers to be double-handled at a marine loading point. If the transfer station is within the Container Port, then loaded containers can be directly loaded to barge. As the Container Port is also the main source of waste, it is therefore considered to be the most likely site for a transfer station. The North Shore facilities would then be as close to Siu Ho Wan as the LAPH transfer station.

Whilst the NLD consultants gave consideration to the acceptance of LAPH wastes at Siu Ho Wan transfer station, this has not allowed for in the design of the station. Consequently there will be increased costs associated with the increase in capacity required to handle LAPH wastes. It is now necessary to carry out further detailed studies to establish the costs of:

- increased capacity of the North lantau RTS;
- road haulage of LAPH waste to North Lantau vs. the Container Port;
- capital costs of transfer station at the Container Port; and
- possible cost savings of exporting North Lantau containers via the Container Port.

Any firm plans for the borrow areas or Lamma Breakwater reclamation are likely to have a major effect on the planning of waste management for LAPH. The waste generation from these areas will otherwise have to be considered in proposals for these developments and separate management systems would need to be provided should development proceed.

11.6.2 Difficult Wastes

Overall production of difficult wastes is summarised in Table 11.9. Generally, the scale of production of these wastes will be small, typically including:

- single drums of absorbed waste from spillage or laboratory chemicals;
- single skips of asbestos waste from specific repair jobs;
- small tankers or drums for the periodic removal of interception wastes and ad-hoc disposals of small numbers of transformers; and
- skips of grit and paint possibly comprising organotin based paints such as tributyl tin.

These wastes can be collected on that basis for disposal to the CWTC on Tsing Yi. Only the oily wastes are likely to arise in bulk. It is understood that the use of bunker storage tanks is uncommon in Hong Kong, although the International Maritime Organisation (IMO, 1976) states that:

'Some 50-60% of ships may sometimes be faced with this requirement, and facilities for these residues will be needed at the great majority of ports...'

It goes on to say that:

'.... facilities for a minimum 500 tonnes dirty ballast water may be necessary. At deep sea container ports, much larger facilities may be required'.

The remaining oily wastes will be sludge from on-board processing of residual fuels, for which the facility to quickly remove 10t is recommended and oily bilge water, for which 100t storage is recommended. Guidance on actual arisings is not provided and this may need to be established by

visiting other facilities.

Essentially the options are either to rely on CWTC's MARPOL Waste Collection Service and/or to provide storage for oily wastes at the Container Port and RTTWs, possibly including oil/water separation facilities if the quantity of oily bilge water exceeds CWTC's capability. The CWTC MARPOL waste collection service will involve use of only one barge initially and possibly two at a later stage. Given the nature of port operations including 24hr/d operation and the need to avoid delays to ship departure, waste will arise at all times and reception facilities will need to be available on a similar basis.

However, as the Container Port will become operational one berth at a time (commencing in 1997, while the collection of MARPOL wastes from other Container Terminals will commence in 1993), it would seem prudent to rely on the CWTC service for any form of treatment at least initially, or until the likely scale of arisings can be forecast with more accuracy. Thus storage facilities only need to be allowed for initially to store fuel processing sludge and oily bilge water. At this stage it is necessary only to set aside a land reserve within the Port which could be used for another purpose if a facility is ultimately not required but conversely may have to be expanded or duplicated during later phases of development.

Clinical wastes from the health centre will arise in very small quantities, mainly sharps and dressings in sharps boxes. These can easily be transferred to CIF at Tuen Mun or hospital incinerators.

11.7 ENVIRONMENTAL IMPACTS

11.7.1 General

The objective of the foregoing analysis is to assist in the provision of adequate collection, storage and disposal systems for wastes, and to minimise environmental impacts. Wastes must be contained, transported and transfer-loaded in such a way as to prevent leakage or escape of the waste and to prevent the emission of odours, occurrence of fires, pests or dusts and any risk to public health.

There will however be potential residual environmental impacts from the waste management system amounting to:

- traffic impacts;
- visual and noise impacts of any transfer station; and
- accident risks of leakage of difficult wastes in storage or transport.

11.7.2 General Operational Waste

The general waste arising from the Lantau Port is predicted to be approximately 66t/d by the year 2001 and up to 209t/d in the year 2011.

Key Impacts

The key environmental impacts potentially associated with the transportation and handling of general refuse wastes relate to the following:

- noise from the collection, handling and transportation process;
- dust particularly from road transportation of wastes;
- leachate generated at waste collection sites and in vehicles used for waste transfer;
- odour; and
- litter.

Evaluation of waste transportation and handling options

Options (i) and (iii), as given in Section 11.6, both require double handling of the wastes arising prior to transportation by barge and therefore potentially will have more significant environmental impacts. Option (i) is not favoured due to the need for road transportation and therefore increased handling requirements.

The peak general waste forecast of 209 t/d in 2011 would amount to some 50 small skips or 12 container skips being moved daily either to Siu Ho Wan transfer station or within the LAPH development. This is considered to be an insignificant addition to the overall port related traffic. Containerised waste from any transfer station would amount to some 14 ISO containers daily, which would be less than the carrying capacity of one 2000t displacement barge.

Although only short distances are involved some noise, dust and odour impacts would be anticipated. Noise will be generated by all traffic movements and also the operation of vehicle machinery. Dust

would be generated by the movement of vehicles on unsurfaced roads and odours could be noticeable at both the loading and unloading areas.

Modern refuse collection vehicles have dedicated facilities for the collection of any leachate, this is not considered to be significant. However, spillage may occur if the vehicles are not properly maintained. Similarly, problems of littering along the transport route may be encountered if the vehicles are not properly enclosed. This also applies to transportation by barge. It is anticipated that vehicle/barge design will control this aspect.

The preferred option, number (ii), would require the provision of a water-side refuse transfer facility, allowing for direct transfer of the waste arising onto waiting barges. In addition, it is possible that a RTS for LAPH could be developed to also cater for the wastes arising in the Discovery Bay and possible residential expansion areas. It is important that the forecasted waste arisings in those areas surrounding the Lantau Port are considered in the planning and detailed design of the RTS.

Option (ii) which links the transportation arrangements with the barging system for the Outlying Islands could potentially reduce the number of journeys required by barge to the WENT landfill and therefore the number of waste handling and transfer operations. However, the feasibility and compatibility of this arrangement will need to be confirmed by the recently commissioned consultancy study for the Outlying Islands Refuse Transfer Facilities.

A subjective comparison of environmental impacts associated with the three waste management options is summarised in Table 11.10 below.

TABLE 11.10

SUMMARY OF POTENTIAL WASTE HANDLING AND COLLECTION IMPACTS

Options	Noise	Dust	Odour	Leachate	Litter
(i)	**	**	**	*	*
(ii)	*	*	*	*	*
(iii)	**	**	**	*	*

Significance of impacts: * minor; ** significant; *** severe

Recommendations

It is considered that given the relatively small quantities of general waste arising from the Port that the provision of a purpose designed refuse transfer facility will minimise the potential environmental impacts. Thus, incorporation of the Port's waste management system into the Outlying Islands waste collection system will be the key requirement. Therefore a site for a RTS with a marine frontage to enable collection of waste by barge will be reserved in the land-use plan.

A transfer station for 200t/d would comprise a relatively small light industrial building with mobile cranes for loading barges. Such facilities are currently located in industrial areas, where noise impacts and visual intrusion are expected to be negligible. Landscaping and noise mitigation would have to be assessed once a specific location is chosen and detailed design is undertaken.

11.7.3 Difficult wastes

Difficult wastes would arise in small quantities on an ad-hoc basis with the exception of oily wastes. It has proved difficult to reliably quantify the oily wastes and IMO suggests 'much larger' than 500 tonnes storage for bunker fuel tanker ballast. As an example, if the oily waste amounted to 1000 tonnes, and was emptied weekly, then this would correspond to some 50 large road tankers which would not be significant in terms of traffic impact. It is possible that this type of waste would be transferred to the CWTC by barge with even less associated traffic impacts.

11.7.4 Construction Wastes

The main impacts resulting from construction wastes would be the marine impacts of reclamation and spoil dumping. These impacts are discussed in Section 6.

Transport impacts are likely to occur within the site during the construction phases, when overall heavy plant activity would be high and is unlikely to be perceived separately from the overall movement.

11.8 MONITORING AND AUDIT REQUIREMENTS

11.8.1 Objectives

The objectives of monitoring is twofold:

- to ensure that waste production is within forecast quantities and can be dealt with at facilities provided within or outside the LAPH development; and

- to ensure that storage and collection facilities are operated to high environmental standards.

11.8.2 Waste Quantities

Monitoring of waste quantities is particularly important in the case of both oily MARPOL wastes, the production of which may be in large quantities, and wastes from the container handling and back-up areas, which is the largest producer of general wastes. In both cases, the slow build up from 1 berth to 17 berths provides an opportunity to use the early years of operation to accurately gauge waste production. Records should therefore be maintained by the operators of all waste movements within and from the LAPH. This could be a system similar to the UK 'Duty of Care' Transfer Note and Description System. Records would need to be collected and evaluated by the appropriate Authority.

11.8.3 Operations

Major facilities such as oil storage or transfer stations would require a licence setting out operating conditions, the facilities would then be inspected frequently by the EPD staff for compliance. It is not envisaged that the facilities cause significant impacts as it is anticipated that they would be designed and operated to modern standards and appropriate monitoring would be a licence condition.

11.9 CONCLUSIONS

11.9.1 Construction Phase

The main waste arisings will be marine mud, which will be disposed of by marine dumping. A dump site has to be identified. Some of the mud will be contaminated and special disposal requirements will be necessary. The quantity of contaminated mud is anticipated to be in the order of 275,000m^3 for Phase I and 575,000m^3 up to and including Phase IV. In addition it is possible that contaminated material from the Cheoy Lee shipyard may require disposal during the re-development of that area.

11.9.2 Operational Phase

Some 200t of general waste will arise daily in 2011. This could be directly delivered to the Siu Ho Wan transfer station, or to a purpose built transfer facility on the Container Port. The marine transport of the waste to WENT should be integrated with that of waste from the other Lantau and Outlying Islands transfer stations. Siu Ho Wan wastes could be barged from the Container Port.

Difficult wastes will generally arise in small quantities on an ad-hoc basis, and collection and disposal will have to be organised appropriately. All of these wastes are likely to be suitable for disposal at Tsing Yi CWTC if capacity permits.

With regard to oily wastes a decision will need to be taken on whether to rely on the CWTC MARPOL barge collection service, or to provide storage facilities at LAPH. As development will proceed on a phased basis it is recommended that the CWTC service be used initially, enabling a more accurate assessment of future storage and disposal requirements to be made before a decision is taken on facilities at LAPH.

11.9.3 Recommendations

Detailed Waste Management

Further detailed study is required to confirm waste storage and disposal options and requirements. This must include policy input, that is, government's view as to whether both the CWTC and its MARPOL collection and reception facilities should be used and would have sufficient capacity and is logistically suitable.

Shipyard: Potentially Contaminated Site

Further investigation including surveys and sampling will be necessary to determine both whether the Cheoy Lee shipyard site is contaminated, and any subsequent implications.