

6 SOLID WASTE MANAGEMENT

6.1 INTRODUCTION

This Section identifies the potential waste management impacts associated with the Sham Tseng Development (STD) and provides an assessment of the potential environmental impacts associated with the handling and disposal of the solid wastes generated during both the construction and operation phases.

The options for reuse, minimisation, recycling, treatment, storage, collection, transport and disposal of wastes arising from the Project have been examined. Where appropriate, procedures for waste reduction and management are considered and environmental control measures for avoiding and minimising the potential impacts are recommended.

6.2 ENVIRONMENTAL LEGISLATION POLICIES, PLANS, STANDARDS AND CRITERIA

The criteria for evaluating potential waste management implications are laid out in the Annex 7 of the *Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM)*. The following legislation covers or has some bearing upon the handling, treatment and disposal of waste in HKSAR, will also be used as assessment criteria:

6.2.1 Government Legislation

- *Waste Disposal Ordinance (Cap 354)*;
- *Waste Disposal (Chemical Waste) (General) Regulation (Cap 354)*;
- *Land (Miscellaneous Provisions) Ordinance (Cap 28)*;
- *Public Health and Municipal Services Ordinance (Cap 132) - Public Cleansing and Prevention of Nuisances Regulation*; and
- *Dumping at Sea Ordinance (1995)*.

Waste Disposal Ordinance

The *Waste Disposal Ordinance (WDO)* prohibits the unauthorised disposal of wastes, with waste defined as any substance or article which is abandoned. Construction and Demolition (C&D) waste is not directly defined in the WDO but is considered to fall within the category of "trade waste". Trade waste is defined as waste from any trade, manufacturer or business, or any waste building, or civil engineering materials, but does not include animal waste.

Under the WDO, wastes can only be disposed of at a licensed site. A breach of these regulations can lead to the imposition of a fine and / or a prison sentence. The WDO also provides for the issuing of licences for the collection and transport of wastes. Licences are not, however, currently required to be issued for the collection and transport of C&D waste and / or trade waste.

Waste Disposal (Chemical Waste) (General) Regulation

Chemical waste as defined under the *Waste Disposal (Chemical Waste) (General) Regulation* includes any substance being scrap material, or unwanted substances specified under *Schedule 1* of the *Regulation* if such substance or chemical occurs in such a form, quantity or concentration so as to cause pollution or constitute a danger to health or risk of pollution to the environment.

A person should not produce, or cause to be produced, chemical wastes unless he is registered with the EPD. Any person who contravenes this requirement commits an offence.

Producers of chemical wastes must treat their wastes, utilising on-site plant licensed by the EPD, or have a licensed collector take the wastes to a licensed facility. For each consignment of wastes, the waste producer, collector and disposer of the wastes must sign all relevant parts of a computerised trip ticket. This system is designed to allow the transfer of wastes to be traced from cradle to grave.

The *Regulation* prescribes the storage facilities to be provided on site including labelling and warning signs. To minimise the risks of pollution and danger to human health or life, the waste producer is required to prepare and make available written procedures to be observed in the case of emergencies due to spillage, leakage or accidents arising from the storage of chemical wastes. He must also provide employees with training in such procedures.

Land (Miscellaneous Provisions) Ordinance

Inert Construction and Demolition Material (C&DM) (or public fill) may be taken to public filling areas which usually form part of land reclamation schemes and are operated by the Civil Engineering Department (CED). The *Land (Miscellaneous Provisions) Ordinance* requires that public filling licences are obtained by individual or company who delivers public fill to public fillings areas to obtain a licence. The licence is issued by the CED under delegated powers from the Director of Lands.

Individual licence and windscreen stickers are issued for each vehicle involved. Under the licence conditions, the public filling areas will accept only inert building debris, soil, rock and broken concrete. There is no size limitation on the rock and broken concrete, and a small amount of timber mixed with other suitable material is permissible. The material should, however, be free from marine mud, household refuse, plastic, metal, industrial and chemical waste, animal and vegetable matter and any other material considered unsuitable by the site supervisor.

Public Cleaning and Prevention of Nuisances By-Laws

These *By-laws* provide a further control on the illegal tipping of waste on unauthorised (unlicensed) sites. The illegal dumping of waste can lead to fines and imprisonment.

Dumping at Sea Ordinance

This *Ordinance* came into operation in April 1995 and empowers the Director of Environmental Protection (DEP) to control the disposal and incineration of substances and articles at sea for the protection of the marine environment. Under the *Ordinance*, a permit from the DEP is required for the disposal of regulated substances within and outside the waters of HKSAR. The permit contains terms and conditions that includes the following specifications:

- type and quantity of substances to be dumped;
- location of the disposal grounds;
- requirement of equipment for monitoring the disposal operations; and
- the need for environmental monitoring.

Additional Guidelines

Other 'guideline' documents which detail how the contractor should comply with the regulations are as follows:

- *Waste Reduction Framework Plan, 1998 to 2007*, Planning, Environment and Lands Bureau, Government Secretariat (5 November 1998);
- *Environmental Guidelines for Planning In Hong Kong (1990)*, Hong Kong Planning Standards and Guidelines, Hong Kong Government;
- *New Disposal Arrangements for Construction Waste (1992)*, Environmental Protection Department and Civil Engineering Department;
- *Code of Practice on the Packing, Labelling and Storage of Chemical Wastes (1992)*, Environmental Protection Department;
- *Technical Circular No. 1-1-92 Classification of Dredged Sediments for Marine Disposal*, Environmental Protection Department;
- *Works Branch Technical Circular (WBTC) No. 6/92, Fill Management*;
- *Works Branch Technical Circular No. 22/92, Marine Disposal of Dredged Mud*;
- *Works Branch Technical Circular No. 2/93, Public Dumps*;
- *Works Branch Technical Circular No. 16/96, Wet Soil in Public Dumps*;
- *Works Bureau Technical Circular No. 4/98, Use of Public Fill in Reclamation and Earth Filling Projects*;

- *Works Bureau Technical Circular No. 5/98, On-site Sorting of Construction Waste on Demolition Site;*
- *Works Bureau Technical Circular No. 5/99, Trip-ticket System for Disposal of Construction and Demolition Material;*
- *Works Bureau Technical Circular No. 25/99, Incorporation of Information on Construction and Demolition Material Management in Public Works Subcommittee Papers; and*
- *Works Bureau Technical Circular No. 3/2000, Management of Dredged/Excavated Sediment.*

6.3 DESCRIPTION OF THE ENVIRONMENT

6.3.1 Baseline Condition

Sham Tseng is situated within Tsuen Wan Waste Arisings Area. Municipal solid waste (MSW) and C&D waste generated in Sham Tseng are currently direct disposed of at Western New Territories (WENT) Strategic Landfill. The WENT Strategic Lanfill was commissioned in November 1993 and has a design capacity and void capacity of about 61 million m³ and 53 million m³ respectively. Based on the current waste input forecasts, and making allowances for the implementation of the Waste Reduction Plan, the HKSAR's strategic landfills will be filled by 2019.

On-site sediment sampling and laboratory analysis have been undertaken between October and December 1999. The sediment quality of the samples, with reference to the *Works Bureau Technical Circular No. 3/2000* for sediment classification, are reported in *Table 6.6b*. The results indicated that quality of the sediment samples near the mouths of the existing Sham Tseng East and West Nullahs is contaminated and careful handling procedures are required if they are dredged. Other sediment samples collected are uncontaminated. Details are presented in *Section 6.6*.

6.4 ASSESSMENT METHODOLOGY

6.4.1 General

The potential environmental impacts due to management of the wastes arising from the Project will be assessed in accordance with the criteria presented in *Annexes 7 and 15* of the *EIAO-TM* and are summarised as follows:

- estimation of the types and quantities of the wastes to be generated;
- assessment of the secondary environmental impacts due to the management of waste with respect to potential hazards, air and odour emissions, noise, wastewater discharges and traffic; and
- assessment of the potential impacts on the capacity of waste collection,

transfer and disposal facilities.

6.4.2 *Marine Dredged Sediments*

Dredged sediments destined for marine disposal are classified according to their level of contamination by seven heavy metals as stipulated in the *EPDTC No. 1-1-92*. The seven metals are cadmium (Cd), chromium (Cr), copper (Cu), mercury (Hg), nickel (Ni), lead (Pb) and zinc (Zn). Definition of the classification is as follows:

Table 6.4a *Classification of Dredged Sediment*

Class	Type
Class A	Uncontaminated material, for which no special dredging, transport or disposal methods are required beyond those which would normally be applied for the purpose of ensuring compliance with EPD's Water Quality Objectives (WQO), or for protection of sensitive receptors near the dredging or disposal areas.
Class B	Moderately contaminated material, which requires special care during dredging and transport, and which must be disposed of in a manner which minimises the loss of pollutants either into solution or by resuspension.
Class C	Seriously contaminated material, which must be dredged and transported with great care, which cannot be dumped in the gazetted marine disposal grounds and which must be effectively isolated from the environment upon final disposal.

Table 6.4b *Classification of Sediments by Metal Content (mg per kg dry weight)*

Class	Cd	Cr	Cu	Hg	Ni	Pb	Zn
Class A	0.0-0.9	0-49	0-54	0.0-0.7	0-34	0-64	0-149
Class B	1.0-1.4	50-79	55-64	0.8-0.9	35-39	65-74	150-199
Class C	1.5 or more	80 or more	65 or more	1.0 or more	40 or more	75 or more	200 or more

It should be noted that for sediments to be identified within a particular class, the concentration of only one metallic species needs to be exceeded. In the case of both Class B and Class C contamination, the final determination of appropriate disposal options, routing and the allocation of a permit to dispose of material at the designated disposal site will be made by the EPD and Fill Management Committee (FMC) in accordance with *WBTC 22/92*.

The new regulatory guidelines for contaminated sediments is recently promulgated by the Works Bureau and has been agreed by Environment and Food Bureau and these will include a new set of sediment quality criteria, as presented in *Table 6.4c*, which may include organic pollutants and other toxic substances, as well as a new class of contamination level for highly contaminated sediment which is not suitable for marine disposal.

Table 6.4c Sediment Quality Criteria for the Classification of Sediment

Contaminants	Lower Chemical Exceedance Level (LCEL)	Upper Chemical Exceedance Level (UCEL)
<i>Metals (mg kg⁻¹ dry weight)</i>		
Cd	1.5	4
Cr	80	160
Cu	65	110
Hg	0.5	1
Ni	40	40
Pb	75	110
Silver (Ag)	1	2
Zinc (Zn)	200	270
<i>Metalloid (mg kg⁻¹ dry weight)</i>		
Arsenic (As)	12	42
<i>Organic-PAHs (mg kg⁻¹ dry weight)</i>		
Low Molecular Weight (LMW) PAHs	550	3160
High Molecular Weight (HMW) PAHs	1700	9600
<i>Organic-non-PAHs (mg kg⁻¹ dry weight)</i>		
Total PCBs	23	180
<i>Organometallics (mg TBT L⁻¹ in interstitial water)</i>		
Tributyltin	0.15	0.15

As the construction of the STD will commence after 1 January 2002 the sampling and testing procedures for the Sediment Quality Report (SQR) should follow the *Works Bureau Technical Circular 3/2000*. The SQR should be submitted during the detail design stage for the purpose of obtaining a dumping permit.

In addition, in accordance with *WBTC Nos 6/92 and 22/92 and Building Ordinance Office Practice Note for Authorised Persons and Registered Structural Engineers No 155*, any proposal to remove more than 500 000 m³ of clean mud or any quantity of contaminated mud must be justified on both cost and environmental grounds and rationale for such removal should be provided to enable an allocation for disposal to be considered. It is desirable, therefore, to demonstrate that the proposed mud dredging is the minimum necessary, and to obtain in-principle agreement from the GEO at the early stage.

6.5 IDENTIFICATION OF ENVIRONMENTAL IMPACTS

6.5.1 Construction Waste Impacts

General

As detailed in *Sections 2.2, 2.4 and Table 2.6a*, the STD and the endorsed Master Development Plan (MDP) will involve a wide range of construction activities which will lead to the generation of solid wastes. The construction programme is provided in *Figure 2.7b*. Major construction activities are listed below:

STD:

- site clearance and demolition of existing unwanted structures
- dredging / excavation;
- construction of seawall / reclamation;
- construction of marine basin and ferry facilities;
- construction of west and east nullahs;
- construction of west and east nullah deckings;
- construction of road and drains;
- construction of Sham Tseng Bypass and raised promenade;
- construction of 3 number of box culverts; and
- landscape works.

The above works will start in November 2004 and complete in August 2012.

MDP:

- housing developments to accommodate a maximum of about 4 470 flats and 14 010 residents;
- three schools;
- an government complex;
- the Sewage Treatment Facilities for Sham Tseng Development;
- a salt water pumping station;
- a Public Transport Terminus (PTT); and
- a marine basin.

It is suggested that the construction of the above structures will commence in November 2004 and will be completed by January 2014.

The construction activities identified above will result in the generation of a variety of wastes which can be divided into distinct categories on their constituents, as follows:

- dredged material;
- construction and demolition material;
- chemical waste; and
- general refuse.

The nature and quantity of each of these waste types arising from the construction of the STD are identified below.

Dredged Material

The proposed reclamation in Sham Tseng will be approximately 15.2 ha. To minimise the amount of sediment to be dredged, dredging will be limited to the small area in order to minimise the total volume of sediment to be dredged.

Use of Public Fill for the Reclamation

The use of public fill as filling material may give rise to floating debris during reclamation. Part of the reclamation will be designated as a public filling area. Public fill comprising earth, building debris and broken concrete may contain a small amount of floatable materials such as timber, plastic and paper. If not properly controlled, it may give rise to floating refuse.

Construction and Demolition Material

Construction and Demolition Material (C&DM) ⁽¹⁾ may be generated from the construction works as mentioned above. C&DM comprises unwanted materials generated during construction, including excavated material, rejected structures and materials, materials which have been over ordered or are surplus to requirements and materials which have been used and discarded. C&DM will arise from a number of construction and maintenance activities and may include:

- wood from formwork and falsework;
- equipment and vehicle maintenance parts;
- materials and equipment wrappings;
- unusable / surplus concrete / grouting mixes; and
- damaged / contaminated construction materials.

The disposal of any bentonite slurry generated during construction works should follow the requirements of *ProPECC Note 1/94 - Construction Site Drainage*.

Excavated material is defined as inert virgin material removed from the ground and sub-surface. According to the layout of the proposed Sham Tseng site and available engineering information, the quantity of excavated material generated from STFR is small. It is expected that excavated material will also be generated during the construction of building foundations.

C&DM will also be generated through the demolition of the existing roads and buildings. The C&DM arisings are likely to be restricted to the buildings along the existing seafront which include the kaito pier at Anglers' Beach (concrete structure with metal roof), existing dolphins (steel structure with concrete cap) offshore of the Brewery San Miguel redevelopment site and the roadworks at the interface of the proposed Sham Tseng Bypass and Castle Peak Road. This will comprise primarily of crushed concrete, steel and general refuse. Based on the available information, it is expected that the volume of C&DM will be small.

If not properly managed, the storage, handling, transport and disposal of C&DM have the potential to create visual, waste, dust and traffic impacts.

Chemical Waste

⁽¹⁾ Construction and Demolition Material (C&DM) contains a mixture of inert and non-inert material. The inert portion is the "public fill". The non-inert portion is the "C&D waste".

Chemical waste, as defined under the *Waste Disposal (Chemical Waste) (General) Regulation*, includes any substance being scrap material, or unwanted substances specified under *Schedule 1* of the *Regulation*. A complete list of such substances is provided under the *Regulation*, however substances likely to be generated by construction activities for the STD will, for the most part, arise from the maintenance of equipment. These may include, but need not be limited to the following:

- scrap batteries or spent acid/alkali from their maintenance;
- used engine oils, hydraulic fluids and waste fuel;
- spent mineral oils/cleaning fluids from mechanical machinery; and
- spend solvents/solutions, some of which may be halogenated, from equipment cleaning activities.

If not properly managed, the storage, handling, transport and disposal of chemical waste will cause adverse environmental impacts and health risk to the public.

General Refuse

The presence of a construction site with large numbers of workers, and site offices and canteens will result in the generation of a variety of general refuse requiring disposal. General refuse will mainly consist of food waste, aluminium cans and waste paper.

The storage of general refuse has the potential to give rise to adverse environmental impacts. These include odour if the waste is not collected frequently (for example, daily), windblown litter, water quality impacts if waste enters water bodies, and visual impact. The sites may also attract pests, vermin, and other disease vectors if the waste storage areas are not well maintained and cleaned regularly. In addition, disposal of wastes at sites other than approved landfills can also lead to similar adverse impacts at those sites.

6.5.2 *Operation Waste Impacts*

Municipal Solid Waste

Municipal solid waste will arise from the residential buildings, commercial buildings, government, institution and community (G/IC) facilities. The storage and handling of municipal solid waste have the potential to give rise to adverse environmental impacts. These may include odour if waste is not collected frequently, litter, water quality impacts if waste enters storm water drains, visual impact and vermin problems if the waste storage area is not well maintained and cleaned regularly. In addition, disposal of wastes at sites other than approved waste transfer or disposal facilities, can also lead to similar adverse impacts at those sites.

Sewage Sludge

Treatment of sewage will generate sludge which will require proper treatment and disposal. In addition to the planned TKSTSTW, Sewage Treatment Facilities for Sham Tseng Development will be constructed to handle additional sewage generated from the proposed STD. The increase in the volume of sludge to be disposal of at landfill will increase the demand in landfill void space.

6.6 PREDICTION AND EVALUATION OF ENVIRONMENTAL IMPACTS

6.6.1 Construction Waste Impact

General

The nature of waste arising from the construction of the STD and the potential environmental impacts which may arise from their handling, storage, transport and disposal are discussed under the headings of each waste type below.

Dredged Materials

To minimise the amount of sediment to be dredged, dredging of sediment should be limited to the seawall area where soft marine sediment needs to be removed and replaced with marine sand. This arrangement will generate approximately 354 000 m³ of dredged sediment, of which 127 000 m³ of dredged sediment will be generated from the dredging of marine basin.

Table 6.6a provides a breakdown of dredged materials produced from the dredging activities.

Table 6.6a Volume of Dredged Materials at Seawall and Its Breakdown

Sources	Volume to be Dredged at Seawall (m ³)	Duration		
		Phase	From	To
Seawall	227 000	1	12/11/2004	11/01/2005
		2	19/11/2005	06/12/2005
		3	14/03/2006	11/04/2006
		4	19/11/2005	06/12/2005
Marine Basin	127 000	1	12/11/2004	11/01/2005
<i>Total</i>	<i>354 000</i>			

The chemical characteristics of the sediment to be dredged at the seawall has been determined under the Site Investigation. Vibrocores samples were collected from the proposed STD area (Figure 6.6a) and tested for the following parameters:

- heavy metals: Cd, Cr, Cu, Ni, Pb, Ag, Zn and Hg;
- Arsenic (As);
- PAHs;
- PCBs;
- TBT.

The above parameters have taken into account the requirements of the existing EPDTC 1-1-92 and chemical screening of the proposed new sediment

classification system.

The analysis results are presented in *Table 6.6b*. The results show that the quality of sediment in the proposed reclamation area is generally uncontaminated except at vibrocore locations SQ11 and SQ13, which are located at the mouths of the Sham Tseng East and West Nullahs, respectively. The sediment samples collected at depths 1.9 m to 2.3 m at SQ11 contains high level of total PCBs which exceed the LCEL of the *Works Bureau Technical Circular No. 3/2000*. Whereas the sediment samples collected at depths between 0.9 m to 1.8 m at SQ13 show high levels of Zn and Cr and are classified as Class C sediment according to the existing *EPDTC 1-1-92*, and exceed the UCEL of the *Works Bureau Technical Circular No. 3/2000*.

Table 6.6b Results of Marine Bottom Sediment Quality Analysis

Vibrocore Station	Sample Depth (m)	Moisture Content (%)	Ag (mg kg ⁻¹)	As (mg kg ⁻¹)	Cd (mg kg ⁻¹)	Cr (mg kg ⁻¹)	Cu (mg kg ⁻¹)	Ni (mg kg ⁻¹)	Pb (mg kg ⁻¹)	Zn (mg kg ⁻¹)	Hg (mg kg ⁻¹)	Total PCB (µg kg ⁻¹)	LMW PAHs (µg kg ⁻¹)	HMW PAHs (µg kg ⁻¹)	TBT (µg-Sn kg ⁻¹)
SQ1	Rock bottom. Unable to collect sediment samples.														
SQ2	Rock bottom. Unable to collect sediment samples.														
SQ3	0.0 - 0.2	13	<0.05	0.4	<0.2	0.32	1.08	0.6	71.4	13	<0.02	<2	<50	<50	<0.5
SQ4	0.0 - 0.4	17.9	<0.05	0.5	<0.2	0.28	0.85	0.35	24.4	32.1	<0.02	<2	<50	<50	<0.5
SQ4	0.65 - 1.05	13	<0.05	<0.1	<0.2	<0.05	0.26	0.06	29.7	33.4	<0.02	<2	<50	<50	<0.5
SQ5	0.0 - 0.4	17.4	<0.05	0.3	<0.2	2.03	2.18	1.6	8.16	15.7	<0.02	<2	<50	<50	<0.5
SQ6	0.05 - 0.45	14.5	<0.05	1.1	<0.2	2.07	0.6	0.4	5.89	7.81	<0.02	<2	<50	<50	<0.5
SQ7	0.0 - 0.9	27.6	0.1	5.2	<0.2	9.01	5.19	5.18	22.6	32.4	<0.02	<2	<50	<50	<0.5
SQ7	0.9 - 1.8	32.3	0.16	5.1	0.3	10.7	7.05	5.73	35.6	45.9	<0.02	<2	<50	<50	<0.5
SQ7	1.9 - 2.3	31.4	0.16	5	0.3	13.5	8	7.24	40.9	52.7	0.02	<2	<50	<50	<0.5
SQ7	2.9 - 3.3	19.2	0.1	2	<0.2	3.69	1.78	1.3	19.6	21.4	<0.02	<2	<50	<50	<0.5
SQ8	0.0 - 0.4	10.8	<0.05	2.2	<0.2	3.03	4.34	3.43	11.4	14.4	<0.02	<2	<50	<50	<0.5
SQ9	0.1 - 0.5	19.2	0.06	1.3	<0.2	0.89	3.39	1.56	16.3	20.5	<0.02	<2	<50	<50	<0.5
SQ9	0.9 - 1.3	8.9	0.07	0.8	<0.2	0.8	1.66	0.72	8.84	9.9	<0.02	<2	<50	<50	<0.5
SQ10A	0.0 - 0.4	19.6	0.07	10.1	<0.2	4.68	3.89	6.89	15.4	28.3	<0.02	<2	<50	<50	<0.5
SQ10A	0.9 - 1.3	18.2	0.1	1.8	<0.2	0.93	1.94	2.02	37.1	45.2	<0.02	<2	<50	<50	<0.5
SQ10AC	1.9 - 2.3	16	0.07	2.2	<0.2	3.01	1.82	2.87	16.3	23.8	<0.02	<2	<50	<50	<0.5
SQ10A	2.7 - 3.1	15.7	0.09	4.8	<0.2	0.91	2.67	0.95	48.2	34.4	<0.02	<2	<50	<50	<0.5
SQ11	0.6 - 0.9	20.9	0.06	1.5	0.4	4.27	5.46	2.29	36.7	38.1	0.09	7	<50	<50	1
SQ11	0.9 - 1.8	15.9	0.06	0.7	<0.2	2.13	4.39	1.43	47.2	32.9	0.04	6	<50	<50	1
SQ11	1.9 - 2.3	21.3	0.11	0.3	<0.2	8.69	10.1	4.63	45.2	66.8	0.06	80	<50	<50	1
SQ11	2.9 - 3.3	15.8	<0.05	2.4	<0.2	4.47	3.8	2.92	14.7	16.3	0.06	13	<50	66	<0.5
SQ12	Alluvium. Unable to collect sufficient sediment samples for analysis.														
SQ13	0.46 - 0.9	10.4	0.2	2.3	<0.2	12.6	15.5	3.15	31.4	43.8	0.08	3	52	300	5
SQ13	0.9 - 1.8	27.2	0.26	3.2	0.3	175	68.6	7.64	81.6	443	0.14	23	190	890	22
SQ13	1.9 - 2.3	20.2	<0.05	3.2	<0.2	5.49	2.17	2.67	11.5	21.5	<0.02	<2	<50	<50	<0.5
EPD	Class A	0.0 - 0.9													
TC 1-1-92	Class B	0 - 49													
	Class C	1.0 - 1.4													
		50 - 79													
		1.5 or more													
		80 or more													
		65 or more													
		40 or more													
		75 or more													
		200 or more													
Works	LCEL	1	12	1.5	80	65	40	75	200	0.5	23	550	1700	0.15 ^(b)	
Bureau	UCEL	2	42	4	160	110	40	110	270	1	180	3160	9600	0.15 ^(b)	
TC 3/2000															

Note:
(a) Values which are bolded and italicised exceed either Class B or C values specified in EPD TC 1-1-92 or UCEL of the proposed New TC.
(b) The unit should be µg TBTI⁻¹ in interstitial water

Currently there is no assessment criterion for TBT concentrations in sediment. Assessment of the TBT results from the current study is therefore made by comparing with data previously gathered in a study on TBT contamination of the marine environment in HKSAR⁽²⁾ which presents a range of uncontaminated and contaminated sites in HKSAR. A 25th percentile values from the TBT contamination study, equivalent to approximately 5.8 µg-Sn kg⁻¹ (with sampling data range from <1 to 1172 µg-Sn kg⁻¹) was employed here as a reference value for the purpose of comparison. It is found that except at vibrocore station SQ13, the TBT levels measured at all vibrocore stations and at all depths are well below 5 µg-Sn kg⁻¹. This reflects that the TBT levels of the sediment in STD area (except at SQ13) is substantially lower than the 25th percentile of TBT levels of sediment recorded from a range of uncontaminated and contaminated sites in Hong Kong. However, the lack of formal criterion prevents any conclusive evaluation of whether the levels recorded in the STD area are of concern.

In addition, a list of organic-PAHs (see *Table 6.6c*) has also been tested. The results show that levels of these organics are either below the detection limits or close to the detection limits. It is therefore concluded that they are not a major area of concern. The parameters tested and their limits of detection are listed in *Table 6.6c*.

Table 6.6c *PAHs Tested and Their Individual Detection Limits*

Organic PAH	Detection Limits (µg kg ⁻¹ dry weight)
Lower Molecular Weight PAHs	
Naphthalene	10
Acenaphthylene	5
Acenaphthene	5
Fluorene	5
Phenanthrene	5
Anthracene	5
Higher Molecular Weight PAHs	
Fluoranthene	5
Pyrene	5
Benz (a) anthracene	5
Chrysene	5
Benzo(b) & (k) fluoranthene	10
Benzo (a) pyrene	5
Indeno (1,2,3-cd) pyrene	5
Dibenz(a,h) anthracene	5
Benzo(g,h,i) perylene	5

From the above analytic results, it is concluded that the sediment of the proposed STD area is generally uncontaminated, except for vibrocore stations SQ11 and SQ13. It is therefore considered that the sediment dredged from the proposed STD, except for those around SQ11 and SQ13, are suitable for open sea disposal at the gazetted marine dumping grounds or exhausted borrow pits, such as the south of Cheung Chau, east of Ninepin and North Lantau borrow pit. However, SQ11 and SQ13 are located near the nullah and is not expect to be dredged under the current construction plan.

(2) Aspinwall (1998). A Study of Tributyltin Contamination of the Marine Environment of Hong Kong. Prepared for the Environmental Protection Department, Hong Kong Government.

If sediment to be dredged at SQ11 and SQ13, it is recommended that further chemical screening and biological testings should be carried out in accordance with the *Works Bureau Technical Circular No. 3/2000*. The further tests aim to gather sufficient information to determine the extent of sediment contamination in vicinity of SQ11 and SQ13 (both laterally and vertically), and to confirm whether treatment of sediment would be required before disposal. Seriously contaminated sediment which do not require special treatment should be disposed of at the East Sha Chau Contaminated Mud Pit.

As prior to site investigation only sediment at seawall will be dredged, vibrocore samples are taken at seawall but not within the reclamation where the sediment deposit located. However, it is expected that the sediment quality at seawall would be similar to those within the STD.

From the sediment quality at the seawall, it is expected that most of the sediment to be dredged within STD is likely to be uncontaminated. However, a small portion of these dredged may be contaminated and may require further testing (e.g. biological screening) before final disposal site can be determined.

Special dredging procedures (*Section 6.7*) should be followed in order to avoid adverse environmental impacts. Marine disposal of dredged materials should follow the requirements of the *Dumping at Sea Ordinance 1995*, which has recently replaced the *Dumping at Sea Act 1974 (Overseas Territories) Order 1975 (App. III, p. DK1)* in its application to HKSAR.

Use of Public Fill for the Reclamation

The STD requires a large amount of fill material (total of about 2.5 million m³) (see *Table 6.6d*) and therefore offers a very good opportunity to utilise the public fill generated in the HKSAR. The use of public fill will not only alleviate the demand for virgin fill material but also reduce the pressure of disposing inert construction and demolition materials at the strategic landfills. The STD will maximise the use of good quality public fill generated in the HKSAR. Within the filling period, the STD will utilise about 1.7 million m³ of public fill which is about 70% of the total fill requirement.

Table 6.6d *Estimated Fill Requirement for STD*

Fill Type	Volume in m³
Sorted Public Fill	455 000
Public Fill	1 230 000
Sand Fill	205 000
Rock Fill	584 500
Filter Layer	38 000
Total	2 512 500

The public fill, while relatively chemically inert, may contain a small amount of floating debris. If not properly managed, the floating debris may result in

impacts and, if allowed to float into the marine channel, may cause damage to marine craft. Provided that mitigation measures such as the use of surface booms to contain the floating debris, are properly implemented, no insurmountable environmental impacts with regards to floating debris will be anticipated.

Construction and Demolition Material

C&D Material from Demolition of Existing Structures: At this stage it is acknowledged that the kaito pier at Anglers' Beach (concrete structure with metal roof) and the existing dolphins (steel structure with concrete cap) offshore of the former San Miguel Brewery redevelopment site are required to be demolished for the construction of STD. Demolished metal structures may be recycled. Also, demolition material will be generated during roadworks construction at the interfaces between the proposed Sham Tseng Bypass and Castle Peak Road. The total amount of demolition material is estimated to be 6 000m³ (55 000m³ inert material and 500m³ C&D waste).

It is recommended that the demolition Contractor should adopt the selective demolition method so that re-usable material, like wood and metal, can be segregated and recycled. Degradable materials can be disposed of at landfills and inert demolition material can be re-used on site or delivered to public filling area (for examples at Tsuen Wan Bay Further Reclamation, Area 35, both of the projects will require import of public fill in 2004⁽³⁾), public filling barging points and land formation sites.

C&D Material from Construction of STD and MDP: The volume of material to be excavated from the construction of building foundations. The nature of the excavated materials will be the same as the fill material which is clean and can be reused for other reclamation projects. Due to the inert nature of the excavated material, it is anticipated that the disposal of this material at the reclamation will not cause adverse environmental input. Therefore, it is expected that relevant potential impacts are minimal. The total amount of C&DM generated from excavation works is estimated to be 25 000m³ (22 500m³ inert material and 2 500m³ C&D waste).

The amount of C&DM generated from construction of new buildings could be estimated based on the domestic gross floor area (GFA) in which a waste generation rate of 0.1 m³ m⁻² of GFA⁽⁴⁾ could be applied.

The development schedule for the residential developments suggests that a total of about 331 820 m² of domestic gross floor area (GFA) and 7 000 m² of commercial GFA will be constructed within the proposed development sites.-

⁽³⁾ Civil Engineering Department (1998). Review of Public Filling Strategy and Programme. *Final Report*, February 1998.

⁽⁴⁾ Hong Kong Polytechnic (1993). Reduction of Construction Waste *Final Report*.

Based on a waste generation rate of $0.1 \text{ m}^3 \text{ m}^{-2}$ of GFA to be constructed, approximately $33\,900 \text{ m}^3$ (about 60 988 tonnes, assuming a bulk density of $1.8 \text{ tonne per m}^3$) of C&DM will be generated during the period between January 2008 and January 2014 (see *Table 2.5a*). On average, there will be about 28 m^3 per day of C&DM generated. As the quantity of C&DM to be disposed of is relatively small, it is anticipated the disposal of the C&DM will not cause adverse environmental impact.

Information related to the GFA from three schools and Leisure Centre (LC), and quantity of C&DM from other construction works (that is, roads, recreational facilities and utilities) is not available. The quantity of C&DM to be generated cannot be determined at this stage, although the quantity is expected to be small (it is anticipated that the generation rate will be less than $28 \text{ m}^3 \text{ d}^{-1}$).

C&DM should be removed from site as soon as practicable to avoid adverse environmental impacts due to on-site storage of the material. Generally, the volume of C&D waste to be generated is about 20% of the volume of C&DM⁽⁵⁾. Therefore the amount of C&D waste to be generated is about $6\,800 \text{ m}^3$ and the average daily generation rate will be about $5.5 \text{ m}^3 \text{ d}^{-1}$. Whereas the amount of public fill to be generated is about $27\,100 \text{ m}^3$ and the average generation rate is about $22 \text{ m}^3 \text{ d}^{-1}$.

Wherever practical, the production of C&DM should be avoided by the careful control of ordering procedures to minimise the amount of surplus materials. Wherever possible, C&DM should be sorted at construction sites before disposing of inert materials (public fill) at public filling areas and non-inert or putrescible materials (wood, paper, plastic, etc), that is, C&D waste at landfills. With respect to the scale of the proposed developments and the sizes of the sites, it is likely that space will be available on site for sorting and separation of inert and non-inert materials. The avoidance of over-ordering and the segregation of materials will minimise waste arisings requiring landfill disposal. It will also assist in minimising costs should landfill charges be introduced.

The disposal of inert C&DM (or public fill) at public filling areas or other reclamation sites is unlikely to raise any long term concerns because of the inert nature of the material. Disposal of C&D waste to licensed landfill will not cause unacceptable environmental impacts.

C&D wastes currently account for approximately 35% of the annual consumption of limited landfill void available in HKSAR (although this proportion has varied widely over recent years). Therefore, it is important to minimise, wherever possible, the wastes being delivered to landfill. To conserve void space at landfill sites, C&D waste with more than 20% (by volume) inert material (dust, dirt, soil, brick, ceramic tile, concrete, etc) should not be disposed of at landfills.

Chemical Waste

(5) Monitoring of Solid Waste in Hong Kong 1997, EPD.

Chemical wastes may pose serious environmental, health and safety hazards if not stored and disposed of in an appropriate manner as outlined in the *Waste Disposal (Chemical Waste) (General) Regulation* and the *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes*. These hazards include:

- toxic effects to workers;
- adverse effects on air, water and land from spills;
- fire hazards; and
- disruption to sewage treatment works due to damage to the sewage biological treatment systems if waste is allowed to enter the sewage system.

It is difficult to quantify the amount of chemical waste which will arise from the construction activities as it will be highly dependent on the contractor's on-site maintenance intention and the number of plant and vehicles utilised. However, it is anticipated that the quality of chemical waste, such as lubricating oil and solvent produced from plant maintenance will be small and in the order to a few hundred litres per month. These types of waste will be readily accepted at the Chemical Waste Treatment Centre at Tsing Yi or other licensed waste oil recycling facilities in HKSAR.

Provided that the handling, storage and disposal of chemical wastes are in accordance with the *Code of Practice*, it will not cause unacceptable environmental impacts.

General Refuse

It is expected that a maximum number of 400 workers will be employed on-site at any one time. Based on the waste generation rate of about 0.6 kg per person, it is estimated that the amount of general refuse to be generated will be in the order of 240 kg per day. Provided that the mitigation measures recommended in *Section 6.6* are adopted, the environmental impacts caused by storage, handling, transport and disposal of general refuse are expected to be minimal. With respect to the small quantity of general refuse to be disposed of, it is not anticipated that it will cause any adverse impact to the operation of the transfer station and landfill.

The environmental impacts from the handling and disposal of various wastes arising from the construction phase are summarised in *Table 6.6e*.

Table 6.6e Summary of Waste Management Impacts During Construction Phase

Waste Type	General Evaluation
Dredged Material	<p>Approximately 227 000 m³ of dredged sediment will be generated from the construction of seawall. Also about 127 000 m³ of dredged sediment will be generated from dredging at marine basin. The results of site investigation at seawall revealed that sediments that would be dredged from the project are suitable for open sea disposal. If dredging is required at vibrocore station SQ13 (see <i>Figure 6.6a</i>), further chemical screening and biological testings are recommended.</p> <p>Should sediment within STD required to be dredged, as proposed by the Engineering Consultant, the total volume of sediment to be dredged would be 354 000 m³ (including dredging at seawall and marine basin).</p> <p>Although sediment to be dredged within STD is not included in the Site Investigation, it is expected that sediment quality within STD would be similar to those at the seawall and therefore most of the sediment is likely to be uncontaminated and small volume may require biological screening before disposal site can be determined.</p>
C&D Material	<p>The volume of excavated material to be generated from the construction of building is estimated to be 25 000m³ (22 500m³ inert material and 2 500m³ C&D waste).</p> <p>Demolition is restricted to the kaito pier at Anglers' Beach, existing dolphins offshore of San Miguel redevelopment site and interface between the proposed Sham Tseng Bypass and Castle Peak Road. Metal structures demolished may be recycled. The volume of C&D material generated from the demolition works is estimated to be 6 000m³ (55 00m³ inert material and 500m³ C&D waste).</p> <p>The generation rate for C&D material from construction of STD and MDP is approximately 33 900m³ (27 100m³ inert material and 6 800m³ C&D waste).</p>
Chemical Waste	<p>A small volume of chemical waste, such as used lubricating oils from plant maintenance materials, will be produced. Storage, handling, transport and disposal of chemical waste should be in accordance with the <i>Code of Practice on the Packaging, Handling and Storage of Chemical Wastes</i>. Provided that this occurs, and chemical wastes are disposed of at a licensed facility, the Contractor should be in compliance with all relevant regulations and no adverse environmental impacts.</p>
General Refuse	<p>Based on a waste generation rate of about 0.6 kg per person, it is estimated that the small amount of general refuse (about 240 kg d⁻¹) will be generated during the construction phase.</p>

6.6.2 Operation Waste Impact

Domestic and Commercial Wastes

With respect to the proposed development at the STD, the principal waste type to be generated during the occupation of the buildings will be domestic and commercial waste. Using the full operation (2014), the amount of domestic waste and commercial waste to be generated are in the order of 1.14 kg per person per day and 1.57 kg per employee per day, respectively⁽⁶⁾. According to the endorsed MDP, the future population in the STD will be about 14 010. The number of future employment that would be provided from the STD is not available at this stage and therefore the amount of waste

⁽⁶⁾ Environmental Protection Department (1998). Monitoring of Solid Waste in Hong Kong 1999.

to be generated cannot be estimated. Using the waste generation rate of 1.13 kg per person per day, the domestic waste generated may be about 16 051 kg per day or about 16 tonnes per day. Since the municipal solid waste to be generated at STD will be directly disposed of at WENT Strategic Landfill, the relatively small generation rate from the STD will only have minor impact on the lifespan of the WENT Strategic Landfill.

To facilitate the recycling, storage and collection of waste from individual buildings, each building should provide a refuse handling and material recycling area. The design of the refuse handling area should take account of the waste arising from the building and make reference to the standards and guidelines stated in *Section 6.2* of the HKPSG. Provided that the mitigation measures recommended in *Section 6.6* are adopted, the potential environmental impacts associated with the storage, collection and disposal of the domestic and commercial waste are expected to be minimal.

Sewage Sludge

According to the recently completed *Sludge Treatment and Disposal Strategy Study (STDS)*⁽⁷⁾, the planned TKSTSTW will employ the chemical treatment plus disinfection process. According to the STDS, the amount of sludge to be generated will be approximately 1100 tonnes dry solids per annum (tds a⁻¹) and 1700 tds in 2003 and 2021, respectively. According to the Sludge Management Strategy (SMS) recommended by the STDS Study, sludge generated from the planned TKSTSTW will be incinerated at a dedicated centralised sludge incineration facility, which is planned to be in operation in 2008. Before the operation of the sludge incineration facility, the sludge will be delivered to landfill for disposal.

The current projection indicates that in 2014 the baseline flow plus the flow generated from the STD (4510 m³ d⁻¹) will be about 21 010 m³ d⁻¹. The suspended solids (SS) and Biochemical Oxygen Demand (BOD) loading will be about 4077 kg d⁻¹ and 4410 kg d⁻¹, respectively. Using the removal efficiency of 75.74% and 58.75%, for SS and BOD, respectively, the amount of sludge to be generated in 2014 will be approximately 1 718 tonnes dry solids per annum (tds a⁻¹) or about 4.7 tds d⁻¹. The amount of sludge contributed from the STD will be 296 tds a⁻¹ or about 0.8 tds d⁻¹ (about 17% of the total sludge generated). Based on a sludge generation rate of approximately 4.7 tds per day of sludge will be generated in 2014, which is equivalent to approximately 15.5 m³ of sludge. 10 m³ skips (as currently employed in Sha Tin Sewage Treatment Works) could be used for transportation of sludge to the disposal facility. A maximum of 2 truck loads will be required. It is therefore considered that the natural air quality and traffic impacts associated with off-site sludge disposal will be minimal.

During the containment, storage and delivery of sewage sludge, odour impact may arise. Provided that fully enclosed containers similar to those used at the Stonecutters' Island Sewage Treatment Works and odour removal systems are installed, no adverse environmental impact is expected.

Screens will be installed at the underground sewage inlet of the sewage pumping station to prevent large solid materials in sewage from entering the

(7) Environmental Resources Management (1999). Sludge Treatment and Disposal Strategy Study Final Report, 9 July 1999.

pumps and causing damage. A small quantity of screenings will therefore be produced. Some industrial wastes will be generated during operation and maintenance activities that will be contained and disposed by licensed contractors and hence be of negligible impact.

6.7 *MITIGATION OF ADVERSE ENVIRONMENTAL IMPACT*

6.7.1 *Introduction*

This section sets out recycling, storage, transportation and disposal measures which are recommended to avoid or minimise potential adverse impacts associated with waste arising from the construction of the STD and the associated developments. The Contractor should incorporate these recommendations into an on-site waste management plan for the construction works. Such a management plan should incorporate site specific factors, such as the designation of areas for the segregation and temporary storage of reusable and recyclable materials.

It is the Contractor's responsibility to ensure that only approved licensed waste collectors are used and that appropriate measures to minimise adverse impacts, including windblown litter and dust from the transportation of these wastes, are employed. In addition, the Contractor must ensure that all the necessary waste disposal permits are obtained.

6.7.2 *Dredged Material*

The volume of material dredged should be minimised as far as practical.

Potential impacts associated with the exposure to and disposal of contaminated sediments could be mitigated by adopting the following measures:

- minimising exposure to any contaminated material by the wearing of protective gear such as gloves, providing adequate hygiene and washing facilities, and preventing eating during dredging;
- any contaminated sediment dredged should not be allowed to stockpile on the site and should be immediately removed from site once dredged;
- all vessels for marine transportation of dredged sediment should be fitted with tight fitting seals to their bottom openings to prevent leakage of materials; and
- loading of barges and hoppers should be controlled to prevent splashing of dredged material to the surrounding water, and barges or hoppers should under no circumstances to be filled to a level which will cause other overflowing of materials or polluted water during loading or transportation.

Other suitable mitigation measures for handling or dredged material are dealt with, in *Section 3*.

6.7.3 *Use of Public Fill for Reclamation*

The Contractor should enforce strict application of the dumping license conditions and monitor the material placed in the reclamation and barges to control disposal of unauthorised material. The Contractor shall also provide floating booms and collect any floating materials on a daily basis at the public filling area.

6.7.4 *Construction and Demolition Material*

Excavated materials are not considered likely to cause adverse impacts with respect to their disposal, since the amount is expected to be minimal. If any surplus uncontaminated inert materials do arise then they may be delivered to public filling areas or other reclamation sites. Excavated materials should be segregated from other wastes to avoid possible contamination, thereby allowing reuse at public filling areas.

In order to minimise waste arisings and keep environmental impacts within acceptable levels, the mitigation measures described below should be adopted.

Measures Taken in the Planning and Design Stages to Reduce the Generation of C&DM

The various waste management options can be categorised in terms of preference from an environmental viewpoint. The options considered to be more preferable have the least impacts and are more sustainable in a long term context. Hence, the waste management hierarchy is as follows:

- avoidance and minimisation, that is, not generating waste through changing or improving practices and design;
- reuse of materials, thus avoiding disposal (generally with only limited reprocessing);
- recovery and recycling, thus avoiding disposal (although reprocessing may be required); and
- treatment and disposal, according to relevant law, guidelines and good practice.

This hierarchy should be used to evaluate the waste management options, thus allowing maximum waste reduction and often reducing costs. For example, by reducing or eliminating over-ordering of construction materials, waste is avoided and costs are reduced both in terms the purchasing of raw materials and in disposing of wastes. Records of quantities of wastes generated, recycled and disposed (locations) should be properly kept.

Standard formwork should be used as far as practicable in order to minimise the arisings of C&DM. The use of more durable formwork or plastic facing for the construction works should be considered during the detailed design.

Any uncontaminated soil should be reused on site as far as possible for landscape works in order to minimise the amount of public fill to be disposed off-site. Should there be any surplus public fill generated from the project, the Engineer should liaise with the Public Fill Committee to identify as far as possible suitable reclamation or site formation projects near the project site to reuse the material.

The purchasing of construction materials will be carefully planned in order to avoid over ordering and wastage of construction materials, such as ready mixed concrete.

Measures To be Taken in the Construction Stage To Reduce the Generation of C&DM

The Contractor should recycle as much as possible of the C&DM on-site. Public fill and C&D waste should be segregated and stored in different containers or skips to enhance reuse or recycling of materials and their proper disposal. Concrete and masonry, for example can be crushed and used as fill and steel reinforcing bar can be used by scrap steel mills. Different areas of the sites should be designated for such segregation and storage.

The use of wooden hoardings shall not be allowed. An alternative material, which can be reused or recycled, for example, metal (aluminium, alloy etc) shall be used.

At present, Government is developing a charging policy for the disposal of waste to landfill. When it is implemented, this will provide additional incentive to reduce the volume of waste generated and to ensure proper segregation to allow disposal of inert material to public filling areas.

In order to minimise the impacts of the demolition works these wastes must be cleared as quickly as possible after demolition. The demolition and clearance works should therefore be undertaken simultaneously.

Management of Waste Disposal

A trip-ticket system should be established in accordance with *Works Bureau Technical Circular No 5/99* to monitor the disposal of C&DM and solid wastes at public filling facilities and landfills, and to control fly-tipping. A trip-ticket system will be included as one of the contractual requirements and implemented by the Engineer. The Engineer should audit the result of the system.

A recording system for the amount of waste generated, recycled and disposed of (including the disposal sites) should be established during the construction stage.

Staff Training

Training should be provided to workers on the concepts of site cleanliness and on appropriate waste management procedures, including waste reduction, reuse and recycling at the beginning of the contract.

6.7.5

Chemical Waste

For those processes which generate chemical waste, it may be possible to find alternatives which generate reduced quantities or even no chemical waste, or less dangerous types of chemical waste.

Chemical waste that is produced, as defined by *Schedule 1 of the Waste Disposal (Chemical Waste) (General) Regulation*, should be handled in accordance with the *Code of Practice on the Packaging, Handling and Storage of Chemical Wastes* as follows. Containers used for storage of chemical wastes should:

- be suitable for the substance they are holding, resistant to corrosion, maintained in a good condition, and securely closed;
- have a capacity of less than 450 L unless the specifications have been approved by the EPD; and
- display a label in English and Chinese in accordance with instructions prescribed in Schedule 2 of the Regulations.

The storage area for chemical wastes should:

- be clearly labelled and used solely for the storage of chemical waste;
- be enclosed on at least 3 sides;
- have an impermeable floor and bunding, of capacity to accommodate 110% of the volume of the largest container or 20% by volume of the chemical waste stored in that area, whichever is the greatest;
- have adequate ventilation;
- be covered to prevent rainfall entering (water collected within the bund must be tested and disposed as chemical waste if necessary); and
- be arranged so that incompatible materials are adequately separated.

Disposal of chemical waste should:

- be via a licensed waste collector; and
- be to a facility licensed to receive chemical waste, such as the Chemical Waste Treatment Facility which also offers a chemical waste collection service and can supply the necessary storage containers; or
- be to a reuser of the waste, under approval from the EPD.

The Centre for Environmental Technology operates a Waste Exchange Scheme which can assist in finding receivers or buyers.

6.7.6

General Refuse

General refuse generated on-site should be stored in enclosed bins or compaction units separate from construction and chemical wastes. A reputable waste collector should be employed by the contractor to remove general refuse from the site, separately from construction and chemical wastes, on a daily basis to minimise odour pest and litter impacts. The burning of refuse on construction sites is prohibited by law.

General refuse is generated largely by food service activities on site, so reusable rather than disposable dishware should be used if feasible. Aluminium cans are often recovered from the waste stream by individual collectors if they are segregated or easily accessible, so separate, labelled bins for their deposit should be provided if feasible.

Office wastes can be reduced through recycling of paper if volumes are large enough to warrant collection. Participation in a local collection scheme should be considered if one is available.

6.7.7

Sewage Sludge

The potential impacts associated with the management of waste generated from the operation of TKSTSTW are limited to the disposal of sludge.

Environmental impacts associated with the transportation of sludges can be reduced by the use of fully enclosed containers similar to those used at the Stonecutters' Island Sewage Treatment Works. Before a container is transported out of the sewage treatment works, it should be inspected and if necessary, washed to make sure that no sludge is attached to the exterior.

The period for storage on-site should be as low as practicable. Sludge should be transported off-site for disposal on a daily basis.

A responsible site officer with adequate authority and training should be appointed to supervise the waste collection and disposal activities to ensure that wastes are collected and transported in a timely and environmentally acceptable manner. Records of the disposal operations should be on site kept for regular inspection.

Table 6.7a summarises the proposed mitigation measures for different types of waste.

6.7.8

Solid Waste

Solid waste will be collected at the screenings of the sewage pumping station. Collection of the waste will be carried out within an enclosed environment. Similar to the sludge treatment of the TKSTSTW, the environmental impacts associated with the transportation of sludges can be reduced by the use of fully enclosed containers. Collection of solid waste is recommended to be twice a week.

A responsible site officer with adequate authority and training should be appointed to supervise the waste collection and disposal activities to ensure that wastes are collected and transported in a timely and environmentally acceptable manner. Records of the disposal operations should be on site kept for regular inspection.

Table 6.7a *Summary of the proposed Mitigation Measures for Different Types of Waste*

Waste Type	Proposed Mitigation Measures
Dredged Material (Section 6.7.2)	<ul style="list-style-type: none"> • The volume of material dredged should be minimised as far as practicable. • Minimising exposure to any contaminated material by the wearing of protective gear such as gloves, providing adequate hygiene and washing facilities, and preventing eating during dredging. • Any contaminated sediment dredged should not be allowed to stockpile on the site and should be immediately removed from site once dredged. • All vessels for marine transportation of dredged sediment should be fitted with tight fitting seals to their bottom openings to prevent leakage of materials. • Loading of barges and hoppers should be controlled to prevent splashing of dredged material to the surrounding water, and barges or hoppers should under no circumstances be filled to a level which will cause other overflowing of materials or polluted water during loading or transportation.
Use of Public Fill for Reclamation (Section 6.7.3)	The Contractor should enforce strict application of the public fill license and monitor the material placed in the reclamation and barges to control disposal of unauthorised material. The Contractor shall also provide floating booms and collect any floating materials on a daily basis at the public filling area.

Waste Type	Proposed Mitigation Measures
C&D Material (Section 6.7.4)	<p data-bbox="639 152 842 181"><i>Excavated Materials</i></p> <ul data-bbox="639 210 1385 360" style="list-style-type: none"> <li data-bbox="639 210 1385 264">• If any surplus uncontaminated inert materials do arise then they may be delivered to public filling areas or other reclamation sites. <li data-bbox="639 277 1385 360">• Excavated materials should be segregated from other wastes to avoid possible contamination, thereby allowing disposal at public filling areas. <p data-bbox="639 387 1286 441"><i>Measures Taken in the Planning and Design Stages to Reduce the Generation of C&DM</i></p> <ul data-bbox="639 468 1334 730" style="list-style-type: none"> <li data-bbox="639 468 1334 521">• avoidance and minimisation, that is, not generating waste through changing or improving practices and design; <li data-bbox="639 535 1334 589">• reuse of materials, thus avoiding disposal (generally with only limited reprocessing); <li data-bbox="639 602 1334 656">• recovery and recycling, thus avoiding disposal (although reprocessing may be required); and <li data-bbox="639 669 1334 730">• treatment and disposal, according to relevant law, guidelines and good practice. <p data-bbox="639 772 1385 880">This hierarchy should be used to evaluate the waste management options, thus allowing maximum waste reduction and often reducing costs. Records of quantities of wastes generated, recycled and disposed (locations) should be properly kept.</p> <p data-bbox="639 907 1377 987">Any uncontaminated soil should be reused on site as far as possible for landscape works in order to minimise the amount of public fill to be disposed off-site.</p> <p data-bbox="639 1014 1382 1095">The purchasing of construction materials will be carefully planned in order to avoid over ordering and wastage of construction materials, such as ready mixed concrete.</p> <p data-bbox="639 1126 1318 1180"><i>Measures To be Taken in the Construction Stage To Reduce the Generation of C&DM</i></p> <p data-bbox="639 1207 1390 1395">The Contractor should recycle as much as possible of the C&DM on-site. Public fill and C&D waste should be segregated and stored in different containers or skips to enhance reuse or recycling of materials and their proper disposal. Concrete and masonry, for example can be crushed and used as fill and steel reinforcing bar can be used by scrap steel mills. Different areas of the sites should be designated for such segregation and storage.</p> <p data-bbox="639 1422 1347 1503">The use of wooden hoardings shall not be allowed. An alternative material, which can be reused or recycled, for example, metal (aluminium, alloy etc) shall be used.</p> <ul data-bbox="639 1529 1355 1637" style="list-style-type: none"> <li data-bbox="639 1529 1355 1637">• In order to minimise the impacts of the demolition works these wastes must be cleared as quickly as possible after demolition. The demolition and clearance works should therefore be undertaken simultaneously. <p data-bbox="639 1664 951 1693"><i>Management of Waste Disposal</i></p> <p data-bbox="639 1720 1390 1883">A trip-ticket system should be established in accordance with <i>Works Bureau Technical Circular No 5/99</i> to monitor the disposal of C&DM and solid wastes at public filling facilities and landfills, and to control fly-tipping. A trip-ticket system will be included as one of the contractual requirements and implemented by the Engineer. The Engineer should audit the result of the system.</p> <p data-bbox="639 1910 1374 1991">A recording system for the amount of waste generated, recycled and disposed of (including the disposal sites) should be established during the construction stage.</p>

Waste Type	Proposed Mitigation Measures
	<p data-bbox="639 152 783 185"><i>Staff Training</i></p> <p data-bbox="639 208 1394 315">Training should be provided to workers on the concepts of site cleanliness and on appropriate waste management procedures, including waste reduction, reuse and recycling at the beginning of the contract.</p>
Chemical Waste (Section 6.7.5)	<p data-bbox="639 338 1230 371">Containers used for storage of chemical wastes should:</p> <ul data-bbox="639 394 1358 584" style="list-style-type: none"> <li data-bbox="639 394 1358 506">• be suitable for the substance they are holding, resistant to corrosion, maintained in a good condition, and securely closed; have a capacity of less than 450 L unless the specifications have been approved by the EPD; and <li data-bbox="639 528 1294 584">• display a label in English and Chinese in accordance with instructions prescribed in Schedule 2 of the Regulations. <p data-bbox="639 607 1118 640">The storage area for chemical wastes should:</p> <ul data-bbox="639 663 1394 1155" style="list-style-type: none"> <li data-bbox="639 663 1334 719">• be clearly labelled and used solely for the storage of chemical waste; <li data-bbox="639 741 999 775">• be enclosed on at least 3 sides; <li data-bbox="639 797 1382 909">• have an impermeable floor and bunding, of capacity to accommodate 110% of the volume of the largest container or 20% by volume of the chemical waste stored in that area, whichever is the greatest; <li data-bbox="639 931 967 965">• have adequate ventilation; <li data-bbox="639 987 1394 1066">• be covered to prevent rainfall entering (water collected within the bund must be tested and disposed as chemical waste if necessary); and <li data-bbox="639 1088 1302 1155">• be arranged so that incompatible materials are adequately separated. <p data-bbox="639 1178 1015 1211">Disposal of chemical waste should:</p> <ul data-bbox="639 1234 1366 1458" style="list-style-type: none"> <li data-bbox="639 1234 1070 1267">• be via a licensed waste collector; and <li data-bbox="639 1290 1366 1402">• be to a facility licensed to receive chemical waste, such as the Chemical Waste Treatment Facility which also offers a chemical waste collection service and can supply the necessary storage containers; or <li data-bbox="639 1424 1294 1458">• be to a reuser of the waste, under approval from the EPD.
General Refuse (Section 6.7.6)	<ul data-bbox="639 1469 1394 1738" style="list-style-type: none"> <li data-bbox="639 1469 1394 1637">• General refuse generated on-site should be stored in enclosed bins or compaction units separate from construction and chemical wastes. A reputable waste collector should be employed by the Contractor to remove general refuse from the site, separately from construction and chemical wastes, on a daily basis to minimise odour pest and litter impacts. <li data-bbox="639 1659 1394 1738">• General refuse is generated largely by food service activities on site, so reusable rather than disposable dishware should be used if feasible.
Sewage Sludge (Section 6.7.7)	<ul data-bbox="639 1783 1334 1872" style="list-style-type: none"> <li data-bbox="639 1783 1318 1816">• Use of fully enclosed container for transportation of sludge. <li data-bbox="639 1839 1334 1872">• The period for storage on-site should be as low as practicable
Solid Waste (Section 6.7.8)	<ul data-bbox="639 1906 1326 2042" style="list-style-type: none"> <li data-bbox="639 1906 1222 1939">• Collection of solid waste in enclosed environment. <li data-bbox="639 1962 1310 1995">• Use of fully enclosed container for transportation of waste. <li data-bbox="639 2018 1326 2042">• The frequency of collection of waste should be twice a week.

6.8 *DEFINITION AND EVALUATION OF RESIDUAL ENVIRONMENTAL IMPACTS*

With the implementation of recommended mitigation measures, in particular the establishment of a Waste Management Plan, minimal residual impacts are anticipated.

6.9 *ENVIRONMENTAL MONITORING AND AUDIT*

It is recommended that audit of each waste stream should be carried out on regular basis (e.g. monthly) by an Independent Environmental Checker to determine if wastes are being managed in accordance with approved procedures and the site waste management plan. The audits should look at all aspects of waste management including waste generation, storage, recycling, transport and disposal. An appropriate audit programme would be to undertake a first audit at the commencement of the construction works and then to audit monthly thereafter.

In order to monitor the disposal of construction and demolition material and solid wastes at public filling facilities and landfills, and to control fly-tipping, a trip-ticket system should be included as one of the contractual requirements and implemented by the Environmental Team during the EM&A programme. An Independent Environmental Checker should be responsible for auditing the result of the system.

6.10 *CONCLUSION AND RECOMMENDATIONS*

As summarised in *Table 6.6e*, the following quantities of waste are expected to arise during the construction of the STD: Dredged materials (approximately 354 000 m³ if dredging only limited at seawall and marine basin), excavated materials (22 500m³ inert material and 2 500m³ C&D waste); demolition material (55 00m³ inert material and 500m³ C&D waste) and construction material (27 100m³ inert material and 6 800m³ C&D waste); chemical waste (a few hundred litres per month); and general refuse (240 kg per day).

Based on the land use arrangement of the endorsed MDP, the future domestic waste generation will be about 16 tonnes per day. No estimation for commercial waste generation can be made as number of employees is not available. No adverse environmental impacts associated with the transportation and disposal of domestic waste is anticipated.

Mitigation measure relating to good site practice have been recommended to ensure that adverse environmental impacts are prevented and that opportunities for waste minimisation and recycling are followed.

Provided that the recommendations put forward in this Report are conscientiously acted upon, no unacceptable environmental impacts will result from the storage, handling, collection, transport, and disposal of wastes arising from the construction and operation of the STD.