

6 WASTE MANAGEMENT

6.1 INTRODUCTION

This section identifies the potential waste arisings from the construction and operation of the proposed developments in the Study Area and provides an assessment of the potential environmental impacts associated with the handling and disposal of these wastes.

The options for reuse, minimisation, recycling, treatment, storage, collection, transport and disposal of wastes arising from the Project have been examined. 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 AND CRITERIA

The criteria for evaluating the potential construction and operational waste management implications are set out in *Annex 7* of the EIAO-TM. The legislation and guidelines related to the handling and disposal of wastes are discussed below.

6.2.1 Legislation

The following legislation cover or have some bearing upon the handling, treatment and disposal of waste in Hong Kong, and will be used as the assessment criteria:

- *Waste Disposal Ordinance (Cap 354)*;
- *Waste Disposal (Chemical Waste) (General) Regulation (Cap 354)*;
- *Crown Land Ordinance (Cap 28)*; and
- *Public Health and Municipal Services Ordinance (Cap 132) - Public Cleansing and Prevention of Nuisances (Urban Council) and (Regional Council) By-laws.*

6.2.2 Criteria

The following documents and guidelines relate to waste management and disposal in Hong Kong:

- *Annex 15* of the EIAO-TM;
- *Waste Disposal Plan for Hong Kong*, Planning, Environment and Lands Branch, Government Secretariat (December 1989);
- *Hong Kong Planning Standards and Guidelines (HKPSG)*;
- *New Disposal Arrangements for Construction Waste*, Environmental Protection Department & Civil Engineering Department (1992);
- *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes*, Environmental Protection Department (1992);

- *Works Branch Technical Circular No 2/93, Public Dumps;*
- *Works Branch Technical Circular No 16/96, Wet Soil in Public Dumps; and*
- *Practice Note for Professional Persons - Construction Site Drainage (ProPECC PN 1/94), Professional Persons Consultative Committee (1994).*

6.3 IDENTIFICATION OF IMPACTS

6.3.1 Construction Phase

General

Construction activities to be carried out for the proposed developments will result in the generation of a variety of wastes which may include:

- site clearance waste;
- surplus excavated materials;
- construction and demolition (C&D) waste;
- chemical waste; and
- general refuse.

If not properly managed, the handling and disposal of these wastes may cause environmental nuisance and impacts. The nature of each of these wastes are discussed below.

Site Clearance Waste

As the proposed sites are being used for open storage and car parking purposes, minimal site clearance works will be required. The clearance works will mainly involve the removal of refuse left behind by the container yards and garages.

Surplus Excavated Materials

All the development sites within the Study Area are located on predominantly flat land and minimal earth works will be required for the formation of these sites. Although excavated materials may arise from the foundation works for new buildings, these can be utilised as fill for the construction of road embankments and other general filling.

Construction and Demolition Waste

Construction and demolition (C&D) material⁽¹⁰⁾ will mainly arise from the construction of the proposed new roads and new buildings. It comprises unwanted materials generated during construction, including rejected structures and materials, materials which have been over-ordered and materials which have been used and discarded. C&D material waste may include:

- wood from formwork and falsework;
- materials and equipment wrappings;
- unusable/surplus concrete/grouting mixes; and

⁽¹⁰⁾ "C&D material" contains a mixture of inert and non-inert material. The inert portion is the "public fill" and the non-inert portion is the "C&D waste".

- damaged/contaminated/surplus construction materials.

Although the Preferred Development Option avoids the removal of the recognised indigenous villages, a number of village houses and existing structures are still required to be demolished for the construction of the new road network and formation of the sites.

Chemical 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 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
- spent solvents/solutions, some of which may be halogenated, from equipment cleaning activities.

Chemical waste may pose serious environmental, health and safety hazards if it is not properly managed. These hazards include:

- toxic effects to workers;
- adverse effects on water quality from spills;
- fire hazards; and
- disruption of sewage treatment works where the chemical waste enters the sewerage system.

General Refuse

General refuse including paper and food waste will be generated from the worksite. The storage of general refuse has the potential to give rise to adverse impacts. These include odour if waste is not collected frequently, windblown litter, water quality impacts if waste enters water bodies, and visual impact. The worksite may also attract pests and vermin if the waste storage area is not well maintained and cleaned regularly. In addition, disposal of waste at sites other than approved waste transfer or disposal facilities, can also lead to similar impacts.

6.3.2

Operational Phase

Domestic Waste

Domestic waste will arise from the proposed residential developments and the storage and handling of domestic 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.

Commercial Waste

Commercial waste will arise from the commercial premises within the proposed developments. Similar to domestic waste, the storage and handling of commercial waste may cause adverse environmental impacts if not properly managed.

6.4 EVALUATION OF IMPACTS

6.4.1 Construction Phase

The amount of waste arising from the construction of the proposed developments and the potential environmental impacts from the handling, storage, transport and disposal are discussed below.

Site Clearance Waste

It is anticipated that only a small amount of refuse will be left behind by the container yards and garages and therefore the amount of site clearance waste will be small. Should clearance of trees be required, the wood should be recycled as far as possible. Tree trunks with a diameter greater than 150 mm are useful for construction of country park facilities (ie wooden fencing, bench). The contractor should liaise with the Agriculture and Fisheries Department for the acceptance of the wood. It is considered that the handling and disposal of site clearance waste will not be a key environmental issue and the potential environmental impacts associated with the handling and disposal of site clearance waste will be negligible.

Surplus Excavated Material

It is estimated a total of 181,900 m³ of excavated materials will be generated from the Project. Approximately 59,200 m³ of excavated materials will be generated during Phase 1 of the project. These wastes are produced during site formation of Site 1 and the first section of the Distributor Road, the works of which are anticipated to commence in 2002 and will last for approximately one years.

During Phase 2, the site formation works of Sites 2, 3 and 4 and the remainder of the Distributor Road will generate about 122,700 m³ of excavated materials. These site formation works, which will commence in late 2003, will last for about two years.

The estimated fill required for Phase 1 and Phase 2 is about 92,450 m³ and 287,940 m³, respectively. With the shortfall in fill material, all the excavated materials generated from the Phase 1 and Phase 2 works are expected to be reused on site as fill materials for the construction of road embankments and general filling. With the reuse of excavated materials, there will still be requirement for extra fill materials. As a result, there will not be any impacts associated with disposal of surplus excavated material.

The formation of Site 2 will require filling of the existing paddy fields. The soft topsoil may have to be excavated to minimise future settlement. This topsoil has high horticultural value and should be reused for landscape works or horticultural uses. The contractor should liaise with the Regional Service Department for the opportunity of reusing the topsoil for their landscape works.

C&D Waste Arising from New Building Construction

The development schedule for the Preferred Development Option suggests that a total

of about 795,964 m² of domestic gross floor area (GFA) and 17,580 m² of commercial GFA will be constructed within the proposed development sites. In addition, five primary schools and five secondary schools will be built, with a total GFA of about 57,300 m² attributable to these schools.

Based on a waste generation rate of 0.1 m³ m⁻² of GFA⁽¹¹⁾ to be constructed, approximately 87,100 m³ (about 156,780 tonnes, assuming a bulk density of 1.8 tonne per m³) of C&D material will be generated during the period between 2003 and 2008. Construction of residential buildings in Site 1, which will begin in March 2003 and last until March 2006 (approximately 155 weeks), will account for the generation of 6,440 m³ of C&D Material. Construction of residential buildings at Sites 2, 3 and 4, to be conducted from April 2005 to March 2008 (approximately 155 weeks), will generate about 73,160 m³ of C&D Material. The remaining C&D Material will be generated from the construction of commercial areas and schools, amounting to a total volume of about 7,490 m³. On average, there will be about 40 m³d⁻¹ of such material generated. As the quantity of C&D material to be disposed of is relatively small, it is anticipated that there will not be any significant environmental impact.

The quantity of C&D material arising from other construction works (ie roads, recreational facilities and utilities) cannot be determined at this stage. C&D material should be removed from site as soon as practicable to avoid adverse environmental impacts due to on-site storage of the material. C&D material 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), ie 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.

Wherever practical, the production of C&D material should be avoided by the careful control of ordering procedures to minimise the amount of surplus 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.

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.

C&D wastes currently account for approximately 35% of the annual consumption of limited landfill void available in Hong Kong (although this proportion has varied widely over recent years). Therefore, it is important to minimise, wherever possible, the wastes being delivered to landfill.

C&D Waste Arising from Demolition of Buildings

The Preferred Development Option has avoided encroachment of the indigenous villages, hence the number of structures to be removed should be small. It is therefore expected that the total quantity of demolition waste will be small.

Given the inert nature of the C&D material it could be delivered to the public filling areas. The disposal of inert C&D material at public filling areas is unlikely to raise any long term concerns because of its inert nature. The potential environmental impacts arising from the handling and disposal of C&D material arising from demolition waste

⁽¹¹⁾ Hong Kong Polytechnic (1993). Reduction of Construction Waste Final Report.

will therefore be negligible.

Chemical Waste

It is difficult to quantify the amount of chemical waste which will arise from the construction activities since it will be highly dependent on the Contractor's on-site maintenance intentions and the numbers of plant and vehicles utilised. However, it is anticipated that the quantity of chemical waste, such as lubricating oil and solvent, produced from plant maintenance will be relatively small. These types of waste will be readily accepted at the Chemical Waste Treatment Facility at Tsing Yi.

Storage, handling, transport and disposal of chemical waste should be arranged in accordance with the *Code of Practice on the Packaging, Labelling and Storage of Chemical Waste* published by the EPD. Provided that this occurs, and the chemical waste is disposed of at a licensed chemical waste treatment and disposal facility, the potential environmental impacts arising from the storage, handling and disposal of a small amount of chemical waste generated from the construction activities will be negligible.

General Refuse

The quantity of general refuse to be generated from the construction workforce cannot be determined at this stage because information on size of the workforce is not available. If good practice is adhered to with respect to storage, transport and disposal and the refuse is disposed of to licensed landfills, the potential environmental impacts will be minimal.

6.4.2

Operational Phase

Domestic Waste

The population forecast for the proposed residential developments is 43,954. Based on a waste generation rate of 1.0 kg per person per day⁽¹²⁾, approximately 44 tonnes of domestic waste will be generated each day.

Suitable waste storage and collection facilities should be provided for the developments. The design of the waste storage and collection facilities should be in accordance with the guidelines stipulated in the HKPSG. Refuse collection point with appropriate vehicular access should be provided in the respective residential development for off-street refuse collection in order to avoid the nuisances arising from on-street refuse collection. Domestic waste should be collected daily and transported to refuse transfer station or landfills. The Yuen Long Refuse Transfer Station which serves the Tuen Mun and Yuen Long areas is scheduled to commission in late 2000. It is recommended that appropriate arrangements be made with the Regional Services Department for the collection of domestic waste from the new residential developments.

The provision of refuse storage and collection facilities in commercial developments should comply with the *Building (Refuse Storage Chambers and Chutes) Regulations*. The waste storage and handling area should be provided with appropriate vehicular access. This will avoid odour nuisance and visual impact of stockpiling waste at the roadside awaiting for collection by refuse collection vehicle.

Provided the environmental control measures are properly implemented and the waste

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Environmental Protection Department (1997). *Monitoring of Solid Waste in Hong Kong 1996*

are disposed of to refuse transfer station or landfill, it is not anticipated that the handling and collection of domestic waste will cause unacceptable environmental impacts.

Commercial Waste

As the types of shops and community facilities to be provided within the Study Area have not been determined at this stage, the quantity of commercial waste to be generated cannot be estimated. The commercial waste can be collected together with the domestic waste and transported to refuse transfer station (if privately collected waste can be accepted at the facility) or landfills.

Each of the commercial developments should be provided with a waste storage and handling area which can be easily accessed by refuse collection vehicle. To minimise the volume of waste to be handled, the use of waste compactor units should be considered.

Provided the recommended waste control measures are properly implemented and the waste is disposed of to refuse transfer station or landfill, it is not anticipated that the handling and collection of commercial waste will cause unacceptable environmental impacts.

6.5 ***MITIGATION OF ADVERSE IMPACTS***

6.5.1 ***Construction Phase***

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 proposed developments. The contractor should incorporate these recommendations into a comprehensive on-site waste management plan. 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.

Waste Management Hierarchy

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 the longer term. Hence, the hierarchy is as follows:

- avoidance and minimisation, ie 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 laws, guidelines and good practice.

The Contractor should consult the Waste Disposal Authority on the final disposal of wastes.

This hierarchy should be used to evaluate waste management options, thus allowing maximum waste reduction and often reducing costs. Waste reduction measures should be introduced at the design stage and carried through the construction activities, wherever possible, by careful purchasing control, reuse of formworks and good site management. By reducing or eliminating over-ordering of construction materials, waste is avoided and costs are reduced both in terms of purchasing of raw materials and in disposing of wastes.

Training and instruction of construction staff should be given at the site to increase awareness and draw attention to waste management issues and the need to minimise waste generation. The training requirement should be included in the site waste management plan.

Storage, Collection and Transport of Waste

Permitted waste hauliers should be used to collect and transport wastes to the appropriate disposal points. The following measures to minimise adverse impacts should be instigated:

- handle and store wastes in a manner which ensures that they are held securely without loss or leakage, thereby minimising the potential for pollution;
- use waste hauliers authorised or licensed to collect specific category of waste;
- remove wastes in a timely manner;
- maintain and clean waste storage areas regularly;
- minimise windblown litter and dust during transportation by either covering trucks or transporting wastes in enclosed containers;
- obtain the necessary waste disposal permits from the appropriate authorities, if they are required, in accordance with the *Waste Disposal Ordinance (Cap 354)*, *Waste Disposal (Chemical Waste) (General) Regulation (Cap 354)*, the *Crown Land Ordinance (Cap 28)*;
- Dispose of waste at licensed waste disposal facilities;
- Develop procedures such as a ticketing system to facilitate tracking of loads, particularly for chemical waste, and to ensure that illegal disposal of wastes does not occur; and
- Maintain records of the quantities of wastes generated, recycled and disposed.

Surplus Excavated Material

Surplus excavated materials could be reused as fill material at public filling areas (PFA). The availability of the PFA for the reception of surplus excavated material from the project will depend on the development programme of the PFAs. The contractor should liaise with the Fill Management Committee (FMC) for the location of the PFA available during the project.

The excavated material may have to be temporarily stockpiled on-site for subsequent re-use. Control measures should be taken at the stockpiling area to prevent the generation of dust and pollution of stormwater channels. Details of environmental control measures for dust and water pollution are discussed in *Sections 4 and 5*. Key control measures are highlight below:

Dust:

- wetting the surface of the stockpiled soil with water when necessary especially during the dry season;
- covering the stockpiled soil with sheets;
- minimising disturbance of the stockpiled soil; and
- enclosure of the stockpiling area.

Water Quality:

- separating surface water drainage system for the stockpiling area;
- installation of silt traps for the surface water drainage system; and
- covering stockpiled material with tarpaulin during heavy rainstorm.

C&D Waste

The C&D Wastes (produced after segregation from C&D materials) generated from the construction phase should be disposed at the three strategic landfills (i.e. NENT, SENT and WENT landfills). With respect to the location of the project site, it is likely that the C&D wastes will be delivered to the WENT landfill.

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

Careful design, planning and good site management can minimise over-ordering and generation of waste materials such as concrete, mortars and cement grouts. The design of formwork should maximise the use of standard wooden panels so that high reuse levels can be achieved. Alternatives such as steel formwork or plastic facing should be considered to increase the potential for reuse.

The Contractor should recycle as much of the C&D material as possible on-site. Proper segregation of wastes on site will increase the feasibility of certain components of the waste stream by the recycling contractors. For example, concrete and masonry can be used as general fill and steel reinforcement bar can be used by scrap steel mills. Different areas of the worksite should be designated for such segregation and storage wherever site conditions permit.

The handling and disposal of bentonite slurries should be undertaken in accordance with ProPECC PN 1/94 on construction site drainage.

Construction and demolition wastes currently comprise approximately 35% of waste inputs to landfills. To maximise landfill life, Government policy does not allow the disposal of C&D wastes with more than 20% inert material (by volume) at landfill.

Inert C&D material are directed to reclamation areas, where they have the added benefit of offsetting the need for removal of materials from borrow areas for reclamation purposes.

Government has established a charging scheme 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 of wastes to allow free disposal of inert material to public filling areas

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 the 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 litres 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 for the small quantity of chemical waste to be generated from the project.

General Refuse

General refuse should be stored in enclosed bins or compaction units separate from C&D and chemical wastes. A reputable waste collector should be employed by the contractor to remove general refuse from the site, separately from C&D and chemical wastes, on a daily or every second day basis to minimise odour, pest and litter impacts. 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.

6.5.2 *Operational Phase*

The location and design of the waste storage and collection area should aim to minimise nuisance to the public and people living and working nearby, where appropriate, by enclosing the whole facility and, if necessary, through the provision of odour control equipment and ventilation. The following facilities should also be provided for the waste storage and handling facilities:

- high-pressure water for regular cleaning purpose;
- leachate drainage system which connected to foul sewer ;
- air/exhaust cleaning facility if the area is enclosed; and
- wheeled refuse bins with lid.

6.5.3 *Residual Impacts*

Provided all the suggested mitigation measures provided in this section are successfully carried out, no significant residual impacts are expected for the handling, transfer and disposal of solid wastes.

6.6 *ENVIRONMENTAL MONITORING AND AUDIT REQUIREMENTS*

As no residual waste impacts are expected from the implementation of the Preferred Development Option, environmental monitoring and audit is not considered necessary with regard to waste management. Notwithstanding that, an implementation schedule with environmental mitigation measures for construction waste impacts is presented in the *Annex* of the EM & A Manual.

CONCLUSIONS

The potential environmental impacts of waste arising from the construction and operation of the proposed housing and commercial developments, and the associated infrastructure and community facilities have been assessed. Key issues include the need for effective waste management planning during both of these phases. Waste management methods and practices and other environmental control measures have been recommended to ensure that potential impacts are avoided or controlled to acceptable levels. With the implementation of the recommended measures, no residual environmental impact is expected with respect to waste management.