

6. WASTE MANAGEMENT

6.1 Introduction

6.1.1 This section identifies the potential waste arising from the construction activities of the Project, based on their sequence and duration, and evaluates the potential environmental impact that may result from waste generated. Mitigation measures and good site practices, including waste handling, storage and disposal, have been recommended with reference to applicable waste legislation and management guidelines. The amount of wastes generated in the operation phase of the Project is negligible and therefore adverse environmental impact is not anticipated. As a result, operation impact related to waste management will not be further discussed.

6.2 Environmental Legislation

6.2.1 The criteria and guidelines for assessing waste management implications are outlined in Annex 7 and Annex 15 of the EIAO-TM, respectively.

6.2.2 The following legislations also cover the handling, treatment and disposal of waste in Hong Kong:

- Waste Disposal Ordinance (Cap. 354)
- Waste Disposal (Chemical Waste) (General) Regulation (Cap. 354C)
- Public Health and Municipal Services Ordinance (Cap. 132) - Public Cleansing and Prevention of Nuisances Regulation
- Land (Miscellaneous Provisions) Ordinance (Cap. 28)
- Waste Disposal (Charges for Disposal of Construction Waste) Regulation (Cap. 354N)
- Dumping at Sea Ordinance (Cap.466)

Waste Disposal Ordinance (Cap. 354)

6.2.3 The Waste Disposal Ordinance (WDO) prohibits any unauthorized disposal of waste. Construction waste, defined under Cap. 354N of the WDO, refers to a substance, matter or thing which is generated from construction works. It includes all abandoned materials, whether processed or stockpiled or not, before being abandoned, but does not include sludge, screenings or matter removed or generated from desludging, desilting or dredging works. Under the WDO, waste can only be disposed of at designated waste disposal facilities licensed by the Environmental Protection Department (EPD).

Waste Disposal (Chemical Waste) (General) Regulation (Cap. 354C)

6.2.4 Under the WDO, the Chemical Waste (General) Regulation provides regulations for chemical waste control, and administers the possession, storage, collection, transport and disposal of chemical waste. EPD has also issued the Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes (1992), which details how the chemical waste producers should comply with the regulations on chemical waste.

Public Health and Municipal Services Ordinance (Cap. 132)

6.2.5 The Public Cleansing and Prevention of Nuisances Regulation provides control on illegal tipping of waste on unauthorized (unlicensed) sites.

Land (Miscellaneous Provisions) Ordinance (Cap 28)

- 6.2.6 The inert portion of Construction and Demolition (C&D) materials (including rocks, soil, broken concrete, building debris, etc.) may be taken to public fill reception facilities (PFRFs). The PFRFs usually form part of land reclamation schemes and are operated by the Civil Engineering and Development Department (CEDD) and others. The Land (Miscellaneous Provisions) Ordinance requires that individuals or companies who deliver public fill to the public fill reception facilities are required to obtain Dumping Licenses. The licenses are issued by CEDD under delegated authority from the Director of Lands.
- 6.2.7 Individual licenses and windscreen stickers are issued for each vehicle involved. Under the license conditions, public fill reception facilities will only accept soil, sand, rubble, brick, tile, rock, boulder, concrete, asphalt, masonry or used bentonite. In addition, in accordance with paragraph 12 of the Development Bureau (DEVB) Technical Circular (Works) (TC(W)) No. 6/2010, Public Fill Committee will advise on the acceptance criteria. The material will, however, be free from marine mud, household refuse, plastic, metal, industrial and chemical wastes, animal and vegetable matter and any other materials considered unsuitable by the public fill reception facility supervisor.

Waste Disposal (Charges for Disposal of Construction Waste) Regulation (Cap. 354N)

- 6.2.8 Under the Waste Disposal (Charges for Disposal of Construction Waste) Regulation enacted in January 2006, construction waste delivered to a landfill for disposal must not contain more than 50% by weight of inert material. Construction waste delivered to a sorting facility for disposal must contain more than 50% by weight of inert material, and construction waste delivered to a PFRF for disposal must consist entirely of inert material.

Dumping at Sea Ordinance (Cap.466)

- 6.2.9 Under Dumping at Sea Ordinance enacted in 1995, application for dumping permits from EPD is required for marine disposal of dredged materials.

6.3 Environmental Guidelines

- 6.3.1 Other guidelines which detail how the Contractor should comply with are as follow:
- A Guide to the Registration of Chemical Waste Producers, Environmental Protection Department, Hong Kong
 - A Guide to the Chemical Waste Control Scheme, Environmental Protection Department, Hong Kong
 - Code of Practice on Package, Labelling and Storage of Chemical Wastes (1992), Environmental Protection Department, Hong Kong
 - Works Branch Technical Circular (WBTC) No. 2/93, Public Dumps
 - Works Branch Technical Circular No. 2/93B, Public Filling Facilities
 - ETWB TC(W) No. 33/2002, Management of Construction/Demolition Materials including Rocks

- DEVB TC(W) No. 6/2010, Trip Ticket System for Disposal of Construction and Demolition Materials
- ETWB TC(W) No. 19/2005, Environmental Management on Construction Sites
- ETWB TC(W) No. 34/2002, Management of Dredged/Excavated Sediment

6.3.2 Current policy related to the disposal of C&D materials is documented in the WBTC No. 2/93, 'Public Dumps'. C&D materials that are wholly inert, namely public fill, should not be disposed of at landfill, but be taken to Public Fill Reception Facilities (PFRFs), which usually form part of reclamation schemes. The Land (Miscellaneous Provisions) Ordinance requires the dumping licenses to be obtained by individuals or companies who deliver public fill to PFRFs. The CEDD issues the licenses under delegated powers from the Director of Lands.

6.3.3 In accordance with the DEVB TC(W) No. 6/2010 'Trip Ticket System for Disposal of Construction and Demolition Materials', all contracts that are expected to generate inert C&D materials (e.g. soil, broken rock, broken concrete and building debris, etc) requiring disposal from site, the project should write to the Public Fill Committee (PFC) through Secretary of the PFC to request a designated disposal ground for incorporation into the tender documents. For contracts where the estimated amount of non-inert C&D materials requiring disposal at landfill facilities equal or exceed 50m³, the project office should seek confirmation from the DEP in terms of the availability of landfill facilities for disposal of such materials. The DEP will designate landfill facilities, if available, for the contract. Where the estimated amount of non-inert C&D materials to be generated from the contract is less than 50m³, the project office is not required to apply to DEP for designated landfill facilities. However, the project office should still specify in the tender documents of the appropriate landfill facilities (e.g. SENT Landfill at Tseung Kwan O, NENT Landfill at Ta Kwu Ling and WENT Landfill at Nim Wan) for disposal.

6.3.4 Further measures are introduced under ETWB TC (W) No. 33/2002, that management of C&D materials, including rocks are strengthened and their generation at sources are minimized. The enhancement measures include: (i) drafting of a Construction and Demolition Material Management Plan (C&DMMP) at an early design stage to minimize C&D materials generation and encourage proper management of such materials; (ii) vetting of the C&DMMP prior to upgrading of the project to Category A in the Public Works Programme; and (iii) providing the contractor with information from the C&DMMP in order to facilitate the preparation of the Waste Management Plan (WMP) and to minimize C&D materials generation during construction. Projects generating C&D materials or importing fill material less than 50,000m³ are exempted from the C&DMMP.

6.3.5 ETWB TC(W) No. 34/2002 -- Management of Dredged/Excavated Sediment sets out the procedures for seeking approval to dredge/excavated sediment and the management framework for marine disposal of such sediment.

6.4 Assessment Approach and Methodology

6.4.1 The criteria for assessing waste management implications are outlined in Annex 7 of the EIAO-TM. The methods for assessing potential waste management impact during the construction and operation phases of the Project follow those presented in Annex 15 of the EIAO-TM and including the following:

- Estimation of types and quantities of the wastes generated;
- Assessment of potential impact from the management of the waste with respect to potential hazards, air and odour emissions, noise, wastewater discharge and public transport; and
- Impact on the capacity of waste collection, transfer and disposal facilities

6.4.2 Opportunities for waste reduction have been assessed based upon the following:

- Avoidance and minimization of waste generation throughout the design stage;
- Segregation of waste materials would be promoted and considered as the best management practices;
- Reuse and recycling on site or on other projects; and
- Material diversion to public fills.

To support the proposed viaduct structures, foundation reaching the bedrock below ground is necessary. As the viaducts are located in reclamation area, marine sediment will be excavated as a result of the piling works. To minimize the amount of marine sediment to be excavated, the best practical pile type with the least excavation volume is chosen. As a result, pre-bored H-piles socketed in rock are chosen. Comparing with the second-best option of large-diameter bored piles (with typical diameter 2000mm), the adopted pre-bored H-piles (with typical diameter 610mm) will generate less excavated sediment.

Identification of Waste Sources during Construction Phase

6.4.3 Construction works is envisaged to commence in the early 2014 and to be completed in 2015. The types of waste generated and their respective sources during construction phase are tabulated in **Table 6.1**.

Table 6.1 Identification of Waste Types and sources during Construction Phase of the Project

Waste Types	Sources of Waste Identified	Examples
Construction and Demolition (C&D) Materials	<ul style="list-style-type: none"> • Excavation • Earthworks and site formation • Demolition works 	<ul style="list-style-type: none"> • Inert C&D materials – Soft inert materials, wet spoil and artificial hard materials (AHM, include concrete and bitumen), etc. • Non- inert C&D materials – Timber, paper and plastic, etc
Chemical Waste	<ul style="list-style-type: none"> • Plant operation and maintenance • Maintenance of mechanical equipment 	<ul style="list-style-type: none"> • Oil and grease, used batteries; used paint and cleaning agents, etc.
General Refuse	<ul style="list-style-type: none"> • Construction works and site-based staff and workers 	<ul style="list-style-type: none"> • Food waste, containers, cans and waste paper, etc.
Marine Sediment	<ul style="list-style-type: none"> • Viaduct piling works 	<ul style="list-style-type: none"> • Sediment excavated from piling works

6.4.4 It is anticipated that negligible amount of waste would arise during operation phase of the Project. Therefore no adverse impact with implications on waste management is expected. Hence, it will not be further discussed in context.

Evaluation of Waste Impact

6.4.5 The construction activities of the Project would generate a variety of wastes which could be categorized into several types based on their composition and disposal methods. The identified waste types are indicated in **Table 6.1**.

Construction and Demolition Materials

6.4.6 C&D materials comprise inert and non-inert materials. The inert portion, such as soil, rock, concrete etc., namely the ‘public dump’, could be reused upon suitable testing while the non-inert portion, such as timber, paper etc. should be reused or recycled as much as possible. Landfill disposal should be considered as last resort for waste handling. C&D materials would be generated in the construction work of the Project and the work activities could be summarized as follow:

- Piling works
- Demolition works and site formation
- Excavation

6.4.7 The construction of new links and improvement works would adopt the in-situ concreting method. In selecting temporary structures for excavation, alternatives like pipe pile wall would be utilized whenever possible. The approach in avoidance in waste generation has been discussed in **Sections 6.5** below. A current estimation of the total volume of C&D materials generated in the Project is presented in **Table 6.2** and is approximately **28,170m³**.

6.4.8 Prior to construction works, the works areas have to be cleared to provide the construction sites. It is expected that existing landscaping materials, such as low-graded trees, will need to be cleared and thereby generate non-inert C&D materials. AHM will be generated from the demolition works of some of the existing structures, roads and pavements. It is predicted that 2,440m³ of AHM and 2,330m³ of non-inert materials would arise from the Project.

6.4.9 The non-inert C&D materials will be disposed of at the North-east New Territories (NENT) Landfill (see **Appendix 6.4D**). The possible non-inert C&D materials to be generated in the Project include:

- Timber from formwork
- Materials generated during site formation such as low grade trees
- Unusable/surplus concrete or grouting mixture

6.4.10 After the stage of site formation, excavation would be done to reach the formation level followed by the construction of underground structures. It is anticipated that these stages of the Project would generate the majority of C&D materials, in which most of the materials would be soft inert materials constituting approximately 21,000m³ generated during deep excavation, out of all inert C&D materials (25,840m³ comprising soft inert materials, artificial hard material and wet spoil) being generated. **Table 6.2** below presents the annual generation of C&D materials in the Project.

Table 6.2 Annual Generation of C&D Materials

	2014	2015	Sub-Total (m³)
Soft Inert Materials (m³)	6,300	14,700	21,000
Wet Spoil (m³)	2,400	-	2,400
Artificial Hard Material (m³)	2,200	240	2,440
Non-inert C&D Materials (m³)	2,130	200	2,330
Total (m³)			28,170

- 6.4.11 The C&D materials generated in the Project should be sorted on-site to segregate reusable and recyclable materials from other. Steel, which has resalable value, should be separated from other materials in this regard. Special designated areas on-site should be provided for the separated storage with proper measures in mitigating the impact as stipulated in **Sections 6.5**.
- 6.4.12 Materials should be reused on-site as far as practicable before being transported off-site. Primary segregation from other C&D materials should be provided to enhance the reusable volume by on-site sorting facilities.
- 6.4.13 A portion of the inert C&D materials generated during the construction would be reused on-site as backfilling materials. Out of 25,840m³ of inert materials, approximately 8,370m³ of soft inert C&D materials which at the time of deposition is capable of being compacted in accordance with the specified requirements to form stable areas of fill will be reused in the stage of earth work as backfilling materials. The inert C&D materials excluding slurry and bentonite (wet spoil) requiring off-site disposal will be delivered to the Tuen Mun Area 38 Fill Bank and the slurry and bentonite (wet spoil) will be delivered to the Tseung Kwan O Area 137 Fill Bank. It is the Contractor's responsibilities to properly manage the materials generated in the work area.
- 6.4.14 With careful planning for handling, storage and disposal of the C&D materials on site and proper implementation of waste management practices, secondary environmental impact from removal of the materials and potential impact on waste handling is expected to be minimal.

Chemical Waste

- 6.4.15 Chemical waste is likely to be generated from the maintenance and servicing of construction plant and equipment and the maintenance of vehicles during construction phase. The possible types of chemical waste may include:
- Oils and grease associated with plant
 - Scrap batteries from vehicle maintenance
 - Spent mineral oils or cleansing fluids from mechanical plants
 - Used paint, cleaners, solvents used in maintaining mechanical equipments

- Used solvents or solutions from equipment cleansing
- 6.4.16 It is difficult to quantify the amount of chemical waste that may arise from the construction activities since it would depend on the Contractor's on-site maintenance practices and the arrangement, quantities of plant and vehicles utilized. However, it is anticipated that the quantity of chemical waste, such as lubricating oil and solvent produced from plant maintenance, would be small and in the order of a few hundred litres per month, making up approximately 14,400L upon completion of the Project. The amount of chemical waste to be generated would be quantified in the Waste Management Plan to be prepared by the Contractors.
- 6.4.17 As stipulated in the Waste Disposal (Chemical Waste) (General) Regulations, chemical wastes arisen during construction phase may pose environmental, health and safety hazards if not stored and disposed of appropriately. These hazards may include:
- Toxic effects to workers
 - Adverse impact on water quality from spills
 - Fire hazard
- 6.4.18 Chemical waste will require special handling and storage arrangements which should be collected by licensed collectors and accepted by the approved Chemical Waste Treatment Centre (CWTC) at Tsing Yi for appropriate treatment. Wherever possible opportunities should be taken to reuse and recycle materials.
- 6.4.19 The handling, storage and disposal of chemical waste should be arranged in accordance with the Code of Practice on Packaging, Labelling and Storage of Chemical Wastes published by EPD. Provided that the guidelines in the Code of Practice are strictly followed, adverse environmental impact are not anticipated.

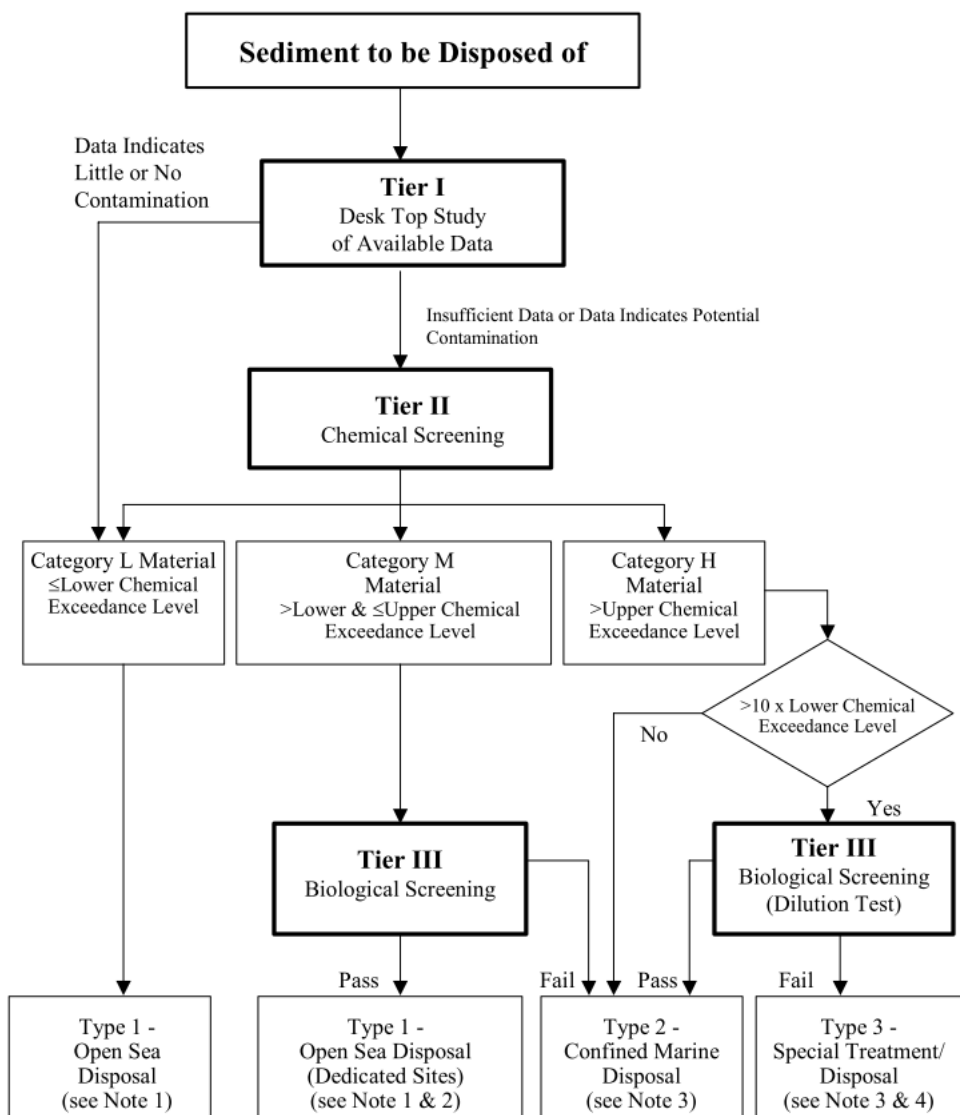
General Refuse

- 6.4.20 During the construction period, the workforce will generate refuse comprising food scraps, waste paper, empty containers, etc. Accidental or intentional release of these refuse to the surrounding environment is not permitted and may cause negative environmental impact. Storage of general refuse at site will generate adverse environmental impact like water contamination, odour nuisance and visual impact if they are not managed in a proper manner. The site may also attract vermin and pests if the waste containers are not cleaned or maintained properly and frequently, thus waste storage area should be well maintained and cleaned regularly. The refuse should be stored in enclosed bin to avoid adverse impact to the surroundings. Recycling bins should be provided to maximize reuse and recycle volume. A reputable licensed collector should be employed to collect the general refuse for later disposal at landfills.
- 6.4.21 Based on a generation rate of 1.9 m³ per week, the total amount of general refuse generated during the construction period are estimated to be approximately 200m³.
- 6.4.22 With the adoption of proper waste management practices, the secondary environmental impact from the collection and handling of general refuse are expected to be minimal.

Marine Sediment

- 6.4.23 Marine sediment will be excavated as a result of the piling works for the viaducts. Among the improvement schemes as described above in Section 1, Scheme H and Scheme I are vehicular viaducts along the West Kowloon Highway. General layout of the viaducts is shown in **Figure 1.1**. Deep foundation in form of pre-bored H-piles will be constructed to support the viaduct structures. As the viaducts are located in reclamation area, it is assessed that approximate 1,000 m³ of marine sediment will be excavated during the course of the piling works based on existing Ground Investigation (GI) records (see **Appendix 6.4B**). The assessed volume will be verified by the proposed GI works under this Project.
- 6.4.24 Management of excavated sediment will be carried out in accordance with ETWB TC(W) No. 34/2002. This includes agreement from MFC on rationale for removal, field investigation sampling, chemical and biological laboratory testing if necessary, classification of sediment quality based on test results, allocation of sediment disposal sites from MFC/EPD, and application for Marine Dumping Permit. These items are elaborated below in **Sections 6.4.25 to 6.4.29**.
- 6.4.25 Rationale for sediment removal was submitted to Marine Fill Committee (MFC) of Civil Engineering and Development Department on 8 March 2013. MFC has confirmed that they have no comment on the Rationale based their letter issued on 25 March 2013. The rationale submission and MFC's letter of no comment can be found in **Appendix 6.4A**.
- 6.4.26 The sediment sampling and testing plan (SSTP) had been submitted to EPD and MFC on 28 March 2013. SSTP (Issue 2) was submitted on 16 April 2013 to address EPD's comments. EPD has confirmed that they have no further comment on the SSTP (Issue 2) based on their letter dated 29 April 2013. The SSTP (Issue 2) were enclosed in **Appendix 6.4A**. The SSTP described the proposal for field investigation sampling and chemical/biological laboratory testing to characterize the excavated sediment. Testing parameters and methods as well as classification of sediments (i.e. Categories L, M or H) are specified in the SSTP. Sediment sampling and testing are proposed for Tier II Chemical Screening in accordance with ETWB TC(W) No. 34/2002 will be carried out to verify the sediment quality in the forthcoming GI works of this Project. The categories of sediment will be verified by the test results.
- 6.4.27 MFC had reserved adequate space for the disposal of sediment (estimated as approximately 1,000m³) from the Project until the completion of the Project in end 2015 (see **Appendix 6.4C**).
- 6.4.28 Disposal options for sediment based on their classification are proposed in accordance with the flow chart in Appendix C of ETWB TC(W) No.34/2002. The flow chart is reproduced below for ease of reference.

Appendix C of ETWB TC(W) No.34/2002



The excavated sediments will be delivered to existing designated disposal sites allocated by MFC/EPD according to their levels of contamination. The levels of contamination will be determined as set out in the SSTP described above in **Section 6.4.26** and enclosed in **Appendix 6.4A**, based on site specific chemical and biological laboratory testing. The test results, the sediment classification and the types of disposal (i.e. Types 1, 2 or 3) will be reported to EPD and MFC when available from the proposed GI works and laboratory testing.

Types of disposal for different categories of sediment are listed in the above flow chart. Disposal options for different types of disposal are listed below:

- For Type 1 disposal, the sediments will be transported to designated CEDD Facilities at open sea, typically at South Cheung Chau and East of Ninepin.
- For Type 2 disposal, the sediments will be transported to designated CEDD Facilities for confined marine disposal, typically at East Sha Chau.

- For Type 3 disposal, EPD's agreement on the most appropriate treatment and disposal arrangement will be sought.

6.4.29 The contractor undertaking the sediment disposal works will make a formal application to EPD for a dumping permit. The permit is granted under the Dumping at Sea Ordinance (DASO) (Cap.466). The contractor shall ensure that all conditions on the DASO permit are met to EPD's satisfaction. SSTP will be submitted separately to EPD's Territorial Control Office when applying for the DASO permit.

6.4.30 The volume of excavated sediment is assessed to be approximately 1,000m³. The assessment is based on thickness of the layer of marine sediment obtained from the existing GI data in the vicinity of the works site retrieved from GIU (see **Appendix 6.4B**). The estimation of the quantity of marine sediment to be generated is based on the existing borehole data in vicinity of the works site rather than GI data specified for this project, as sufficient time should be allowed for arranging a competent contractor who has the capability to arrange safe access into the works site and without causing adverse traffic impact by appropriate temporary traffic arrangement for carrying out the required GI works. In this regard, detailed planning and design of the temporary traffic arrangements for seeking approval by the relevant authorities is required. It is particularly the case as the works site for the GI works are either within expressway or within high speed roads. As the detailed design of the foundation (including quantity, type, and diameter of the piles) for the relevant schemes are substantially completed, the estimated volume of 1,000m³ is reasonably in order.

Classification of the Excavated Sediment

6.4.31 In accordance with the "Final Report on Assessment of Management Options (Rev A)" on CEDD website, contamination of sediment is expected to be confined to the uppermost 2m of the soil profile.

By assuming the uppermost 2m of the sediment to be Category H, and the remaining sediment below the uppermost 2m to be Category L, the following estimated volumes are derived:

- Estimated volume of Category H sediment = 300m³
- Estimated volume of Category L sediment = 700m³
- Total estimated volume of sediment = 1000m³

Category	Biological screening	Disposal Option	Estimated Volume (in-situ) (m³)
Category L	N/A	Type 1 – Open Sea	700
Category M	Pass	Type I – Open Sea (Dedicated Sites)	-
	Fail	Type 2 – Confined Marine Disposal	-
Category H (>UCEL)	N/A	Type 2 – Confined Marine Disposal	-
Category H (> 10 x LCEL)	Fail	Type 3 – Special Treatment/Disposal	300

The estimated volumes above will be verified by GI works and sediment sampling/testing as described above in **Section 6.4.26**. For the worse case, i.e. all 1,000m³ of sediment is of Category H and Type 3 disposal is required, adequate space of disposal sites will be available (see **Section 6.4.23** below and **Appendix 6.4C**). When test results are available, the sediment categories will be classified solely based on the chemical/biological test results.

6.4.32 Based on the estimated volume of the marine sediment excavated under this project is approximately 1,000m³, MFC of CEDD has confirmed that adequate space of disposal site will be reserved for disposal of the marine sediment of this project, notwithstanding that the allocation of the disposal space shall be subject to the classification of the marine sediment based on their letter dated 22 May 2013 (see **Appendix 6.4C**).

6.4.33 The categories of sediment/mud which are to be disposed of will be further verified by both chemical and biological tests and their quantities will also be verified accordingly. EPD will be notified of the test results once available. In accordance with ETWB TC(W) No. 34/2002, a Preliminary Sediment Quality Report (PSQR) shall be submitted to EPD and copied to MFC once the chemical testing results are available. If biological testing is required based on the results of the chemical testing, a Sediment Quality Report (SQR) shall be submitted to EPD for approval. Dumping permit will only be applied after the categories and estimated volume of sediments have been confirmed by the test results. No sediment removal works (i.e. piling works) is allowed to proceed until all issues on management of excavated sediments have been resolved and all relevant arrangements have been endorsed by the relevant authorities including MFC and EPD. Exact location of marine disposal will be assigned by MFC.

6.5 Mitigation of Adverse Environmental Impact

Waste Management Hierarchy

6.5.1 Development of mitigation measures for waste which aims at evaluating the desirability of waste management methods should be based on the recommended waste management hierarchy as follow:

- Avoidance and reduction of waste generation
- Reuse of materials as far as practicable
- Recovery and recycling of residual materials where possible
- Treatment and disposal according to relevant laws, guidelines and good practices

Avoidance and Reduction of Waste Generation

6.5.2 In order to avoid and reduce the amount of waste generation, alternative methods of construction had been considered based on the engineering and environmental factors identified in the planning and design stage.

6.5.3 Apart from a better designed construction scheme, the following measures would also be taken to minimize the quantity of C&D materials:

- Reduction of the size and number of offline plant rooms during design stage; and
- Minimization of the overall size of plant buildings throughout effective structural scheming for plan buildings.

On-site Sorting, Reuse and Recycle of Materials

6.5.4 Whenever materials are excavated, minimal segregation should be provided in order to enhance the reusable volume. Specific areas should also be allocated for on-site sorting of the C&D materials and other waste generated within the works area and provide temporary storage of the materials. If provision of storage area is constrained, minimal segregation into inert and non-inert C&D materials should be performed. Possible categories of waste separation are recommended below:

- Excavated materials suitable for reuse
- Inert C&D materials for disposal at PFRF
- Non-inert C&D materials for disposal at landfills
- Chemical waste
- General refuse

6.5.5 Prior to transport of materials off-site, possibility of reuse should be vigorously considered which should be coupled with the practices of on-site segregation. Inert C&D materials, like fill should be reused as far as practicable as filling materials before the final outlets of disposal at PFRFs. The reusable and the recyclable of Non-inert C&D materials shall be recovered before being disposed of at designated landfills. Metals, in particular for steel which has resalable value, should be segregated and recycled from other C&D materials.

6.5.6 Opportunities of reusing the inert C&D materials have been explored. As discussed in **Section 6.4**, out of 25,840m³ of inert materials, approximately 8,370m³ of them which at the time of deposition is capable of being compacted in accordance with the specified requirements to form stable areas of fill will be reused in the stage of earth work as backfilling materials. Possibilities of reusing the materials in other projects have also be evaluated but found to be limited. Nonetheless, possible outlets of reuse will be continuously investigated in the detailed design and construction stages.

Good Site Practices and Waste Reduction Measures

6.5.7 Adverse impact related to waste management is not anticipated, provided that good site practices are strictly followed. The recommended good site practices during construction phase include:

- Training of site personnel in, site cleanliness, proper waste management and chemical handling procedures;
- Provision of sufficient waste disposal points and regular collection of waste;
- Appropriate measures to minimize windblown litter and dust during transportation of waste by either covering trucks or by transporting wastes in enclosed containers;
- Regular cleaning and maintenance programme for drainage systems, sumps and oil interceptors
- Separation of chemical wastes for special handling and appropriate treatment.

6.5.8 Good management and control can prevent the generation of a significant amount of waste. Waste reduction is best achieved at the planning and design stage, as well as by ensuring the implementation of good site practices. Recommendations to achieve waste reduction include:

- Sorting of demolition debris and excavated materials from demolition works to recover reusable/ recyclable portions (i.e. soil, broken concrete, metal etc.)
- Segregation and storage of different types of waste in different containers or skips to enhance reuse or recycling of materials and their proper disposal
- Encourage collection of aluminium cans by providing separate labelled bins to enable this waste to be segregated from other general refuse generated by the workforce
- Proper storage and site practices to minimize the potential for damage or contamination of construction materials
- Plan and stock construction materials carefully to minimize amount of waste generated and avoid unnecessary generation of waste
- Training should be provided to workers about the concepts of site cleanliness and appropriate waste management procedures, including waste reduction, reuse and recycle

6.5.9 The Contractor should prepare and implement a Waste Management Plan (WMP) as a part of the Environmental Management Plan (EMP) in accordance with ETWB TCW No. 19/2005 which describes the arrangements for avoidance, reuse, recovery, recycling, storage, collection, treatment and disposal of different categories of waste to be generated from the construction activities. Such a management plan should incorporate site specific factors, such as the designation of areas for segregation and temporary storage of reusable and recyclable materials. The EMP should be submitted to the Engineer for approval. The Contractor should implement the waste management practices in the EMP throughout the construction stage of the Project. The EMP should be reviewed regularly and updated by the Contractor, preferably in a monthly basis.

6.5.10 All surplus C&D materials arising from or in connection with the works should become the property of the Contractor when it is removed unless otherwise stated. The Contractor will be responsible for devising a system to work for on-site sorting of C&D materials and promptly removing all sorted and process materials arising from the construction activities. The system should be included in the EMP identifying the source of generation, estimated quantity, arrangement for on-site sorting, collection, temporary storage areas and frequency of collection by recycling Contractors or frequency of removal off-site.

Handling, Storage, Collection, Transportation and Disposal of Waste

6.5.11 Storage of materials on site may induce adverse environmental impact if not properly managed, recommendations to minimize the impact include:

- Waste, such as soil, should be handled and stored well to ensure secure containment, thus minimising the potential of pollution;
- Maintain and clean storage areas routinely;

- Excavated area should be provided with covers and water spraying system where appropriate to prevent materials from wind-blown or being washed away; and
 - Different locations should be designated to store different materials to enhance reuse.
- 6.5.12 Waste haulier with appropriate permits should be employed by the Contractor for the collection and transportation of waste from works areas to respective disposal outlets. The following suggestions should be enforced to minimise the potential adverse impacts:
- Remove waste in timely manner;
 - Waste collectors should only collect wastes prescribed by their permits;
 - Impacts during transportation, such as dust and odour, should be mitigated by the use of covered trucks or in enclosed containers;
 - Obtain relevant waste disposal permits from the appropriate authorities, in accordance with the Waste Disposal Ordinance (Cap. 354), Waste Disposal (Charges for Disposal of Construction Waste) Regulation (Cap. 345) and the Land (Miscellaneous Provisions) Ordinance (Cap. 28)
 - Dispose of waste at licensed waste disposal facilities
 - Present valid ‘CHIT’ of the trip ticket system to the authority for disposal at landfills.
- 6.5.13 Implementation of trip ticket system with reference to DEVB TC(W) No. 6/2010, “Trip Ticket System for Disposal of Construction & Demolition Materials”, to monitor disposal of waste and to control fly-tipping at designated landfill. A recording system for the amount of waste generated, recycled and disposed (including disposal sites) should be proposed.
- In order to fully implement the trip-ticket system, it is recommended that warning signs should be put up at the temporary and permanent accesses of vehicle to remind the drivers of dump truck of the proper designated disposal outlet and the penalties of offence.
- C&D Materials**
- 6.5.14 In addition to the above general measures, other specific mitigation measures on handling the C&D materials and materials generated from site formation and demolition works are recommended below, which should form the basis of the Waste Management Plan (WMP) to be prepared by the Contractor in the construction phase.
- 6.5.15 Wheel wash facilities have to be provided before the trucks leave the works area. This can reduce the introduction of dust to the public road network.
- 6.5.16 Wet spoil generated from the piling works should be treated before disposal at PFRFs. With the agreement from Fill Management Department (FMD) of CEDD, wet spoil would be mixed with dry materials to reduce water content to less than 25% dry density before disposal, which reduce the impact to the reception facilities.
- 6.5.17 The waste delivered to landfill should not contain any free water or have water content more than 70% by weight. Concerning the requirement on the truck load of waste to

landfill, the haulier must ensure suitable amount of waste would be loaded on different types of trucks used.

Chemical Wastes

- 6.5.18 If chemical wastes are produced at the construction site, the Contractor would be required to register with the EPD as a chemical waste producer and to follow the guidelines stated in the Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes.
- 6.5.19 Containers used for storage of chemical waste should:
- Be compatible with the chemical wastes being stored, maintained in good condition and securely sealed;
 - Have a capacity of less than 450 litres unless the specifications have been approved by EPD;
 - Display a label in English and Chinese in accordance with instructions prescribed in Schedule 2 of the Waste Disposal (Chemical Waste)(General) Regulation.
- 6.5.20 The Chemical storage area should:
- Be clearly labelled to indicate corresponding chemical characteristics of the chemical waste and used for storage of chemical waste only
 - Be enclosed on at least 3 sides
 - Have an impermeable floor and binding 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 from entering
 - Be properly arranged so that incompatible materials are adequately separated
- 6.5.21 Lubricants, waste oils and other chemical wastes would be generated during the maintenance of vehicles and mechanical equipment. Used lubricants should be collected and stored in individual containers which are fully labelled in English and Chinese and stored in a designated secure place. These chemical wastes should be sent to oil recycling companies, if possible, and the empty oil drums should be collected by appropriate companies for reuse or refill. They should not be allowed to discharge into water courses, either by direct discharge, or as contaminants carried in surface water runoff from the construction site.
- 6.5.22 A trip-ticket system should be operated in accordance with the Waste Disposal (Chemical Waste)(General) Regulation to monitor all movements of chemical waste. The Contractor should employ a licensed collector to transport and dispose of the chemical wastes, to either the approved CWTC at Tsing Yi, or another licensed facility, in accordance with the Waste Disposal (Chemical Waste)(General) Regulation.

General Refuse

- 6.5.23 General refuse should be stored in enclosed bins or compaction units separate from C&D materials and chemical waste. A reputable waste collector should be employed by the contractor to remove general refuse from the site, separately from C&D materials and chemical wastes. Preferably, an enclosed and covered area should be provided to reduce the occurrence of wind-blown light material.
- 6.5.24 The recyclable component of general refuse, such as aluminium cans, paper and cleansed plastic containers should be separated from other waste. Provision and collection of recycling bins for different types of recyclable waste should be set up by the Contractor. The Contractor should also be responsible for arranging recycling companies to collect these materials. The non-recyclable components should be collected by licensed collectors employed by the Contractor on daily basis to avoid any adverse impact on storage of refuse, which would be disposed of at designated landfills.
- 6.5.25 The Contractor should carry out an education programme for workers in avoiding, reducing, reusing and recycling of materials generation. Posters and leaflets advising on the use of the bins should also be provided in the sites as reminders.

Marine Sediment

- 6.5.26 In order to determine the disposal requirements of the excavated marine sediment, sediment sampling and testing are required to be carried out at the design phase of the Project. The basic requirements and procedures for sediment disposal are specified under the ETWB TC(W) No. 34/2002. The excavated sediments will be loaded onto barges and transported to designated disposal sites depending on their level of contaminants.

Application for allocation of marine disposal shall be made to the Secretary of Marine Fill Committee (MFC). Marine Dumping Permits as stipulated under the Dumping at Sea Ordinance are required from EPD for the disposal of excavated sediment. No sediment removal works (i.e. piling works) is allowed to proceed until all issues on management of excavated sediments have been resolved and all relevant arrangements have been endorsed by the relevant authorities including MFC and EPD. Exact location of marine disposal will be assigned by MFC.

According to ETWB TC(W) No. 34/2002, the sediment is classified into the following three categories based on its contaminant levels.

- Category L: all contaminant levels \leq Lower Chemical Exceedance Level (LCEL)
- Category M: any one or more contaminant levels $>$ LCEL and none \leq Upper Chemical Exceedance Level (UCEL)
- Category H: any one or more contaminant levels $>$ UCEL

The disposal options of the sediment based on the chemical and biological screening test results are summarised below.

Category	Biological screening	Disposal option	Estimated Volume (in-situ) (m ³)
Category L	N/A	Type 1 – Open Sea	700
Category M	Pass	Type I – Open Sea (Dedicated Sites)	-
	Fail	Type 2 – Confined Marine Disposal	-
Category H (>UCEL)	N/A	Type 2 – Confined Marine Disposal	-
Category H (> 10 x LCEL)	Fail	Type 3 – Special Treatment/Disposal	300

Currently, open sea disposal of uncontaminated sediment is carried out at South Cheung Chau and East Ninepin and various empty marine borrow pits while contaminated sediment is disposed of at confined contaminated mud pits such as East Sha Chau. Nevertheless, no marine disposal works is allowed to proceed until all issues on management of excavated sediments have been resolved and all relevant arrangements have been endorsed by the relevant authorities including MFC and EPD.

6.5.27 For Type 3 disposal, a possible arrangement is by geosynthetic containment. A geosynthetic containment method is a method whereby the sediments are sealed in geosynthetic containers and, at the disposal site, the containers would be dropped into the designated contaminated mud pit where they would be covered by further mud disposal and later by the mud pit capping, thereby meeting the requirements for fully confined mud disposal. The technology is readily available for the manufacture of the geosynthetic containers to the project-specific requirements. Similar disposal methods have been used for projects in Europe, the USA and Japan and the issues of fill retention by the geosynthetic fabrics, possible rupture of the containers and sediment loss due to impact of the container on the seabed have been addressed.

Moreover, the geosynthetic containment is proposed for Type 3 disposal in local project “Wan Chai Development Phase II and Central-Wan Chai Bypass”. Field trials were also undertaken during WD II Design and Construction (D&C) Consultancy (Agreement No. CE54/2001 (CE)) using uncontaminated mud to demonstrate the feasibility of the geosynthetic containment. Report on the field trials concluded that disposal by sealing the sediments in geosynthetic containers and dropping these containers into the contaminated mud pits at East Sha Chau has been shown to be a successful and viable disposal method. The use of a geosynthetic container system for special disposal was considered to be an effective system with negligible loss of contaminants to the marine environment during disposal.

Table 6.3 provides a summary of the various waste types likely to be generated in the Project with the recommended handling methods and disposal routes.

Table 6.3 Summary of Waste Handling Methods and Disposal Routes

Waste Material Type	Generation from work items	Material Generated	Total quantity generate	Disposal quantity	Handling methods/reuse	Destinations
C&D Materials	Excavation	Soft Inert Materials	21,000m ³	12,630 m ³	<ul style="list-style-type: none"> Segregation from other C&D materials Excavated area should be well managed with cover and water spraying systems where appropriate. Separate areas should be provided for different materials. Transport offsite by covered trucks 	Reuse PFRFs
	Piling works	Wet Spoil	2,400m ³	2,400m ³	<ul style="list-style-type: none"> Segregation from other C&D materials Mix with dry materials to reduce water contents 	Reuse PFRFs
	Demolition works	Artificial Hard Materials (AHM) - Bitumen	300m ³	300 m ³	<ul style="list-style-type: none"> Segregation from other C&D materials Storage area should be provided on-site for future reuse 	Reuse PFRFs
		Artificial Hard Materials (AHM) – Broken Concrete	2,140 m ³	2,140 m ³	<ul style="list-style-type: none"> Segregation from other C&D materials Size larger than 250mm should be crushed Transport off site by covered truck 	Reuse PFRFs
	Site formation	Non-inert C&D materials	2,330 m ³	2,330 m ³	<ul style="list-style-type: none"> Transport off site by covered truck 	Designated landfills Recycling collectors
Chemical Waste	Maintenance and operation of equipment and plants	Oils and grease, hydraulic fluids, paints, solvents, etc.	14,400 L	14,400 L	<ul style="list-style-type: none"> Stored in compatible containers in designated areas on-site Collected and recycled by licensed collectors 	Chemical Waste Treatment Centre at Tsing Yi

Waste Material Type	Generation from work items	Material Generated	Total quantity generate	Disposal quantity	Handling methods/reuse	Destinations
General Refuse	Resident Workers	Food waste, plastic, paper, aluminium cans, etc.	200 m ³	200 m ³	<ul style="list-style-type: none"> • Provide on-site collection points along with recycle bins • Collected by licensed collectors on daily basis 	Designated landfills Recycling collectors
Marine Sediment	Piling Works	Sediment excavated from piling works	300m ³ *	300m ³ *	Category H Sediment* passing the biological dilution test <ul style="list-style-type: none"> • Type 2 Confined Marine Disposal 	Designated CEDD Facilities for confined marine disposal, typically at East Sha Chau.
					Category H Sediment* failing the biological dilution test <ul style="list-style-type: none"> • Type 3 Special Treatment/Disposal 	EPD's agreement on the most appropriate treatment and disposal arrangement will be sought. It may include treatment of sediment to render it suitable for confined marine disposal.

Waste Material Type	Generation from work items	Material Generated	Total quantity generate	Disposal quantity	Handling methods/reuse	Destinations
			700m ³ *	700m ³ *	Category L Sediment* <ul style="list-style-type: none"> • Type 1 Open Sea Disposal 	Designated CEDD Facilities at open sea, typically at South Cheung Chau and East Ninepin.

(*Remarks: See Section 6.4.29 on rationales of the estimated volumes and sediment categories. The estimated volumes and sediment categories will be further verified when GI data and chemical/biological testing results are available. Results of the GI, chemical/biological tests, revised estimation volumes and re-assessed sediment categories will be reported to EPD and MFC before application of dumping licence.)

Impact Caused by Handling, Storage, Collection, Transportation and Disposal of Waste

6.5.28 The assessment should cover the following area: potential hazard, air and odour emission, noise and wastewater discharge. With the implementation of mitigation measures as discussed below, impacts caused by handling, collection, transportation and disposal of waste regarding the above mentioned issue is expected to be minimal.

Mitigation measures are required to ensure the proper handling, storage, transportation and disposal of waste being carried out. In addition, measures to ensure that the generation of waste is avoided and minimized and that waste materials are recycled and treated as far as practicable. The recommended mitigation measures for all categories of waste are as follows. With proper implementation of these measures, the handling (including labeling, packaging & storage), collection, transportation and re-use/disposal of wastes will not cause adverse impacts on potential hazard, air and odour emissions, noise, wastewater discharge, ecology and public transport.

- (i) The requirements as stipulated in the ETWB TC(W) No.19/2005 Environmental Management on Construction Sites and the other relevant guidelines should be included in the Particular Specification for the Contractor as appropriate.
- (ii) The Contractor should be requested to submit a Waste Management Plan (WMP) prior to the commencement of construction work, in accordance with the ETWB TC(W) No.19/2005 so as to provide an overall framework of waste management and reduction. The WMP should include:
 - Waste management policy;
 - Record of generated waste;
 - Waste reduction target;
 - Waste reduction programme;
 - Role and responsibility of waste management team;
 - Benefit of waste management;
 - Analysis of waste materials;
 - Reuse, recycling and disposal plans;
 - Transportation process of waste products; and
 - Monitoring and action plan.
- (iii) The waste management hierarchy below should be strictly followed. This hierarchy should be adopted to evaluate the waste management options in order to maximise the extent of waste reduction and cost reduction. The records of quantities of waste generated, recycled and disposed (locations) should be properly documented.
- (iv) A trip-ticket system should be established in accordance with DevB TC(W) No. 6/2010 and Waste Disposal (Charges for Disposal of Construction Waste) Regulation to monitor the disposal of public fill and solid wastes at public filling facilities and landfills, and to control fly-tipping. A trip-ticket system would be included as one of the contractual requirements for the Contractor

to strictly implement. The Engineer would also regularly audit the effectiveness of the system.

- (v) A recording system for the amount of waste generated, recycled and disposed (locations) should be established. The future Contractor should also provide proper training to workers regarding the appropriate concepts of site cleanliness and waste management procedures, e.g. waste reduction, reuse and recycling all the time.
- (vi) The CEDD should be timely notified of the estimated volumes of excavated materials to be generated and the Public Fill Committee should be notified and agreement sort on the disposal of surplus inert C&D materials. Wherever practicable, C&D materials should be segregated from other wastes to avoid contamination and to ensure acceptability at public filling areas or reclamation sites.
- (vii) The site and surroundings shall be kept tidy and litter free.
- (viii) No waste shall be burnt on-site.
- (ix) Prohibit the Contractor to dispose of C&D materials at any sensitive locations e.g. natural habitat, etc. The Contractor should propose the final disposal sites in the EMP and WMP for approval before implementation.
- (x) Excavated material shall be covered by tarpaulin and /or watered as appropriate to prevent windblown dust and surface run off.
- (xi) Excavated material in trucks shall be covered by tarpaulins to reduce the potential for spillage and dust generation.
- (xii) Wheel washing facilities shall be used by all trucks leaving the site to prevent transfer of mud onto public roads.
- (xiii) The Contractor should recycle as many C&D materials as possible on-site. The public fill and C&D waste should be segregated and stored in separate containers or skips to facilitate the reuse or recycling of materials and proper disposal. Where practicable, the concrete and masonry should be crushed and used as fill materials. Steel reinforcement bar should be collected for use by scrap steel mills. Different areas of the sites should be considered for segregation and storage activities.
- (xiv) Chemical waste producers should register with the EPD. Chemical waste should be handled in accordance with the Code of Practice on the Packaging, Handling and Storage of Chemical Wastes as follows:
 - suitable for the substance to be held, resistant to corrosion, maintained in good conditions and securely closed;
 - Having a capacity of <450L unless the specifications have been approved by the EPD; and
 - Displaying a label in English and Chinese according to the instructions prescribed in Schedule 2 of the Regulations.
 - Clearly labelled and used solely for the storage of chemical wastes;
 - Enclosed with at least 3 sides;

- Impermeable floor and bund with capacity to accommodate 110% of the volume of the largest container or 20% by volume of the chemical waste stored in the area, whichever is greatest;
 - Adequate ventilation;
 - Sufficiently covered to prevent rainfall entering (water collected within the bund must be tested and disposed of as chemical waste, if necessary); and
 - Incompatible materials are adequately separated.
- (xv) Waste oils, chemicals or solvents shall not be disposed of to drain.
- (xvi) Adequate numbers of portable toilets should be provided for on-site workers. Portable toilets should be maintained in reasonable states, which will not deter the workers from utilising them. Night soil should be regularly collected by licensed collectors.
- (xvii) General refuse arising on-site should be stored in enclosed bins or compaction units separately from C&D and chemical wastes. Sufficient dustbins shall be provided for storage of waste as required under the Public Cleansing and Prevention of Nuisances By-laws. In addition, general refuse shall be cleared daily and shall be disposed of to the nearest licensed landfill or refuse transfer station. Burning of refuse on construction sites is prohibited.
- (xviii) All waste containers shall be in a secure area on hardstanding;
- (xix) Aluminium cans are usually collected and recovered from the waste stream by individual collectors if they are segregated and easily accessible. Separately labelled bins for their deposition should be provided as far as practicable.
- (xx) Office wastes can be reduced by recycling of paper if such volume is sufficiently large to warrant collection. Participation in a local collection scheme by the Contractor should be advocated. Waste separation facilities for paper, aluminium cans, plastic bottles, etc should be provided on-site.
- (xxi) Training shall be provided to workers about the concepts of site cleanliness and appropriate waste management procedure, including waste reduction, reuse and recycling.

Evaluation of Residual Impact

- 6.5.29 With the implementation of the recommended mitigation measures for the handling, transportation and disposal of the identified waste arising, no residual impact is expected during construction phase.

Environmental Monitoring and Audit Requirements

- 6.5.30 During the construction period, it is the Contractor's responsibility to ensure that all waste produced during the construction of the Project are handled, stored and disposed of in accordance with good waste management practices, relevant legislation and waste management guidelines.
- 6.5.31 Waste materials generated during construction activities, such as C&D materials, are recommended to be audited at regular intervals to ensure that proper storage, transportation and disposal practices are being implemented. This would ensure the

waste generated would be properly disposed of. The Contractor would be responsible for the implementation of any mitigation measures to minimize waste or mitigate problems arisen from waste materials.

- 6.5.32 A WMP, as a part of the Environmental Management Plan(EMP), should be prepared in accordance to with ETWB TC(W) No.19/2005 and submitted to the Engineer for approval. The recommended mitigation measures should form the basis of the EMP. The monitoring and auditing requirement stated in ETWB TC(W) No.19/2005 should be followed with regard to the management of C&D materials.

6.6 Conclusion

- 6.6.1 Waste types generated by the construction activities are likely to include C&D materials (from excavation, piling works and demolition of existing structures), general refuse from workforce, chemical waste from maintenance of construction plant and equipment and marine sediment from viaduct piling works. Provided that these wastes are handled, transported and disposed of using approved methods and that the recommended good site practices are strictly followed, adverse environmental impact are not expected during the construction phase.
- 6.6.2 It is predicted that amount of waste to be generated in the operation phase of the Project, which may include silt or grit from road gullies and litter collected from road surface, is negligible, thus no adverse environmental impact in the operation phase is expected.