

8 Waste Management Impact Assessment

8.1 Introduction

This section identifies the potential waste arising from the construction and operation activities of the Project and evaluates the potential environmental impacts that may result from waste generated. Mitigation measures on waste handling, transportation and disposal, are recommended with reference to applicable waste legislation and management guidelines to minimise potential waste management impacts.

8.2 Environmental Legislation, Standards and Guidelines

8.2.1 Environmental Impact Assessment Ordinance

The criteria and guidelines for assessing waste management implications are outlined respectively in Annexes 7 and 15 of the Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM).

The following legislation relates to the handling, treatment and disposal of wastes in Hong Kong and has been used in assessing potential impacts:

- Waste Disposal Ordinance (Cap. 354)
- Waste Disposal (Chemical Waste) (General) Regulation (Cap. 354C)
- Dumping at Sea Ordinance (Cap. 466)
- Public Health and Municipal Services Ordinance (Cap. 132) - Public Cleansing and Prevention of Nuisances Regulation.

8.2.2 Waste Disposal Ordinance

The Waste Disposal Ordinance (WDO) is the principal piece of legislation for management and control of waste disposal in Hong Kong. The WDO prohibits the unauthorised disposal of wastes. Construction waste is defined as any substance, matter or thing that is generated from construction work and abandoned, whether or not it has been processed or stockpiled before being abandoned, but does not include any sludge, screenings or matter removed in or generated from any desludging, desilting or dredging works. Under the WDO, waste can be disposed of only at designated waste disposal facilities.

8.2.3 Waste Disposal (Chemical Waste) (General) Regulation

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 wastes.

According to the Waste Disposal (Chemical Waste) (General) Regulation, all producers of chemical waste must register with Environmental Protection Department (EPD) and treat their wastes, either utilising on-site plant licensed by EPD, or arranging for a licensed collector to transport the wastes to a licensed facility. The Regulation also prescribes the storage facilities to be provided on site, including labelling and

warning signs, and requires the preparation of written procedures and training to deal with emergencies such as spillages, leakages or accidents arising from the storage of chemical wastes.

The EPD has also issued a 'guideline' document, the Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes (1992), which details how the Contractor should comply with the regulations on chemical wastes.

8.2.4 Dumping at Sea Ordinance

In accordance with the Dumping at Sea Ordinance (DASO), application for dumping permits from EPD is required for marine disposal of dredged materials.

The Practice Notes for Authorised Persons, Registered Structural Engineers and Registered Geotechnical Engineers ADV-21 (PNAP ADV-21) – *Management Framework for Disposal of Dredged/ Excavated Sediment*, set out the procedures for seeking approval to dredge/ excavate sediment and the management framework for marine disposal of such sediment. Applications for approval of dredging proposal and allocation of marine disposal shall be made to the Secretary of Marine Fill Committee (MFC). The aforementioned documents outline the requirements to be followed for assessing and classifying the sediment and explain the marine disposal arrangement for the classified material.

8.2.5 Public Cleansing and Prevention of Nuisances Regulation

The Public Cleansing and Prevention of Nuisances Regulation provides control on illegal tipping of wastes on unauthorised (unlicensed) sites.

8.3 Assessment Methodology

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

8.3.1 Analysis of Activities and Waste Generation

- Identify the quantity, quality and timing of waste arising as a result of the construction and operation activities of the Project;
- Estimate the types and quantities of the wastes required to be disposed of.
- Identify the disposal methods / options for each type of waste.
- Identify the transportation routings and the frequency of the vessels involved.
- Assess the potential impacts from the management of solid waste with respect to potential hazards, air and odour emissions, noise, wastewater discharges, ecology and public transport.

8.3.2 Dredging and Dumping

- Identify and quantify all dredging, dredged sediment transportation and disposal activities and requirements.
- Identify potential dumping ground to be involved.
- Identify appropriate field investigation and testings and categories of sediment.
- Identify and evaluate the best practicable dredging methods to minimise dredging and dumping requirements.

8.4 Identification, Prediction and Evaluation of Environmental Impact

8.4.1 Construction Phase

The activities to be carried out for construction of the Project would generate a variety of wastes that can be divided into different key categories based on their composition and ultimate method of disposal. The identified waste types include:

- Marine sediment;
- Chemical waste; and
- General refuse.

Each type of the above waste arising is described below, together with an evaluation of the potential environmental impacts associated with the waste generation, handling, storage, transport and disposal.

8.4.1.1 Marine Sediment

The major source of waste generation is marine sediment from the proposed dredging works. The Project requires improvement dredging of the navigation channel. The main dredging area will be within the navigation channel boundary as shown in **Figure 8.1**. Side slope of navigation channel will be dredged within the project boundary to maintain the stability. It is estimated that up to approximately 3.2 million m³ of dredged marine sediment will be generated.

Baseline Conditions

Routine Monitoring by EPD

Based on the data from EPD's published Marine Water Quality in Hong Kong in 2015¹, two of the EPD reference marine sampling locations at West Lamma Channel (SS3 and SS4) are located near the proposed dredging area of the Project. The latest available testing results from EPD on the recovered sediments at SS3 and SS4 indicated that all the sediments samples are classified as Category L, i.e., the testing results of all parameters not exceeding the Lower Chemical Exceedance Level (LCEL), as defined

¹ Marine Water Quality in Hong Kong, Environmental Protection Department (2015).

in PNAP ADV-21. Excerpts of the published marine sediment testing results at SS3 and SS4 are given in **Appendix 8.1**.

Previous Site Investigation Studies

According to the 2003 approved EIA and the Sediment Sampling and Testing Plan (SSTP)² prepared in March 2014, five rounds of marine sediments sampling and testing were carried out in the past, as summarised in **Table 8-1**.

Table 8-1: Summary of Previous Sediment Sampling Works

No.	Year of Sampling Works	Sampling Locations and Quantities	Sample Testing Results
1	1994	10 sampling locations at the Navigation Channel – eight were core samples of 2 m in depth, with sub-samples collected from the top and middle layers of the cores, and the remaining two were surface grab samples.	All samples classified as Category L
2	1997	8 sampling locations at the turning basin of the Navigation Channel – all samples were taken by piston corer, with sub-samples collected from the surface and five depths, i.e., 0.0- 0.1m, 0.9-1.0m, 1.9- 2.0m, 2.9-3.0m and 5.9-6.0m.	All samples classified as Category L
3	1998	16 sampling locations at the new power station extension area – all vibrocore samples taken continuously, with sub-samples collected from the surface, 0.9m down, 1.9m down, 2.9m down and then every 3m to the base of the vibrocore sample.	All samples classified as Category L
4	2003	5 sediment samples collected along the submarine gas pipeline around the Navigation Channel	All samples classified as Category L
5	2008	52 sediment samples collected at the Navigation Channel	All samples classified as Category L

Based on the five rounds of sediment sampling and testing works completed between 1994 and 2008, all the collected samples were consistently found to be of Category L, without any major changes in sediment quality.

Marine Sediment Quality

The sediment sampling works at the proposed dredging area were carried out in April 2014 and the laboratory testing works were then completed in May 2014. A total of 45 sampling locations are selected for collecting seabed surface samples by using a grab sampler as shown in **Figure 8.1**. Surface sampling at a grid of 200m x 200m was adopted during the sampling exercise. The sampling locations, measurement and testing methodology as well as the testing results are detailed in the Sediment Quality Report (SQR), which is approved by EPD in June 2014. The approval letter and the SQR are shown in **Appendix 8.2**. According to the SQR, the collected sediment samples are all classified as Category L, which is consistent with all the previous testing results. The sample testing results as extracted from the

² Sediment Sampling and Testing Plan, Chemical Screening for Determination of Sediment Quality for Improvement Dredging of Navigation Channel of Lama Power Station, AECOM (2014).

Improvement Dredging for Lamma Power Station Navigation Channel
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SQR are summarised in **Table 8-2** below and detail laboratory testing results is shown in Table 3.2 of the SQR.

Table 8-2: Summary of Laboratory Testing Results of Sediment Samples Collected in April 2014

Parameters	Results of Chemical Analysis of SQR		Lower Chemical Exceedance Level (LCEL)	Classification
	Min	Max		
Metals (mg/kg dry wt.)				
Cadmium (Cd)	<0.2	<0.2	1.5	Category L
Chromium (Cr)	34	52	80	Category L
Copper (Cu)	14	36	65	Category L
Mercury (Hg)	0.05	0.32	0.5	Category L
Nickel (Ni)	21	32	40	Category L
Lead (Pb)	32	50	75	Category L
Silver (Ag)	0.1	0.4	1	Category L
Zinc (Zn)	85	142	200	Category L
Metalloids (mg/kg dry wt.)				
Arsenic (As)	8	12	12	Category L
Organic- PAH (µg/kg dry wt.)				
Low Molecular Weight PAHs [^]	<550	<550	550	Category L
High Molecular Weight PAHs [^]	<1700	<1700	1700	Category L
Organic-non-PAH (µg/kg dry wt.)				
Total PCBs [^]	<18	<18	23	Category L

Note: [^] For every individual compound

Based on the previous site investigation studies and monitoring record from EPD, the marine sediments at the Channel area were consistently classified as Category L and no major changes in sediment quality was found between 1994 and 2014. Therefore, it is expected the marine sediment to be dredged from the side slope of the navigation channel should be also classified as Category L.

Subject to the result of future bathymetric surveys, sediment sampling will be carried out at the actual dredging area prior to dredging activity in the future to confirm the classification of sediment, and to comply with the DASO permitting requirements and Marine Fill Committee's (MFC) approval on disposal allocation.

Marine Sediment Disposal

Based on PNAP ADV-21, the disposal methods for sediments classified as Category L is Type 1 Open Sea Disposal. Therefore, marine dumping permit for disposal of sediments to be dredged from the Navigation Channel will need to be obtained in advance according to the relevant requirements of PNAP ADV-21.

The SQR was approved by EPD in June 2014. The disposal arrangement as identified for this Project will be subject to procedural agreement from MFC. No dredging work would be permitted to proceed until all matters on management of dredged sediments have been resolved with all relevant authorities including MFC and EPD.

To minimise any potential adverse impacts arising from the dredged marine sediment, the sediment will be dredged, transported and disposed of in a manner that will minimise the loss of contaminants. Mitigation measures to minimise potential environmental impacts in relation to waste handling are described in **Section 8.5.1**. With the implementation of mitigation measures, no environmental impacts would be anticipated from the transportation and disposal of the dredged sediment.

8.4.1.2 Chemical Waste

Chemical wastes arising during the construction phase may pose environmental, health and safety hazards if not stored and disposed of in an appropriate manner as stipulated in the Waste Disposal (Chemical Waste) (General) Regulations. The potential hazards include:

- Toxic effects to workers;
- Adverse impacts on water quality from spills; and
- Fire hazards.

The maintenance and servicing of dredgers may generate some chemical wastes such as used solvents, contaminated rags and waste lubricating oil. It is difficult to quantify the amount of chemical waste that will arise from the construction activities since it will be dependent on the Contractor's on-site maintenance requirements. However, it is anticipated that the quantity of chemical waste, such as waste lubricating oil and solvents produced from plant maintenance, will be small and in the order of a few litres per month. The amount of chemical waste to be generated will be quantified in the Waste Management Plan to be prepared by the Contractor for the site.

Materials classified as chemical wastes will require special handling and storage arrangements before removal for off-site disposal at the approved Chemical Waste Treatment Facility or recycling by licensed facilities. Mitigation and control requirements for chemical wastes are detailed in **Section 8.5.2**. Provided that the handling, storage and disposal of chemical wastes are in accordance with these requirements, adverse environmental impacts are not expected.

8.4.1.3 General Refuse

The construction workforce will generate refuse comprising food scraps, waste paper and empty containers etc. As the dredging activities are marine-based works, such refuse will be properly managed so that intentional or accidental release to the surrounding environment will be avoided. Disposal of refuse at sites other than approved waste transfer or disposal facilities will be prohibited.

Effective collection of wastes will be required to prevent waste materials being blown around by wind, flushed or leached into the marine environment, or creating an odour nuisance or pest/ vermin problem. As

the workers are working on the barges, proper education to the construction workforce and provide general refuse collection containers on the barges can minimise the refuse contaminate the marine environment. Such refuse will be properly managed so that intentional or accidental release to the surrounding environment will be avoided. Waste collection containers will be well maintained and cleaned regularly. The daily arising of general refuse from the construction workforce can be estimated based on a generation rate of 0.65 kg per worker per day.

The maximum number of construction workers to be employed for each day is approximately 450 workers. Based on a generation rate of 0.65 kg per worker per day, the maximum daily arising of general refuse during the construction period would be approximately 300 kg and this waste can be effectively controlled by normal measures. With the proper education and the implementation of good waste management practices as detailed in **Section 8.5.3**, no adverse environmental impacts associate with general refuse are anticipated.

8.4.2 Operation Phase

During operation phase, improvement dredging will be required periodically to maintain sufficient depth for marine passage. It is anticipated that the wastes generated from this recurring improvement dredging is the same as that for construction phase, include:

- Marine sediment;
- Chemical waste; and
- General refuse.

It is anticipated that with recurrent dredging of localised high spots once every 4 years or so (with estimated dredging quantity up to 0.9 million m³ each time), full re-profiling of the Channel with a dredging quantity of up to 2.9 million m³ can be delayed to approx. once every 10+ years.. The extent of dredging area within the project boundary will be subjected to the result of the future bathymetric surveys. As discussed in **Section 8.4.1.1**, based on the previous site investigation studies, the marine sediments at the Channel area were consistently classified as Category L and no major changes in sediment quality was found between 1994 and 2014. Therefore, the marine sediment to be dredged is expected to be classified as Category L (for Type 1, Open Sea Disposal).

In any case, recurring improvement dredging would require sediment sampling and testing in accordance with the requirements of the PNAP ADV-21 for proper disposal of the dredged sediment. MFC would determine the most appropriate marine disposal site on the basis of the testing results and formally allocate marine disposal space in accordance with the PNAP ADV-21. No dredging of sediment would be permitted to proceed until all matters on marine sediment disposal have been resolved and all relevant arrangements have been endorsed by the appropriate authorities, including MFC and EPD.

To minimise any potential adverse impacts arising from the dredged marine sediment, the sediment will be dredged, transported and disposed of in a manner that will minimise the loss of contaminants. Mitigation measures to minimise potential environmental impacts in relation to waste handling are described in

Section 8.5.1. With the implementation of mitigation measures, no environmental impacts would be anticipated from the transportation and disposal of the dredged sediment.

Aside from the aforementioned, no other potential impact due to recurring improvement dredging is anticipated given that the nature of the operation phase waste management implication will be the same as that for construction phase.

8.5 Mitigation Measures

8.5.1 Marine Sediment

The Category L marine sediment will require Type 1 Open Sea Disposal. No dredging work is allowed to proceed until all matters on management of dredged sediments have been resolved and all relevant arrangements have been endorsed by the relevant authorities including MFC and EPD.

The sediment at the Project area would be dredged and transferred to barges for subsequent open-sea disposal at location to be allocated by MFC. Release of dredged sediment into the surrounding water during the transfer process should be avoided. It is therefore recommended that the distance between the barge and the dredging point should be shortened as far as possible to avoid dropping of sediment from the close grab to seawater.

During transportation and disposal of the dredged marine sediments, the following measures should be taken to minimise potential impacts:

- Bottom opening of barges will be fitted with tight fitting seals to prevent leakage of material;
- Excess material shall be cleaned from the decks and exposed fittings of barges and dredgers before the vessel is moved;
- Monitoring of the barge loading should be conducted to ensure that loss of material does not take place during transportation;
- Barges or hopper barges should not be filled to a level that would cause the overflow of materials or sediment laden water during loading or transportation;
- Dumping barges should be installed with Real Time Tracking and Monitoring of Vessel (RTTMV) system for monitoring the mud dumping activities; and
- All conditions stipulated in the dumping permit should be strictly followed.

8.5.2 Chemical Waste

If chemical wastes are produced, the Contractor will 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”. Good quality containers compatible with the chemical wastes should be used, and incompatible chemicals should be stored separately. Appropriate labels should be securely attached on each chemical waste container indicating the corresponding chemical characteristics of the chemical waste, such as explosive, flammable, oxidising, irritant, toxic, harmful, corrosive, etc. Licensed collector should be deployed to transport and dispose of the chemical wastes at the approved Chemical

Waste Treatment Centre or other licensed recycling facilities, in accordance with the Waste Disposal (Chemical Waste) (General) Regulation.

8.5.3 General Refuse

General refuse should be stored in enclosed bins or compaction units and delivered to the refuse collection point accordingly. The Contractor should remove general refuse regularly to avoid odour nuisance or pest/vermin problem. Preferably an enclosed and covered container should be provided to minimise the refuse contaminate the marine environment. Sufficient recycling containers are recommended to be provided to encourage recycling of such waste as aluminium cans, plastics and waste paper.

8.6 Evaluation of Residual Impacts

With the implementation of the recommended mitigation measures for the handling, transportation and disposal of the identified waste arising, residual impacts are not anticipated during both construction and operation phases of the Project.

8.7 Environmental Monitoring and Audit Requirements

It will be the Contractor's responsibilities to ensure that all the marine sediment produced during the construction phase and operation phase of the Project are handled, stored and disposed of in accordance with good waste management practices and the relevant regulations and requirements. The Contractor should properly implement the recommended mitigation measures to avoid or minimise the potential for waste impact.

During construction phase, regular site inspection as part of the EM&A procedures should be carried out to check if the marine sediments are being managed in accordance with recommended mitigation measures above.

The Contractor should ensure to obtain the marine dumping permit from the relevant authorities before commencement of dredging work. No dredging work would be permitted to proceed until all matters on management of dredged sediments have been resolved with all relevant authorities including MFC and EPD.

8.8 Conclusion

8.8.1 Construction Phase

The major waste types generated by the construction activities will be marine sediment. Based on the review of the sediment quality data from the 2003 approved EIA report, previous marine site investigation studies and SQR, the marine sediment to be dredged is classified as Category L (for Type 1, Open Sea Disposal). The total volume of dredged sediment requiring marine disposal is estimated to be up to 3.2

million m³. With implementation of the recommended mitigation measures and management procedures in accordance with the requirements of PNAP ADV-21, no environmental impact is anticipated.

Chemical waste will be generated from maintenance and servicing of dredging plant and equipment as well as general refuse to be generated from the workforce. Provided that all these identified wastes are handled, transported and disposed of in strict accordance with the relevant legislative and recommended requirements and that the recommended mitigation measures are properly implemented, no adverse environmental impact is expected during the construction phase.

8.8.2 Operation Phase

During the operation phase, it is anticipated that with recurrent dredging of localised high spots once every 4 years or so (with estimated dredging quantity up to 0.9 million m³ each time), full re-profiling of the Channel with a dredging quantity of up to 2.9 million m³ can be delayed to approx. once every 10+ years. The extent of dredging area within the project boundary will be subjected to the result of the future bathymetric surveys. Based on the previous site investigation studies, the marine sediment to be dredged should be classified as Category L (for Type 1, Open Sea Disposal). In any case, recurring improvement dredging would require sediment sampling and testing in accordance with the requirements of the PNAP ADV-21 for proper disposal of the dredged sediment. MFC would determine the most appropriate marine disposal site on the basis of the testing results and formally allocate marine disposal space in accordance with the PNAP ADV-21. With implementation of the recommended mitigation measures and management procedures in accordance with the requirements of PNAP ADV-21, no environmental impact is anticipated.

Chemical waste will be generated from maintenance and servicing of dredging plant and equipment as well as general refuse to be generated from the workforce. Provided that all these identified wastes are handled, transported and disposed of in strict accordance with the relevant legislative and recommended requirements and that the recommended mitigation measures are properly implemented, no adverse environmental impact is expected during the operation phase.