2. Project Description

2.1 Location and Scale of the Project

The Project site is situated next to Victoria Road and Cadogan Street in Kennedy Town and adjacent to Victoria Harbour. The Project site boundary and EIA Study Area are shown in **Figure 2.1**.

The Project site has a total area of about 32,000 m^2. The total estimated volume of soil requiring decontamination within the site is projected to be around 112,666 m^3. **Table 2.1** below shows the estimated volume of contaminated soil according to the type of contamination (Heavy Metals, Hydrocarbons, or a mixture of both).

Table 2.1: Estimated Volumes of Contaminated Soil Requiring Excavation and Decontamination, by Type

Soil Type	Description	Vol. (m^3)
Type A	Soil contaminated with Heavy Metals (HM)	57,254
Type B	Soil contaminated with Hydrocarbons (HC)	17,233
Type C	Soil contaminated with both HM and HC	38,179
	Total contaminated soil volume	112,666
	Soil not requiring decontamination (including concrete slab), but needs to be excavated	73,746
	Total excavated soil volume (including concrete slab)	186,412

2.2 Need for the Project

2.2.1 Purpose and Objective of the Project

The Project is necessary to prepare the Kennedy Town CDA site for the proposed future land uses.

The alternative decontamination works is required for the following reasons. Firstly, the Original EIA Study (EIA Register No. AEIAR-025/2002) recommended that contaminated soil from the site would require disposal at landfill following pre-treatment. However, such disposal method is no longer acceptable due to the significantly larger quantity of soil than previously predicted. The Project could not proceed without a practicable alternative treatment and disposal method being identified. Secondly, if the contaminated site is not appropriately decontaminated to the Risk-Based Remediation Goals (RBRGs) standard, the redevelopment of the site would not be allowed due to the potential risk of released contaminants to human receptors during construction/ operation phase of the redevelopment.

2.2.2 Environmental Benefits of the Project

The environmental benefits of the Project are expected to be the mitigation, avoidance or otherwise reduction in the risk of pollution to air, soil, and water, and associated long-term risks to human health derived from the presence of in-situ contaminated ground at the Kennedy Town CDA site. Therefore, the Project could prepare a risk-free site for future development of Kennedy Town, for example, development of a waterfront promenade etc. Other environmental benefits of the alternative decontamination works include:

- Saving landfill space – the Original EIA Study recommended landfill disposal for soil contaminated with hydrocarbons whereas the proposed alternative decontamination methods would allow on-site reuse of decontaminated soil; and
- The RBRGs Approach is a more robust framework for the assessment of decontamination works than the Dutch B Approach, as this was developed using Hong Kong data in respect of typical working schedules, soil conditions, meteorological conditions, typical building designs, etc. to suit local conditions. This approach provides a more relevant and technically defensible framework for the assessment of contaminated sites, and promotes cost-effective decontamination in Hong Kong (reference from S.1.4 of "Guidance Manual for Use of Risk-Based Remediation Goals for Contaminated Land Management"). ,

2.2.3 Changes to Relevant Findings in the Original EIA Report

The previous EIA carried out at the Kennedy Town CDA for Agreement no. CE15/99, outlined proposals for decontamination of Heavy Metal and Hydrocarbon contamination using in-situ cement solidification and off-site landfilling, in line with the recommendations of the 'Dutch B' guidelines prevalent at the time. According to the Final EIA Report (dated September 2001), the total quantity of contaminated soil at the Project site was 6,055 m^3 with about 4,635 m^3 requiring decontamination on site by immobilisation, and the remaining 1,420 m^3 to be transferred to landfill.

As stated previously in **Section 1.1**, the latest Project scope of works includes a significantly larger quantity of soil requiring decontamination than the previously predicted amount; and the recommended ground decontamination methods in the approved EIA Report are no longer applicable according to current guidance (RBRG). The total volume of contaminated material at the site is currently estimated to be around 112,666 m^3, compared to 6,055 m^3 estimated in the previous EIA (September, 2001).

In addition, landfilling is no longer considered to be appropriate for decontamination of contaminated soils. Instead biopiling and cement solidification are proposed to take place within the site in order to decontaminate the contaminated materials present.

2.3 Consideration of "Without Project" Scenario

The "without project" scenario considers the implications of the decontamination works not occurring at the Project site. The Project has been conceived and designed to meet the needs as described in **Section 2.2**.

If the Project was not to proceed, the need for the Project would not be met and the contaminated soil within the Project boundary would not be cleaned up to the RBRGs standard, hence risk to human receptors from released contaminants could not be eliminated.

Furthermore, a risk-free site is required for the future development of Kennedy Town, for example, development of a waterfront promenade etc. Without the Project, these developments would not be allowed.

2.4 Consideration of Ground Decontamination Methods

Referring to the findings in the Final Site Investigation Report of 2004[1], there are three types of contaminated soil based on the nature of contaminants:

- Type A - Heavy metals contaminated soil
- Type B - Hydrocarbons contaminated soil
- Type C - Heavy metals and hydrocarbons contaminated soil

Options of available ground decontamination are reviewed, and their applicability, benefits and limitations are summarised, in the subsequent sections. Based on the EPD (2011) *Practice Guide for Investigation and Remediation of Contaminated Land,*[2] the selection of appropriate decontamination methods should consider the following factors:

- Nature and level of contamination
- Extent of contamination
- Site characteristics such as site hydrogeology, soil and groundwater chemical characteristics
- Site constraints such as available space and surrounding areas
- Time available for decontamination

2.4.1 Options for Ground Decontamination Methods

Annex G2 of the 2011 EPD *Practice Guide for Investigation and Remediation of Contaminated Land* provides information of the following methods for decontamination of contaminated soils, which have been applied in Hong Kong and overseas. A description of these methods and their applicability for the treatment of HM and HC is provided in **Table 2.2** below.

Table 2.2: Methods for Decontamination of Contaminated Soils

Method	Description	HM	HC
Biopiles	Biopiling involves accumulation of contaminated soils into piles and then simulating aerobic microbial activity by aeration and the addition of minerals, nutrients, and moisture. Heat and pH can also be controlled to enhance biodegradation. Biopiles are usually covered with tarpaulins, lined with impermeable sheeting and bunded to prevent contaminated surface runoff and leachate from entering the uncontaminated soil. Biopiles may be covered to prevent runoff, evaporation and volatilisation, and to promote solar heating. If VOCs are present in the soil, air emissions require treatment before being discharged.		✓
Soil Vapour Extraction	Soil Vapour Extraction (SVE) involves the installation of vertical and/or horizontal wells in the area of soil contamination. Vacuums are applied through the wells near the source of contamination to evaporate the volatile constituents of the contaminated mass which are subsequently withdrawn through an extraction well. Air blowers are often used to aid the evaporation process. Extracted vapours are then treated (commonly with carbon		✓

[1] Mott Connell Limited. March 2004. No. CE 85/2001 (CE) Demolition & Decontamination Works at Kwai Chung Incineration Plant and at Proposed Kennedy Town Comprehensive Development Area Site – Design & Construction: Final Site Investigation Report for Kennedy Town Comprehensive Development Area

[2] EPD. 2011. *Practice Guide for Investigation and Remediation of Contaminated Land*. Published by the Government of HKSAR.

Method	Description	HM	HC
	adsorption) before being released into the atmosphere. The increased airflow through the subsurface provided by SVE also stimulates the biodegradation of contaminants.		
Stabilisation / Solidification (Cement Solidification)	Solidification/stabilisation reduces the mobility of hazardous substances and contaminants in the environment through both physical and chemical means. Solidification refers to the process that encapsulates the waste materials in a monolithic solid of high structural integrity. Stabilisation generally refers to the process that reduces the risk posed by a waste by converting the contaminant into a less soluble, immobile, and less toxic form. In-situ solidification and stabilisation involves mixing the contaminated soil in place, a reagent storage, preparation, and feed system; and a means to deliver the reagents to the soil mixing zone.	✓	
Thermal Desorption	Thermal desorption is a treatment technology where contaminated soil is excavated, screened, and heated to release contaminants from the soil. It involves heating soils to temperatures of 100–600°C so that those contaminants with boiling points in this range will vaporise and separate from the soil. The vaporised contaminants are then collected and treated by other means.		✓
Bioventing	The bioventing process injects air into the contaminated media at a rate designed to maximise in situ biodegradation and minimise or eliminate the off-gassing of volatilised contaminants to the atmosphere. Bioventing also degrades less volatile organic contaminants and, because a reduced volume of air is required, it allows for the treatment of less permeable soils.		✓
Chemical methods	Chemical methods including Chemical oxidation, soil flushing, solvent extraction, Glycolate Dehalogenation, involve the in-situ or ex-situ application of reactive chemicals (i.e. oxidants) to soil in order to neutralise contaminants contained within it to safe levels.	✓	✓
Incineration	Incineration is the treatment of contaminated soils by burning, to destroy contaminants.		✓
In-ground Containment / Capping	Engineered impermeable barriers (‘caps’) designed to protect identified receptor. Capping involves placing a cover over contaminated materials to keep them in place, in order to avoid contact with people or the environment.	✓	
Soil Washing	Soil washing uses liquids (usually water, occasionally combined with solvents) and mechanical processes to scrub soils. Solvents are selected on the basis of their ability to solubilise specific contaminants, and on their environmental and health effects. The soil washing process separates fine soil (clay and silt) from coarse soil (sand and gravel).	✓	✓
Windrows	Windrows are soil piles in which aeration and mixing of contaminated soils, addition of nutrients, and control of moisture content allows contaminants to be broken down by microorganisms. Windrows differ from biopiles since there are limited engineering methods to control the environmental conditions.		✓
Excavation / Landfilling*	Removal of contaminated materials and disposing of them off site at landfill.	✓	✓

Source: EPD (2011) *Practice Guide for Investigation and Remediation of Contaminated Land*

Note: Permeable Reactive Barriers, Air Sparging, and Recovery Wells are not considered, as these methods are applicable to remediation of groundwater (rather than contaminated soils).
* Not included in list EPD (2011) practice guide.

The following sections briefly describe the above decontamination options. References are made to various published documents.[3]

The applicability, limitations, environmental benefits and dis-benefits of the above decontamination options are summarised in **Table 2.3**.

[3] Khan, F.I., Husain, T. and Hejazi, R. 2004. An overview and analysis of site remediation technologies. *Journal of Environmental Management, 71*, 95-122.

Table 2.3: List of Ground Decontamination Methods for Heavy Metals / Hydrocarbons Contaminated Soil

Option	Applicability	Environmental Benefits	Limitations and Environmental Dis-benefits
Biopile	• For VOCs, SVOCs and hydrocarbons • Applicable to soils contaminated with biodegradable organic compounds, e.g. TPH, PAH etc.	• Very effective for treating petroleum carbon ranges / total petroleum hydrocarbons (PCR/TPH) and non-halogenated VOCs with some successful local case studies • Halogenated VOCs, SVOCs and pesticides can also be treated but may vary in process effectiveness • Most cost-effective for large volumes of contaminated soil • Can be designed to be a closed system; vapour emissions can be controlled • Allows natural processes to breakdown harmful chemicals	• Labour-intensive; require considerable maintenance • Space required for biopile formation • Time-consuming (~1 year required) and not cost-effective for treating small volume of soil.
Soil Vapour Extraction (SVE)	• For VOCs and SVOCs • Coarse-textured soils are best suited for SVE. • Typically more applicable in cases where the contaminated unsaturated zone is relatively permeable and homogeneous. • Most successful when it is applied to lighter, more volatile petroleum products.	• Very effective at removing VOCs from unsaturated zone. With the addition of an air sparging system, contaminants can be removed from saturated zone as well • Minimal disturbance to site operations • Short treatment times (usually 6 months to 2 years under optimal conditions)	• Treatment/disposal of residual liquids required. Also, regeneration or disposal of the spent activated carbon will be required. • To eliminate possible harm to the public and the environment, exhaust air from in-situ SVE system may require treatment. • Soil with high organic content or is extremely dry has a high sorption capacity of VOCs, which results in reduced removal rates. Fine-grained soil or soil with a high degree of saturation will require higher vacuums (increasing costs) and/or hindering the operation of the in-situ SVE system.
Solidification/ Stabilisation (Cement Solidification)	• For heavy metals and inorganics	• Applicable practical and cost-effective method to stabilise inorganic contaminants such as metals. • Solidification/stabilisation has been used on certain contaminated sites in Hong Kong and demonstrated as a successful treatment method for inorganic contaminated soil, e.g. Kwai Chung Incineration Plant site, decontamination works at the Cheoy Lee Shipyard at Penny's Bay, reclamation works at North Tsing Yi Shipyard site and few isolated sites identified in the Deep Bay Link project. • Limits the solubility or mobility of the contaminants in the solidified mixture. • Time required for decontamination is relatively short (i.e. ranges from several weeks to a few months)	• The effectiveness reduces with the presence of organic contaminants: • Large boulders may hinder the mixing process. Soil sorting is necessary before the treatment taken place (NB. Soil required for decontamination were mainly sand and silt based on the borehole log)

Option	Applicability	Environmental Benefits	Limitations and Environmental Dis-benefits
Thermal desorption	• Method effective at sites where soil is contaminated with volatile and semi-volatile chemicals, including: – BTEX (benzene, toluene, ethyl benzene and xylene) – chlorinated VOCs – Polycyclic Aromatic Hydrocarbons (PAH)	• Only a small amount of gas is generated and the removed organics (contaminants) can be held for further treatment if necessary. • Temperatures are relatively low compared to incineration and can be made lower with the use of a vacuum.	• Thermal desorption has variable degrees of effectiveness against the full spectrum of organic contaminants. Organics (contaminants) may not be destroyed in the process unless operated at high temperatures. • Clay, silty soils and high humic content soils increase reaction time as a result of binding of contaminants. Leads to increased cost and overall duration. • Highly abrasive substances can potentially damage the thermal desorption equipment. Debris greater than 60 mm in diameter typically must be removed prior to processing. • Dust and organic matter in the soil increases the difficulty of treating the gas stream.
Bioventing	• For SVOCs and medium to heavy hydrocarbons. • Proven successful for soils contaminated by petroleum hydrocarbons, non-chlorinated solvents, some pesticides and other organic chemicals.	• Suitable for decontamination in built up areas because wells can be placed between or below buildings • Applicable to large sites with widespread contamination • Uses readily available equipment; easy to install • Vapour emissions can be controlled but not to the extent of biopiling due to underground soil in-situ properties	• This method is usually applied for the case with large area of organic contaminated soil. • Effectiveness is limited by underground soil features e.g. soil moisture content, permeability, etc. • May induce possible air emission to the sensitive receivers. • Requires large space for the system development.
Chemical Methods	• Depends on contaminants and methods chosen. However, Metals, PCRs, PAH, PCBs, Dioxins, VOCs, and SVOCs are all potentially treatable using chemical treatment of methods.	• Chemical oxidation methods do not generate large volumes of waste material that must be disposed of and/or treated • Can be implemented over a shorter time frame than many more established methods.	• Very specialised contractors likely to be required. • Requires the handling of large quantities of hazardous oxidising chemicals. • Some COCs are resistant to chemicals. • Effectiveness less certain when applied to sites with low permeability soil or stratified soils. • Chemical oxidation is not well established in Hong Kong as a decontamination method. • The full spectrum of reaction intermediates and products is not fully understood at this time for all contaminants.
Incineration	• Effective in destroying PCRs, PAH, PCBs, Dioxins, VOCs, Free Cyanide and SVOCs.	• Can be a permanent solution. • Applicable to a wide variety of contaminants and media types.	• Ash residues produced. • Volatile heavy metals leave the combustion unit with the flue gasses, and require a gas treatment system. • Metals can react with other elements in the feed stream, such as sulphur/ chlorine, forming more volatile/toxic compounds.

Option	Applicability	Environmental Benefits	Limitations and Environmental Dis-benefits
In Ground Containment/ Capping	• For metal-based chemicals of concern.	• Can be used for containing contamination in soils and groundwater in place, avoids need for excavation and disposal, particularly where extensive subsurface contamination exists or other potential hazards, cost of excavation and handling is unrealistic, or there is a lack of adequate treatment technologies. • Does not lessen toxicity, mobility, or volume of hazardous wastes, but does mitigate migration.	• Long-term monitoring and maintenance required. Further treatment in the future cannot be ruled out, which may place constraints on any future development of the site. • So far has only been used outside Hong Kong as a decontamination method for metal-based chemicals of concern.
Soil Washing	• For SVOCs, medium to heavy hydrocarbons, inorganics and heavy metals. • Soil washing is most effective for soil that does not contain a large amount of silt and clay.	• Applicable to clean inorganic contaminants such as metals from coarse-grained soils. • The water used for washing the contaminated soil is treated and reused in the same washing process, reducing the total amount of water required. • The relatively clean coarser materials can be recovered for beneficial use – in other words, a volume-reduction method.	• The effectiveness of the treatment depends on soil particle size. Fine soil particles may require the addition of a polymer to remove them from the washing fluid. (N.B. Soil required for decontamination was mainly sand and silt, i.e. fine soil particles, based on the borehole log). • Complex waste mixtures make formulating washing fluid difficult. • Generation of residuals including sludge and wastewater, which may require further treatment and disposal. • Cost intensive for treatment of residuals. • Variable timeframe (months to ~1 year required).
Windrows	• For petroleum carbon ranges / total petroleum hydrocarbons (PCR/TPH), PAH, VOCs and SVOCs.	• Relatively more cost-effective for small volumes of contaminated soil as less engineered measures, e.g. aeration system and pipes underneath the piles, is required. • Fewer truck movements required (compared with other methods). • Decontaminated soil can be used for composting.	• Require considerable maintenance, frequent turning to oxygenate the materials and accelerate treatment. • Space required for windrows formation and operation. • Time-consuming (~1 year required). • Conditions affecting biological degradation of contaminants are largely uncontrolled.
Excavation and Landfill Disposal	• Applicable to all waste or mixture that meet land disposal restriction treatment standards. • Common practice for shallow, highly-contaminated soils.	• Simple and fast method for disposing of large volumes of contaminated soil. • Contamination is completely removed from subject site. • Historic experience in Hong Kong. • Decontamination time is short.	• Pre-treatment may be required for contaminated soil to meet landfill disposal criteria. • Increase the burden of limited landfill space. • Indirect costs to the landfill management on monitoring and maintenance. • Need large volume of suitable backfill materials. • Least desirable management option.

References:
1. EPD. 2011. *Practice Guide for Investigation and Remediation of Contaminated Land*. Published by the Government of HKSAR.
2. Khan, F.I., Husain, T. and Hejazi, R. 2004. An overview and analysis of site remediation technologies. *Journal of Environmental Management, 71*, 95-122.
3. Mott Connell Limited. 2002. Agreement No. CE 85/2001 (CE) Demolition & Decontamination Works at Kwai Chung Incineration Plant and at Proposed Kennedy Town Comprehensive Development Area Site – Design & Construction: *Final Review Report – Kennedy Town Comprehensive Development Area*. For Civil Engineering and Development Department of HKSAR Government.

2.4.2 Comparison of Ground Decontamination Methods

A comparison of the ground decontamination methods is shown in **Table 2.4** and the following paragraphs below.

Table 2.4: Comparison of Ground Decontamination Methods

	Cost	Duration	Environmental Impact	Suitability HC	Suitability HM	Suitability HM & HC
Biopile	Med	Med	Low	Yes	No	No
Soil Vapour Extraction (SVE)	Med	High	Low	Yes	No	No
Solidification/ Stabilisation (Cement Solidification)	Med	Med	Low	No	Yes	No
Thermal desorption	Med	Med	Med	Yes	No	No
Bioventing	Med	High	Med	Yes	No	No
Chemical Methods	High	Low	High	Yes*	Yes*	Yes*
Incineration	Low	Low	High	Yes	No	No
In Ground Containment	Low	Low	Low	No	Not recommended	Not recommended
Soil Washing	High	Med	Med	Yes	Yes	Yes
Windrows	Low	High	High	Yes	No	No
Excavation / Landfill	Low	Low	High	Not recommended	Not recommended	Not recommended

* Dependent on COCs present and specific method(s) adopted.

Excavation and landfill is not consistent with current Hong Kong legislation and guidance and has been excluded. In-ground containment/ capping have also been excluded, as this method would not lead to decontamination of the site, and would prevent the site being approved for development. There are other practicable methods available as shown in **Table 2.4**.

Heavy Metal Contaminated Soils

Cement Solidification, Soil Washing and Chemical methods are applicable for the decontamination of HM contaminated soils.

Soil washing is not preferred, as this method would require large volumes of water in order to treat the high volume of contaminated soils present at the site, and the potential occurrence of associated water resource related environmental impacts.

Chemical methods are also not preferred, as these approaches are not well demonstrated in Hong Kong and would be likely to require highly specialised contractors to carry out the works. As such, the cost of using this approach would be likely to be high, the efficiency of decontamination is uncertain, and the availability of suitable contractors may also be a barrier to implementation.

Among the methods considered, cement solidification is recommended to be the most appropriate alternative based on its technical suitability, and its performance against cost, duration and environmental impact criteria. This method is also considered to be an effective decontamination method that is well established in Hong Kong.

Hydrocarbon Contaminated Soils

Windrows, Biopiling, SVE, Soil Washing, Thermal Desorption, Chemical Method, Incineration and Bioventing have been considered for the decontamination of soils contaminated with HC.

Windrows are not considered to be an appropriate method for the current project, as this method would not effectively control emissions of dust and vapours to air, and contaminated runoff/leachate. Infiltration of rain water/moisture and low/uneven aeration would also be likely to reduce the effectiveness of the process.

Bioventing is a similar process to biopiling, with the material left in-situ. However, this is not preferred as the method is only effective for soils above the water table, is more technically demanding to implement on a large scale, and the effectiveness is difficult to monitor, as the material remains in the ground. Similarly, biopiling is preferred over SVE, as it is a more established method of decontamination in Hong Kong, and the effectiveness of this approach is more easily monitored.

Soil washing is not preferred for the current project, as this method would require large volumes of water in order to treat the high volume of contaminated soils present at the site, and the potential occurrence of associated water resource related environmental impacts.

Incineration is not preferred for this project, as this method would produce ash residues and require gas treatment system for the volatile heavy metals. Volatile and toxic compounds would be produced if metals react with other elements in the feed stream and results in to high impact to the environment.

Chemical methods are not preferred, as these approaches are not well demonstrated in Hong Kong and would be likely to require highly specialised contractors to carry out the works. As such, the cost of using this approach would be likely to be high, the efficiency of decontamination is uncertain, and the availability of suitable contractors may also be a barrier to implementation.

Thermal Desorption is also not preferred, as biopiling can be more effective at treating contaminants, particularly considering the presence of clays and silts at the site, and also the need to remove coarse-grained materials / rocks.

Among the methods considered, biopiling is recommended to be the most appropriate alternative based on its technical suitability, and its performance against cost, duration and environmental impact criteria. This method is also considered to be an effective decontamination method that is well established in Hong Kong.

Heavy Metals and Hydrocarbon Contaminated Soils

With the same reasons as stated above, method of Biopiling followed by Cement Solidification is recommended for the decontamination of soils contaminated with both HM and HC.

2.4.3 Preferred Scenario of Decontamination Methods

For the three contaminated soil categories within the Project site the preferred decontamination methods are summarised in **Table 2.5** and detailed in the CAR/RAP (**Appendix 7.2**).

Table 2.5: Recommended Ground Decontamination Methods for Contaminated Soil (Preferred Scenario)

Soil Type	Definition of Soil Type	Recommended Decontamination Method	Description
A	Heavy metals contaminated soil	Cement solidification	Ex-situ immobilisation technique which treats contaminated soil by mixing soil with binding agents (i.e. cement) so that the contaminants become physically bound within a stable mass
B	Hydrocarbons contaminated soil	Biopiling	Ex-situ bioremediation method where bacteria is grown in the piled contaminated soil and reduces the concentrations of petroleum constituents
C	Heavy metals and hydrocarbons contaminated soil	Biopiling followed by cement solidification	See descriptions for Types A and B above respectively.

The preferred scenario described in the table above was determined to be the most technologically suitable and cost effective methods of decontamination, and are considered to have relatively low environmental impacts.

2.4.4 Contingency Measures

In-case the decontamination works are less effective or slower than expected the following contingency measures are planned:

For decontamination of soils contaminated with hydrocarbons:

During the operation of biopiles, soil samples will be extracted from each biopile on a monthly basis in order to monitor the rate of decontamination. If the concentration of the contaminant reflects any abnormality (e.g. showing the bio-pile is not as effective as expected or the decontamination rate is slow), mitigation measures including adjustment of air flow rate, adding nutrients and/or adding suitable bacteria will be implemented. Closer monitoring will be conducted to those abnormal bio-piles until the problem is identified and rectified.

For decontamination of soils contaminated with heavy metals:

Various cement/soil mixes will be tried prior to the cement solidification will be conducted in order to determine the most suitable ratio. Also, trial mix will ensure the effectiveness of the cement solidification. In addition, Universal Treatment Standards (UTS) and Unconfined Compressive Strength (UCS) tests will be conducted after the cement solidification to ensure the process has been effective. Cement solidification will be carried out again if failure of the testing occurs.

2.5 Scope of Work

The Project consists of the following key project components:

- Excavation – This includes earth lateral support, excavation, and temporary stockpile of excavated soils.

- On-site Decontamination – This includes decontamination of contaminated soil by biopiling and/or cement solidification (refer to **Section 2.4.3** for details of preferred decontamination methods).
- Final site formation – This includes deposition, compaction, drainage works and boundary fencing.

The site has been divided into Zones 1A, 1B, 1C, 2, 3, 4, 5A, and 5B as shown in **Figure 2.2**.

The area of Zones 1A to 5B and corresponding volumes of material to be excavated are shown in **Table 2.6** below.

Table 2.6: Projected Volume of Soil Excavated and Decontaminated at the Kennedy Town CDA Site

Zones	Area (m^2)	Total Excavated Soil Vol. (m^3) (1)	Contaminated Soil Vol. (m^3)	Type A	Type B	Type C
Stage 1						
Zone 1A	1,800	2,787	1,710	843	867	0
Zone 1B	3,700	39,286	20,364	10,887	3,767	5,710
Zone 1C	4,200	23,690	14,411	2,658	5,623	6,130
Zone 2	8,700	55,761	32,334	22,682	1,068	8,584
Zone 3	7,400	30,282	23,516	14,034	0	9,482
Stage 2						
Zone 4	2,800	11,370	6,455	784	1,374	4,297
Zone 5A	1,500	10,775	5,382	2,318	1,050	2,014
Zone 5B	1,900	12,461	8,494	3,048	3,484	1,962
Total	32,000	186,412	112,666	57,254	17,233	38,179

Notes: (1) 'Zones' = gross volume of excavated soils included clean and contaminated fractions.

The main works planned for each Zone are listed below.

Zone 1A

- Removal of capping layer, excavation, earth lateral support and temporary stockpiling of soils

Zone 1B

- Removal of capping layer, excavation, earth lateral support and temporary stockpiling of soils
- Cement Solidification

Zone 1C

- Removal of capping layer, excavation, earth lateral support and temporary stockpiling of soils

Zone 2

- Removal of capping layer, excavation, earth lateral support and temporary stockpiling of soils
- Biopile formation / operation / decommissioning

Zone 3

- Removal of capping layer, earth lateral support, excavation and temporary stockpiling of soils
- Biopile formation / operation / decommissioning

Zone 4

- Excavation, earth lateral support and temporary stockpiling of soils
- Biopile formation / operation / decommissioning (for Reprovisioning Option A only – **Section 2.6 refers**)

Zone 5A

- Excavation, earth lateral support and temporary stockpiling of soils
- Cement Solidification (For Reprovisioning Option A only– **Section 2.6 refers**)

Zone 5B

- Excavation, earth lateral support and temporary stockpiling of soils

As the Project involves mainly ground decontamination, after which the decontaminated site will then be handed over to Lands Department for redevelopment, the Project has no operational phase.

2.6 Reprovisioning Options of Temporary Community Facilities

2.6.1 Reprovisioning Options

Three Reprovisioning Options for the existing temporary community facilities (Public Car Park, Refuse Collection Point (RCP) and Garden) within the Project site have been identified as follows.

Reprovisioning Option A – 13-year Project duration, to take place in two stages: Stage 1 involving decontamination of approximately 80% area of the site (the whole site except Cadogan Street Temporary Garden), and on-site reprovisioning (by others) of the existing public car park and RCP; Stage 2 involving decontamination of the remaining area of the site (Cadogan Street Temporary Garden) after construction of the proposed future waterfront promenade at a decontaminated area of the site (by others).

Reprovisioning Option B – 7-year Project duration, involving removal of the existing public car park, temporary garden, and RCP, and decontamination of the whole site in a single stage. Only public car park and RCP would be reprovisioned on-site (by others) during the ground decontamination works.

Reprovisioning Option C – 4.5-year Project duration, involving removal of the existing public car park, temporary garden, and RCP, and decontamination of the whole site in a single stage. There would be no reprovisioning of community facilities under this Option.

Each of these Reprovisioning Options has been fully assessed in this EIA report. A description of each of the three Reprovisioning Options is provided below. The tentative Project implementation schedules for the three Reprovisioning Options are shown in **Appendix 2.1a, Appendix 2.1b** and **Appendix 2.1c** respectively.

2.6.2 Reprovisioning Option A – 13-year Project Duration (Two Stages - Full Reprovisioning)

Under Reprovisioning Option A, the Project will take place in two distinct stages, with decontamination works planned to take place in Stage 1 (Zones 1A, 1B, 1C, 2 and 3) and Stage 2 (Zones 4, 5A and 5B) as shown in **Figure 2.3a**. Decontamination works include earth lateral support works, excavation, stockpiling and transfer of soils, cement solidification; and formation, operation and decommissioning of biopiles. Biopiling will be carried out to decontaminate Hydrocarbon contaminated soils, prior to reinstatement within the site. During Stage 1, biopiles will be formed in 3 cycles in Zone 3 (Biopiles A, B and C) and 1 cycle in Zone 2 (Biopile D). During Stage 2, biopiles will be formed in 2 cycles in Zone 4 (Biopiles E and F). Cement solidification of Heavy Metal contaminated soils will take place in situ during Stages 1 and 2 concurrently with the excavation schedule provided in **Appendix 2.1a**.

The estimated volume of cement stabilised soil is shown in **Table 2.7**. The assumed area of Biopiles A, B, C, D, E and F and estimated volume of material to be decontaminated in each biopile are shown in **Table 2.8** below.

Table 2.7: Source of Constituent Soils and Volume of Cement Stabilised Soil for Reprovisioning Option A (Same for Reprovisioning Options B and C)

Main Source	Cement Stabilised Soil Vol. (m^3)
Zone 1A	843
Zone 1B	10,887
Zone 1C	2,658
Zone 2	22,682
Zone 3	14,034
Zone 4	784
Zone 5A	2,318
Zone 5B	3,048
Total	57,254

Table 2.8: Assumed Biopiles Location, Source of Constituent Soils, Area and Volume of Biopiles for Reprovisioning Option A

Biopile	Location	Main Source	Area (m^2)	Vol. (m^3)(1)
Stage 1				
Biopile A	Zone 3	Zones 1A & 1C	3,200	11,600
Biopile B	Zone 3	Zone 1B	3,200	11,600
Biopile C	Zone 3	Zone 2	3,200	11,600
Biopile D	Zone 2	Zone 3	3,200	11,600
Stage 2				
Biopile E	Zone 4	Zones 4, 5A & 5B	2,250	8,900
Biopile F	Zone 4	Zones 4, 5A & 5B	1,750	7,000
Total				62,300

Notes: (1) = total volume of soil in completed biopile, assumed size of biopile has allowed some spared capacity for potential swelling of excavated soil.

2.6.3 Reprovisioning Option B – 7-year Project Duration (Single Stage – Partial Reprovisioning)

The Project will take place in one single stage, with decontamination works planned to take place in Zones 1A, 1B, 1C, 2, 3, 4, 5A and 5B as shown in **Figure 2.3b**. Decontamination works include earth lateral support works, excavation, stockpiling and transfer of soils, formation, operation and decommissioning of biopiles and cement solidification. Biopiling will be carried out to decontaminate Hydrocarbon contaminated soils, prior to reinstatement within the site. Biopiles will be formed in 3 cycles in Zone 3 (Biopiles A, B and C) and 1 cycle in Zone 2 (Biopile D) as shown in **Figure 2.3b**. Cement solidification of Heavy Metal contaminated soils will take place in situ concurrently with the excavation schedule provided in **Appendix 2.1b**.

The area of Zones 1A to 5B and corresponding volumes of material to be excavated are shown in **Table 2.6**. The estimated volume of cement stabilised soil is shown in **Table 2.7**. The assumed area of Biopiles A, B, C and D and estimated volume of material to be decontaminated in each biopile are shown in **Table 2.9** below.

Table 2.9: Assumed Biopiles Location, Source of Constituent Soils, Area and Volume of Biopiles for Reprovisioning Option B

Biopile	Location	Main Source	Area (m^2)	Vol. (m^3)(1)
Biopile A	Zone 3	Zones 1A, 1B &1C	3,600	14,900
Biopile B	Zone 3	Zones 3, 4, 5A & 5B	3,600	14,900
Biopile C	Zone 3	Zone 2	3,600	14,900
Biopile D	Zone 2	All Zones	4,500	17,600
Total				62,300

Notes: (1) = total volume of soil in completed biopile, assumed size of biopile has allowed some spared capacity for potential swelling of excavated soil.

2.6.4 Reprovisioning Option C – 4.5-year Project Duration (Single Stage – No Reprovisioning)

The Project will take place in one single stage, with decontamination works planned to take place in Zones 1A, 1B, 1C, 2, 3, 4, 5A and 5B as shown in **Figure 2.3c**. Decontamination works include earth lateral support works, excavation, stockpiling and transfer of soils, formation, operation and decommissioning of biopiles and cement solidification. Biopiling will be carried out to decontaminate Hydrocarbon contaminated soils, prior to reinstatement within the site. Biopiles will be formed in 2 cycles in Zones 1A and 3 (Biopiles A and B) and 1 cycle in Zone 2 (Biopile C) as shown in **Figure 2.3c**. Cement solidification of Heavy Metal contaminated soils will take place in situ concurrently with the excavation schedule provided in **Appendix 2.1c**.

The area of Zones 1A to 5B and corresponding volumes of material to be excavated is shown in **Table 2.6**. The estimated volume of cement stabilised soil is shown in **Table 2.7**. The assumed area of Biopiles A, B and C, and estimated volume of material to be decontaminated in each biopile are shown in **Table 2.10** below.

Table 2.10: Assumed Biopiles Location, Source of Constituent Soils, Area and Volume of Biopiles for Reprovisioning Option C

Biopile	Location	Main Source	Area (m^2)	Vol. (m^3)(1)
Biopile A	Zone 1A & 3	Zones 1A, 2 & 3	5,400	21,600
Biopile B	Zone 1A & 3	Zones 1B & 1C	5,400	21,600
Biopile C	Zone 2	Zones 4, 5A & 5B	4,800	19,100
Total				62,300

Notes: (1) = total volume of soil in completed biopile, assumed size of biopile has allowed some spared capacity for potential swelling of excavated soil.

2.7 Concurrent and Interfacing Projects

The following concurrent and interfacing projects under planning have been identified and included in the assessment for the Project, as shown in **Figure 2.4**.

- Residential Development at the Ka Wai Man Road and Ex-Mount Davis Cottage Area
- Reprovisioning of Kennedy Town Saltwater Pumping Station
- Development within the Kennedy Town CDA site (for Reprovisioning Option A only)

A summary of these projects is provided in the below paragraphs. Cumulative impact assessment have been addressed and evaluated in this EIA report.

Residential Development at the Ka Wai Man Road and Ex-Mount Davis Cottage Area

Housing Department (HD) has a planned public housing development at Ka Wai Man Road and Ex-Mount Davis Cottage Area to the south of the Kennedy Town CDA, along Victoria Road.

Demolition works are currently underway. The demolition of the existing Police Quarters began in 2013 and is expected to be completed in 2015 prior to the start of the Project (Kennedy Town CDA ground decontamination works). Demolition of the Hong Kong Academy is tentatively planned to start in 2015. It is tentatively assumed that the public housing development would have population intake starting from 2021.

Reprovisioning of Kennedy Town Saltwater Pumping Station

Water Supplies Department (WSD), at the request of the Planning Department (PlanD), will re-provision the existing Kennedy Town Saltwater Pumping Station, to the western end of Sai Ning Street. The existing Kennedy Town Saltwater Pumping Station is adjacent to the Project's western site boundary, and the proposed reprovisioning site is approximately 300 m to the west of the Project site. At the time of issuing this EIA, no information regarding the development programme or construction methods for this project are available. However, the position of the relocated saltwater intake (around 140 m to the west of the Project site) is noted, such that the sea water quality in this area shall not be affected by the Project.

Development within the Kennedy Town CDA Site

Development at the Kennedy Town CDA site is under planning. No further information regarding the nature, scale and timing of this development is available at present. However, it is conservatively assumed that this will be a concurrent project throughout the entire duration of the Stage 2 decontamination works, under Reprovisioning Option A only.