Task Force on Harbourfront Developments on Hong Kong Island

For reference
on 29 February 2016

TFHK/06/2016

Ground Decontamination Works at the Site of Ex-Kennedy Town Incineration Plant/Abattoir and Adjoining Area

PURPOSE

The purpose of this paper is to provide the details of the captioned ground decontamination works including the decontamination methods and implementation programme.

BACKGROUND

2. The ex-Kennedy Town Incineration Plant (KTIP) and ex-Kennedy Town Abattoir (KTA) sites have been temporarily used as West Island Line (WIL) works area and for accommodating a maintenance depot of the Highways Department (HyD) since 2009. Other existing uses on the Site primarily include a short-term bus depot, a temporary refuse collection point (RCP), a temporary public car park, and the Cadogan Street Temporary Garden. The Site is about 3.2 hectares. The site plan and a photo showing the general view of the Site are attached at **Appendix I**.

3. According to the Environmental Impact Assessment (EIA) and site investigation, the underground soil of the Site is contaminated with heavy metals and hydrocarbons. As a result, ground decontamination works are required before the Site can be developed for other uses. The quantity of contaminated soil that requires decontamination is about 110 000 cubic metres. The proposed decontamination works at the Site are scheduled to commence after the return of the WIL works area to the Government by the MTR Corporation Limited and the removal of the maintenance depot of HyD to facilitate future development at the Site.

DECONTAMINATION METHODS

4. The environmental impact assessment (EIA) has reviewed the pros and cons of various decontamination methods including biopiles, soil vapour extraction, cement solidification, thermal desorption, bioventing, chemical methods, incineration, ground containment/

capping and soil washing. The details of the above review are attached at **Appendix II**. In summary, cement solidification is recommended for treatment of heavy metals and biopiles for treatment of hydrocarbons. The details of the above two decontamination methods are shown at **Appendix III**. A flow chart for decontamination works is attached at **Appendix IV**.

5. According to Environmental Protection Department's Practice Guide for Investigation and Remediation of Contaminated Land, the possibility of carrying out in situ remediation (without excavation) and recycling and reuse of remediated materials should be explored first. Ex situ remedial measures could then be considered if the in situ remediation is not considered to be practical. Off-site disposal of contaminated materials to landfills should be adopted only as a last resort. Since ex situ remedial measures (e.g. cement solidification and biopiles) are considered practical in this case, the contaminated soil at the Site will be excavated and handled on site. The treated soil will then be reused for backfilling. The EIA report on the proposed decontamination works by using cement solidification and biopiles on site was exhibited for public inspection in January 2015 and was approved by the Director of Environmental Protection in April 2015.

IMPLEMENTATION OPTIONS

6. Various implementation options have been explored in respect of the potential impacts on the existing temporary community facilities and are shown as follows.

Options	**Estimated Cost of Works**	**Duration**	**Maintenance/Re-provisioning of Community Facilities within the Site during Decontamination**		
			Public Carpark	**Refuse Collection Point**	**Cadogan Street Garden**
Option 1	1.5 billion	13 years	√	√	√
Option 2	1.1 billion	7 years	√	√	X
Option 3	0.9 billion	4.5 years	X	X	X

7. To strike a balance amongst the potential environment impacts to nearby residents due to prolonged decontamination works, the

availability of temporary community facilities and the future development at the subject site, Option 2 is recommended for implementation. The details of the works sequence under recommended Option 2 is shown at **Appendix V**.

DECONTAMINATION PERIOD

8. The proposed decontamination works including the demolition of disused structures, re-provisioning of temporary RCP and public carpark and site formation will take about 7 years for completion. The main reasons are:

(a) The total quantity of contaminated soil is huge, about 110,000 cubic metres (equivalent to 45 standard swimming pools).

(b) The contaminated soil is scattered all over the Site with maximum depth at about 13m (about 4 storeys).

(c) To address the need of local district, the existing temporary refuse collection point and temporary public carpark will need to be maintained /re-provisioned throughout the decontamination period. This requirement will inevitably impose additional site constraints and prolong the decontamination works.

(d) Each cycle of biopile will take about 12-15 months for completion. Due to the need to maintain/re-provision the temporary refuse collection point and temporary carpark, the remaining site area that can be used for excavation, stockpiling of excavated soils with different contamination, setting up of the cement solidification plant and biopiles, etc., will be limited. We envisage that the Site can accommodate only one biopile of size approximately 50m x 90m x 5m high at any one time. Based on the quantity of soils contaminated with hydrocarbons, a total of 4 biopile cycles will be required, which will thus require up to 5 years for such operation.

(e) As the Site is the vicinity of residential areas, the rates and active area of excavation will be carefully controlled. Moreover, more stringent environmental

mitigation measures will be required which will in turn limit the rate of excavation.

(f) As the Site is close to the existing old seawalls and piers, the excavation works will involve complicated temporary lateral support and dewatering system.

PUBLIC CONSULTATION

9. Regarding the proposed decontamination works, we have consulted the following stakeholders in the past few years.

Stakeholders	Dates
Central and Western District Council	May 2013, March 2015
Public forums organised by C&WDC members	April 2015, June 2015
District Affair Forums organised by The Merton Owners' Committee	November 2013, December 2014, May 2015
Legislative Council Panel on Development	April 2015
Legislative Council Public Works Sub-Committee	June 2015

10. The C&WDC and LegCo Members and the public generally supported the proposed decontamination works with a 7-year programme. However, they have asked for more environmental mitigation measures as well as community efforts during the decontamination period. As such, we have proposed extra environmental mitigation measures as shown at **Appendix VI**. Moreover, we have agreed to establish a works liaison group and convene regular meetings with C&WDC Members and local representatives to address their concerns on environmental issues and to further improve the mitigation measures if necessary.

CURRENT STATUS

11. Tender documents for the proposed decontamination works have been finalised and tenders will be invited in end September 2015. Commencement of the works is tentatively scheduled in the first quarter of 2016.

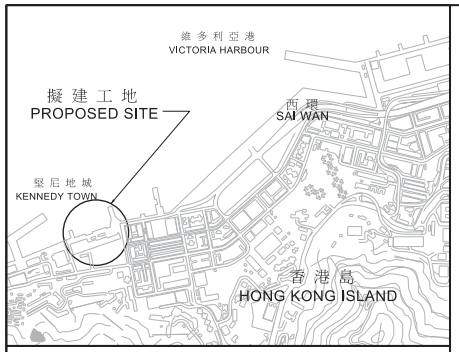
Appendices

Appendix I	-	Site Plan and General View of the Site
Appendix II	-	Review of Different Decontamination Works
Appendix III	-	Cement Solidification and Biopiles
Appendix IV	-	Flow Chart for Decontamination Works
Appendix V	-	Works Sequence
Appendix VI	-	Extra Environmental Mitigation Measures

Civil Engineering and Development Department
September 2015

Appendix I

Site Plan and General View of the Site



位置圖
LOCATION PLAN

圖例 LEGEND :

土地除污工程範圍
GROUND DECONTAMINATION WORKS BOUNDARY

土地除污工程範圍
Ground Decontamination Works Boundary

西港島線施工區
West Island Line Works Area
(前堅尼地城焚化爐及屠房)
(Ex-Kennedy Town Incineration Plant and Abattoir)

臨時垃圾收集站
Temporary Refuse Collection Point

路政署維修廠
HyD Maintenance Depot
(前堅尼地城焚化爐)
(Ex-Kennedy Town Incineration Plant)

臨時公衆停車場
Temporary Public Car Park

加多近街臨時花園
Cadogan Street Temporary Garden

新巴巴士廠
NEW WORLD FIRST BUS DEPOT

維多利亞公眾殮房
Victoria Public Mortuary

休憩場地
Sitting-out Area

加多近街 Cadogan Street

西市街 Sai See Street

西寧街 Sai Ning Street

域多利道 VICTORIA ROAD

工程名稱 Project Title

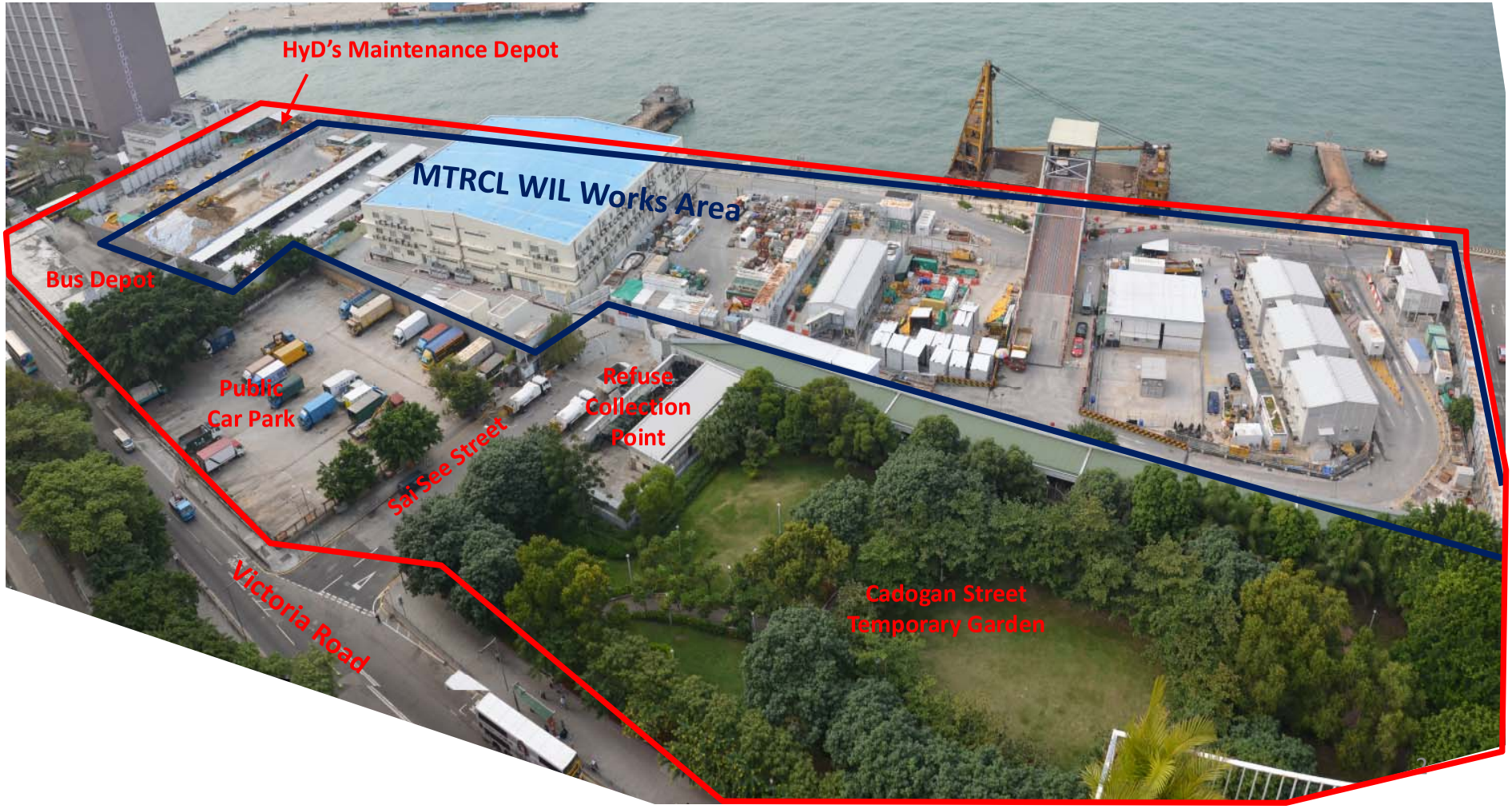
工務計劃項目第570CL號
前堅尼地城焚化爐、屠房及毗鄰用地
土地除污工程

PWP ITEM NO. 570CL
GROUND DECONTAMINATION WORKS AT THE SITE OF EX-KENNEDY TOWN INCINERATION PLANT / ABATTOIR AND ADJOINING AREA

圖則名稱 Plan Title

平面圖
SITE PLAN

General View of the Site



Appendix II

Review of Different Decontamination Works

Table 1: 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.

Appendix III

Cement Solidification and Biopiles

Cement Solidification

For **Heavy Metals** Contaminated Soil:

- Cement Solidification – Mix contaminated soil with cement and water
- The bond so formed can stabilise heavy metals and prevent them from releasing from soil
- The treated soil will be tested to confirm compliance before backfilling on site

Biopiles

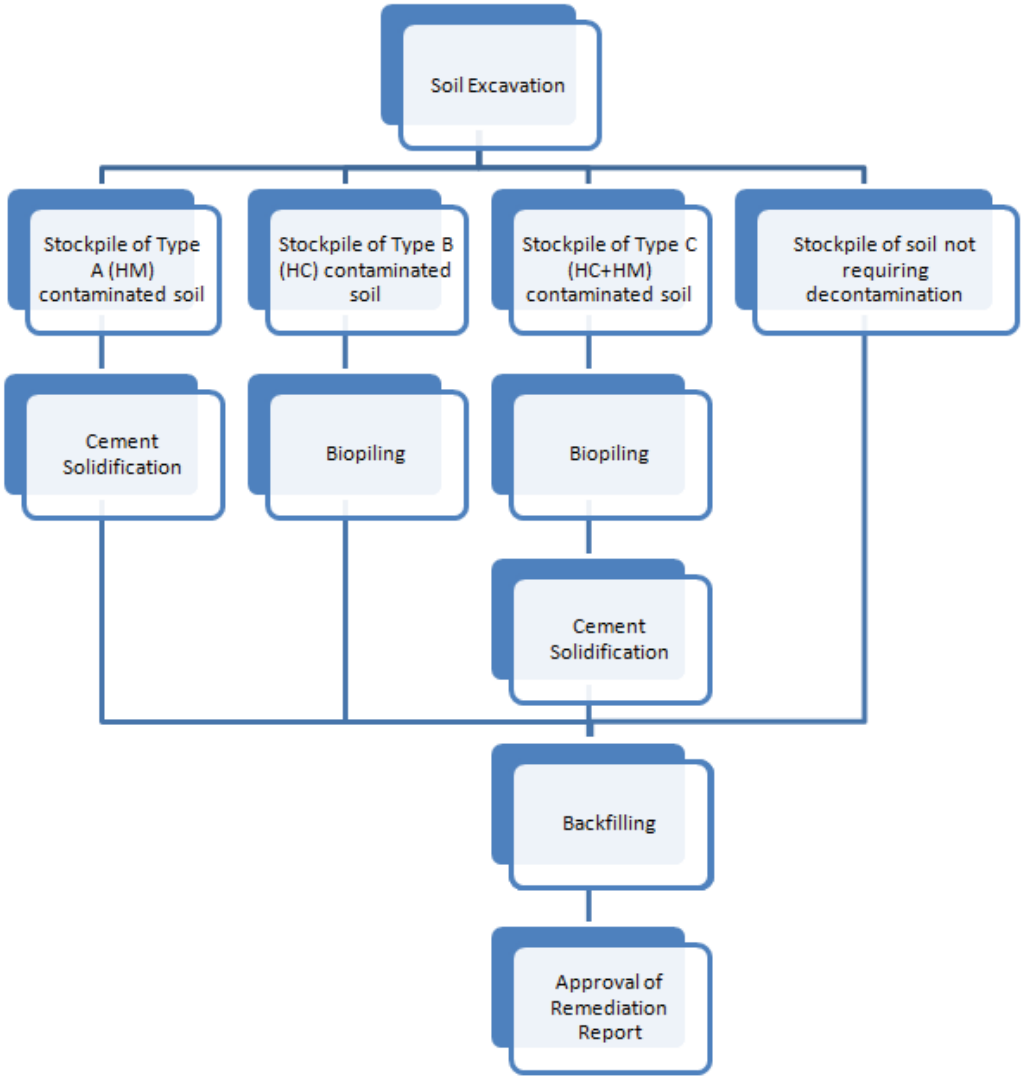
For **Hydrocarbons** Contaminated Soil:

- Biopiling – Heaping contaminated soil into piles and stimulating aerobic activity of microorganism to breakdown the hydrocarbons through aeration
- Each cycle of biopile will take about 12-15 months (from formation, operation and decommissioning) for completion
- Treated soil will be tested to confirm compliance before backfilling on site

Appendix IV

Flow Chart for Decontamination Works

Flow Chart for Ground Decontamination Works

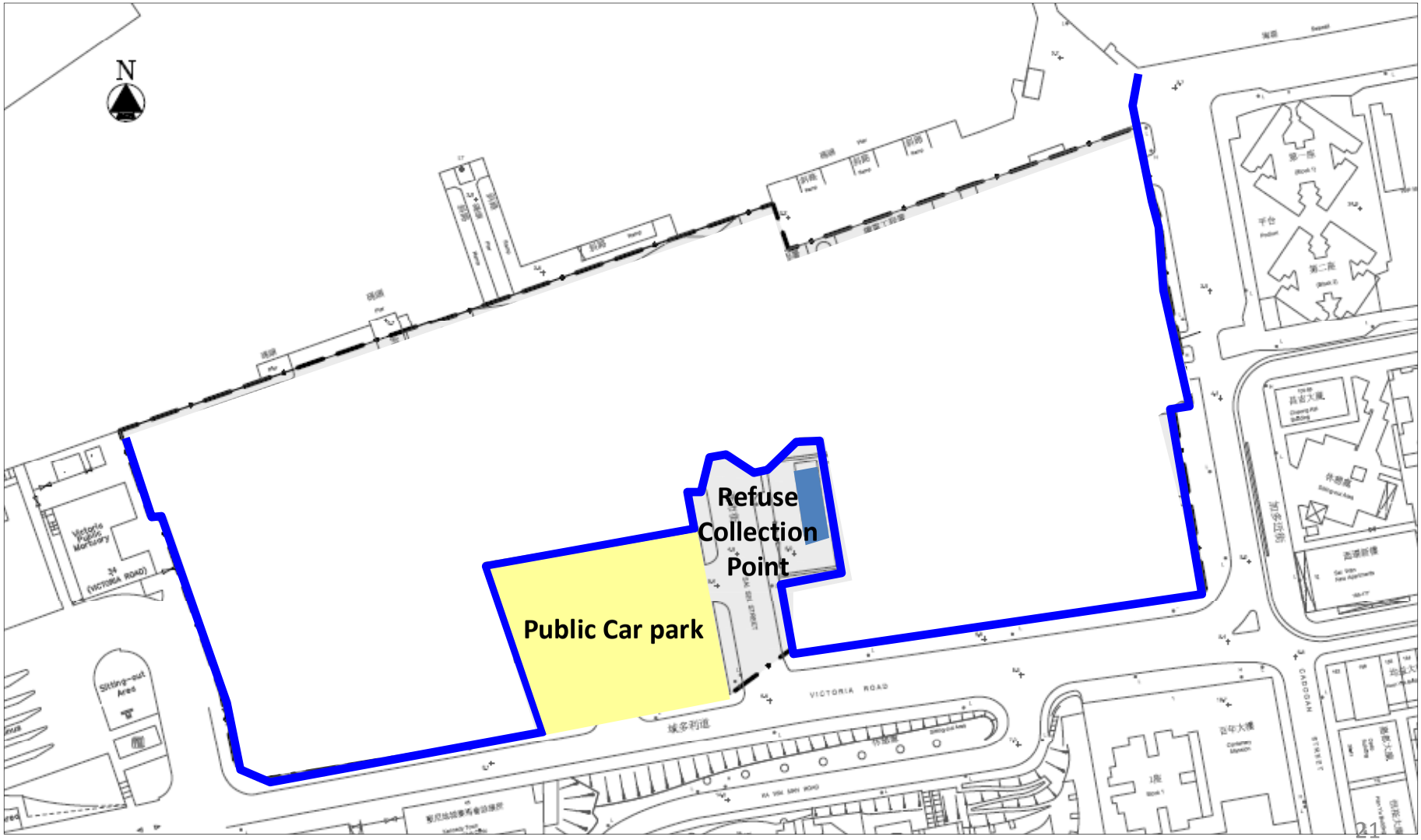


Appendix V

Works Sequence

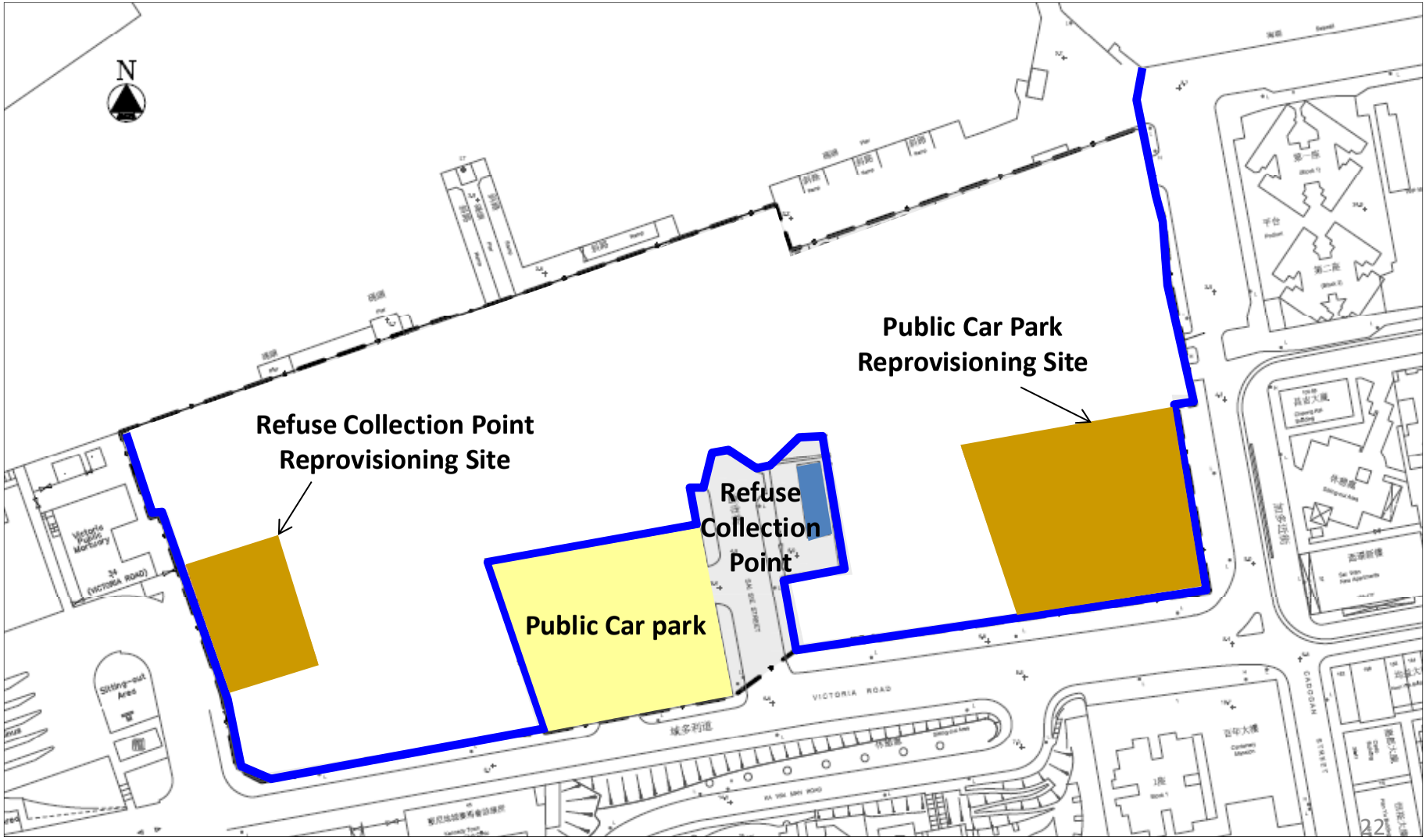
Ground Decontamination Works – 7-Year Option

- **Erect hoarding at site boundary (Existing public car park and refuse collection point in service)**



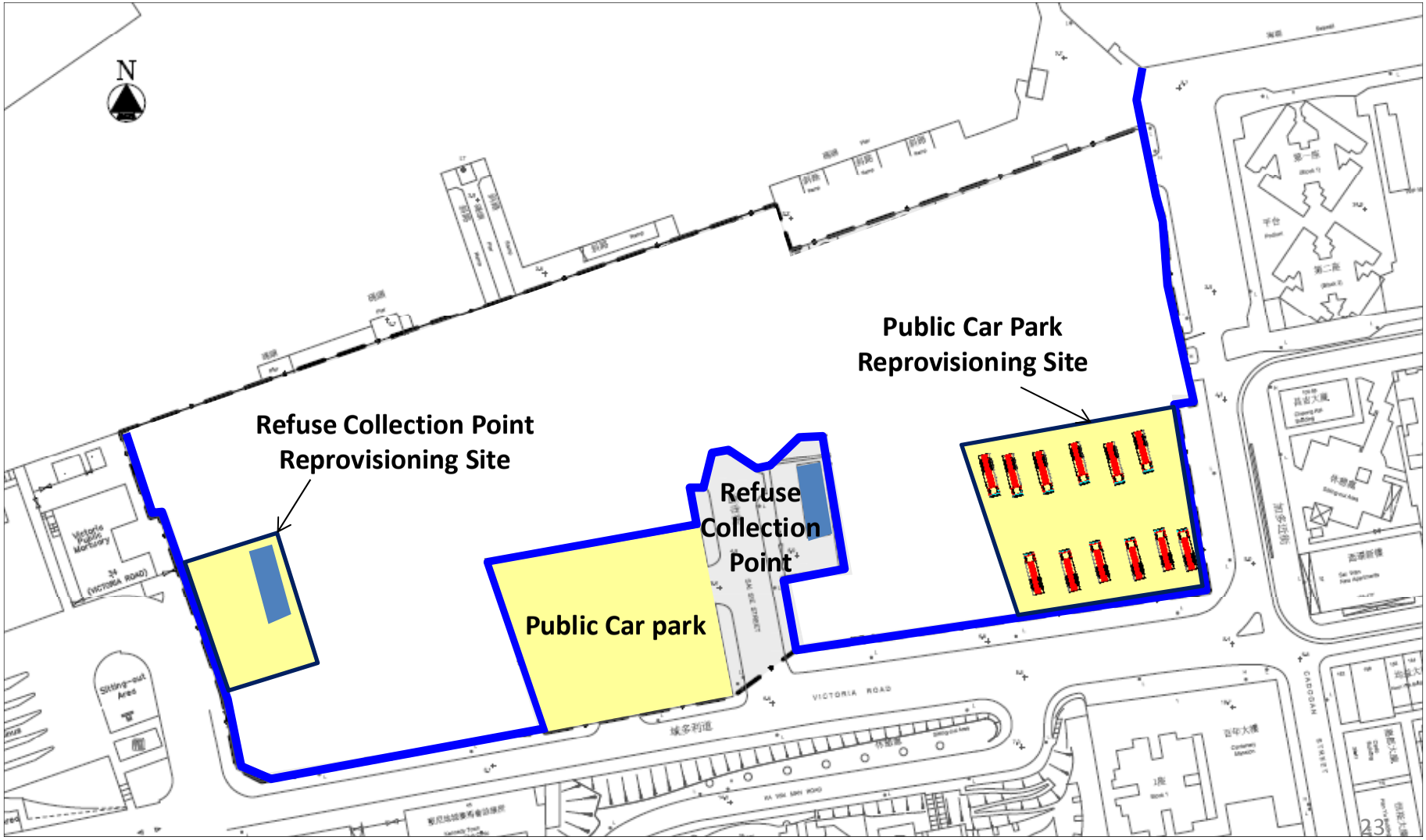
Ground Decontamination Works – 7-Year Option

- **Excavate and backfill the reprovisioning sites for public car park and refuse collection point**



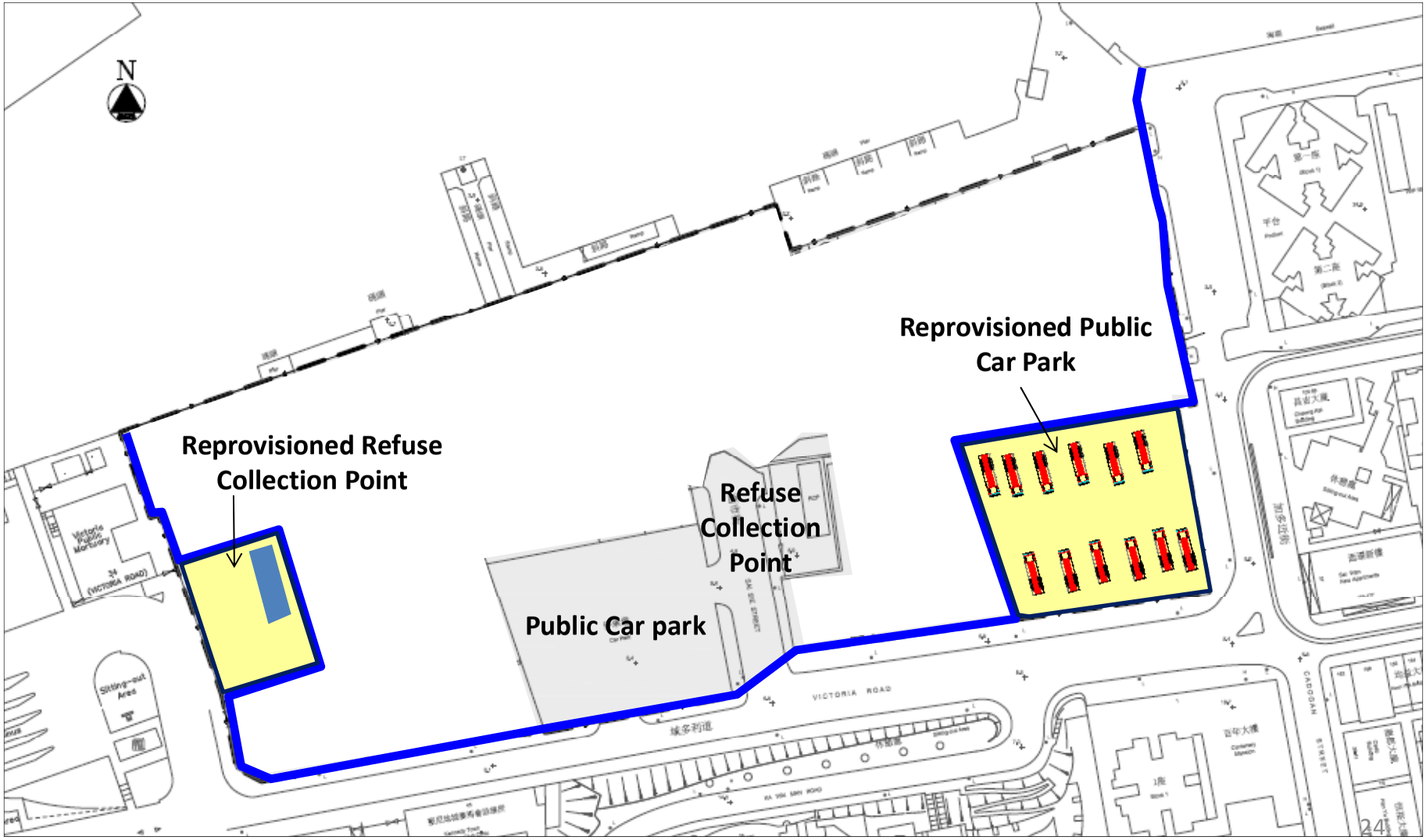
Ground Decontamination Works – 7-Year Option

- **Reprovision public car park and refuse collection point**



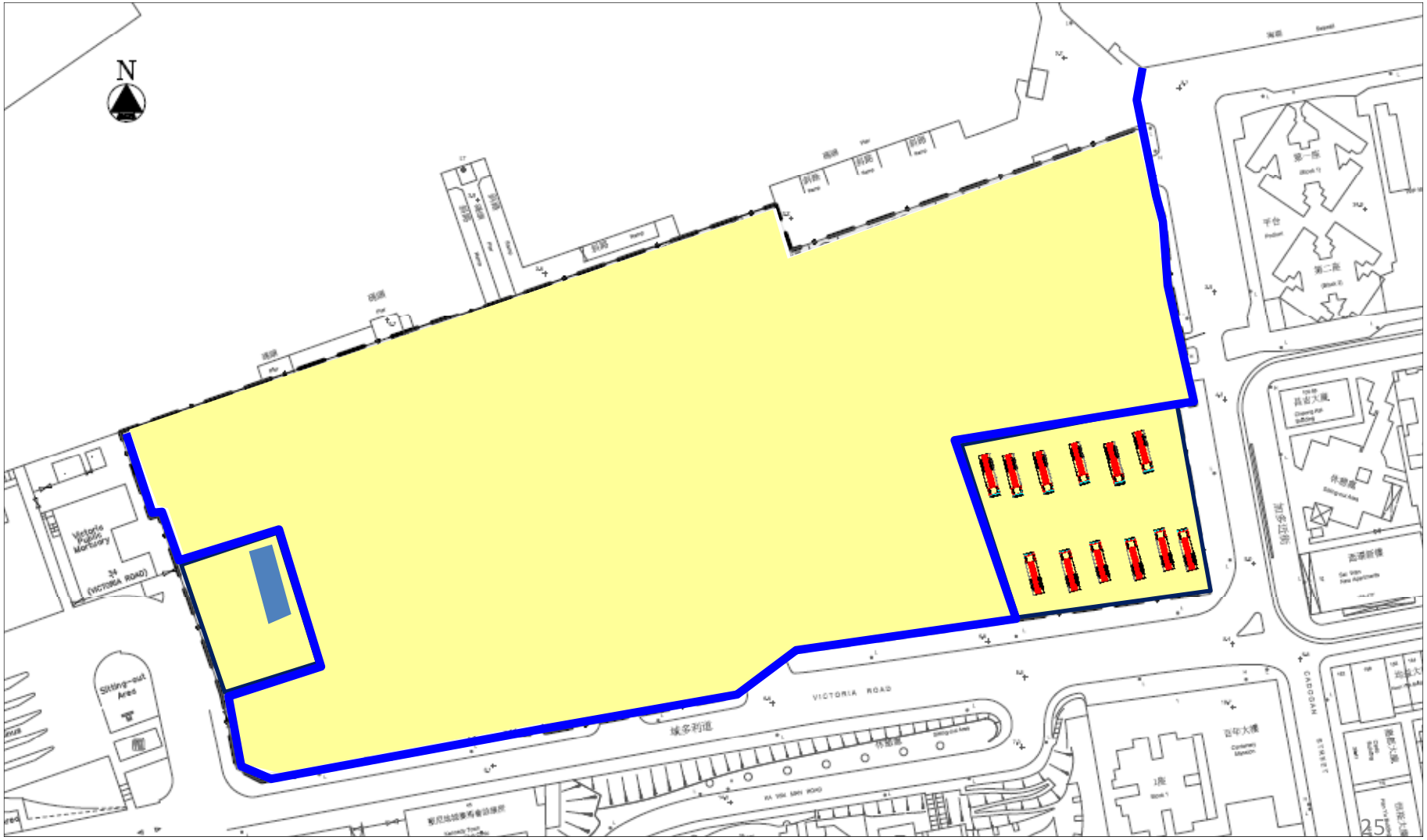
Ground Decontamination Works – 7-Year Option

- **Close and remove existing public car park and refuse collection point**



Ground Decontamination Works – 7-Year Option

- **Complete the decontamination works for the whole site (about 7 years)**



Appendix VI

Extra Environmental Mitigation Measures

Extra Environmental Mitigation Measures

- **Restrict active excavation area to about 10% of site area to minimise any dust and noise impact generated from excavation activities**

- **Height of hoarding will increase from standard 2.4m to 5.5m to minimise noise and dust**

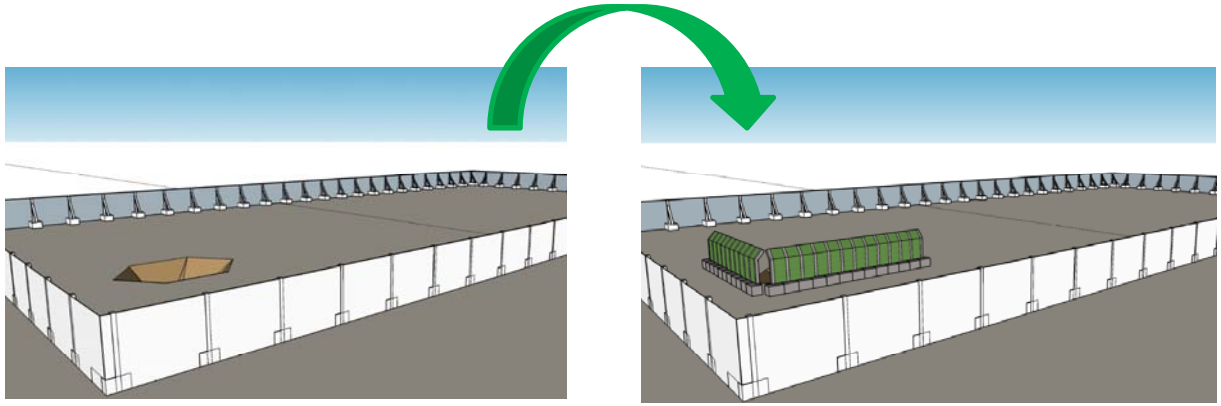
- **Art work panel will be adopted for hoarding to enhance appearance**

Extra Environmental Mitigation Measures

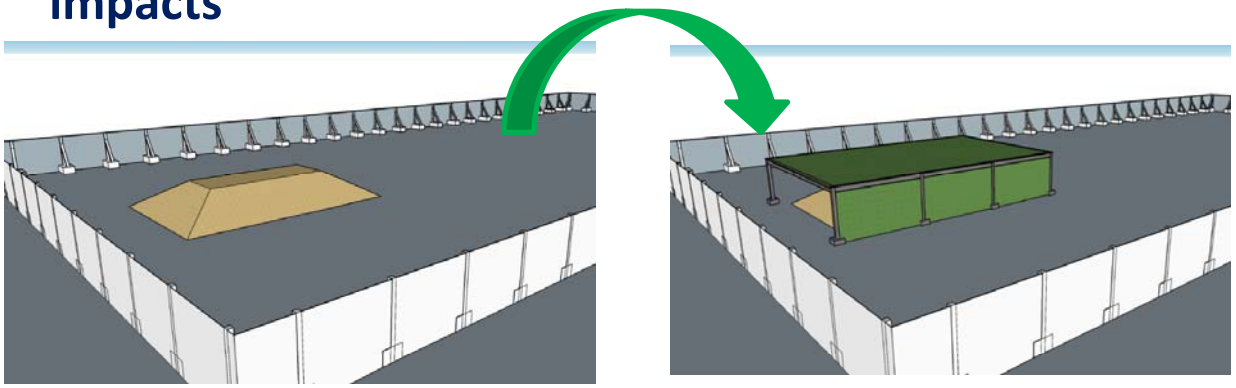
Suggested Graphic for Art Work Panel of Hoarding

Extra Environmental Mitigation Measures

- **Erect movable barrier around active excavation area to minimise noise, dust and visual impacts**



- **Erect temporary cover at stockpiling area to minimise dust and visual impacts**



Extra Environmental Mitigation Measures

- **Use green colour cover on top of biopiles to enhance visual effect**