

8 LAND CONTAMINATION IMPACT

8.1 Introduction

This chapter presents the findings of the land contamination assessment of the impacts from the Assignment during the construction phase.

A Contamination Assessment Plan (CAP) has been prepared which set out the requirements and methodologies for a land contamination assessment along the CKR alignment and was endorsed by EPD on 23 September 2008 (appended in **Appendix 8.1**). A total of 10 boreholes (including 7 in the West Portion and 3 in the East Portion) were proposed in the endorsed CAP to identify the potential land contamination issues along the CKR alignment.

A total of 74 soil and 7 groundwater samples were collected from these 10 boreholes. The analytical testing results of the soil and groundwater samples collected were presented in the Contamination Assessment Report (CAR) and Remediation Action Plan (RAP) which was submitted to EPD in November 2010 (appended in **Appendix 8.2**).

Based on the testing results, exceedances of the relevant Risk-Based Remediation Goal (RBRG) values have been identified in 3 boreholes (PBH4, PBH5 and PBH7). Hence, a confirmatory investigation involving 7 boreholes (including 5 in the West Portion and 2 in the East Portion) was proposed in the CAR/RAP to delineate the extent of the contamination detected.

Subsequently, additional at-grade works areas have been proposed and a Supplementary CAP (appended in **Appendix 8.3**) was prepared and submitted to EPD separately to address the latest changes and also to cover the confirmatory investigation works proposed in the CAR/RAP. The Supplementary CAP was endorsed by EPD in February 2012.

A total of 8 boreholes were proposed in the Supplementary CAP including 7 boreholes for the confirmatory investigation and 1 borehole for the additional works area. However, due to site constraints, only 5 boreholes have been partially or fully completed from which a total of 41 soil samples were collected. All the collected samples were analysed by a HOKLAS accredited laboratory for all parameters listed in the Supplementary CAP. A Supplemented CAR/RAP presenting the findings of the SI works has been submitted to EPD for retention in January 2013 (appended in **Appendix 8.4**).

8.2 Legislation and Guidance

Legislation and non-statutory guidance for carrying out the land contamination assessment is as follow:

- Technical Memorandum on Environmental Impact Assessment Process (TM-EIAO);
- Practice Guide for Investigation and Remediation of Contaminated Land;
- Guidance Notes for Contaminated Land Assessment and Remediation; and

- Guidance Manual for Use of Risk-Based Remediation Goals (RBRGs) for Contaminated Land Management, EPD.

8.3 Background Information

The assessment of the potential land contamination concerns along the CKR alignment has been carried out by reviewing the relevant information such as geological information, aerial photos and site survey. Potentially contaminated sites have been identified based on the information reviewed.

8.3.1 Geology

The geological profile of the proposed CKR alignment is shown in the endorsed CAP in **Appendix 8.1**. The materials encountered during the SI works consists of fill, fill derived from marine deposit, marine deposit and alluvium.

8.3.2 Historical Information

With the aid of selected aerial photos between 1967 and 2008, the historical landuse along the CKR alignment has been reviewed and the findings are summarised in below.

West Portion (Yau Ma Tei)

From the aerial photos covering areas near the Yau Ma Tei Typhoon Shelter, areas along the West Portion of the proposed CKR alignment is mainly occupied by residential buildings. Reclamation in the old Yau Ma Tei Typhoon Shelter to form a new reclaimed land and the new typhoon shelter was completed in 1992. West Kowloon Highway Interchange was constructed in 1990s. The land that will be affected by the Assignment has not undergone much change since the completion of the reclamation and is mainly open space and open car parks. No former shipyard sites were found within the project boundary of the Assignment.

Central Portion (Ho Man Tin)

Landuse identified along the Central Portion of the proposed CKR alignment is mainly natural terrain and residential use. The Housing Authority Mock-up Centre was already constructed in 2000 and remained unchanged. No other major change in landuse was observed.

East Portion (To Kwa Wan/ Ma Tau Kok/ Kai Tak)

Landuse identified along the East Portion of the proposed CKR alignment include Kai Tak Airport, Hong Kong & China Gas Company Ltd (HKCG) Ma Tau Kok Gas Works (North Plant & South Plant), Bus Terminus/ Car park, Ma Tau Kok Ferry Pier, Kapok Industrial Building, and EMSD Sung Wong Toi Vehicle Repair and Maintenance Workshop which were constructed before 1967. Kai Tak Airport ceased operation since 1997. The HKCG Ma Tau Kok Gas Works (South Plan) was demolished in the 1990s and the site was developed into residential use in 2007.

8.4 Site Survey

Site survey was conducted to confirm findings of the desktop study and to identify other landuse along the proposed CKR alignment which may cause potential soil and groundwater contamination. The potentially contaminative landuse identified during the site survey include:

- Liquefied Petroleum Gas (LPG) Filling Station
- Open Car Park Areas (Flyway Carpark)
- CLP Yau Ma Tei Substation
- Ma Tau Kok Gas Work
- Kowloon City Bus Terminus

8.5 Future Landuse and Activities

The RBRGs was categorised into four different post-restoration landuse, namely “Urban Residential”, “Rural Residential”, “Industrial” and “Public Parks”, to reflect the actual settings which people could be exposed to contaminated soil or groundwater. Definitions of the four post-restoration landuse categories are given in EPD’s *Guidance Note for Contaminated Land Assessment and Remediation and RBRGs Guidance Manual*.

Considering the future landuse of CKR which will either be intended for public open spaces or roads, RBRGs (Public Park)¹ would be adopted. Yet, the assessment has covered all four landuse categories in case the excavated contaminated soil was used as public fill for unidentified after-uses.

For the additional works area, since the future landuse has not yet been confirmed, the most stringent set of RBRGs (the lowest RBRGs values) will be adopted for data analyses.

8.6 Potentially Contaminated Sites

Based on the selected aerial photos and information collected from the site survey, 8 potentially contaminated sites have been identified. Details of the potentially contaminated sites are summarised in **Table 8.1** below.

Table 8.1: Potentially Contaminated Sites

Landuse with Potential Land Contamination Concern	Potential Sources of Contamination	Site Investigation Requirement	Remarks
West Portion			
Liquefied Petroleum Gas (LPG) Filling Station	Potential contamination due to the on-site underground storage	No	The site is located 50m away from the project boundary and there is little chance

¹ Considering the future landuse of CKR, the corresponding RBRGs would be “Lower of Industrial or Public Park”. Taken into account the respective RBRGs criteria for the two parameters concerned (i.e. Lead and PCBs), RBRGs (Public Park) would be adopted.

Landuse with Potential Land Contamination Concern	Potential Sources of Contamination	Site Investigation Requirement	Remarks
	tanks (USTs) for LPG		of land contamination by nature of the storage and activities on-site
Open Car Park Areas (Flyway Carpark)	Possible spillage/ leakage of fuel	No	No chemicals were used on-site. The car park is asphalt paved and no evidence of spills/ leakages were likely.
CLP Yau Ma Tei Substation	Potential contamination due to chemical wastes	Yes	-
East Portion			
Ma Tau Kok Gas Work	Potential contamination from the on-site diesel USTs	Yes	-
Kowloon City Bus Terminus	Potential contamination from fuel	Yes	-
Area adjacent to the To Kwa Wan Vehicle Inspection Centre	Possible spillage/ leakage of fuel	Yes	-
EMSD Sung Wong Toi Vehicle Repair and Maintenance Workshop	Release of oils and fuels and lubricants from vehicles, vehicle and equipment maintenance and refuelling. Use of chemicals and solvent in maintenance activities. Motor vehicle painting and storage and portable containers.	No	Remediation work is in progress under another consultancy service ^[1]
Former Kai Tak Airport	Historical leakage of aviation fuel	No	Site cleaned up by CEDD (former TDD) ^[2]

Note:

- [1] Agreement No.: 2P10CT10 Consultancy for Decontamination and Remediation Works for Sung Wong Toi Vehicle Repair and Maintenance Workshop and Kowloon Bay Vehicle Servicing Station
- [2] CEDD and TDD denote “Civil Engineering and Development Department” and “Territory Development Department” respectively.

8.7 Site Investigation

A Contamination Assessment Plan (CAP) has been prepared which set out the requirements and methodologies for a land contamination assessment along the CKR alignment and was endorsed by EPD on 23 September 2008. Site investigation (SI) proposed in the endorsed CAP were conducted in 2009 at 10 boreholes (including 7 in the West Portion and 3 in the East Portion as shown in **Figures 8.1 and 8.2**) in accordance with the requirements stipulated in the endorsed CAP (**Appendix 8.1**). A total of 74 soil and 7 groundwater samples were collected from these 10 boreholes. All the samples collected were analysed by a HOKLAS accredited laboratory for all parameters listed in the endorsed CAP.

A CAR/RAP (**Appendix 8.3**) was submitted to EPD in November 2011 to summarise and present the testing results of the SI works. Based on the testing results, exceedances of the relevant Risk-Based Remediation Goal (RBRG) values have been identified in 3 boreholes (PBH4, PBH5 and PBH7). Locations of these boreholes are shown in **Figures 8.3 and 8.4**. In order to delineate the extent of the contamination detected, a confirmatory investigation involving 7 boreholes (including 5 in the West Portion and 2 in the East Portion as shown in **Figures 8.3 and 8.4**) was proposed in the CAR/RAP.

Subsequently, since additional at-grade works areas have been proposed, a Supplementary CAP (appended in **Appendix 8.2**) was prepared and submitted to EPD separately to address the latest changes. The Supplementary CAP was endorsed by EPD in February 2012.

A total of 8 boreholes were proposed in the endorsed Supplementary CAP including 7 boreholes for the confirmatory investigation proposed in the CAR/RAP and 1 borehole for the additional works area (as shown in **Figures 8.3 and 8.4**). SI works for these boreholes were conducted in 2011 and 2012.

However, due to site constraints, only 5 out of the 8 boreholes proposed in the endorsed Supplementary CAP have been completed or partially completed. A total of 41 soil samples were collected from these 5 boreholes and all the samples were analysed by a HOKLAS accredited laboratory for all parameters listed in the endorsed Supplementary CAP. Based on the testing results of the soil samples collected from these 5 boreholes, no RBRGs exceedances have been detected. A Supplemented CAR/RAP presenting the findings of the SI works has been submitted to EPD for retention on January 2013 (appended in **Appendix 8.4**). A summary of the SI works conducted is given in **Table 8.2**.

Table 8.2: Summary of SI Works Conducted

Borehole ID	Locations	Purpose of the Boreholes	Remarks
SI works in 2009			
PBHO/PBH0A			-
PBH1	West Portion	Borehole locations for land contamination assessment of the CKR alignment	-
PBH2			-

Borehole ID	Locations	Purpose of the Boreholes	Remarks		
PBH3			-		
PBH4			Exceedances of RBRGs detected		
PBH5			Exceedances of RBRGs detected		
PBH6	East Portion	Borehole locations for land contamination assessment of the CKR alignment	-		
PBH7			Exceedances of RBRGs detected		
PBH8			-		
SI works in 2011 and 2012 (for confirmatory investigation and the additional works area)					
WBH1A			-		
WBH2A			-		
WBH3			-		
WBH4			Sampling completed to 1.50 mbgl ^[1] as oppose to the proposed 20.00 mbgl due to underground utility encountered.		
WBH5			Could not be completed due to concrete slab encountered.		
EBH1	West Portion	Borehole locations for confirmatory investigation	Sampling completed to 0.50 mbgl as oppose to the proposed 20.00 mbgl due to underground utility encountered.		
EBH2			Could not be completed due to constraints of site access		
EBH3			Could not be completed due to constraints of site access		

Note:

[1] "mbgl" denotes meter below ground level.

8.8 Identification and Evaluation of Land Contamination

For the SI works conducted in 2009, no exceedances of RBRGs were detected except for 3 soil samples collected from PBH4, PBH5, and PBH7 where exceedance of the RBRGs for Lead or PCBs have been identified. As summarised in **Table 8.3** below, the contamination detected exceeded the RBRGs for "Urban

Residential” and “Rural Residential” but not “Industrial” and “Public Park”. Locations of these contaminated boreholes are shown in **Figures 8.1 and 8.2**.

For the SI works conducted in 2011 and 2012, based on the available testing results, no exceedances were detected in any of the soil samples collected.

Table 8.3: Summary of Soil Samples with RBRGs Exceedance

Borehole ID	Locations	Sample Depth (mgb)	Contaminants	Concentrations (mg/kg)
PBH4	West Portion	3.00 – 3.95	PCBs	0.5
PBH5		7.00 – 7.95	Lead	570
PBH7	East Portion	7.00 – 7.95	Lead	490

Note:

1. RBRGs for Lead – Urban residential: 258mg/kg; Rural Residential: 255 mg/kg; Industrial: 2290 mg/kg; Public Park: 857mg/kg.
2. RBRGs for PCBs – Urban residential: 0.236mg/kg; Rural Residential: 0.226mg/kg; Industrial: 0.748; Public Park – 0.756mg/kg.

8.9 Possible Soil Contamination Extent

As discussed above, RBRGs exceedances have been detected in PBH4, PBH5 and PBH7. However, only PBH4 and PBH7 are located within the CKR cut-and-cover section, PBH5 is located outside the CKR alignment and does not fall within the excavation extent, hence the contaminated soil identified at PBH5 would not be excavated.

Contamination extent has been estimated for PBH4 based on the available testing results from WBH1, WBH2 and WBH3 which are intended to investigate the coverage of contamination detected at PBH4. Since only marginal exceedance of the RBRGs limit of PCBs was detected in PBH4, and the PCBs level detected at WBH1, WBH2, and WBH3 were all below detection limit (i.e. <0.1mg/kg), it could be reasonably assumed that the contamination detected at PBH4 was relatively localised. Hence, a circular area with a radius of 5m centred at PBH4 is considered adequate to cover the contamination extent at PBH4. The contamination extent is depicted in **Figure 8.5**.

Based on the contamination extent, it is estimated that approximately 157m³ of contamination soil would be excavated from PBH4. The estimation of the contaminated soil quantity to be excavated is summarised in **Table 8.4** below.

Table 8.4: Estimated Quantity of Contaminated Soil

Contaminated Borehole	Radius of the Contaminated Zone (m)	Estimated Vertical Extent of Contamination (m) ^[1]	Estimated Area of the Contaminated Zones (m ²)	Estimated Quantity of Contaminated Soil (m ³)
PBH4	5	2.0 (2.5m – 4.5m)	78.5	157
Total:				157

Note:

- [1] In estimating the vertical extent of contamination, the full depth of soil sampling (i.e. 1m) is taken as contaminated. Besides, a depth of 0.5m above and below the sampling depth will also be taken as contaminated as a conservative estimate.

For PBH7, since the SI works could not be completed for boreholes EBH1 and EBH2, which are intended to confirm the extent of the contamination detected at PBH7, the contamination extent of PBH7 could not be determined at this stage.

Similarly, since SI works could not be completed for EBH3, the potential land contamination issues at the additional works area could not be evaluated at this stage.

8.10 Remaining SI Works

8.10.1 Confirmatory Investigation at WBH4 and WBH5

The purpose of WBH4 and WBH5 is the same as WBH1, WBH2 and WBH3 which is to confirm the extent of contamination detected at PBH4. Since no RBRGs exceedances were identified in all the available testing results from WBH1, WBH2 and WBH3, the exceedance detected at PBH4 could reasonably be regarded as localised contamination. As the purpose of confirming the contamination extent at PBH4 has already been achieved, subject to agreement with EPD, WBH4 and WBH5 would be cancelled.

8.10.2 Confirmatory Investigation at EBH1 and EBH2

At this stage, SI works could not be completed for EBH1 and EBH2 due to underground utility and site access constraints respectively. The SI works at these two boreholes would need to be carried out at a later stage e.g. after possession of site and utility diversion by the construction contractor.

8.10.3 Land Contamination Assessment at EBH3

Due to site access constraints, SI works at EBH3 could not be conducted at this stage and therefore would need to be carried out at a later stage e.g. after possession of site by the construction contractor.

Following the completion of the remaining SI works at EBH1, EBH2 and EBH3, the Project Proponent would prepare and submit a Second Supplementary CAR/RAP to EPD to present the findings of the remaining SI works and to recommend specific remediation measures, if required. Upon completion of the remediation works, if any, a Remediation Report (RR) would be prepared and submitted to EPD for agreement prior to commencement of the construction works.

8.11 Soil Remediation Options & Recommendations

It is currently estimated that approximately 157m³ of contaminated soil will be generated during the construction phase of the Assignment. Considering the small quantity involved and that the level of contamination detected did not exceed RBRGs (Public Park) which is a more representative landuse for CKR, on-site reuse of the contaminated soil within the boundary of CKR, such as using to backfill in non-pedestrian use area under new flyover, would be recommended as the remediation option for the contaminated soil. A Remediation Action Plan (RAP) presenting the remediation option recommended has been prepared and submitted to EPD for agreement in May 2012 (appended in **Appendix 8.4**).

Although the above estimation is subject to findings of the remaining SI works which would be re-scheduled at a later stage e.g. after possession of site and utility diversion by the construction contractor, the contamination issue is anticipated to be surmountable with the supportive view that the contamination identified are relatively localised, likely contaminants are generic and easily remediated as remediation methods available in the market are well established and nature of the possible contaminants can be dealt with by sufficient local remediation experience.

8.12 Conclusion

A land contamination assessment has been conducted for the Assignment. Background information including geological conditions and selected aerial photos has been reviewed and site survey has been conducted to identify the potentially contaminated sites along the proposed CKR alignment.

Based on the testing results collected from the SI works conducted in 2009, exceedances were detected at 3 boreholes including PBH4, PBH5 and PBH7. Based on the confirmatory investigation conducted in 2011 and 2012, the contamination extent at PBH4 has been determined and the quantity of contaminated soil to be generated from PBH4 was estimated at 157m³.

Considering the small quantity of contaminated soil to be generated from PBH4 and that the level of contamination detected did not exceed RBRGs (Public Park) which is a more representative landuse for CKR, on-site reuse of the contaminated soil within the boundary of CKR, such as using to backfill in non-pedestrian use area under new flyover, would be recommended as the remediation option for the contaminated soil. A Remediation Action Plan (RAP) presenting the remediation option recommended has been prepared and submitted to EPD for retention in January 2013.

Investigation of contamination extents at PBH5 is not required as this borehole is located outside the CKR alignment and does not fall within the excavation extent. For PBH7, since the SI works could not be completed for boreholes EBH1 and EBH2 which are intended to confirm the extent of the contamination detected at PBH7, the contamination extent of PBH7 could not be determined at this stage.

The potential for land contamination issues at EBH1, EBH2, and EBH3 will be confirmed by site investigation after site possession and utility diversion by the construction contractor. Following the completion of the remaining SI works, the Project Proponent would prepare and submit a Second Supplementary CAR/RAP to EPD to present the findings of the SI works and to recommend specific remediation measures, if required. Upon completion of the remediation works, if any, a Remediation Report (RR) would be prepared and submitted to EPD for agreement prior to commencement of the construction works.

Nevertheless, the contamination issue is anticipated to be surmountable with the supportive view that the contamination identified are relatively localised, likely contaminants are generic and easily remediated as remediation methods available in the market are well established and nature of the possible contaminants can be dealt with by sufficient local remediation experience.