



Architectural Services Department

PWP No. 016NB

**Phased Reprovisioning of Cape
Collinson Crematorium Environmental
Impact Assessment Study**

Contamination Assessment Plan

March 2008

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Table of Contents

	Page
1 INTRODUCTION	1
Background.....	1
Objectives	1
2 ENVIRONMENTAL LEGISLATION, POLICIES, PLANS, STANDARDS AND CRITERIA	2
3 LAND CONTAMINATION SITE APPRAISAL	3
General Site Context	3
Geology and Hydrogeology	3
Review of Historical Aerial Photographs	3
4 SITE INSPECTION AND OBSERVATIONS	5
5 SAMPLING PLAN FOR SITE INVESTIGATION	8
Sampling Locations.....	8
Requirements of Site Investigation.....	8
Sampling Method and Depth of Sampling	10
Strata Logging.....	10
Free Product and Groundwater Level Measurement	10
Groundwater Sampling	10
Sampling Size and Decontamination Procedures	11
QA/QC Procedures	11
Health and Safety Measures	11
6 LABORATORY ANALYSIS	13
7 INTERPRETATION OF RESULTS FOR SITE INVESTIGATION	14

List of Tables

TABLE 3.1	REVIEWED HISTORICAL AERIAL PHOTOGRAPHS	4
TABLE 4.1	FINDINGS OF SITE INSPECTION.....	5
TABLE 4.2	SUMMARY OF ON-SITE LAND USE.....	7
TABLE 5.1	SAMPLING AND TESTING PLAN.....	9
TABLE 6.1	PRELIMINARY TESTING PARAMETERS PROPOSED FOR LABORATORY ANALYSIS.....	13
TABLE 7.1	RBRGS (INDUSTRIAL) VALUES FOR SOIL AND GROUNDWATER	14

List of Drawings

Drawing No. 1	Location Plan
Drawing No. 2	Structural Layout of Existing Crematorium
Drawing No. 3	Proposed Sampling Locations

List of Appendices

Appendix A	Site Photographs
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1 INTRODUCTION

Background

- 1.1 The existing Cape Collinson Crematorium (The Existing Crematorium) consists of four service halls with twelve cremators. The Existing Crematorium was first in use in 1962 and had several cremators upgraded in 1995 and 2001. To cope with the growing service demand while meeting the emission standards, the Food and Environmental Hygiene Department (FEHD) as the Project Proponent will replace all the existing cremators by new ones with higher capacity and more efficiency. The construction of the replacement crematorium was proposed in two phases. Phase 1 works involve the site formation work for the new crematorium, the construction of four new cremators and the provision of ancillary facilities. After commissioning of the four new cremators and their ancillary facilities, Phase 2 works will proceed to demolish the existing twelve cremators and construct six new cremators with ancillary facilities.
- 1.2 This "*Phased Re-provisioning of Cape Collinson Crematorium*" (The Project) is a designated project under Part I, Schedule 2, Item N4 of the *Environmental Impact Assessment Ordinance* (EIAO). In October 2007, Architectural Services Department (ArchSD), being the works agent commissioned ENSR Asia (HK) Limited (ENSR) to conduct Environmental Impact Assessment for the Project of which the area (Project Area) is shown in **Drawing No. 1**.
- 1.3 Potential land contamination resulting from the operation of the Existing Crematorium has been identified in the Project Profile (No. PP 338/2007). The Environmental Protection Department (EPD) issued the EIA Study Brief (No. ESB-177/2008) in January 2008 which demands a detailed assessment of land contamination impacts for the Project Area. This Contamination Assessment Plan (CAP) is to formulate the necessary investigation to address the potential land contamination concern associated with historic/current land uses in the Project Area. This CAP and the subsequent Contamination Assessment Report (CAR) and Remediation Action Plan (RAP) (if required) will form part of the EIA Study and be included in the EIA Report.

Objectives

- 1.4 The objectives of this CAP are to:
- (i) present the findings of the desktop study and site appraisals;
 - (ii) identify potential hotspots of land contamination for intrusive site investigation; and
 - (iii) propose a sampling and testing strategy for the site investigation.

2 ENVIRONMENTAL LEGISLATION, POLICIES, PLANS, STANDARDS AND CRITERIA

- 2.1 Three publications issued by EPD, "*Guidance Note for Contaminated Land Assessment and Remediation*" (referred to as Guidance Note 1), "*Guidance Notes for Investigation and Remediation of Contaminated Sites of: Petrol Filling Stations, Boatyards, and Car Repair /Dismantling Workshops*" (referred to as Guidance Note 2) and "*Guidance Manual for Use of Risk-based Remediation Goals for Contaminated Land Management*" (referred to as Guidance Manual) provide guidance on land contamination assessment.
- 2.2 According to Guidance Note 2, Risk-based Remediation Goal (RBRG) shall be used as the criteria for assessing land contamination and as the remediation goals if remediation is required.

3 LAND CONTAMINATION SITE APPRAISAL

General Site Context

- 3.1 The Project Area is located at Cape Collinson Road, Eastern District near Buddhist Cemetery, with site area of about 2000m². The Existing Crematorium consists of four service halls for carrying out ceremonies, two cremation rooms consisting of twelve cremators and several offices.
- 3.2 The Existing Crematorium is bounded to west and south by six columbarium blocks and Hong Kong Electric substation. Cemeteries and Fung Wah Estate are at the west and north of the Existing Crematorium respectively.

Geology and Hydrogeology

- 3.3 According to the Hong Kong Geological Survey Map (Series: HGM20) – Sheet No. 11 (1:20,000 scale) on the solid and superficial geology of the Project Area, the Project Area is mainly underlain by Shing Mun Formation, undivided sedimentary and volcanic rock consisting of tuffite of Upper Jurassic Period of Mesozoic Era.
- 3.4 A review of previous ground investigation (GI) reports undertaken at or in vicinity of the Project Area was conducted at the Civil Engineering and Development Department's (CEDD) Geotechnical Information Library to obtain information about the geological and hydrogeological conditions of the Project Area. Details of the reviewed GI reports are listed below:
- *Agreement No. CE 9/95 Feature No. 11SE-D/F19 Chai Wan Ground Investigation Factual Fieldwork Report* by Bachy Soletanche Group in 1995. (CEDD's Geotechnical Information Unit Report No. 21583)
 - *Slope No. 11SE-D/R2 Regional Council Crematorium, Tai Tam Road, H.K. Ground Investigation Factual Fieldwork Report* by Bachy Soletanche Group in 1999. (CEDD's Geotechnical Information Unit Report No. 30513)
 - *Agreement No. CE 10/2004 (GE) 10-Year Extended LPM Project, Phase 5, Package D – Hong Kong Island Landslip Preventive Works on Government Slopes and Related Studies – Investigation, Design and Construction Feature No. 11SE-D/C71 Location: Cape Collinson Crematorium Final Factual Fieldwork Report* by Fugro Geotechnical Services Ltd. in 2006. (CEDD's Geotechnical Information Unit Report No. 42859)
- 3.5 With reference to the above GI reports, the area close to the Project Area is generally covered by a layer of fill materials/colluvium (~0.5m to 1.5m in thickness) composed of sandy SILT and clayey sandy SILT with occasional fine to medium gravel. It is then followed by a layer (~1.15m to 10.1m in thickness) of saprolitic soil (in the majority of fine ash vitric TUFF and sandy SILT) before reaching the lower variable decomposed rock (rock of grade IV with thickness of ~0.4m to 6m). In terms of the likelihood of migration of contaminants, fill materials (i.e. top soil layer) generally have higher permeability and therefore, ability of potential contaminant migration through this horizon is higher than downward migration.
- 3.6 According to the general topography of the Project Area and groundwater levels recorded in some of the reviewed GI reports, elevation of the groundwater level varies from +153mPD to +110mPD from hillside south to hillside north of the Existing Crematorium. The general groundwater pattern likely flows from south to north, i.e. from Tai Tam Road towards Fung Wah Estate.

Review of Historical Aerial Photographs

- 3.7 A review of historical aerial photographs (as shown in **Table 3.1**) available in the Survey and Mapping Office of Lands Department was undertaken. The aim of this review is to identify the landuses associated with potential contamination implication within or near the Project Area.

Table 3.1 Reviewed Historical Aerial Photographs

Year	Height (Ft.)	Photograph Reference No.
1945	20000	4062
1949 ✓	8600	6063
1961	30000	120
1963 ✓	2700	6979
1967	6250	5631
1972	13000	2289
1974 ✓	12500	9697
1976	4000	12673
1978	4000	23782
1980	4000	29864
1982	4000	40872
1984 ✓	4000	53720
1986	4000	A06043
1987	4000	A10339
1989	4000	A17812
1992	4000	A32626
1994	4000	CN6926
1996 ✓	4000	CN14150
1998	4000	CN21101
2000	4000	CN28278
2002	3500	CW39611
2004	4000	CW55553
2006	4000	CW72455
2007	3000	CW77143

3.8 As concluded from the review of aerial photographs, the location of the Existing Crematorium was open area until 1962 and residential houses were found in the location of current Fung Wah Estate. Six columbarium blocks were built successively from 1970s to 1990s. Tai Tam Gap Correctional Institution at the southeast of the Existing Crematorium was also built in 1972. Residential houses were demolished and Fung Wah Estate was built in 1980s. No major land uses changes of the Project Area were observed since then.

4 SITE INSPECTION AND OBSERVATIONS

- 4.1 A site visit to Cape Collinson Crematorium was conducted on 1 February 2008 to inspect and identify any potential contamination hotspots within the Project Area. There were four service halls for carrying out ceremonies, two cremation rooms with twelve cremators and a number of smaller structures such as offices. New Cape Collinson Garden of Remembrance, which was open in December 2007, was situated at the west of the Existing Crematorium.
- 4.2 A capacity of 15,000L underground storage tank (UST), located at the south of the Existing Crematorium, has been used for diesel storage. The diesel fuel stored in the UST was pumped via the underground pipeline to the aboveground storage tank (AST) which situated at ground floor of the Existing Crematorium serving the cremators thereby by gravity. The exact alignment of the underground pipeline was concealed and could not be identified visually or from the available as-built plans. As a follow-up, an enquiry on the alignment was made to ArchSD. During a site interview with the site person in charge (PIC) from Electrical and Mechanical Services Department (EMSD), there noted no reportable events of leakage concerning the fuel tanks and pipeline.
- 4.3 Twelve cremators were located in two cremation rooms at the ground floor of the Existing Crematorium. Floors of both cremation rooms were covered by intact ceramic tiles while the cremators were set up on concrete foundation. Diesel fuel was fed to the cremators from the AST via vertical pipelines that ran outside along the wall. The oil pipes ended behind the cremators where their connections were clad in metal plates. Given the limited space and burn hazard from the operating cremator for close inspection, it was not able to access to the pipe joint or coupling where their conditions or any signs of leakage were uncertain. The site PIC from EMSD expressed that small-scale leakage of fuel from the pipes happened occasionally inside the cremation room. There was no storage of chemicals or dangerous goods as told by the manager of the Crematorium and observation during site visit.
- 4.4 Six chimneys connected to the twelve cremators were located at the top roof of the Existing Crematorium. Some areas around the Existing Crematorium were landscaped with trees and shrubs while other areas were paved with intact concrete. No stain or odour was observed during site inspection.
- 4.5 **Table 4.1** summarizes the findings of site inspection and photographs taken during site inspection were shown in **Appendix A. Drawing No. 2** illustrates the layout of the Existing Crematorium.

Table 4.1 Findings of Site Inspection

Location	Site Observation	SI Proposed?
Underground Storage Tank	<ul style="list-style-type: none"> ● Located at the south of Existing Crematorium with capacity of ~15,000L for fuel storage; ● No leakage incident happened as told by site PIC from EMSD; ● Fuel is pumped from the underground fuel tank to the aboveground storage tank via underground pipeline. Exact location of the pipeline was not clear. ● As the UST has been used for more than 40 years, there was potential leakage from the tank via cracks to the ground, further site investigation is required. 	Yes

Location	Site Observation	SI Proposed?
Aboveground Storage Tank	<ul style="list-style-type: none"> • Located inside the tank room at the ground floor of Existing Crematorium for fuel storage ; • Tank room covered by intact concrete floor with no stain observed during site visit; • Fuel was pumped from the underground tank via underground pipeline; • As the underground pipe had been used for more than 40 years, there was potential leakage of fuel from the pipe via cracks to the ground, further site investigation is required. 	Yes
Cremation Room 1	<ul style="list-style-type: none"> • Located at the ground floor of Existing Crematorium ; • The floors were well covered by intact tiles with no stain observed; • The oil pipes ended behind the cremators where their connections were clad in metal plates. Given the limited space and burn hazard from the operating cremator for close inspection,. Therefore, any signs of leakage were uncertain. • It was told by PIC from EMSD that occasional leakage of fuel was suspected. Further site investigation is required. 	Yes
Cremation Room 2	<ul style="list-style-type: none"> • Located at the ground floor of Existing Crematorium with one cremator; • The floors were covered by intact tiles with no stain observed; • It was told by PIC from EMSD that occasional leakage of fuel was suspected. Further site investigation is required. 	Yes
East of Chimneys	<ul style="list-style-type: none"> • Some part of the ground was covered by intact concrete while some part of the area was landscaped with trees and shrubs; • Construction works may be conducted within these areas. As contaminants of stack emissions might deposit on the soil where the ground was unpaved, further site investigation is required. 	Yes
South of Chimneys	<ul style="list-style-type: none"> • As no works would be carried out at the south of Existing Crematorium, disturbance of soil is not anticipated, site investigation is not proposed for area at the south of chimneys. 	No
West of Chimneys	<ul style="list-style-type: none"> • Construction works may be conducted within these areas. As contaminants of stack emissions might deposit on the soil where the ground was unpaved, further site investigation is required. 	Yes
North of Chimneys	<ul style="list-style-type: none"> • Some part of the ground was covered by intact concrete while some part of the area was landscaped with trees and shrubs; • As contaminants of stack emissions might deposit on the soil where the ground was unpaved, further site investigation is required 	Yes

4.6 Other areas inside the Existing Crematorium, which were covered by intact tiles, were used as service halls and offices. Chemicals were seldom used inside these areas and thus potential land contamination is not likely. Site investigation is not recommended for these areas.

4.7 An interview with the manager of the Crematorium has conducted. A summary of past, current and anticipated future land uses for the Project Area is presented in **Table 4.2** below.

Table 4.2 Summary of On-site Land Use

Current Use

Study Area	Type of facility/ business	On-site property land use	Date began	Description of business process/ primary products	Owner or Occupier	Approximate size of on-site property (m ²)	Off-site property affected?
Existing Crematorium Building	Crematorium	Crematorium	1962	To cremate the remains	Food and Environmental Hygiene Department (FEHD)	~1500	Yes
Car Park	Car Park	Car Park		Vehicles parked on site		~400	No

Past Use

Are past uses different from current uses? Yes No

Study Area	Type of facility/ business	On-site property land use	Date began	Date ended	Description of business process/ primary products	Owner or Occupier	Approximate size of on- site property (if different from current size) (m ²)	Off-site property affected?
Existing Crematorium Building	Open Area	Vacant	Unknown	1962	Vacant	Unknown	~1500	No
Car Park							~400	

Future Use

Are future uses different from current uses? Yes No

Study Area	Type of facility/ business	On-site property land use	Description of business process/ primary products	Owner or Occupier	Approximate size of on- site property (m ²)
Existing Crematorium Building	New Crematorium Building	Crematorium	To cremate the remains	FEHD	~2200
Car Park					

5 SAMPLING PLAN FOR SITE INVESTIGATION

Sampling Locations

- 5.1 Ten sampling locations are proposed for the potential contamination hotspots mentioned in **Table 4.1**, except for the cremation rooms 1 and 2. . Locations of proposed sampling points are illustrated in **Drawing No. 3**. The strategy of selection of sampling locations are based on the site observation of stain/floor discolourisation, machine/chemical storage locations, areas with contaminative activities undertaken or information provided by site personnel during the interviews.
- 5.2 Four boreholes and one trial pit along the fuel tank system are proposed to investigate whether there is contamination around the fuel tank system due to seepage or leakage. Five sampling locations are proposed for surface soil sampling to investigate whether there is surface soil contamination associated with aerial depositions from stack emissions.
- 5.3 As the cremators are still in operation, it is not possible to carry out site investigation behind the cremators at this stage. To maintain uninterrupted cremation services, further site investigation in cremation rooms is proposed at the later stage in Phase 2 during/ after the demolition of the Existing Crematorium. A supplementary CAP, which details further site investigation and testing plan for the cremation rooms, shall be prepared for EPD endorsement. Findings of supplementary site investigation and appropriate remediation methods (if contamination found) shall be presented in the supplementary CAR/RAP for EPD approval before the commencement of any earthworks.

Requirements of Site Investigation

- 5.4 Underground utilities survey shall be conducted to locate/ identify any underground utilities at/ in vicinity of the proposed borehole locations prior to commencement of drilling works. The exact sampling locations of the SI shall be determined on site and subject to fine adjustment due to site specific conditions (e.g. locations, presence of foundations, underground utilities, delivery pipes and services). The locations shall be agreed with both the premise owner, the Architect and the land contamination specialist prior to drilling and sampling.
- 5.5 It should be noted that if serious contamination is revealed during SI, more sampling locations or more number of samples at the specific sampling points would be recommended to determine the exact extent of contamination. For the proposed trial pit, additional soil sample would be collected if contamination is found at the sample collected at 3m.
- 5.6 The selection of potential contaminants recommended for laboratory analysis at each proposed SI location is referenced to the EPD's "*Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol Filling Stations, Boatyards, and Car Repair/Dismantling Workshops*" and "*Guidance Note for Contaminated Land Assessment and Remediation*". **Table 5.1** presents the sampling and testing plan for the 10 locations proposed for SI at the Project Area.

Table 5.1 Sampling and Testing Plan

Locations	Proposed Sampling ID	Sampling Method	Sample Matrix	Testing Parameters				When to conduct?	
				TPH	VOCs	Heavy Metals	Dioxins		
Fuel Tank System	BH1 – BH 4	Borehole to 2m below GW level or 6m bcl if no GW is encountered	Soil	0.5m bcl	Y	Y	Lead	-	In this Study
			Soil	1.5m bcl	Y	Y	Lead	-	
			Soil	At GW level or at 6m bcl	Y	Y	Lead	-	
			GW	If present	Y	Y	Lead	-	
West of Chimneys	TP1	Trial pit to 3m bcl	Soil	Immediately below pipeline	Y	Y	Lead	-	In this Study
			Soil	Every 1m below pipeline	Y	Y	Lead	-	
			GW	If present	Y	Y	Lead	-	
North of Chimneys	S2 – S3	Surface soil sample to 0.5m of exposed areas	Soil	0.1m	-	-	Y	Y	In this Study
			Soil	0.5m (Subject to the test results of 0.1m sample)	-	-	Y	Y	
East of Chimneys	S4 – S5	Surface soil sample to 0.5m of exposed areas	Soil	0.1m	-	-	Y	Y	In this Study
			Soil	0.5m (Subject to the test results of 0.1m sample)	-	-	Y	Y	

Notes:

bcl = below concrete layer; GW = groundwater; BH = borehole; TP=trial pit; S=surface sample; Y = testing proposed; TPH=Total Petroleum Hydrocarbons; VOCs=Volatile Organic Chemicals; SVOCs=Semi-volatile Organic Chemicals.
 Details of the chemical parameters should be referred to Table 6.1.
 This table should be read in conjunction with Drawing No. 3.

Sampling Method and Depth of Sampling

- 5.7 All soil boring and sampling should be supervised by a qualified land contamination specialist. Boreholes should be undertaken by means of dry rotary drilling method i.e. without the use of flushing medium. For safety reasons, an inspection pit should be excavated down to 1.5m below ground to inspect for underground utilities at the proposed borehole location. Disturbed soil samples should be collected at the depth of 0.5m and 1.5m below concrete slab. Soil boring using drill rigs should then be performed for depth from 1.5m to the maximum boring depth. Undisturbed U100/U76 (stainless steel) soil samples should be collected at the groundwater level, or 6m below concrete layer if no groundwater is encountered.
- 5.8 Trial pit should be excavated by means of hand tools to expose the soil under the fuel pipeline for sampling. Disturbed soil samples should be collected immediately below the pipeline and every 1m below the pipeline from trial pit by hand sampling.
- 5.9 Surface soil samples should be taken at 0.1m and 0.5m by hand tools. The second soil sample at 0.5m shall be analyzed if contamination is found at the 0.1m sample.

Strata Logging

- 5.10 Strata logging for boreholes or trial pit should be undertaken during the course of drilling/digging and sampling by a qualified geologist. The logs should include the general stratigraphic descriptions, depth of soil sampling, sample notation and level of groundwater (if encountered). The presence of rocks/boulders/cobbles discoloration, odour and foreign materials such as metals, wood and plastics should also be recorded. If trial pit is used, photographic records should be taken.

Free Product and Groundwater Level Measurement

- 5.11 The thickness of any free product and groundwater level if present at sampling locations should be measured with an interface probe. The free product if encountered in sufficient amount should be collected for laboratory analysis to determine the composition.

Groundwater Sampling

- 5.12 Groundwater samples shall be collected if groundwater is encountered at the sampling locations.
- 5.13 For each proposed borehole location, a groundwater sampling well should be installed into the boreholes prior to ground the commencement of sampling if groundwater is encountered or agreed by the land contamination specialist. After installation of the monitoring wells, the depth to water table and the thickness of free product (if exists) at all monitoring wells should be measured using an interface probe. Well developments (approximately five well volumes) should be carried out to remove silt and drilling fluid residue from the wells. The wells should then be allowed to stand for a day to permit groundwater conditions to equilibrate. Groundwater level and thickness of free product layer, if present, should be measured at each well before groundwater samples are taken.
- 5.14 Prior to groundwater sampling, the monitoring wells should be purged (at least three well volumes) to remove fine-grained materials and to collect freshly refilled representative groundwater samples. Time for each groundwater purging/recharge should be recorded as well as the estimated groundwater flow.
- 5.15 After purging, one groundwater sample should then be collected at each well using Teflon bailer and decanted into appropriate sample vials or bottles in a manner that minimises agitation and volatilisation of VOCs from the samples. All samples should be uniquely labeled.
- 5.16 Apart from boreholes, groundwater sample should be also collected at the trial pit if encountering groundwater during excavation. The trial pit should be pumped to near dry and

allowed to stand for 24 hours. Groundwater sample should be collected using decontaminated bucket.

- 5.17 Immediately after collection, groundwater samples should be transferred to new, clean, laboratory-supplied glass jars for sample storage/transport. The sampling jars should be of opaque type that minimizes any sunlight effect on the sample. Groundwater samples should be placed in the glass jars with zero headspace and promptly sealed with a septum-lined cap. All sample jars should be transported in ice chests where they are cooled and maintained at a temperature of around 0-4°C until delivered to the analytical laboratory.

Sampling Size and Decontamination Procedures

- 5.18 All equipment in contact with the ground should be thoroughly decontaminated between each excavation, drilling and sampling event to minimise the potential cross contamination. The equipment (including drilling pit, digging tools and soil/groundwater samplers) should be decontaminated by steam cleaning/ high-pressure hot water jet, and then washed by phosphate-free detergent and finally rinsed by distilled/deionized water.
- 5.19 Prior to sampling, the laboratory responsible for analysis should be consulted on the particular sample size and preservation procedures that are necessary for each chemical analysis. Extra soil samples shall be reserved for Toxicity Characteristics Leaching Procedure (TCLP) analysis, if it is required.
- 5.20 The sample containers should be laboratory cleaned, sealable, water-tight, made of glass or other suitable materials with aluminium or Teflon-lined lids, so that the container surface will not react with the sample or adsorb contaminants. No headspace should be allowed in the containers which contain samples to be analysed for VOCs, TPH or other volatile chemicals.
- 5.21 The containers should be marked with the sampling location codes and the depths at which the samples were taken. If the contents are hazardous, this should be clearly marked on the container and precautions taken during transport. Samples should be stored at between 0-4°C but never frozen. Samples should be delivered to laboratory within 24 hours of the samples being collected and analysed within 7 days upon delivery.

QA/QC Procedures

- 5.22 QA/QC samples shall be collected in the following frequency during the SI. Chain of Custody protocol shall be adopted.
- 1 equipment blank per 20 samples for full suite analysis.
 - 1 field blank per 20 samples for full suite analysis.
 - 1 trip blank per 20 samples for full suite of analysis.
- 5.23 From the proposed sampling plan, there should be at least 2 equipment blanks, 2 field blanks and 2 trip blanks to be collected under this Study.

Health and Safety Measures

- 5.24 The specific safety measures to be taken depend on the nature and content of contamination, the site conditions and the regulations related to site safety requirements. Workmen Compensation Insurance and third party insurance must be provided for the SI.
- 5.25 Extreme care should be exercised when toxic gases or other hazardous materials are encountered. Any abnormal conditions found shall be reported immediately to the safety officer and the land contamination specialist.
- 5.26 The SI contractor shall establish and maintain a Health and Safety Plan, before commencement of the SI, that will include the following:
- (i) Instruction of works on work procedures, safe practices, emergency duties, and applicable regulations;

- (ii) Regularly scheduled and impromptu meetings of the workers in which the possible hazards, problems of the job, and related safe practices are emphasized and discussed;
 - (iii) Good housekeeping practices; and
 - (iv) Availability of and instruction in the location, use and maintenance of personal protective equipment.
- 5.27 The SI Contractor shall maintain equipment and supplies reasonably required in an emergency, including lifesaving, evacuation, rescue and medical equipment in good working order and condition at all times. The SI Contractor shall use all reasonable means to control and prevent fires and explosions, injury to personnel and damage to equipment of property. Without limiting the foregoing, the SI Contractor shall:
- (i) Maintain proper safety devices, barriers to minimise hazards during performance of the work;
 - (ii) Prohibit smoking and open flames and the carrying of matches and lighters;
 - (iii) Develop and maintain a written emergency plan applicable to the Work and Site;
 - (iv) Maintain equipment in good operating condition and have emergency and first aid equipment ready for immediate use, where applicable;
 - (v) Conduct equipment tests to ensure that equipment is properly placed and in good operating condition, and that workers are able to respond to emergency situations;
 - (vi) Require all workers employed or retained by the Contractor, or a subcontractor, to at all time wear clothing suitable for existing work, weather and environmental conditions; and
 - (vii) The personnel are required to wear respirator and gloves for vapour exposure protection, if necessary. Safety helmet and protective boots should be worn.

6 LABORATORY ANALYSIS

6.1 Laboratory analysis is proposed in order to assess the presence of potential contaminants that are of concern at the Site. **Table 6.1** summarises the parameters, detection limits and reference methods for the laboratory analyses of soil and groundwater samples for this Study.

Table 6.1 Preliminary Testing Parameters Proposed for Laboratory Analysis

Item	Parameter	Soil		Groundwater	
		Detection Limit (mg/kg) or otherwise stated	Reference Method	Detection Limit (mg/L) or otherwise stated	Reference Method
1	Total Petroleum Hydrocarbons (TPH)	C6 – C8: 5 C9 – C16: 200 C17 – C35: 500	USEPA 8015	C6 – C8: 0.02 C9 – C16: 0.5 C17 – C35: 0.5	USEPA 8015
2	VOCs				
	Benzene	0.2	USEPA 8260	0.001	USEPA 8260
	Toluene	0.2	USEPA 8260	0.002	USEPA 8260
	Ethylbenzene	0.2	USEPA 8260	0.002	USEPA 8260
	Meta & para Xylene	0.4	USEPA 8260	0.004	USEPA 8260
	Ortho xylene	0.2	USEPA 8260	0.002	USEPA 8260
3	Heavy Metals				
	Antimony	1	USEPA 6020	NA	NA
	Arsenic	1	USEPA 6020	NA	NA
	Barium	0.5	USEPA 6020	NA	NA
	Cadmium	0.2	USEPA 6020	NA	NA
	Chromium III	1	USEPA 6020	NA	NA
	Chromium VI	1	USEPA 6020	NA	NA
	Cobalt	0.5	USEPA 6020	NA	NA
	Copper	1	USEPA 6020	NA	NA
	Lead	1	USEPA 6020	NA	NA
	Manganese	1	USEPA 6020	NA	NA
	Mercury	0.05	USEPA 6020	0.05	USEPA 6020
	Molybdenum	1	USEPA 6020	NA	NA
	Nickel	1	USEPA 6020	NA	NA
	Tin	0.5	USEPA 6020	NA	NA
	Zinc	1	USEPA 6020	NA	NA
4	Dioxins (I-TEQ)	0.5 ug/kg	USEPA 8280A	NA	NA

Note:

NA: No test is required.

- 6.2 For sampling and laboratory analyses, chain of custody procedure shall be included as QC/QA procedure.
- 6.3 All laboratory analyses for soil and groundwater samples shall be conducted by laboratory accredited by the Hong Kong Laboratory Accreditation Scheme (HOKLAS).
- 6.4 Extra soil samples shall be stored at 0-4°C and tested for Toxicity Characteristics Leaching Procedure (TCLP) before submission of Remediation Action Plan (RAP) if excavation and landfill disposal is identified as the last resort.

7 INTERPRETATION OF RESULTS FOR SITE INVESTIGATION

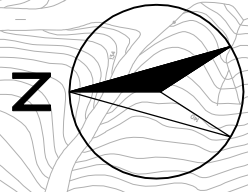
- 7.1 The results of the laboratory analyses shall be interpreted in accordance with and *Guidance Note for Contaminated Land Assessment and Remediation* (Guidance Note 1) and *Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol Filling Stations, Boatyards, and Car Repairing/Dismantling Workshops* (Guidance Note 2), published by EPD.
- 7.2 Risk-Based Remediation Goals (RBRGs) would be used as criteria for the soil and groundwater contamination assessment. The Guidance Manual launched by EPD on 15 August 2007 provides RBRGs for 4 types of land-uses including Urban Residential, Rural Residential, Industrial and Public Park. For each type of land-uses, a list of limits is provided for assessing land contamination purposes.
- 7.3 According to the Guidance Manual, land contamination data should be compared with the relevant RBRGs in accordance with the future land-use of the site. It is understood that the future site development will be crematorium. As workers are likely the group exposed to potential contaminated soil during excavation stage and maintenance works, RBRGs for Industrial is proposed to adopt as the land contamination assessment criteria. Relevant soil and groundwater Industrial RBRGs levels for this Study are presented in **Table 7.1**.

Table 7.1 RBRGs (Industrial) Values for Soil and Groundwater

Parameter	Soil (mg/kg)		Groundwater(mg/L)	
	Industrial	Soil Saturation Limit	Industrial	Solubility Limit
VOCs				
Benzene	9.21	336	54	1,750
Toluene	10,000	235	10,000	526
Ethylbenzene	8,240	138	10,000	169
Xylenes (total)	1,230	150	1,570	175
Total Petroleum Hydrocarbons (TPH)				
C6-C8	10,000	1,000	1,150	5.23
C9-C16	10,000	3,000	9,980	2.8
C17-C35	10,000	5,000	178	2.8
Heavy Metals				
Antimony	261	NA	NA	NA
Arsenic	196	NA	NA	NA
Barium	10,000	NA	NA	NA
Cadmium	653	NA	NA	NA
Chromium III	10,000	NA	NA	NA
Chromium VI	1,960	NA	NA	NA
Cobalt	10,000	NA	NA	NA
Copper	10,000	NA	NA	NA
Lead	2,290	NA	NA	NA
Manganese	10,000	NA	NA	NA
Mercury	38.4	NA	6.79	NA
Molybdenum	3,260	NA	NA	NA
Nickel	10,000	NA	NA	NA
Tin	10,000	NA	NA	NA
Zinc	10,000	NA	NA	NA
Dioxins				
Dioxins (I-TEQ)	0.005	NA	NA	NA

- 7.4 A Contamination Assessment Report (CAR) shall be compiled following the SI. The CAR shall present the methodology used during the soil boring and sampling work, details of field observations, and interpretation of laboratory testing results for soil and groundwater contamination.
- 7.5 If land contamination is confirmed, a Remediation Action Plan (RAP) shall be drawn up to formulate necessary remedial measures. The subsequent CAR and RAP, as part of the EIA Study, shall be endorsed by EPD before implementation of any remediation work.
- 7.6 Since the cremators are still in operation, it is not possible to carry out site investigation inside the cremation rooms at this stage. Referring to Section 4.5, potential land contamination at cremation rooms would mainly be due to fuel spillage and leakage from the cremators. Since there is no record of large scale spillage, only small scale spillage or leakage from the cremator are anticipated. Further site inspection is recommended during Phase 2 works of demolishing the existing cremators. Further the site inspection, a supplementary CAP shall be prepared for EPD endorsement to present detailed sampling and testing plan. Findings of site investigation and appropriate remediation methods shall be presented in supplementary CAR/ RAP for EPD endorsement prior to the commencement of any earthworks.

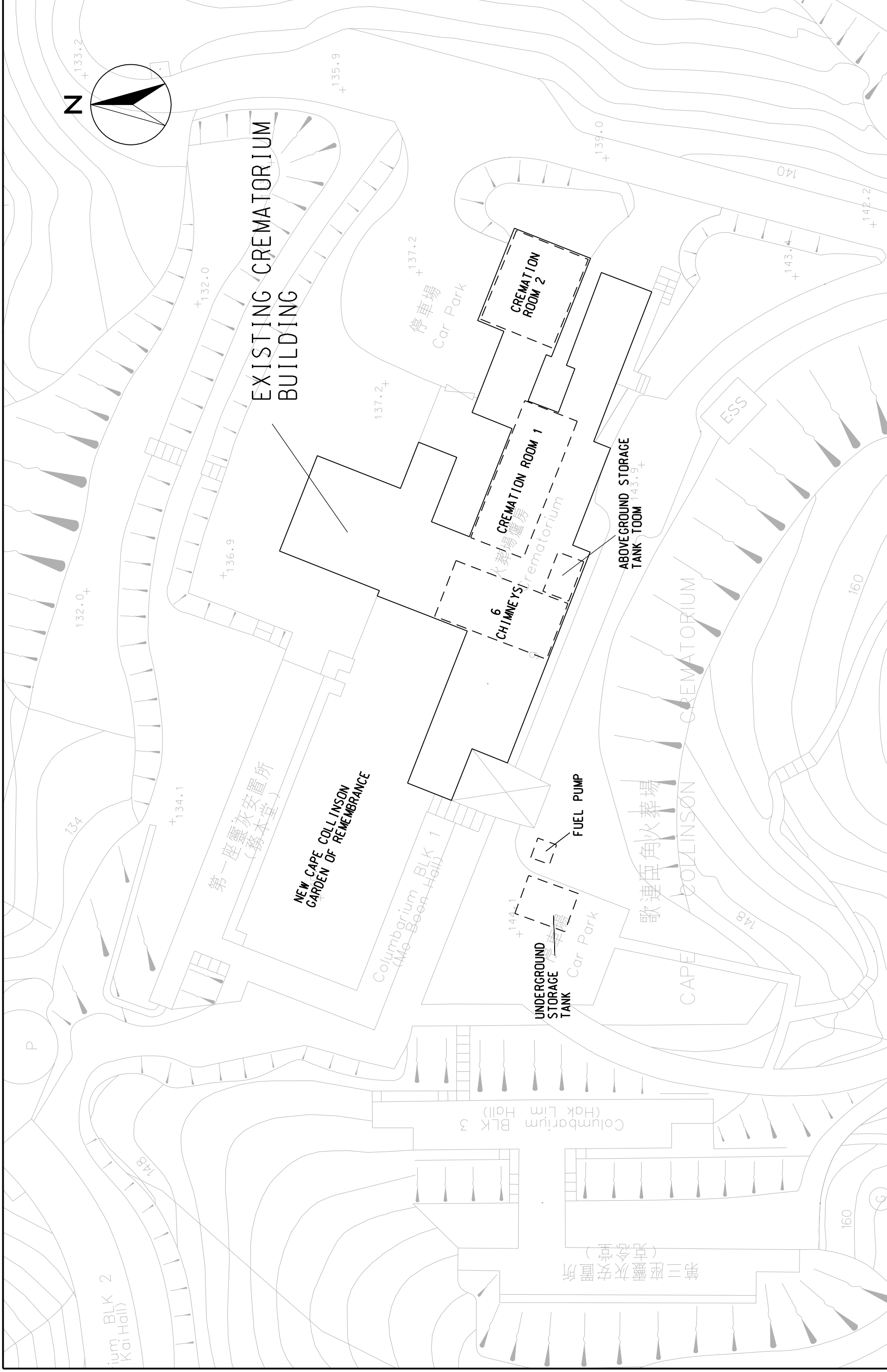
Drawings



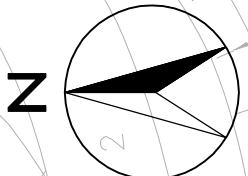
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		REV	—

PMP No. 016NB
 PHASED REPROVISIONING OF CAPE COLLINSON CREMATORIUM ENVIRONMENTAL IMPACT ASSESSMENT STUDY
 LOCATION PLAN

AECOM
 ENSR
 MAUNSELL
 ENSR Asia (HK) Ltd

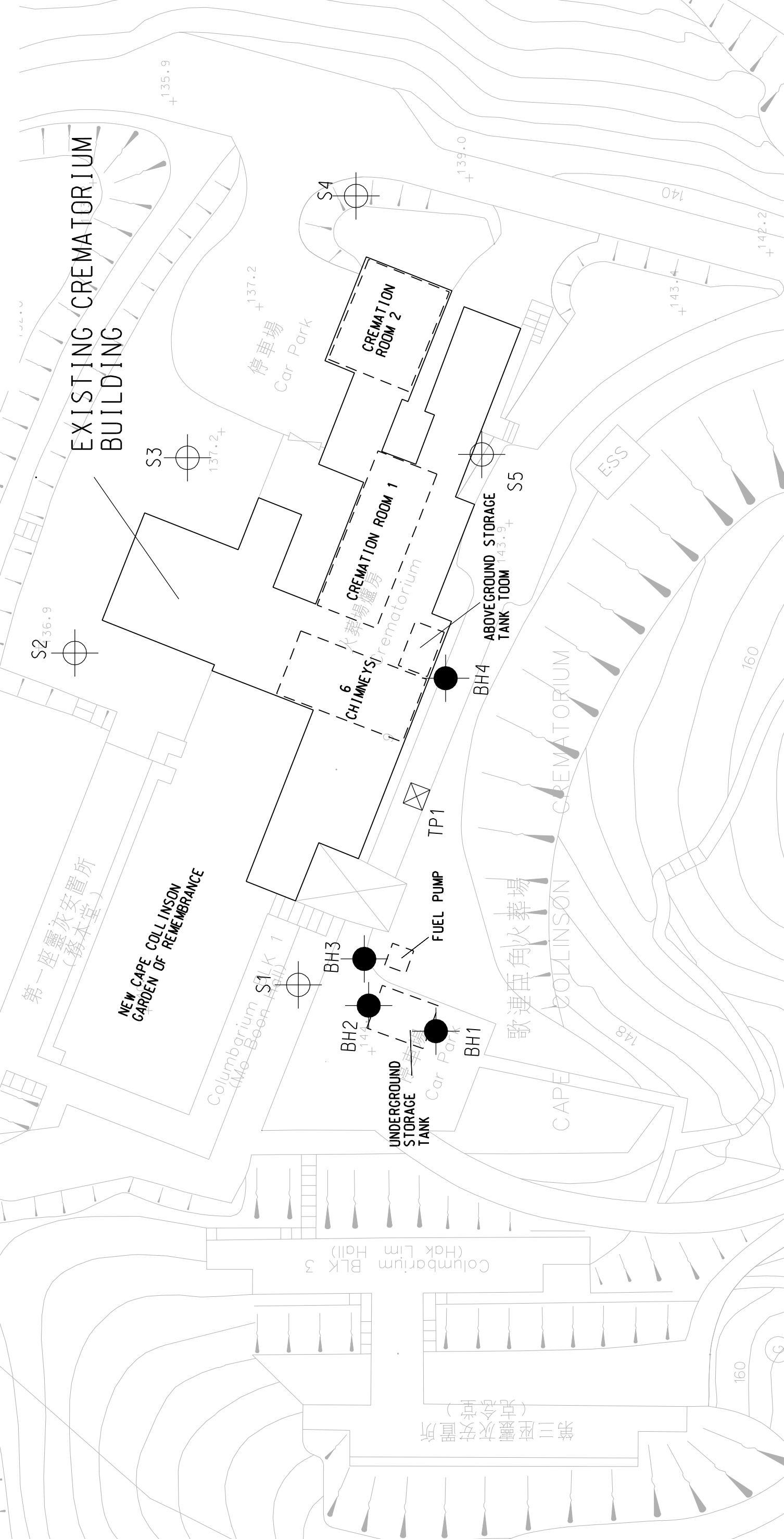


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	STRUCTURAL LAYOUT OF THE EXISTING CREMATORIUM		JOB No.	N.T.S.	DATE	REV
	60028568		60028568	2	FEB 08	CHKM



LEGEND:

- PROPOSED BOREHOLES SAMPLING IN THIS STUDY
- ⊙ PROPOSED SURFACE SOIL SAMPLING POINTS
- ⊠ PROPOSED TRIAL PIT



<p>AECOM</p> <p>ENSR MAUNSELL ENSR Asia (HK) Ltd</p>	<p>PHASED REPROVISIONING OF CAPE COLLINSON CREMATORIUM ENVIRONMENTAL IMPACT ASSESSMENT STUDY</p> <p>PWP No. 016NB</p>		<p>SCALE</p> <p>CHECK</p> <p>JOB NO.</p>	<p>N.T.S.</p> <p>IWSL</p> <p>60028568</p>	<p>DATE</p> <p>DRAWN</p> <p>DRAWING NO.</p>	<p>FEB 08</p> <p>CHKM</p> <p>3</p>	<p>REV</p> <p>—</p>
	<p>PROPOSED SAMPLING LOCATIONS</p>						
	<p>P: /60028568/1.01/CAD/Drawing/Report/CAP/DRAWING NO 3.DGN</p>						

Appendix A

PHOTOGRAPHIC LOG



Client Name: Architectural Services Department		Site Location: Cape Collinson Crematorium	Project No. 60028568
Photo No. 1	Date: Feb. 08		
Direction Photo Taken: South of Existing Crematorium			
Description: Underground Storage Tank System With capacity of ~15,000L. It is used for diesel fuel storage. Stain was observed on intact concrete paved ground.			

Photo No. 2	Date: Feb. 08	
Direction Photo Taken: South Portion of Existing Crematorium		
Description: Aboveground Storage Tank Located at the ground floor of Crematorium. For diesel fuel storage. No stain was observed on intact concrete paved ground.		

PHOTOGRAPHIC LOG



Client Name: Architectural Services Department		Site Location: Cape Collinson Crematorium		Project No. 60028568
Photo No. 3	Date: Feb. 2008			
Direction Photo Taken: West of Chimneys				
Description: A total of 6 chimneys connected to 12 cremators were located at the roof of existing crematorium.				

Photo No. 4	Date: Feb. 2008			
Direction Photo Taken: East of Chimneys				
Description: Some area was landscaped with shrubs and trees. Stack emissions may deposit on exposed soil.				

PHOTOGRAPHIC LOG

Client Name: Architectural Services Department		Site Location: Cape Collinson Crematorium		Project No. 60028568	
Photo No. 5	Date: Feb. 2008				
Direction Photo Taken: North of Chimneys					
Description: Some area was landscaped with shrubs and trees. Stack emissions may deposit on exposed soil.					

AERIAL PHOTOGRAPHIC LOG

Client Name: Architectural Services Department		Site Location: Cape Collinson Crematorium	Project No. 60028568
Photo No. A	Date: Feb. 2008		
Description: (Extracted from aerial photo Ref. No. 6063 dated 1949) Crematorium has not yet been built. The area was left open.			

AERIAL PHOTOGRAPHIC LOG

Client Name: Architectural Services Department		Site Location: Cape Collinson Crematorium	Project No. 60028568
Photo No. B	Date: Feb. 2008		
Description: (Extracted from aerial photo Ref. No. 6979 dated 1963) Crematorium has been built.			

香港特別行政區政府 地政總署測繪處

Survey & Mapping Office, Lands Department
 The Government of Hong Kong Special Administrative Region


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AERIAL PHOTOGRAPHIC LOG

Client Name: Architectural Services Department		Site Location: Cape Collinson Crematorium	Project No.: 60028568
Photo No.: C	Date: Feb. 2008		
Description: (Extracted from aerial photo Ref. No. 9697 dated 1974) Columbarium Blocks 1 and 2 have been built.			

AERIAL PHOTOGRAPHIC LOG

Client Name: Architectural Services Department		Site Location: Cape Collinson Crematorium	Project No. 60028568
Photo No. D	Date: Feb. 2008		
Description: (Extracted from aerial photo Ref. No. 53720 dated 1984) Columbarium Blocks 3 and 4 have been built.			

AERIAL PHOTOGRAPHIC LOG

Client Name: Architectural Services Department		Site Location: Cape Collinson Crematorium	Project No.: 60028568
Photo No.: E	Date: Feb. 2008		
Description: (Extracted from aerial photo Ref. No. CN14150 dated 1996) Residential houses in the north of crematorium were demolished and Fung Wah Estate has been built on it. Columbarium Block 5 and 6 have also been built.			

AERIAL PHOTOGRAPHIC LOG

Client Name: Architectural Services Department		Site Location: Cape Collinson Crematorium	Project No.: 60028568
Photo No.: F	Date: Feb. 2008	 <p>香港特別行政區政府 地政總署測繪處 Survey & Mapping Office, Lands Department The Government of Hong Kong Special Administ</p> <p>CW77143 12 Jul 2007 3000' CHAI WAN</p> <p>版權所 © Copyright reser</p>	
Description: (Extracted from aerial photo Ref. No. CW77143 dated 2007) No major land use changes were observed.			