

Annex F

Contamination Assessment Report (including CAP)

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1 INTRODUCTION

1.1 BACKGROUND TO THE STUDY

The Shenzhen River Regulation Office (SzRRO) of the Shenzhen Municipal Government and the Drainage Services Department (DSD) of the HKSAR Government proposed to train an approximately 4 km long section of the Shenzhen River to facilitate development of the proposed Liantang/Heung Yuen Wai (LT/HYW) Border Control Point (BCP) to meet the required flood prevention standard of the BCP (hereafter referred to as “the Project”). The Project location is presented in *Figure 1.1*.

In July 2009, ERM-Hong Kong, Ltd (ERM) was commissioned by the SzRRO and the DSD to carry out an Environmental Impact Assessment (EIA) of the Project, in accordance with the EIA Study Brief No. ESB-200/2009 dated January 2009. As part of the EIA Study, a land contamination assessment was required, and a Contamination Assessment Plan (CAP) was prepared to describe the investigation required to complete a land contamination assessment for the Project. The CAP proposed a contamination investigation at one sampling location, located next to the historical bean curd sheets/sticks manufacturing plant (hereafter referred to as “the Site”). A copy of the CAP is attached in *Annex A*. The CAP was approved by EPD on 17 December 2009.

The site investigation (SI) at the Site was undertaken on 21st January 2010 in accordance with the investigation programme proposed in the CAP. This Contamination Assessment Report (CAR) has been prepared based on the results of the SI. During the SI, no groundwater was present at the maximum proposed sampling depth of 3 m, therefore no groundwater sample was collected.

1.2 OBJECTIVES OF THE CAR

The purpose of this CAR is to provide information on the underlying soil at the Site and identify any pollutant linkages and propose appropriate remedial actions in accordance with the EPD’s *Guidance Manual for Use of Risk-Based Remediation Goals for Contaminated Land Management* (the *RBRGs Guidance Manual*).

1.3 STATUTORY LEGISLATION AND EVALUATION CRITERIA

The assessment of land contamination sources and the potential impacts associated with development projects are undertaken under the direction of EPD. The Project is a Designated Project under the *Environmental Impact Assessment Ordinance (EIAO)*, and the *RBRGs Guidance Manual*, the associated *Guidance Note for Contaminated Land Assessment and Remediation* (the *RBRGs Guidance Note*), and the EPD’s *Guidance Notes for Investigation and Remediation*

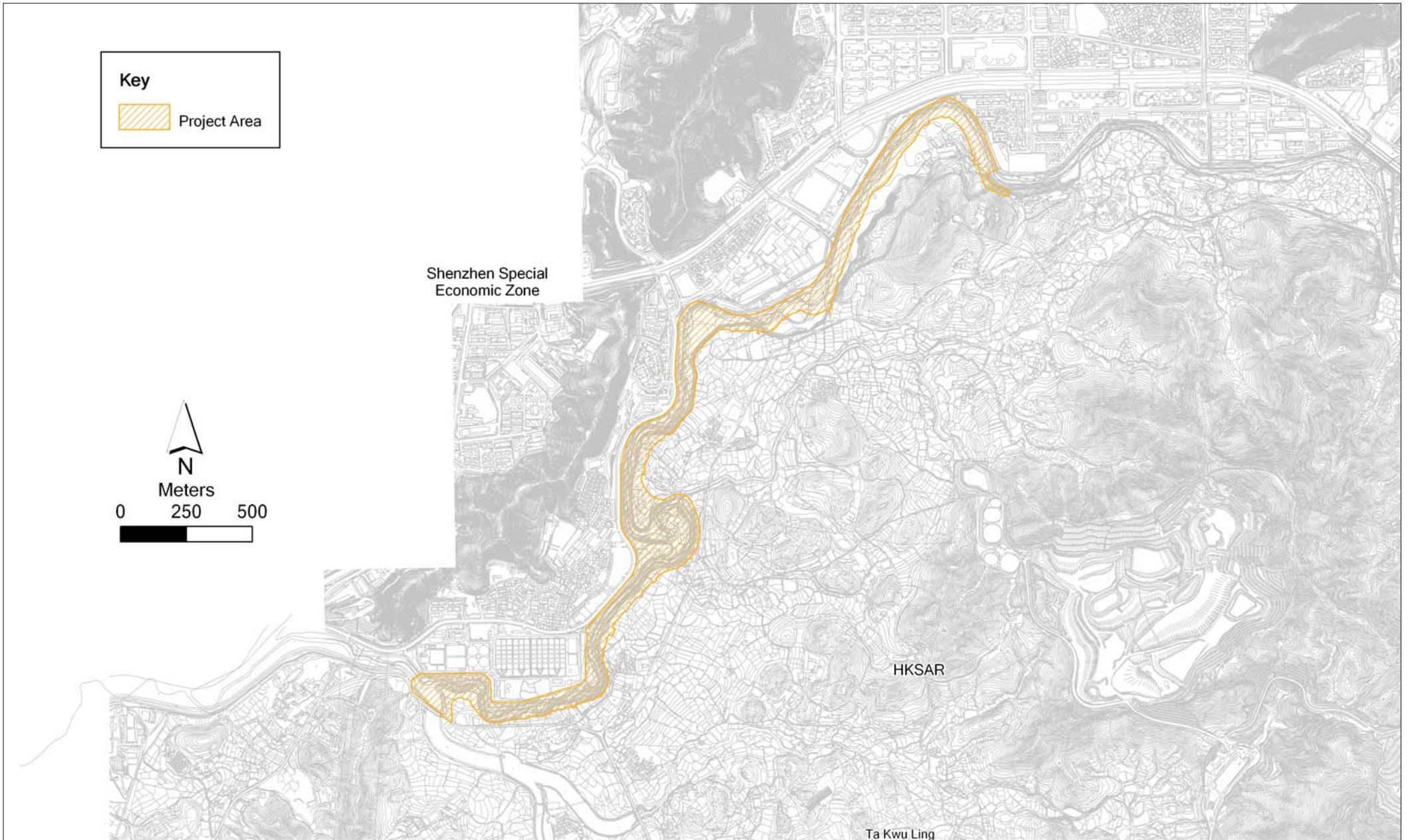


Figure 1.1

Location of Project Site

of Contaminated Sites of Petrol Filling Stations, Boatyards, and Car Repair/Dismantling Workshop (the EPD's Guidance Notes) are the key sets of guidelines to which reference are made.

The RBRGs were developed for four different post-restoration land-use scenarios namely; urban residential, rural residential, industrial and public parks. For the purposes of this CAR, the Project area has been given a preliminary classification as a Rural Residential Site, as defined in the *RBRGs Guidance Manual*.

RBRGs for soil, used in conjunction with associated Soil Saturation Limits (C_{sat}), set the remediation goals for soil. Detected concentrations of Chemicals of Concern (COCs) in soil at the Site will be compared to the RBRG values for Rural Residential Land Use and the associated C_{sat} values.

The following legislation, documents and guidelines may also cover or have some bearing upon the assessment contamination and the handling, treatment and disposal of contaminated materials for the Project.

- *Waste Disposal Ordinance (WDO) (Cap 354);*
- *Waste Disposal (Chemical Waste) (General) Regulation (Cap 354C);*
- *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes;*
- *Water Pollution Control Ordinance (WPCO) (Cap 358); and*
- *Technical Memorandum on Standards for effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters.*

1.4 DESCRIPTION OF THE PROJECT

This Project was commissioned by the governments of the Shenzhen Special Economic Zone and the Hong Kong SAR which the primary objective of floor protection, with associated benefits including pollution control and navigation improvement.

The Stage IV regulation work consists of training an approximately 4 km long section of the Shenzhen River in order to facilitate development of the proposed LT/HYW BCP to meet the required flood protection standard of the BCP. Additionally, approximately 4 km of the border road and boundary security fence running alongside the relevant river section will be re-aligned. Associated drainage and landscaping works also formed part of the Project. It is anticipated that excavation and disposal of river sediment will be required for training works. The management of the dredged sediments and the potential environmental impact associated with the handling and disposal of the sediments will be discussed in the Waste Management Section of the EIA Report.

The Project is a designated project under Item I “Waterways and Drainage Works” of Schedule 2, Part 1 of the EIAO: *A drainage channel or river training and diversion works which discharges or discharge into an area which is less than 300 m from the nearest boundary of an existing site of special scientific interest (SSSI), i.e., Mai Po Marshes and Inner Deep Bay SSSI.*

1.5

STRUCTURE OF THE CAR

The remainder of this report is structured according to the assessment methodology for contaminated sites as outlined in the *RBRGs Guidance Manual* and the *EPD’s Guidance Notes*.

- *Section 2* provides a summary of the relevant information from the *CAP* and other historical information such as the previous *SI*;
- *Section 3* reports on the *SI* undertaken;
- *Section 4* presents the results of the *SI*; and
- *Section 5* concludes the findings of the *SI*.

The report is also supported by the following materials which are provided in the following annexes:

- *Annex A* Contamination Assessment Plan
- *Annex B* Site Investigation Location
- *Annex C* Laboratory Analytical Report
- *Annex D* Trial Pit Log and Photographs from Site Investigation

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PREVIOUS INVESTIGATION RESULTS

A desktop review of available information on land contamination that may impact the Project area was undertaken. This included a review of aerial photographs, historical maps, historical contamination study in the nearby area and a site survey. No intrusive contamination investigation at the Project area has previously been undertaken and therefore no contamination data specific to the Project area was available.

The land contamination assessment within the CAP is limited to the identification of potential contamination from sources located within or adjacent to the Project area. According to the findings of the CAP, only one location within the Project area is proposed for the SI works, which is described in *Section 3* and are described further in the CAP.

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3 *SITE INVESTIGATION*

3.1 *SITE INVESTIGATION*

SI works for the Project was undertaken on 21 January 2010, in accordance with the approved CAP. The following sections provide a summary of the SI works.

3.1.2 *Sampling Locations*

One (1) sampling location was situated within the Project area, as presented in *Annex B*. Soil samples collected were visually inspected for olfactory evidence of potential contamination.

The SI involved the used of a trial pit to investigate and determine the presence of soil contamination. Soil samples were taken from 0.5 m, 1.5 m and 2.95 m ⁽¹⁾ below the ground surface (bgs) for analysis of metals (Antimony, Arsenic, Barium, Cadmium, Chromium III, Chromium VI, Cobalt, Copper, Lead, Manganese, Mercury, Molybdenum, Nickel, Tin and Zinc), total petroleum hydrocarbons (TPH), benzene, toluene, ethylbenzene and xylenes (BTEX) and polycyclic aromatic hydrocarbons (PAHs).

As mentioned above, no groundwater sample was collected during the SI due to the absence of groundwater at the maximum excavation depth of 3 m (bgs).

The detection limits for the proposed laboratory testing of soil samples are set out in *Box 3.1*.

⁽¹⁾ There is a big boulder underneath 2.95 rendering the material not suitable for lab analysis.

Parameters	Reporting Limit for Soil (mg/kg)	Reporting Limit for Groundwater (ug/L)	Reference Method
VOCs			
Benzene	0.1 (0.2)	5	USEPA 8260
Ethylbenzene	0.5	5	USEPA 8260
Toluene	0.5	5	USEPA 8260
Xylenes (total)	2	20	USEPA 8260
Total Petroleum Hydrocarbons			
C6 - C8	5	20	USEPA 8015
C9 - C16	200	500	USEPA 8015
C17 - C35	500	500	USEPA 8015
SVOCs			
Acenaphthene	0.5	2	USEPA 8270
Acenaphthylene	0.5	2	USEPA 8270
Anthracene	0.5	2	USEPA 8270
Benzo(a)anthracene	0.5	N/A	USEPA 8270
Benzo(a)pyrene	0.5	N/A	USEPA 8270
Benzo(b)fluoranthene	1	1 (4)	USEPA 8270
Benzo(k)fluoranthene			USEPA 8270
Benzo(g,h,i)perylene	0.5	N/A	USEPA 8270
Chrysene	0.5	0.5 (2)	USEPA 8270
Dibenzo(a,h)anthracene	0.5	N/A	USEPA 8270
Fluoranthene	0.5	2	USEPA 8270
Fluorene	0.5	2	USEPA 8270
Indeno(1,2,3-cd)pyrene	0.5	N/A	USEPA 8270
Indeno(1,2,3-cd)pyrene	0.5	--	USEPA 8270
Naphthalene	0.5	N/A	USEPA 8270
Phenanthrene	0.5	N/A	USEPA 8270
Pyrene	0.5	N/A	USEPA 8270
Metals			
Antimony	1	N/A	USEPA 6020
Arsenic	1	N/A	USEPA 6020
Barium	1	N/A	USEPA 6020
Cadmium	0.2	N/A	USEPA 6020
Chromium III	1	N/A	*
Chromium VI	1	N/A	APHA 3500CR:D
Cobalt	1	N/A	USEPA 6020
Copper	1	N/A	USEPA 6020
Lead	1	N/A	USEPA 6020
Manganese	1	N/A	USEPA 6020
Mercury	0.2	0.5ug/L	USEPA 6020
Molybdenum	1	N/A	USEPA 6020
Nickel	1	N/A	USEPA 6020
Tin	1	N/A	USEPA 6020
Zinc	1	N/A	USEPA 6020
Remarks			
* By calculation using APHA 3500CR:D and USEPA 6020			
N/A: Testing for this parameter is not required			

3.2 *SAMPLING METHODOLOGY*

3.2.1 *Site Clearance and Soil Sampling*

An excavation location clearance inspection was performed to check for underground services. This included a review of relevant underground service/utilities drawings prior to excavation works. Manual digging was used to excavate the trial pit to an initial depth of 1.2 m to verify the absence of underground services before excavating deeper.

All sampling equipment used was either stainless steel. The equipment used for sample collection was not the same as that used to advance the excavation pit.

Clean latex gloves were worn and were changed before each new sample was collected. The sampling equipment was cleaned with a non-phosphate detergent between each sampling event. Excavation tools were decontaminated prior to the excavation.

The excavation pit was reinstated to initial conditions upon completion of the sampling activities.

3.2.2 *Sample Handling*

All samples were placed directly into laboratory supplied pre-cleaned sample bottles and labeled with a permanent waterproof marker.

Chain-of-custody documentation was initiated immediately after soil samples were collected. COCs were filled in the field with the date, sampling location, sample depths, project name, time of collection and analysis to be performed.

The soil samples were kept chilled with ice (at approximately 4°C) on-site and during transport.

3.2.3 *Analytical Laboratory*

Analysis of soil samples was carried out by ALS Technichem Limited which is a HOKLAS certified analytical laboratory. All analysis was conducted according to standard procedures set by the United States Environmental Protection Agency (USEPA), along with laboratory internal Quality Assurance/Quality Control (QA/QC) procedures. All laboratory test methods were accredited by HOKLAS or one of its Mutual Recognition Arrangement partners.

3.3 *QUALITY CONTROL AND QUALITY ASSURANCE (QA/QC)*

3.3.1 *Laboratory QA/QC Procedures*

Laboratory QA/QC program used in order to ensure that the data obtained are accurate and representative of actual soil conditions included collection of one duplicate soil sample.

4 SITE INVESTIGATION RESULTS

4.1 INTRODUCTION

On 21 January 2010, the following samples were collected from the Site;

- BH1: Between the patrol road and Site 4 - Four (4) soil samples (including one duplicate sample).

The results section of this CAR is presented as follows:

- Section 4.2 contains an assessment of the soil results by means of point by point comparison of results against the soil RBRGs and C_{sat} ; and
- Section 4.3 contains a summary of analytical results.

4.2 SOIL ANALYTICAL RESULTS

Based on the previous land uses and the approved CAP, soil samples were analysed for metals, TPH, BTEX and PAHs.

4.2.1 Comparison of Soil Results against RBRGs

Soil samples analytical results are presented in *Table 4.2* and summarised in *Table 4.1*, as required under the *RBRGs Guidance Manual*.

All analytical results of soil samples were below the RBRG standard for Rural Residential Land Use. The field observations made during the SI works did not record any evidence of discolouration, odours or the presence of non-aqueous phase liquids (NAPLs).

Overall the results indicate no significant contamination in the soils to be excavated.

Table 4.1 Soil Data Summary and Comparison to RBRGs and C_{sat} (mg/kg)

Chemical	Frequency of detection (x/y) ^(a)	Range of detected conc. (mg/kg)	LOR	RBRG (mg/kg) ^(b)	C_{sat} (mg/kg)	Maximum concentration exceeds RBRG / C_{sat}	
Metals							
Antimony	0/4	BRL	1	29.1	N/A	None	None
Chromium (VI)	0/4	BRL	1	218	N/A	None	None
Chromium (III)	4/4	8 – 18	1	10,000	N/A	None	None
Arsenic	4/4	9 – 21	1	21.8	N/A	None	None
Barium	4/4	21 - 52	1	10,000	N/A	None	None
Cadmium	1/4	BRL – 0.2	0.2	72.8	N/A	None	None
Cobalt	4/4	1 – 2	1	1,460	N/A	None	None
Copper	4/4	7 – 30	1	2,910	N/A	None	None
Lead	4/4	29 – 47	1	255	N/A	None	None
Manganese	4/4	34 – 182	1	10,000	N/A	None	None
Mercury	0/4	BRL	0.2	6.52	N/A	None	None
Molybdenum	4/4	1 – 2	1	364	N/A	None	None
Nickel	4/4	3 – 7	1	1,460	N/A	None	None
Tin	4/4	1 – 2	1	10,000	N/A	None	None
Zinc	4/4	24 - 774	1	10,000	N/A	None	None
TPH							
C ₆ -C ₈	0/4	BRL	20	545	N/A	None	None
C ₉ -C ₁₆	0/4	BRL	200	1,330	N/A	None	None
C ₁₇ -C ₃₅	0/4	BRL	500	10,000	N/A	None	None
BTEX							
Benzene	0/4	BRL	0.1	0.279	336	None	None
Toluene	0/4	BRL	0.5	705	235	None	None
Ethylbenzene	0/4	BRL	0.5	298	138	None	None
Xylenes (Total)	0/4	BRL	0.5 - 1	36.8	150	None	None
PAHs							
Various	0/4	BRL	0.5 - 1	Var	Var	None	None
Notes:							
Table based on Standard Form 3.2 of the <i>RBRGs Guidance Manual</i>							
(a) x = number of samples above laboratory reporting limit, y = number of samples analysed							
(b) RBRG for rural residential land use was used for this Project							
LOR = Level of reporting							
N/A = not applicable (no C_{sat} values were available for these parameters)							
BRL = Below reporting limit							

Table 4.2 Soil Analytical Results (mg/kg)

Chemical	LOR	RBRG	C _{sat}	Sample ID			
				BH1 0.5m	BH1 1.5m	BH1 2.95m	BH1 DUP
Metals							
Antimony	1	29.1	N/A	BRL	BRL	BRL	BRL
Chromium (VI)	1	218	N/A	BRL	BRL	BRL	BRL
Chromium (III)	1	10,000	N/A	14	18	8	15
Arsenic	1	21.8	N/A	9	21	11	21
Barium	1	10,000	N/A	47	51	21	52
Cadmium	0.2	72.8	N/A	0.2	BRL	BRL	BRL
Cobalt	1	1,460	N/A	2	2	1	2
Copper	1	2,910	N/A	30	11	7	11
Lead	1	255	N/A	40	46	29	47
Manganese	1	10,000	N/A	182	57	34	62
Mercury	0.2	6.52	N/A	BRL	BRL	BRL	BRL
Molybdenum	1	364	N/A	1	2	1	2
Nickel	1	1,460	N/A	7	6	3	5
Tin	1	10,000	N/A	2	2	1	2
Zinc	1	10,000	N/A	774	35	24	32
TPH							
C ₆ -C ₈	20	545	N/A	BRL	BRL	BRL	BRL
C ₉ -C ₁₆	200	1,330	N/A	BRL	BRL	BRL	BRL
C ₁₇ -C ₃₅	500	10,000	N/A	BRL	BRL	BRL	BRL
BTEX							
Benzene	0.1	0.279	336	BRL	BRL	BRL	BRL
Toluene	0.5	705	235	BRL	BRL	BRL	BRL
Ethylbenzene	0.5	298	138	BRL	BRL	BRL	BRL
Xylenes (Total)	0.5 - 1	36.8	150	BRL	BRL	BRL	BRL
PAHs							
Various	0.5 - 1	Var	Var	BRL	BRL	BRL	BRL
Notes:							
LOR = Level of reporting							
RBRG values for Rural Residential land use were used for comparisons of results							
Var. = various RBRG and C _{sat} values for individual compound							
BRL = below reporting levels							
N/A = not applicable (no C _{sat} values were available for these parameters)							

4.2.2 Summary of Results

Based on the analytical results, soil samples collected from BH1 do not exceed the RBRG (Rural Residential) limits for the parameters tested. No further testing nor remediation is required.

A QA/QC programme was incorporated into the land contamination investigation for the Project. The program included collection and analysis of one field duplicate sample and laboratory internal QA/QC samples.

Field Duplicate

Data validation was carried out by calculation of relative percentage difference (RPD) between duplicate samples. For this project, one duplicate soil samples, *DUP*, were collected for primary soil samples BH1/1.5m.

Duplicates were within the acceptable RPD range of 30% to 50 %. A summary of the field duplicate QA results is provided in *Table 4.3.*

Table 4.3 *QA/QC Soil Sample Analytical Results (mg/kg)*

Chemical	LOR	Original Sample BH1 1.5m	Duplicate Sample BH1 DUP	RPD (%)
Metals				
Antimony	1	BRL	BRL	N/A
Chromium (VI)	1	BRL	BRL	N/A
Chromium (III)	1	18	15	18.2
Arsenic	1	21	21	0
Barium	1	51	52	1.9
Cadmium	0.2	BRL	BRL	N/A
Cobalt	1	2	2	0
Copper	1	11	11	0
Lead	1	46	47	2.2
Manganese	1	57	62	8.4
Mercury	0.2	BRL	BRL	N/A
Molybdenum	1	2	2	0
Nickel	1	6	5	18.2
Tin	1	2	2	0
Zinc	1	35	32	9.0
TPH				
C ₆ -C ₈	20	BRL	BRL	N/A
C ₉ -C ₁₆	200	BRL	BRL	N/A
C ₁₇ -C ₃₅	500	BRL	BRL	N/A
BTEX				
Benzene	0.1	BRL	BRL	N/A
Toluene	0.5	BRL	BRL	N/A
Ethylbenzene	0.5	BRL	BRL	N/A
Xylenes (Total)	0.5 - 1	BRL	BRL	N/A
PAHs				
Various	0.5 - 1	BRL	BRL	N/A
Notes:				
LOR = Level of reporting				
BRL = below reporting levels				
RPD = relative percent difference				
N/A = not applicable				
Acceptable QA criteria (ie. RPD results) are				
<ul style="list-style-type: none"> • >30% where both values, primary and duplicate, exceed ten times the LOR or • >50% where both values fall below ten times the LOR. 				
%RPD are not calculated for samples with concentrations below the LOR.				

Laboratory QA Results

ALS performed an internal QA programme comprising method blanks, matrix spikes, surrogates, laboratory control samples and duplicates. Laboratory QA results is included with the laboratory reports in *Annex C*. ALS's QA compliance assessment is summarised as follows:

- Method blanks were performed and no concentrations were detected above the laboratory LOR;
- Surrogates were used on all gas chromatography (GC) analyses. Surrogate recoveries for soil and groundwater samples were acceptable;
- Laboratory control samples analyses were performed and the results met acceptance recovery limits respectively for soil and groundwater. Laboratory duplicate analyses were also performed and met the RPD acceptance criteria; and
- Matrix spikes were also performed and met the acceptance RPD criteria.

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*5.1**CONCLUSION OF SITE INVESTIGATION RESULTS*

Based on the soil analytical results, it is concluded that there is no significant contamination at BH1. All results were below the respective RBRGs – Rural Residential for the parameters tested. There is no risk to humans from the soil and no further assessment or remediation of soil is required. Please note that no groundwater was present at the total sampling depth of 3 m (bgs), therefore groundwater samples were not retrieved.

Annex A

CAP

Shenzhen River Regulation Office
Drainage Services Department

Regulation of Shenzhen River
Stage IV EIA Study:
Contamination Assessment Plan

October 2009

Environmental Resources Management

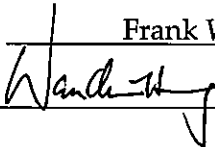
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Shenzhen River Regulation Office
Drainage Services Department

Regulation of Shenzhen River
Stage IV EIA Study:
Contamination Assessment Plan

October 2009

Reference 0101759

For and on behalf of ERM-Hong Kong, Limited
Approved by: <u>Frank Wan</u>
Signed: <u></u>
Position: <u>Partner</u>
Date: <u>29 October 2009</u>

This report has been prepared by ERM-Hong Kong, Limited with all reasonable skill, care and diligence within the terms of the Contract with the client, incorporating our General Terms and Conditions of Business and taking account of the resources devoted to it by agreement with the client.

We disclaim any responsibility to the client and others in respect of any matters outside the scope of the above.

This report is confidential to the client and we accept no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report at their own risk.

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ANNEX B **PROPOSED SITE INVESTIGATION LOCATIONS**

ANNEX C **RBRG VALUES**

1 INTRODUCTION

1.1 BACKGROUND TO THE STUDY

The Shenzhen River Regulation Office (SzRRO) of the Shenzhen Municipal Government and the Drainage Services Department (DSD) of the HKSAR proposed to train an approximately 4 km long section of the Shenzhen River to facilitate development of the proposed Liantang/Heung Yuen Wai (LT/HYW) Border Control Point (BCP) to meet the required flood prevention standard of the BCP (hereafter referred to as “the Project”). This work shall involve dredging and excavation works.

In July 2009, ERM-Hong Kong, Ltd (ERM) was commissioned by the SzRRO and the DSD to carry out an Environmental Impact Assessment of the Project, in accordance with the EIA Study Brief No. ESB-200/2009 dated January 2009. As part of the EIA Study, a land contamination assessment is required, including preparation of a Contamination Assessment Plan (CAP), and future work related to the investigation proposed in this CAP.

This CAP has been prepared to describe the investigation required to complete a land contamination assessment of the Site. The CAP primarily addresses the land contamination aspects of the Project and assesses the potential for contaminated soils to be present within the area to be excavated during the construction of the Project.

This CAP takes into account the information on land contamination from available historical contamination assessment reports.

1.2 OBJECTIVES OF THE CAP

The purpose of this CAP is to provide information, guidance and instruction to characterise land contamination and identify where any contamination is or may be present in order to avoid or minimise any risks or hazards associated with contaminated materials during the construction and operation of the Project. This CAP provides systematic procedures for identifying any potential sources of land contamination, identifies the contaminants of concern and evaluates the potential impacts from such contamination to the Project.

The CAP determines and details the requirements for an intrusive investigation of the Site to identify the nature and extent of the on site contamination (if any). The specific tasks in relation to the CAP include:

- A review of the background information on, and land history of, the Project area in relation to possible land contamination;

- Identification of potential contamination and associated impacts, risks or hazards; and
- Submission of a plan for contamination assessment for agreement with the Environmental Protection Department (EPD) prior to the implementation of any proposed intrusive investigation.

The findings of the site investigation will be evaluated and reported in the Contamination Assessment Report (CAR) and if the assessment of results from the investigation indicates contamination above the Risk Based Remediation Goals (RBRGs), a Remediation Action Plan (RAP) will also be prepared and both documents will be submitted to the EPD for approval.

1.3

STATUTORY LEGISLATION AND EVALUATION CRITERIA

The assessment of land contamination sources and the potential impacts associated with development projects are undertaken under the direction of EPD. The Project is a Designated Project under the *Environmental Impact Assessment Ordinance (EIAO)*, and EPD's *Guidance Manual for Use of Risk-based Remediation Goals for Contaminated Land Management (the RBRGs Guidance Manual)*, the associated *Guidance Note for Contaminated Land Assessment and Remediation (the RBRGs Guidance Note)*, and the EPD's *Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol Filling Stations, Boatyards, and Car Repair/Dismantling Workshop (the EPD's Guidance Notes)* are the key sets of guidelines to which reference are made.

The RBRGs were developed for four different post-restoration land-use scenarios namely; urban residential, rural residential, industrial and public parks. For the purposes of this CAP, the Project area has been given a preliminary classification as a Rural Residential Site, as defined in the *RBRGs Guidance Manual*. This interim designation may be reviewed in the CAR depending on the findings of the investigation and the proposed future use of any areas of detected contamination. Remedial options, if required will be detailed in a RAP.

For the treatment and disposal of contaminated soil in Hong Kong, the treatment and disposal standards will be agreed upon with the EPD.

The following legislation, documents and guidelines may also cover or have some bearing upon the assessment contamination and the handling, treatment and disposal of contaminated materials for the Project.

- *Waste Disposal Ordinance (WDO) (Cap 354)*;
- *Waste Disposal (Chemical Waste) (General) Regulation (Cap 354C)*;
- *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes*;
- *Water Pollution Control Ordinance (WPCO) (Cap 358)*; and

- *Technical Memorandum on Standards for effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters.*

1.4

STRUCTURE OF THE CAP

The remainder of this report is structured according to the assessment methodology for contaminated sites as outlined in the *RBRGs Guidance Manual* and the *EPD's Guidance Notes*.

- *Section 2* provides a summary of the desktop study, site survey information on the present and past land uses and other information available for areas affected by the identified sources of land contamination within the Project area;
- *Section 3* summarises the potential sources of contamination based on the information available;
- *Section 4* identifies potential human health impacts and environmental impacts;
- *Section 5* proposes the contamination investigation programme to assess the potential contamination in Project area; and
- *Section 6* concludes the CAP and briefly discusses the potential subjects to be covered in CAR and RAP.

The report is also supported by the following materials which are provided in the following annexes:

- *Annex A* Site Maps and Photographs
- *Annex B* Proposed Site Investigation Locations
- *Annex C* RBRG Values

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2.1 INTRODUCTION

This Section presents a summary of a desktop review of available information on land contamination that may impact the Project area. These include a review of aerial photographs, historical maps, historical contamination study in the nearby area and a site survey. The land contamination assessment within this CAP is limited to the identification of potential contamination from sources located within or adjacent to the Project area. The findings of this assessment have been used to plan the proposed site investigation described in *Section 5*.

Of note is that, no intrusive contamination investigation at the Project area has previously been undertaken and therefore no contamination data specific to the Project area was available.

2.2 DESKTOP STUDY

The desktop study comprised a review of past and present activities and installations located within or adjacent to the Project area that could have caused contamination or may still have the potential for causing contamination within the Project area. Existing information from historical land contamination site investigations and other contamination reports for the Project area were also reviewed.

Table 2.1 lists the historical maps showing the Project area, sourced from the Hong Kong SAR Government Lands Department, that have been reviewed to identify historical sources of contamination.

Table 2.1 *Historical Maps of the Project Area*

1:1,200 Map Name	Years	1:1,000 Map Name	Years
42-SE-B	1963, 1969, 1976	3-NW-4C	1984, 1994, 1999, 2003, 2004, 2006, 2009
42-SE-D	1963, 1970, 1976	3-NW-8B	1984, 1999, 2003, 2004, 2007, 2008, 2009
43-SW-A	1963, 1970, 1976	3-NW-8C	1984, 1999, 2001, 2004, 2007, 2008, 2009
43-SW-C	1963, 1970, 1976	3-NW-8D	1984, 1998, 1999, 2002, 2004, 2007, 2008, 2009
43-NW-B	1969, 1976	3-NW-9A	1984, 1999, 2001, 2003, 2004, 2007, 2009
43-NW-C	1969, 1975	3-NW-12D	1984, 1999, 2004, 2005, 2006, 2007, 2008, 2009
43-NW-D	1970, 1975	3-NW-13A	1984, 1998, 1999, 2001, 2004, 2005, 2007, 2008, 2009
		3-NW-13B	1984, 1999, 2001, 2004, 2007, 2008, 2009
		3-NW-13C	1984, 1998, 1999, 2002, 2004, 2005, 2007, 2008, 2009

Historical aerial photographs of the Project Area, sourced from the Hong Kong Government Lands Department, from the following years have also been reviewed to identify historical sources of contamination:

- 1924
- 1982
- 1983
- 1986
- 1991
- 1992
- 1993
- 1994
- 1995
- 1996
- 1997
- 1999
- 2000
- 2001
- 2002
- 2003
- 2004
- 2005
- 2006
- 2008

Based on the review of the above historical maps and aerial photographs, no significant development has occurred in the Project area, and no obvious indications of potential contamination sources, such as large aboveground bulk storage or industrial facilities were evident.

2.3

SITE SURVEY

The objective of the site survey was to confirm the findings of the desktop study and to identify any other land uses within or adjacent to the Project area which may have the potential for causing soil and groundwater contamination.

Walk-over site surveys of the potential land contamination sources within or adjacent to the Project area identified in the desktop review was carried out on 30 July 2009 and 7 August 2009 by ERM. During the surveys, the area was inspected for evidence of any of the following characteristics:

- open burning;
- areas of dead or stressed vegetation;
- areas of stained soil;
- recent soil disturbances;
- on site disposal of municipal or hazardous wastes;
- oil slicks or discoloration on surface waters;
- storage and handling of chemicals, oils and other materials;
- abnormal odours; and,
- indications of presence of septic tanks or underground storage tanks (UST).

The Project area comprises an approximately 4 km long section of the Shenzhen River and is located at the border of Shenzhen and Hong Kong. A location map is presented in *Figure A1, Annex A*. The Site is predominantly rural. To the west of

the river within the Shenzhen Special Economic Region, schools, residential dwellings and a sewage treatment works have been identified. The area which is located to the east of the Project area is predominately rural with mainly village houses, farm lands and undeveloped lands.

In the vicinity of the Project area, a few potential commercial and industrial developments have been identified. These include several storage facilities such as abandoned poultry farm, a non-operating industrial facility with an air emission stack, a police station with dangerous goods store and a pumping station for the Ping Yuen River (River Ganges) as listed in *Table 2.2*. Locations of these facilities and photographs taken during the site survey are presented in *Annex A*.

Table 2.2 *Potential Commercial and Industrial Developments Identified in the Vicinity of the Project Area during Site Survey*

Site	Description ^(a)	Approximate Distance to Project Area (m)	Potential Contaminants
1	Abandoned poultry farm.	170	-
2	Abandoned poultry/livestock farm.	65	-
3	A nursery - storage of fertilizers in the field, the area is not paved but is covered by plastic sheets structure.	170	Fertilizers and pesticides
4	Fenced off area with buildings and an air emission stack. Next to this area were large buildings in fenced off area. Information from a local villager indicates that the site was a bean curd sheets/sticks manufacturing plant. It appears that it was not in operation for some times. It is not sure about the type of fuel to be used for the operation of the plant (charcoal/woods or diesels).	Partly within the Project area	Petroleum hydrocarbons, volatile organic compounds
5	Police station with dangerous goods store. Opposite police station was a fire station. An emergency generator was installed in a plant room within the police station building. An above ground diesel tank (about 250 litre with a drip tray) was provided within the plant room. The plant room was paved and there is no sign of oil spillage. A Dangerous Goods (DG) store contains Types 4 and 5 DG in containers. The room is paved and with no sign of chemical spillage	90	Petroleum hydrocarbons, volatile organic compounds
6	River Ganges water pumping station.	90	Petroleum hydrocarbons

Notes:

(a) All Sites identified through aerial photographs and maps and site survey

PREVIOUS INVESTIGATIONS

The following section provides a review of contamination investigations carried out for the *Spoil Impact Assessment of the Shenzhen River Regulation Project Stage III Environmental Impact Assessment* dated 1998.

As part of the 1998 EIA study for the Shenzhen River Regulation Project Stage III, river bank soils was sampled for a section of the Shenzhen River downstream from the Project area.

The investigation included 7 sampling locations for bank soil. Results from the 1998 Study were compared to the current Hong Kong RBRGs standards under the Rural Residential land-use classification. Concentrations of the analysed pollutants in bank soil samples taken during the *Stage III Environmental Impact Assessment* were well below the respective RBRGs standards.

Based upon the findings from the desk study and site survey (as described in *Section 2*) this Section identifies potential sources of soil contamination and the associated impacts, risks or hazards.

3.1

POTENTIAL CURRENT SOURCES

Six (6) potential areas with land contamination concern have been identified in the desktop review and the first site survey on 30 July 2009 and the second site survey on 7 August 2009.

Site 1 is located at about 170 m from the Project area. The location of this establishment was identified through a review of aerial photographs and verified by site visit. Although access into the site was not available, based on the nature of its setting and the building arrangements, the facility was identified to be an abandoned poultry farm. Given the previous use of the site and that the site is located at about 170 m from the Project area, no further contamination investigation for this area is recommended.

Site 2 is located adjacent to the Project area. The location of this establishment was identified through a review of aerial photographs. ERM visited this site on 7 August 2009 and identified that was for poultry/livestock farm uses. The facility was abandoned and most of the buildings/sheds were damaged. No land contamination sources were identified within the site.

Site 3 is a nursery which is located at approximately 170 m from the Project area. Site survey found that fertilizers stored in bags were stored on site. The fertilizer storage at this site is not considered to be a significant off site source that could cause significant on-going contamination at the Project area. No further contamination investigation for these areas is recommended.

A potential industrial site (Site 4), partly located within the Project area was identified in the site visit. Restricted site access meant that the potential contaminations from this site could not be confirmed during the site surveys and no information was available through previous investigations or historical maps/photographs. During the second site visit on 7 August 2009, a local villager informed the study team that the site was formally used for production of bean curd sheets and sticks. However, the type of fuels (eg charcoals/woods or diesel) used for the production cannot be determined. The potential for land contamination at this site cannot be excluded. Further contamination investigation for this area is recommended.

A DG store and an oil storage tank were identified at Site 5 (the Ta Kwu Ling Police Station) which is located at about 90 m from the Project area. The above ground oil storage tank (about 250 L with a drip tray) was installed within the plant room of the genset. The plant room is paved and with no sign of oil spillage. Types 4 and 5 DG are stored in containers and the DG

store is paved and with no sign of chemical spillage. The potential for land contamination of the Project area due to the operation of the DG store and the above ground oil storage tank is considered low. No further contamination investigation for these areas is recommended.

Site 6 is a water pumping station (located at about 90m from the Project area) for the Ping Yuen River (River Ganges). As the Ping Yuen River has been widened and pumping station is seldom used. Four small above ground transformers were found on site (two within the pumping station site and two at the CLP substation near to the pumping station) which are mounted on paved area. No visual evidence of leakage of transformers oil at the pumping station site and CLP substation site was observed. It is confirmed that no emergency generator or underground fuel storage tank is provided in the pumping station. The operations of the water pumping station and the CLP substation are not considered to be significant off site sources that could cause significant on-going contamination at the Project area. No further contamination investigation for these areas is recommended.

In addition to the industrial and commercial sites identified above, the Shenzhen River receives discharges from the nearby areas and contamination at the river bank from long-term deposition of pollutants from the river cannot be excluded. However, as the river bank data from the 1998 Study indicated that river bank soil down stream are not polluted, further contamination investigation along the river bank is not recommended.

Table 3.2 *Potential Sources of Contamination*

Site	Description	Distance to Project Area (m)	Potential Impacts to Project Area?	Further Investigation Required?
1	Abandoned poultry farm.	170	No	No
2	Abandoned poultry/livestock farm.	65	No	No
3	A nursery with storage of fertilizers in the field. The area is not paved but is covered by plastic sheets structure.	170	No	No
4	Fenced off area with buildings and an air emission stack. Next to this area were large buildings in fenced off area.	Partly within the Project area	Yes	Yes
5	Ta Kwu Ling Police Station with an above ground diesel oil storage tank and DG within the paved rooms of the station.	90	No	No
6	River Ganges water pumping station.	90	No	No

Site	Description	Distance to Project Area (m)	Potential Impacts to Project Area?	Further Investigation Required?
7	Shenzhen River.	0-10	No	No

3.2

POTENTIAL FUTURE SOURCE

It is not considered that the future operations of the Project are likely to cause on-going contamination of the underlying ground.

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There may be potential human health and environmental impacts associated with excavation, general site preparation and construction work, as site workers may come into contact with soils.

Once the Project has been completed, development of the land adjacent to the Shenzhen River may occur. This includes the proposed development of the Liantang / Heung Yuen Wai Border Control Point (BCP), and re-provision of a border road and border security fence. These facilities are anticipated to be fully paved with no underground structures. No potential exposure of future users to the any contamination that may remain is anticipated.

4.1 POTENTIAL IMPACTS CONNECTED DURING THE CONSTRUCTION WORKS AND COMPLETED DEVELOPMENT

The potential impacts, which may arise from any contaminated soils encountered during the construction works are considered to be the following:

- Health risks to site workers; and
- Disposal of contaminated soils and materials.

As already mentioned above there are not expected to be any risks posed to future users of the Project Area.

4.1.1 Health Risk to Site Workers

Site construction workers may become exposed to contaminated soils and groundwater (if any) during excavation works. The main exposure routes for site construction workers are considered to be accidental direct ingestion of contaminated material through poor hygiene, eating and smoking on site, or through direct contact with potentially toxic or harmful contaminants in excavated soil or sediments.

The appointed contractors for the construction works will be required to prepare a Health and Safety Plan prior to the commencement of the site formation and construction works. An appointed Safety manager would be required to ensure that all site workers and visitors to the Project construction site are aware of the requirements outlined in the plan.

The plan will be based on the information obtained from the site investigation and will detail how the potential risks can be mitigated against by the use of appropriate Personal Protective Equipment (PPE). The plan will also detail the facilities and procedures for workers to follow after they have left an area of known contamination.

As has been described in *Sections 2 and 3*, there is no data on the chemical composition of the soils in the Project area, however, previous report suggests that soil along the river bank is uncontaminated with reference to the RBRGs.

The site investigation plan in *Section 5* is designed in order to obtain additional information that can be used to formulate an adequate Health and Safety plan.

4.1.2 *Disposal of Contaminated Materials*

The investigation work proposed in this CAP will enable areas of potential contamination to be identified in advance. It is envisaged that, based on the results of the extent and levels of contamination, any appropriate remediation can be proposed in a RAP.

Remediation, which will be determined on the basis of the results of the investigation, may result in soils being suitable for re-use on site for landscaping or for off site re-use. Off-site disposal of contaminated materials will only be considered as a last resort.

Any contaminated materials which are excavated and ultimately require off site disposal at an appropriately licensed site (one which is licensed to accept 'contaminated' soils) will need to be classified by means of stating the type of waste soil and concentration of contaminants. Apart from landfills, other available disposal options are dependent upon the level of contamination, the material characteristics and volumes of material to be disposed. The Chemical Waste Treatment Centre (CWTC) provides an alternative option to landfill disposal although the capacity of the facility is relatively small. Based on the information available, the excavated soils are not expected to be contaminated to levels deemed to be significant to cause harm to humans. The final disposal requirements will be determined following agreement of the proper disposal option with the EPD.

If any unexpected and unknown areas of contamination are discovered during excavation works further sampling will be necessary and the material removed to a designated storage area pending results and identification of a suitable remediation or disposal option.

4.1.3 *Potential Health Risks to Future Users*

During the operational phase and after completion of the construction works, it is considered that the Project will not cause unacceptable risk to humans from any contamination that may be present at the Project area.

On development of the Liantang/Heung Yuen Wai Border Control Point and border road, it is envisioned that any potential contaminated remaining will be sealed behind or below concrete. Therefore the risk of contact by future site users with contaminated materials under these developments is considered unlikely. It is not considered necessary to remediate potential contaminated materials that may lie below the maximum depth of the excavation.

5.1 INTRODUCTION

Based on the information from the desktop study and site survey, this Section proposes a sampling and analytical programme to increase the knowledge of potential contamination at the Project area. The proposed site investigation work should, after agreement with the EPD, be implemented prior to the construction.

The objective of the site investigation is to determine presence and to a certain extent the level of contamination associated with the potential contamination sources identified, at the Project area to assist in the evaluation of impacts associated with soil excavation during the construction of the Project.

The sampling strategy for the further site investigation has been developed based on the *RBRGs Guidance Note* and the *EPD's Guidance Notes*.

As the presence of contamination from one of the sources identified within of the Project area has not been determined, it is proposed that a site investigation be carried out within the Project area. The indicative location for the proposed sampling and parameters to be analysed are described in *Section 5.2*. The sampling location has been determined based upon the *EPD's Guidance note*, but the available information.

The sampling location will need to be confirmed when access to the Project area is granted. The proposed borehole location will be reviewed and any additional locations, if deemed necessary, will be submitted to the EPD for approval before the site investigation work will commence.

5.2 PROPOSED SITE INVESTIGATION

Areas with potential soil contamination, which may cause impact within the Project area, have been identified in the previous sections. The following sampling and analytical programme has been developed and is proposed to identify the presence or further investigate the extent of the potential contaminants and to determine appropriate remediation measures to mitigate any identified contamination.

5.2.1 Proposed Sampling Locations

One (1) sampling location is proposed within the Project area, which will be converted into a groundwater monitoring well for groundwater sampling (see *Figure B1, Annex B*). In addition to visual inspection of olfactory evidence of potential contamination, a photo-ionisation detector (PID) will be used to detect volatile organic compounds in soil samples to assist selection of samples for laboratory analysis and determine whether sampling at greater

depths is required. *Table 5.1* sets out the number of samples that will be taken, and the parameters that will be analysed.

The detection limits for the proposed laboratory testing of both soil and groundwater samples are set out in *Box 5.1*.

Box 5.1 Laboratory Analysis Parameters

Parameters	Reporting Limit for Soil (mg/kg)	Reporting Limit for Groundwater (ug/L)	Reference Method
VOCs			
Benzene	0.1 (0.2)	5	USEPA 8260
Ethylbenzene	0.5	5	USEPA 8260
Toluene	0.5	5	USEPA 8260
Xylenes (total)	2	20	USEPA 8260
Total Petroleum Hydrocarbons			
C6 - C8	5	20	USEPA 8015
C9 - C16	200	500	USEPA 8015
C17 - C35	500	500	USEPA 8015
SVOCs			
Acenaphthene	0.5	2	USEPA 8270
Acenaphthylene	0.5	2	USEPA 8270
Anthracene	0.5	2	USEPA 8270
Benzo(a)anthracene	0.5	N/A	USEPA 8270
Benzo(a)pyrene	0.5	N/A	USEPA 8270
Benzo(b)fluoranthene			USEPA 8270
Benzo(k)fluoranthene	1	1 (4)	
Benzo(g,h,i)perylene	0.5	N/A	USEPA 8270
Chrysene	0.5	0.5 (2)	USEPA 8270
Dibenzo(a,h)anthracene	0.5	N/A	USEPA 8270
Fluoranthene	0.5	2	USEPA 8270
Fluorene	0.5	2	USEPA 8270
Indeno(1,2,3-cd)pyrene	0.5	N/A	USEPA 8270
Indeno(1,2,3-cd)pyrene	0.5	--	USEPA 8270
Naphthalene	0.5	N/A	USEPA 8270
Phenanthrene	0.5	N/A	USEPA 8270
Pyrene	0.5	N/A	USEPA 8270
Metals			
Antimony	1	N/A	USEPA 6020
Arsenic	1	N/A	USEPA 6020
Barium	1	N/A	USEPA 6020
Cadmium	0.2	N/A	USEPA 6020
Chromium III	1	N/A	*
Chromium VI	1	N/A	APHA 3500CR:D
Cobalt	1	N/A	USEPA 6020
Copper	1	N/A	USEPA 6020
Lead	1	N/A	USEPA 6020
Manganese	1	N/A	USEPA 6020
Mercury	0.2	0.5ug/L	USEPA 6020
Molybdenum	1	N/A	USEPA 6020
Nickel	1	N/A	USEPA 6020
Tin	1	N/A	USEPA 6020
Zinc	1	N/A	USEPA 6020
Remarks			
* By calculation using APHA 3500CR:D and USEPA 6020			
N/A: Testing for this parameter is not required			

Table 5.1 Sampling and Analysis Plan

Sampling ID	Sampling Location	Rationale for Sampling Location	Max Excavation Depth (m)	Soil		Groundwater	
				Sample Depths (m bgl)	Parameters Analysed	No. Samples	Parameters Analysed
BH1	Between the patrol road and Site 4.	Investigation aims to determine potential contamination from current and historical activities at Site 4.	3	0.5, 1.5, 3	PP metals, TPH, BTEX, PAH	1	PP metals, TPH, BTEX, PAH

Notes: PP metals include: Antimony, Arsenic, Berium, Cadmium, Chromium III, Chromium VI, Cobalt, Copper, Lead, Manganese, Mercury, Molybdenum, Nickel, Tin and Zinc, TPH = Total Petroleum Hydrocarbons (petroleum carbon ranges C6-C8, C9-C16 and C17-C35 will be analysed, BTEX = Benzene, Toluene, Ethylbenzene and Xylenes, PAH = Polyaromatic hydrocarbons.

In general, there are three commonly used sample collection methods when conducting land contamination investigations, these are:

- Trial pit excavation, a cost effective method which allows for a visual assessment of the ground material;
- Borehole drilling, which is the more widely used method as it is capable of sampling to greater depths than 3 m or when disruption to a site must be minimised; and
- Grab sampling, which is used to sample soil and or water samples as encountered.

The proposed site investigation involves the use of trial pit to investigate and determine the presence of soil contamination.

5.3.1 Site Clearance, Drilling and Soil Sampling

An excavation location clearance inspection will be performed to check for underground services. These include a review of relevant underground service/utilities drawings and perform utility scanning prior to excavation works and to agree to the excavation location.

Hand auger or manual digging will be used to excavate the initial 1.2 m to verify the absence of underground services before excavating deeper. As the excavation advances, soil geological constituents and visual evidence of potential contamination (if any) will be inspected and recoded in an excavation log. Samples will be collected for laboratory analysis as set out in *Table 5.1*. Excavation will be terminated and the depths set out in *Table 5.1*.

All samples shall be collected as to minimise cross contamination and be sent to the laboratory on the day they are collected, stored and tested as outlined below.

Soil sampling equipment will be either stainless steel or ceramic. The equipment used for sample collection will not be the same as that used to advance the excavation pit. Clean latex gloves will be worn and will be changed before each new sample is collected. Whenever possible, a new set of sampling equipment will be used for each sampling event. When this is not possible, the equipment will be cleaned with a non-phosphate detergent between each sampling event, as described below.

As appropriate the excavation pit will be reinstated to their initial conditions upon completion of the sampling activities.

5.3.2 Groundwater Monitoring Well Installation

The pit will be converted to a temporary water monitoring well to allow for collection of the shallow groundwater. The water monitoring well will be

constructed with a 50 mm diameter Poly-vinyl chloride (PVC) monitoring well casing.

5.3.3 *Well Development, Water Level Measurements, Water Sampling and Elevation Survey*

Well development aims to lift up silt and other materials that may have entered the well during construction. Development also removes the stagnant groundwater in the well during the installation and allows fresh groundwater to enter. Therefore, well development allows the collection of a representative groundwater sample for analysis. The monitoring wells will be developed by evacuating groundwater using dedicated Teflon™ bailers.

Water level measurement and water sampling will be carried out after the water level in the well has been stabilised. The static water level will be measured with an electronic water level indicator. The data will be used to prepare the excavation log.

A dedicated and disposable Teflon™ bailer will be used to collect the water and transferred into laboratory supplied containers. One (1) water sample will be collected from the well for laboratory analysis.

5.3.4 *Sample Handling and Laboratory Analysis*

All samples will be placed either directly into laboratory supplied pre-cleaned sample bottles, or doubled bagged in laboratory supplied PE plastic bags, which are sealed with heavy duty rubber bands and labeled with a permanent waterproof marker.

Chain-of-custody documentation will be initiated immediately after soil samples are collected. Containers will be labelled in the field with the date, well designation, project name, time of collection and analysis to be performed. The field work is expected to take several days at each Site and soil samples will be kept chilled with ice (at approximately 4°C) on-site and during transport. Samples will be delivered to ALS, a Hong Kong Laboratory Accreditation Scheme (HOKLAS) accredited laboratory, for chemical analyses at regular intervals to reduce sample holding time. All analysis shall be conducted according to standard procedures set by the United States Environmental Protection Agency (USEPA), along with laboratory internal Quality Assurance/Quality Control (QA/QC) procedures. All laboratory test methods must be accredited by HOKLAS or one of its Mutual Recognition Arrangement partners.

The soil and groundwater samples will be analysed for the parameters set out in *Table 5.1*.

5.3.5 *Quality Assurance / Quality Control Samples*

QA/QC samples will be collected to allow an assessment of the quality of data collected. The QA/QC samples are listed below.

- One duplicate soil sample will be taken every 20 soil samples collected during the land contamination investigation. The duplicate samples will be collected on a random basis and submitted for laboratory analysis;
- One trip blank will be collected per sample container. A trip blanks will consist of laboratory supplied de-ionized water stored in the cooler boxes during sample shipment and analyzed for BTEX and TPH to account for any potential cross-contamination; and
- One equipment blank will be collected and analysed for PP metals to account for any potential cross-contamination.

5.3.6 *Sampling Programme*

The sampling programme will be undertaken with strict adherence to appropriate protocols so as to minimise the potential for cross-contamination between sampling locations. These include decontamination procedures, sample collection, preparation and preservation, and chain of custody documentation, as outlined below. The volume of soil samples to be collected will be confirmed with the analytical laboratory taking into account the sample analysis requirements and sample preservation procedures.

5.3.7 *Decontamination Procedures*

Sampling equipment used during the course of the further site investigation will be thoroughly decontaminated, to minimize the potential for cross-contamination. All equipment will be decontaminated using a non-phosphate soap solution and water, with a distilled water rinse to clean all smaller pieces of equipment, in particular those used to sample materials such as sampling cores, hand excavation and grab samples. Larger equipment and materials may be steam cleaned using mains water, where possible, or at a minimum pressure jet washed with mains water. This cleaning procedure will be repeated after use at each borehole to avoid potential cross contamination between boreholes, and during sampling, to ensure that any contamination from the surface of the site does not affect deeper substrata.

During sampling and decontamination activities, disposable latex/nitrile gloves will be worn to prevent transfer of contaminants from other sources. Any disposable equipment will be disposed as general waste after each use. Decontamination fluids shall be handled and disposed of in accordance with Water Pollution Control Ordinance requirements.

6.1 *CONCLUSIONS*

It is concluded that based on the available information, that limited site investigation is required in order to determine the presence and level of contamination associated with the identified source within the Project area. One soil and groundwater sampling location is proposed for the Project.

The results of the investigation proposed in this CAP will then be used for to assess the contamination present and to propose any necessary remediation.

6.2 *NEXT STEPS*

Following approval of this CAP, the investigation will be carried out and a CAR will be developed. The CAR will present the findings of the land contamination assessment investigation and establish whether potential exposure pathways exist between the contaminants identified and potential sensitive receptors during the construction and operational phases of the project. The analytical results will be compared against the Hong Kong RBRGs.

If necessary, the CAR will be supported by a RAP and will be submitted to EPD for approval. Any proposed remedial options will examine the relevant issues of soil treatment versus disposal, proposed future land uses of potential risks based upon the soil, contamination type and concentrations and any further site investigation required during the execution of the remediation work.

Annex A

Site Maps

Annex A1

Project Location Map

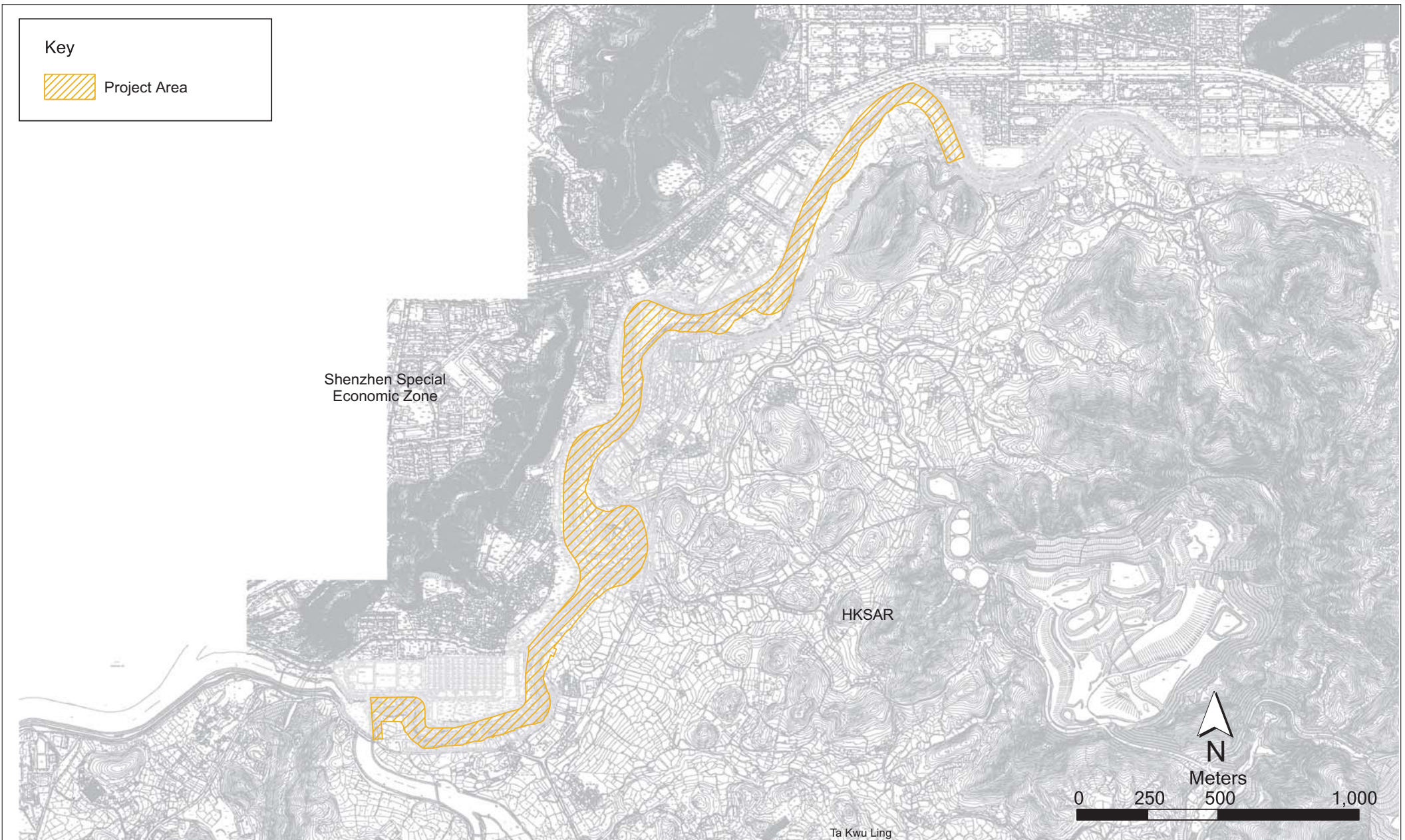


Figure A1-1

Location of Project Site

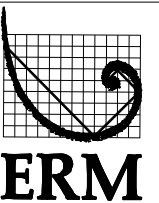


Figure A1-2

General Layout and Extent of the Trained River
(1 of 2)

FILE: 0101759a1.dgn
DATE: 23/10/2009

Environmental
Resources
Management



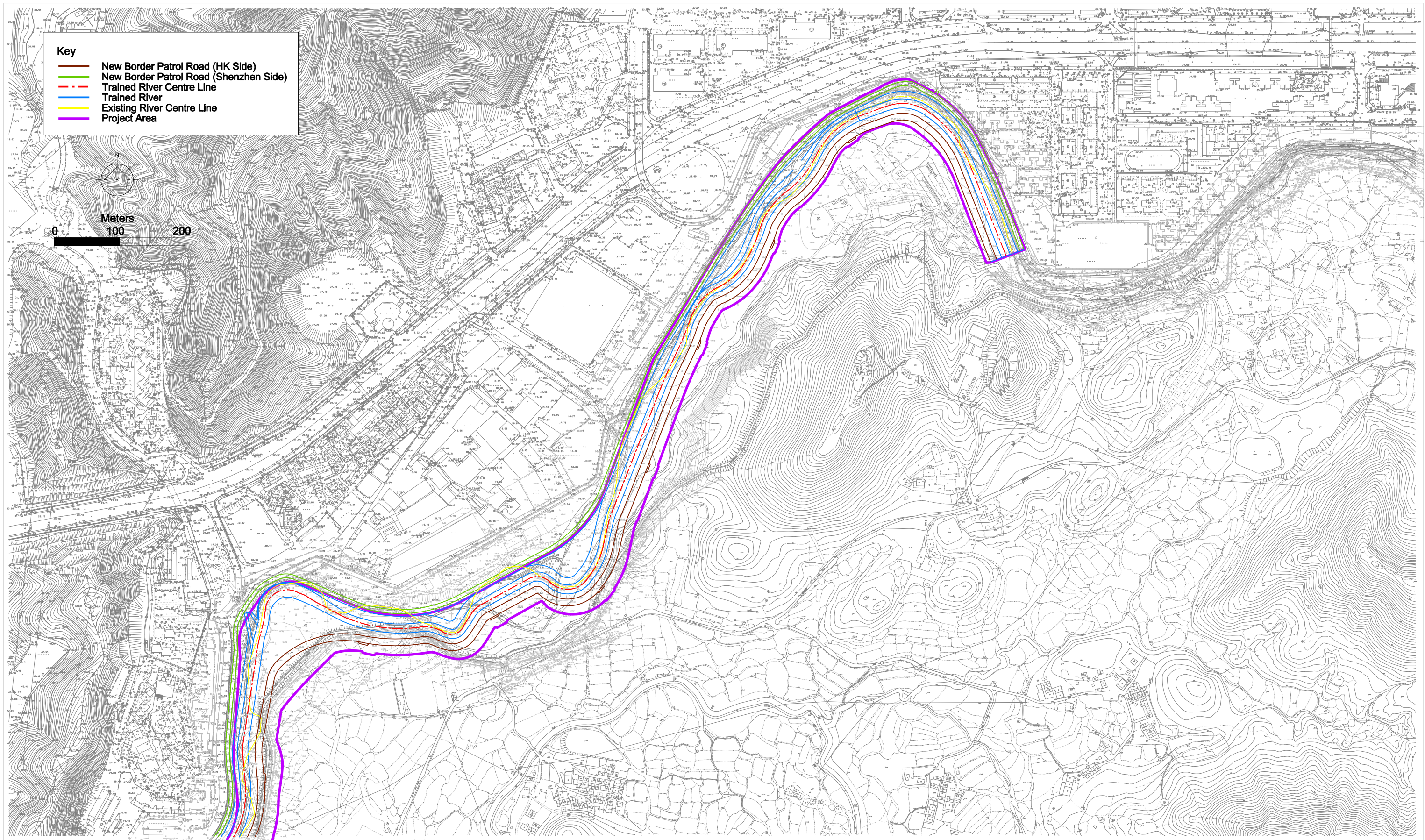
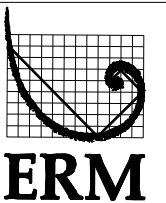


Figure A1-2

General Layout and Extent of the Trained River
(2 of 2)

FILE: 0101759a1-b.dgn
DATE: 23/10/2009

Environmental
Resources
Management



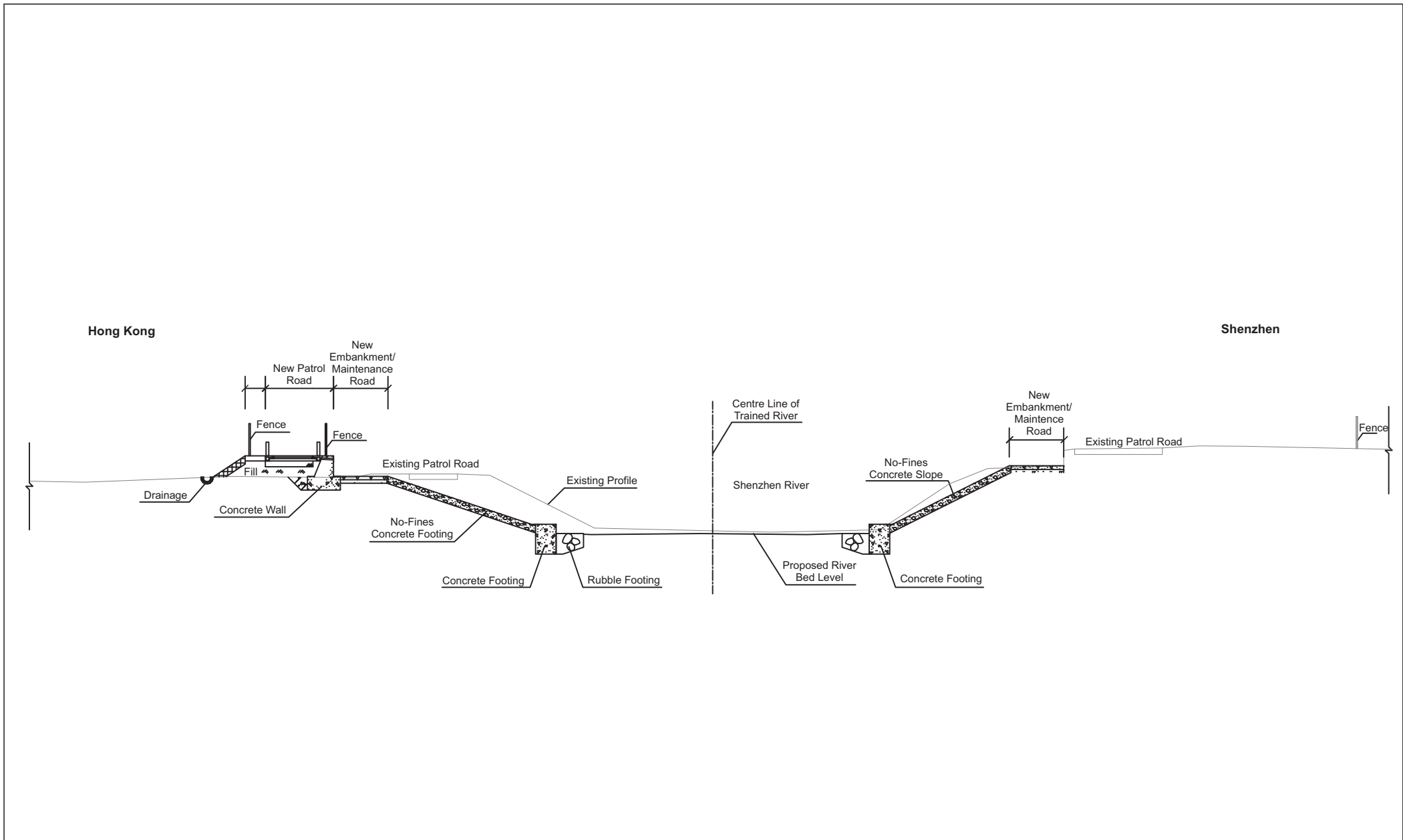


Figure A1-3

Typical Cross Section of the River Design

Annex A2

Location Map for
Potential Commercial and
Industrial Developments



Figure A2

Commercial and Industrial Developments in Vicinity of the Project Area

Annex A3

Detailed Location Maps for Potential Commercial and Industrial Developments



Figure A3.1

Commercial and Industrial Developments in Vicinity of the Project Area

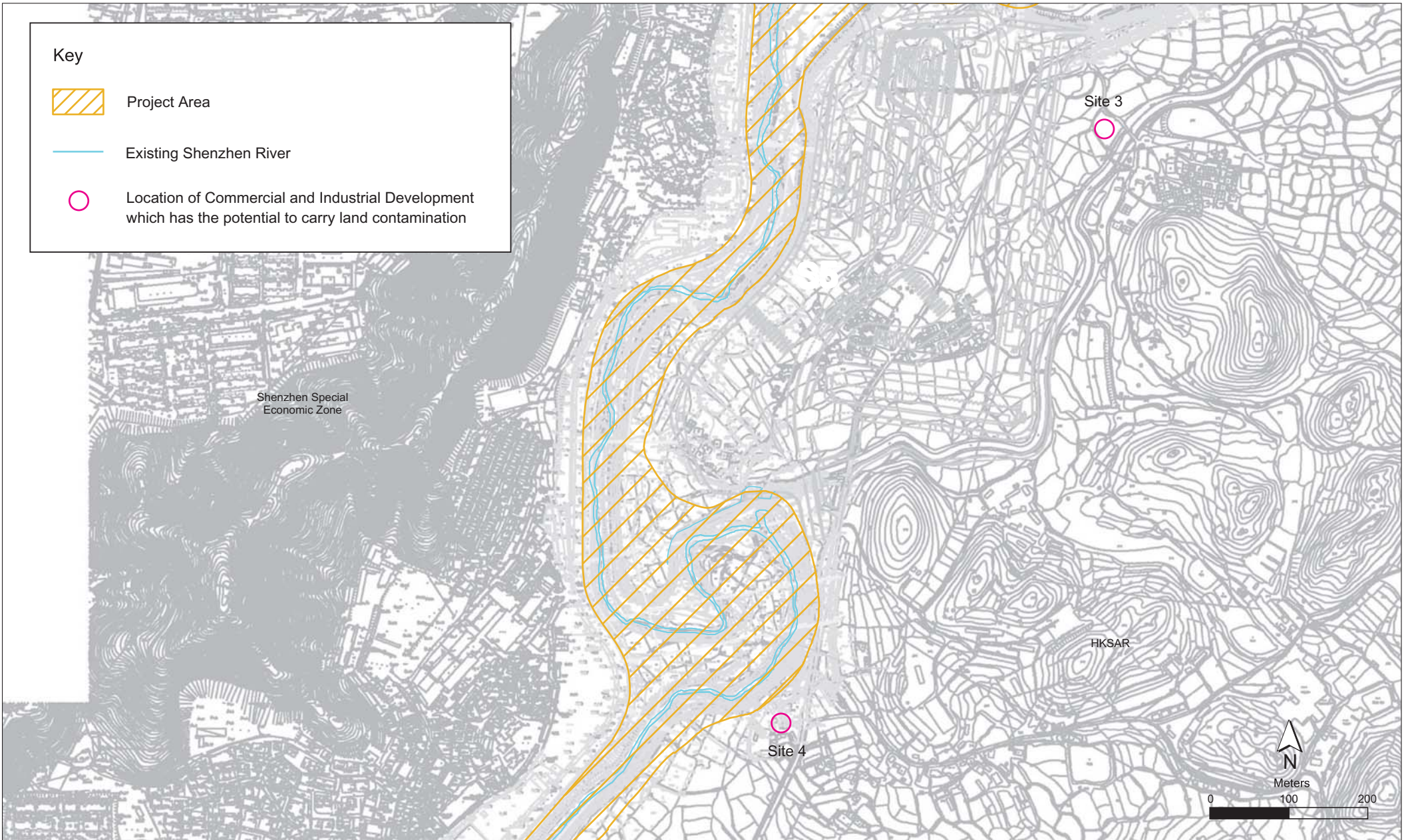


Figure A3.2

Commercial and Industrial Developments in Vicinity of the Project Area

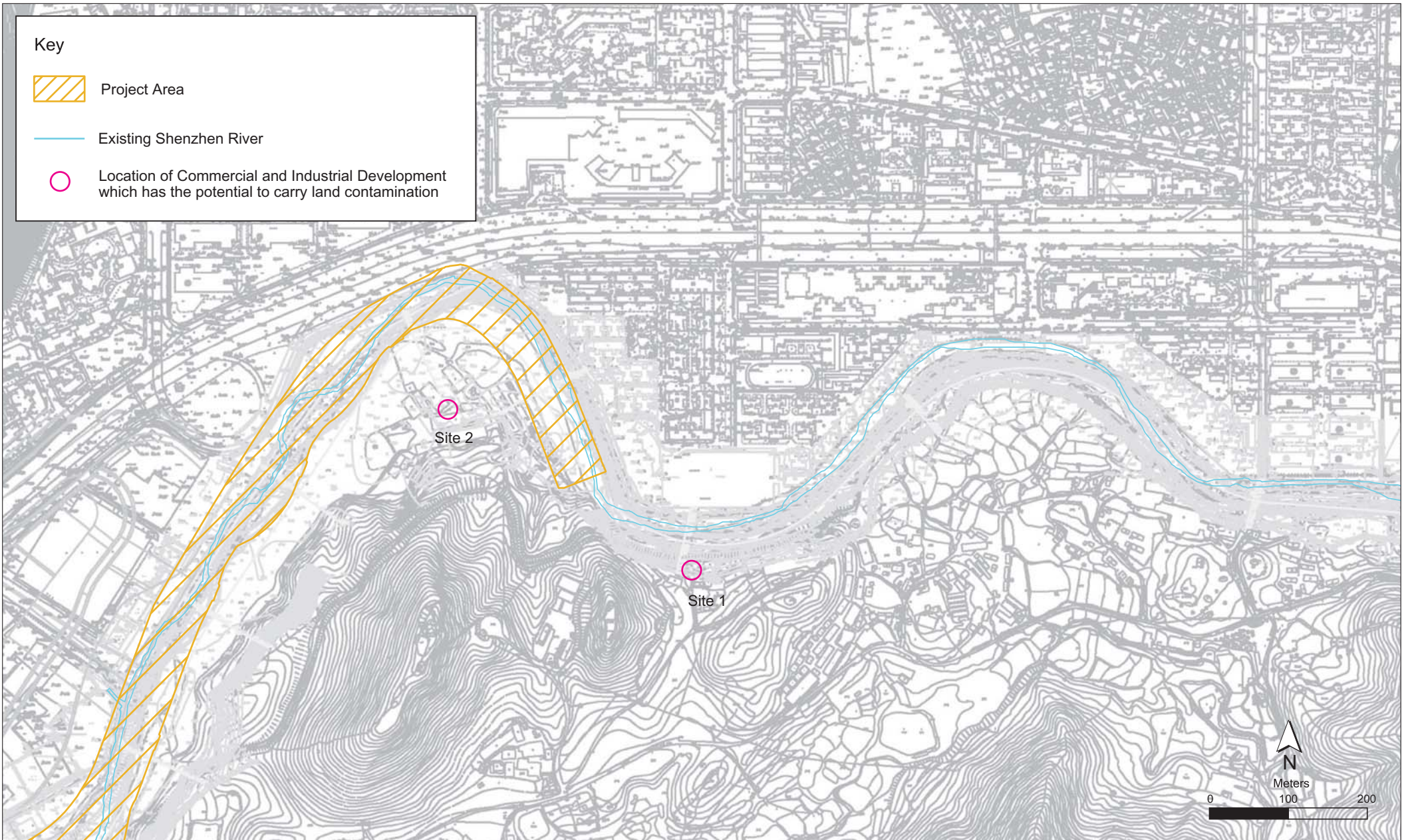


Figure A3.3

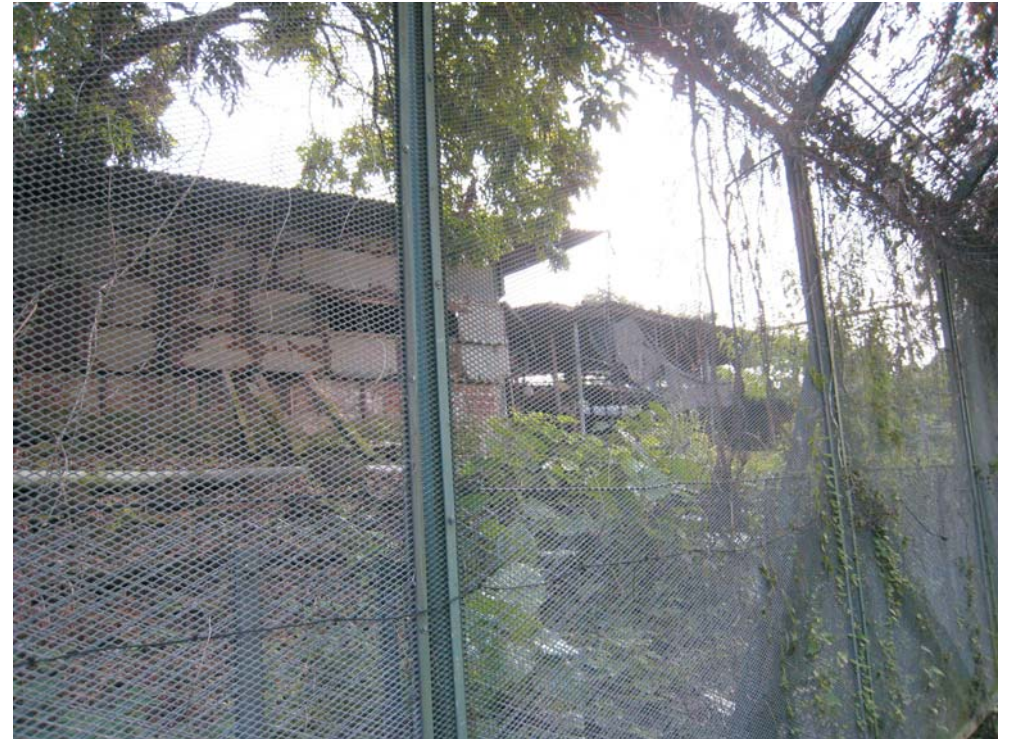
Commercial and Industrial Developments in Vicinity of the Project Area

Annex A4

Photographs for Site 1



Abandoned poultry farm in Site 1



Abandoned poultry farm in Site 1

Annex A5

Photographs for Site 2



Abandoned poultry / livestock farm in Site 2



Abandoned poultry / livestock farm in Site 2



Abandoned poultry / livestock farm in Site 2

AnnexA6

Photographs for Site 3



Nursery in site 3



Storage of Fertilizers in the field

Annex A7

Photographs for Site 4



An industrial site with an air emission stack in Site 4



An industrial site with an air emission stack in Site 4

Annex A8

Photographs for Site 5



Ta Kwu Ling Police Station



Above ground oil storage tank



Emergency generator



The dangerous goods storeroom

Annex A9

Photographs for Site 6



River Ganges water pumping station



Above ground storage tanks

Annex B

Proposed Site Investigation Locations

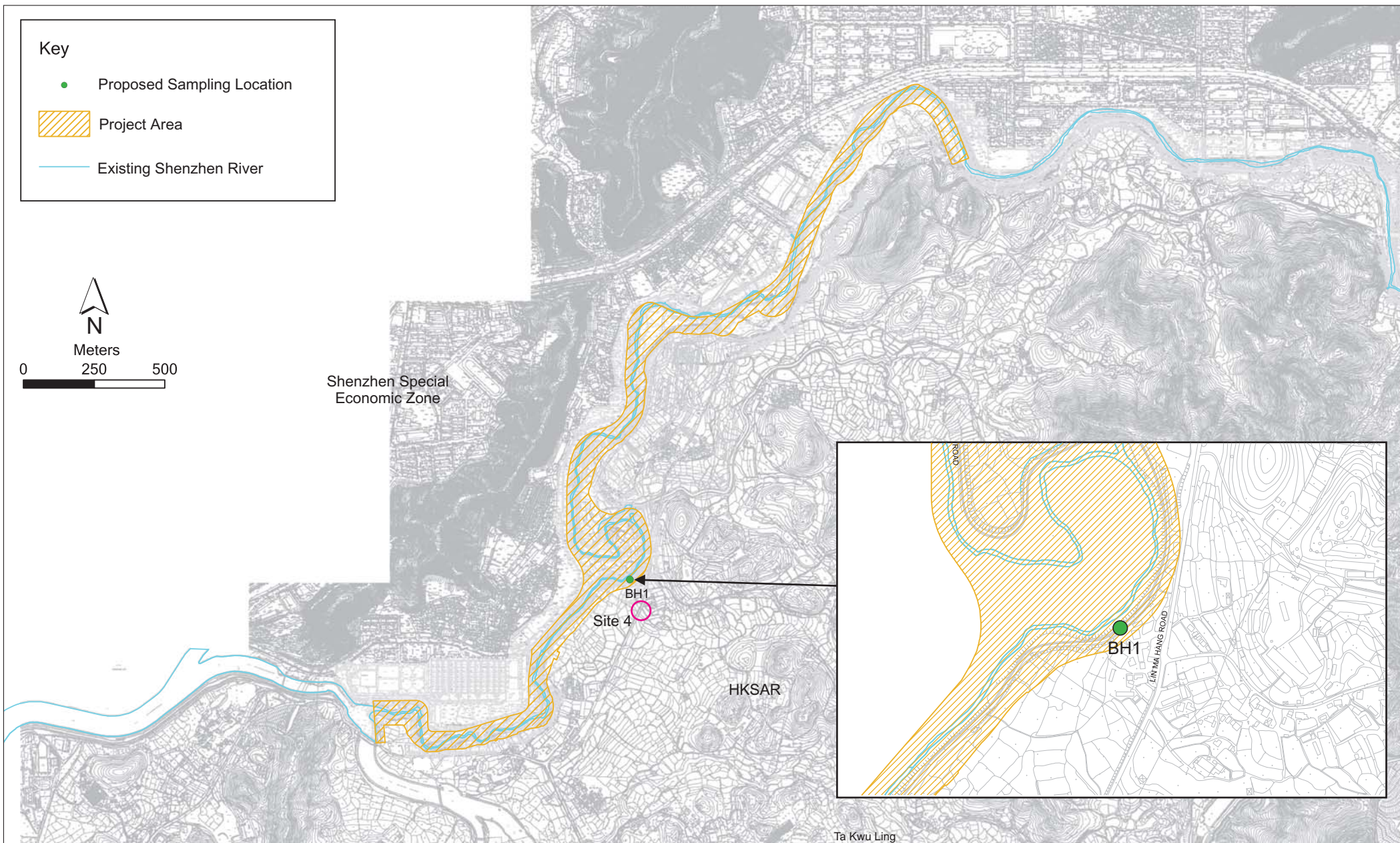


Figure B1

Proposed Land Contamination Sampling Locations

Annex C

RBRG Standards

**Table 2.1
Risk-Based Remediation Goals (RBRGs) for Soil & Soil Saturation Limit**

Chemical	Risk-Based Remediation Goals for Soil				Soil Saturation Limit (C _{sat}) (mg/kg)
	Urban Residential (mg/kg)	Rural Residential (mg/kg)	Industrial (mg/kg)	Public Parks (mg/kg)	
VOCs					
Acetone	9.59E+03	4.26E+03	1.00E+04*	1.00E+04*	***
Benzene	7.04E-01	2.79E-01	9.21E+00	4.22E+01	3.36E+02
Bromodichloromethane	3.17E-01	1.29E-01	2.85E+00	1.34E+01	1.03E+03
2-Butanone	1.00E+04*	1.00E+04*	1.00E+04*	1.00E+04*	***
Chloroform	1.32E-01	5.29E-02	1.54E+00	2.53E+02	1.10E+03
Ethylbenzene	7.09E+02	2.98E+02	8.24E+03	1.00E+04*	1.38E+02
Methyl tert-Butyl Ether	6.88E+00	2.80E+00	7.01E+01	5.05E+02	2.38E+03
Methylene Chloride	1.30E+00	5.29E-01	1.39E+01	1.28E+02	9.21E+02
Styrene	3.22E+03	1.54E+03	1.00E+04*	1.00E+04*	4.97E+02
Tetrachloroethene	1.01E-01	4.44E-02	7.77E-01	1.84E+00	9.71E+01
Toluene	1.44E+03	7.05E+02	1.00E+04*	1.00E+04*	2.35E+02
Trichloroethene	5.23E-01	2.11E-01	5.68E+00	6.94E+01	4.88E+02
Xylenes (Total)	9.50E+01	3.68E+01	1.23E+03	1.00E+04*	1.50E+02
SVOCs					
Acenaphthene	3.51E+03	3.28E+03	1.00E+04*	1.00E+04*	6.02E+01
Acenaphthylene	2.34E+03	1.51E+03	1.00E+04*	1.00E+04*	1.98E+01
Anthracene	1.00E+04*	1.00E+04*	1.00E+04*	1.00E+04*	2.56E+00
Benzo(a)anthracene	1.20E+01	1.14E+01	9.18E+01	3.83E+01	
Benzo(a)pyrene	1.20E+00	1.14E+00	9.18E+00	3.83E+00	
Benzo(b)fluoranthene	9.88E+00	1.01E+01	1.78E+01	2.04E+01	
Benzo(g,h,i)perylene	1.80E+03	1.71E+03	1.00E+04*	5.74E+03	
Benzo(k)fluoranthene	1.20E+02	1.14E+02	9.18E+02	3.83E+02	
bis-(2-Ethylhexyl)phthalate	3.00E+01	2.80E+01	9.18E+01	9.42E+01	
Chrysene	8.71E+02	9.19E+02	1.14E+03	1.54E+03	
Dibenzo(a,h)anthracene	1.20E+00	1.14E+00	9.18E+00	3.83E+00	
Fluoranthene	2.40E+03	2.27E+03	1.00E+04*	7.62E+03	
Fluorene	2.38E+03	2.25E+03	1.00E+04*	7.45E+03	5.47E+01
Hexachlorobenzene	2.43E-01	2.20E-01	5.82E-01	7.13E-01	
Indeno(1,2,3-cd)pyrene	1.20E+01	1.14E+01	9.18E+01	3.83E+01	
Naphthalene	1.82E+02	8.56E+01	4.53E+02	9.14E+02	1.25E+02
Phenanthrene	1.00E+04*	1.00E+04*	1.00E+04*	1.00E+04*	2.80E+01
Phenol	1.00E+04*	1.00E+04*	1.00E+04*	1.00E+04*	7.26E+03
Pyrene	1.80E+03	1.71E+03	1.00E+04*	5.72E+03	
Metals					
Antimony	2.95E+01	2.91E+01	2.61E+02	9.79E+01	
Arsenic	2.21E+01	2.18E+01	1.96E+02	7.35E+01	
Barium	1.00E+04*	1.00E+04*	1.00E+04*	1.00E+04*	
Cadmium	7.38E+01	7.28E+01	6.53E+02	2.45E+02	
Chromium III	1.00E+04*	1.00E+04*	1.00E+04*	1.00E+04*	
Chromium VI	2.21E+02	2.18E+02	1.96E+03	7.35E+02	
Cobalt	1.48E+03	1.46E+03	1.00E+04*	4.90E+03	
Copper	2.95E+03	2.91E+03	1.00E+04*	9.79E+03	
Lead	2.58E+02	2.55E+02	2.29E+03	8.57E+02	
Manganese	1.00E+04*	1.00E+04*	1.00E+04*	1.00E+04*	
Mercury	1.10E+01	6.52E+00	3.84E+01	4.56E+01	
Molybdenum	3.69E+02	3.64E+02	3.26E+03	1.22E+03	
Nickel	1.48E+03	1.46E+03	1.00E+04*	4.90E+03	
Tin	1.00E+04*	1.00E+04*	1.00E+04*	1.00E+04*	
Zinc	1.00E+04*	1.00E+04*	1.00E+04*	1.00E+04*	
Dioxins / PCBs					
Dioxins (I-TEQ)	1.00E-03	1.00E-03	5.00E-03	1.00E-03	
PCBs	2.36E-01	2.26E-01	7.48E-01	7.56E-01	
Petroleum Carbon Ranges					
C6 - C8	1.41E+03	5.45E+02	1.00E+04*	1.00E+04*	1.00E+03
C9 - C16	2.24E+03	1.33E+03	1.00E+04*	1.00E+04*	3.00E+03
C17 - C35	1.00E+04*	1.00E+04*	1.00E+04*	1.00E+04*	5.00E+03
Other Inorganic Compounds					
Cyanide, free	1.48E+03	1.46E+03	1.00E+04*	4.90E+03	
Organometallics					
TBTO	2.21E+01	2.18E+01	1.96E+02	7.35E+01	

Notes:

- (1) For Dioxins, the cleanup levels in USEPA Office of Solid Waste and Emergency Response (OSWER) Directive of 1998 have been adopted. The OSWER Directive value of 1 ppb for residential use has been applied to the scenarios of "Urban Residential", "Rural Residential", and "Public Parks", while the low end of the range of values for industrial, 5 ppb, has been applied to the scenario of "Industrial".
- (2) Soil saturation limits for petroleum carbon ranges taken from the Canada-Wide Standards for Petroleum Hydrocarbons in Soil, CCME 2000.
- (3) * indicates a 'ceiling limit' concentration.
- (4) *** indicates that the C_{sat} value exceeds the 'ceiling limit' therefore the RBRG applies.

**Table 2.2
Risk-Based Remediation Goals (RBRGs) for Groundwater and Solubility Limit**

Chemical	Risk-Based Remediation Goals for Groundwater			Solubility Limit (mg/L)
	Urban Residential (mg/L)	Rural Residential (mg/L)	Industrial (mg/L)	
VOCs				
Acetone	1.00E+04*	1.00E+04*	1.00E+04*	***
Benzene	3.86E+00	1.49E+00	5.40E+01	1.75E+03
Bromodichloromethane	2.22E+00	8.71E-01	2.62E+01	6.74E+03
2-Butanone	1.00E+04*	1.00E+04*	1.00E+04*	***
Chloroform	9.56E-01	3.82E-01	1.13E+01	7.92E+03
Ethylbenzene	1.02E+03	3.91E+02	1.00E+04*	1.69E+02
Methyl tert-Butyl Ether	1.53E+02	6.11E+01	1.81E+03	***
Methylene Chloride	1.90E+01	7.59E+00	2.24E+02	***
Styrene	3.02E+03	1.16E+03	1.00E+04*	3.10E+02
Tetrachloroethene	2.50E-01	9.96E-02	2.95E+00	2.00E+02
Toluene	5.11E+03	1.97E+03	1.00E+04*	5.26E+02
Trichloroethene	1.21E+00	4.81E-01	1.42E+01	1.10E+03
Xylenes (Total)	1.12E+02	4.33E+01	1.57E+03	1.75E+02
SVOCs				
Acenaphthene	1.00E+04*	7.09E+03	1.00E+04*	4.24E+00
Acenaphthylene	1.41E+03	5.42E+02	1.00E+04*	3.93E+00
Anthracene	1.00E+04*	1.00E+04*	1.00E+04*	4.34E-02
Benzo(a)anthracene				
Benzo(a)pyrene				
Benzo(b)fluoranthene	5.39E-01	2.03E-01	7.53E+00	1.50E-03
Benzo(g,h,i)perylene				
Benzo(k)fluoranthene				
bis-(2-Ethylhexyl)phthalate				
Chrysene	5.81E+01	2.19E+01	8.12E+02	1.60E-03
Dibenzo(a,h)anthracene				
Fluoranthene	1.00E+04*	1.00E+04*	1.00E+04*	2.06E-01
Fluorene	1.00E+04*	1.00E+04*	1.00E+04*	1.98E+00
Hexachlorobenzene	5.89E-02	2.34E-02	6.95E-01	6.20E+00
Indeno(1,2,3-cd)pyrene				
Naphthalene	6.17E+01	2.37E+01	8.62E+02	3.10E+01
Phenanthrene	1.00E+04*	1.00E+04*	1.00E+04*	1.00E+00
Phenol				
Pyrene	1.00E+04*	1.00E+04*	1.00E+04*	1.35E-01
Metals				
Antimony				
Arsenic				
Barium				
Cadmium				
Chromium III				
Chromium VI				
Cobalt				
Copper				
Lead				
Manganese				
Mercury	4.86E-01	1.84E-01	6.79E+00	
Molybdenum				
Nickel				
Tin				
Zinc				
Dioxins / PCBs				
Dioxins (I-TEQ)				
PCBs	4.33E-01	1.71E-01	5.11E+00	3.10E-02
Petroleum Carbon Ranges				
C6 - C8	8.22E+01	3.17E+01	1.15E+03	5.23E+00
C9 - C16	7.14E+02	2.76E+02	9.98E+03	2.80E+00
C17 - C35	1.28E+01	4.93E+00	1.78E+02	2.80E+00
Other Inorganic Compounds				
Cyanide, free				
Organometallics				
TBTO				

Notes:

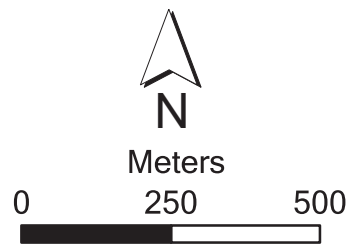
- (1) Blank indicates that RBRG could not be calculated because the toxicity or physical/chemical values were unavailable, or the condition of Henry's Law Constant > 10 was not met for the inhalation pathway.
- (2) Water solubilities for Petroleum Carbon Range aliphatic C9-C16 and greater than C16 generally are considered to be effectively zero and therefore the aromatic solubility for C9-C16 is used.
- (3) * indicates a 'ceiling limit' concentration.
- (4) *** indicates that the solubility limit exceeds the 'ceiling limit' therefore the RBRG applies.

Annex B

Site Investigation Location

Key 图例

- 采样位置
Sampling Location
- ▨ 工程范围 Project Area
- 现有的深圳河
Existing Shenzhen River



Shenzhen Special
Economic Zone

HKSAR

Ta Kwu Ling

BH1
Site 4

BH1

LIN MA HANG ROAD

Figure B1

Soil Sampling Location

Annex C

Laboratory Analytical Report

CERTIFICATE OF ANALYSIS

Client	: ERM HONG KONG	Laboratory	: ALS Technichem HK Pty Ltd	Page	: 1 of 8
Contact	: MS LAURENCE GENEÉ	Contact	: Chan Kwok Fai, Godfrey	Work Order	: HK1001588
Address	: 21/F, LINCOLN HOUSE, 979 KING'S ROAD, TAIKOO PLACE, ISLAND EAST, QUARRY BAY, HONG KONG	Address	: 11/F., Chung Shun Knitting Centre, 1 - 3 Wing Yip Street, Kwai Chung, N.T., Hong Kong		
E-mail	: laurence.geneé@erm.com	E-mail	: Godfrey.Chan@alsenviro.com	Date Samples Received	: 21-JAN-2010
Telephone	: +852 2271 3000	Telephone	: +852 2610 1044	Issue Date	: 04-FEB-2010
Facsimile	: +852 2723 5660	Facsimile	: +852 2610 2021	No. of samples received	: 4
Project	: 0101759	Quote number	: ----	No. of samples analysed	: 4
Order number	: ----				
C-O-C number	: 00521				
Site	: ----				

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This document has been electronically signed by those names that appear on this report and are the authorised signatories. Electronic signing has been carried out in compliance with procedures specified in the Electronic Transactions Ordinance of Hong Kong, Chapter 553, Section 6.

<i>Signatories</i>	<i>Position</i>	<i>Authorised results for</i>
Anh Ngoc Huynh	Senior Chemist - Organics	Organics
Chan Siu Ming, Vico	Chemist	Inorganics
Wong Wing, Kenneth	Assistant Supervisor	Inorganics



General Comments

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release. When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for processing purposes. If the sampling time is displayed as 0:00 the information was not provided by client. The completion date of analysis is: 29-JAN-2010

Key: LOR = Limit of reporting; CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

Specific comments for Work Order: **HK1001588**

Project Name: Shenzhen River EIA River.

Sample(s) were received in a chilled condition.

Soil sample(s) analysed on an as received basis. Result(s) reported on a dry weight basis.

Soil sample(s) as received, digested by In-house method E-ASTM D3974-81 based on ASTM D3974-81, prior to the determination of metals.

The testing of Trivalent Chromium (Method: EG049) and Volatile Organic Carbons (Method: EP074LL) are not HOKLAS accredited.



Analytical Results

Sub-Matrix: SOIL

Client sample ID

Client sampling date / time

Compound	CAS Number	LOR	Unit	BH1 0.5M	BH1 1.5M	BH1 2.95M	BH1 DUP
				[21-JAN-2010]	[21-JAN-2010]	[21-JAN-2010]	[21-JAN-2010]
				HK1001588-001	HK1001588-002	HK1001588-003	HK1001588-004
EA/ED: Physical and Aggregate Properties							
EA055: Moisture Content (dried @ 103° C)	----	0.1	%	10.1	14.8	7.2	15.7
EG: Metals and Major Cations							
EG020: Antimony	7440-36-0	1	mg/kg	<1	<1	<1	<1
EG020: Arsenic	7440-38-2	1	mg/kg	9	21	11	21
EG020: Barium	7440-39-3	1	mg/kg	47	51	21	52
EG020: Cadmium	7440-43-9	0.2	mg/kg	0.2	<0.2	<0.2	<0.2
EG020: Cobalt	7440-48-4	1	mg/kg	2	2	1	2
EG020: Copper	7440-50-8	1	mg/kg	30	11	7	11
EG020: Lead	7439-92-1	1	mg/kg	40	46	29	47
EG020: Manganese	7439-96-5	1	mg/kg	182	57	34	62
EG020: Molybdenum	7439-98-7	1	mg/kg	1	2	1	2
EG020: Nickel	7440-02-0	1	mg/kg	7	6	3	5
EG020: Tin	7440-31-5	1	mg/kg	2	2	1	2
EG020: Zinc	7440-66-6	1	mg/kg	774	35	24	32
EG036: Mercury	7439-97-6	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2
EG049: Trivalent Chromium	16065-83-1	1	mg/kg	14	18	8	15
EG3060: Hexavalent Chromium	18540-29-9	1	mg/kg	<1	<1	<1	<1
EP-071HK: Total Petroleum Hydrocarbons (TPH)							
C6 - C8 Fraction	----	5	mg/kg	<5	<5	<5	<5
C9 - C16 Fraction	----	200	mg/kg	<200	<200	<200	<200
C17 - C35 Fraction	----	500	mg/kg	<500	<500	<500	<500
EP-074A: Monocyclic Aromatic Hydrocarbons (MAH)							
Benzene	71-43-2	0.10	mg/kg	<0.10	<0.10	<0.10	<0.10
Toluene	108-88-3	0.50	mg/kg	<0.50	<0.50	<0.50	<0.50
Ethylbenzene	100-41-4	0.50	mg/kg	<0.50	<0.50	<0.50	<0.50
meta- & para-Xylene	108-38-3 106-42-3	1.00	mg/kg	<1.00	<1.00	<1.00	<1.00
ortho-Xylene	95-47-6	0.50	mg/kg	<0.50	<0.50	<0.50	<0.50
EP-075B: Polycyclic Aromatic Hydrocarbons (PAHs)							
Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5
Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5
Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5
Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5
Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5



Sub-Matrix: SOIL				Client sample ID	BH1 0.5M	BH1 1.5M	BH1 2.95M	BH1 DUP	
				Client sampling date / time	[21-JAN-2010]	[21-JAN-2010]	[21-JAN-2010]	[21-JAN-2010]	
Compound	CAS Number	LOR	Unit	HK1001588-001	HK1001588-002	HK1001588-003	HK1001588-004		
EP-075B: Polyaromatic Hydrocarbons (PAHs) - Continued									
Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5		
Benzo(b) & Benzo(k)fluoranthene	205-99-2 207-08-9	1	mg/kg	<1	<1	<1	<1		
Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5		
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5		
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5		
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5		
EP-080S: TPH(Volatile)/BTEX Surrogate									
Surrogate control limits listed at end of this report.									
Dibromofluoromethane	1868-53-7	0.1	%	98.0	96.8	98.2	99.4		
Toluene-D8	2037-26-5	0.1	%	99.0	99.4	98.9	99.6		
4-Bromofluorobenzene	460-00-4	0.1	%	96.2	97.4	97.3	97.7		
EP-074S: VOC Surrogates									
Surrogate control limits listed at end of this report.									
Dibromofluoromethane	1868-53-7	0.1	%	98.0	96.8	98.2	99.4		
Toluene-D8	2037-26-5	0.1	%	99.0	99.4	98.9	99.6		
4-Bromofluorobenzene	460-00-4	0.1	%	96.2	97.4	97.3	97.7		
EP-075S: Acid Extractable Surrogates									
Surrogate control limits listed at end of this report.									
2-Fluorophenol	367-12-4	0.1	%	74.0	70.1	75.3	78.0		
Phenol-d6	13127-88-3	0.1	%	71.5	64.7	67.1	65.1		
2.4.6-Tribromophenol	118-79-6	0.1	%	83.6	73.6	75.0	79.6		
EP-075T: Base/Neutral Extractable Surrogates									
Surrogate control limits listed at end of this report.									
Nitrobenzene -d5	4165-60-0	0.1	%	78.5	73.7	74.1	78.3		
2-Fluorobiphenyl	321-60-8	0.1	%	75.1	70.3	72.8	77.0		
4-Terphenyl-d14	1718-51-0	0.1	%	95.1	85.7	88.2	92.4		



Laboratory Duplicate (DUP) Report

Matrix: SOIL				Laboratory Duplicate (DUP) Report				
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)
EA/ED: Physical and Aggregate Properties (QC Lot: 1232515)								
HK1001588-001	BH1 0.5M	EA055: Moisture Content (dried @ 103°C)	----	0.1	%	10.1	9.2	9.2
HK1001637-007	Anonymous	EA055: Moisture Content (dried @ 103°C)	----	0.1	%	9.9	10.2	3.3
EG: Metals and Major Cations (QC Lot: 1232022)								
HK1001588-001	BH1 0.5M	EG036: Mercury	7439-97-6	0.2	mg/kg	<0.2	<0.2	0.0
EG: Metals and Major Cations (QC Lot: 1232025)								
HK1001588-001	BH1 0.5M	EG020: Cadmium	7440-43-9	0.2	mg/kg	0.2	0.2	0.0
		EG020: Antimony	7440-36-0	1	mg/kg	<1	<1	0.0
		EG020: Arsenic	7440-38-2	1	mg/kg	9	8	0.0
		EG020: Barium	7440-39-3	1	mg/kg	47	45	4.5
		EG020: Cobalt	7440-48-4	1	mg/kg	2	2	0.0
		EG020: Copper	7440-50-8	1	mg/kg	30	31	4.2
		EG020: Lead	7439-92-1	1	mg/kg	40	41	3.2
		EG020: Manganese	7439-96-5	1	mg/kg	182	180	1.2
		EG020: Molybdenum	7439-98-7	1	mg/kg	1	1	0.0
		EG020: Nickel	7440-02-0	1	mg/kg	7	7	0.0
		EG020: Tin	7440-31-5	1	mg/kg	2	2	0.0
EG020: Zinc	7440-66-6	1	mg/kg	774	830	7.0		
EG: Metals and Major Cations (QC Lot: 1232026)								
HK1001588-001	BH1 0.5M	EG3060: Hexavalent Chromium	18540-29-9	1	mg/kg	<1	<1	0.0
EP-071HK: Total Petroleum Hydrocarbons (TPH) (QC Lot: 1230999)								
HK1001588-001	BH1 0.5M	C6 - C8 Fraction	----	5	mg/kg	<5	<5	0.0
EP-071HK: Total Petroleum Hydrocarbons (TPH) (QC Lot: 1231005)								
HK1001588-001	BH1 0.5M	C9 - C16 Fraction	----	200	mg/kg	<200	<200	0.0
		C17 - C35 Fraction	----	500	mg/kg	<500	<500	0.0
EP-074A: Monocyclic Aromatic Hydrocarbons (MAH) (QC Lot: 1230998)								
HK1001588-001	BH1 0.5M	Benzene	71-43-2	0.10	mg/kg	<0.10	<0.10	0.0
		Toluene	108-88-3	0.50	mg/kg	<0.50	<0.50	0.0
		Ethylbenzene	100-41-4	0.50	mg/kg	<0.50	<0.50	0.0
		ortho-Xylene	95-47-6	0.50	mg/kg	<0.50	<0.50	0.0
		meta- & para-Xylene	108-38-3	1.00	mg/kg	<1.00	<1.00	0.0
			106-42-3					
EP-075B: Polyaromatic Hydrocarbons (PAHs) (QC Lot: 1226199)								
HK1001550-001	Anonymous	Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	0.0
		Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	0.0
		Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	0.0
		Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	0.0
		Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	0.0
		Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	0.0



Matrix: SOIL				Laboratory Duplicate (DUP) Report				
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)
EP-075B: Polyaromatic Hydrocarbons (PAHs) (QC Lot: 1226199) - Continued								
HK1001550-001	Anonymous	Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	0.0
		Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	0.0
		Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	0.0
		Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	0.0
		Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	0.0
		Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	0.0
		Dibenz(a,h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	0.0
		Benzo(g,h,i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	0.0
		Benzo(b) & Benzo(k)fluoranthene	205-99-2 207-08-9	1	mg/kg	<1	<1	0.0

Method Blank (MB), Laboratory Control Spike (LCS) and Laboratory Control Spike Duplicate (DCS) Report

Matrix: SOIL		Method Blank (MB) Report			Laboratory Control Spike (LCS) and Laboratory Control Spike Duplicate (DCS) Report						
Method: Compound	CAS Number	LOR	Unit	Result	Spike Concentration n	Spike Recovery (%)		Recovery Limits (%)		RPD (%)	
						LCS	DCS	Low	High	Value	Control Limit
EG: Metals and Major Cations (QC Lot: 1232022)											
EG036: Mercury	7439-97-6	0.02	mg/kg	<0.2	0.1 mg/kg	100	----	85	115	----	----
EG: Metals and Major Cations (QC Lot: 1232025)											
EG020: Antimony	7440-36-0	1	mg/kg	<1	5 mg/kg	89.8	----	85	115	----	----
EG020: Arsenic	7440-38-2	1	mg/kg	<1	5 mg/kg	86.1	----	85	115	----	----
EG020: Barium	7440-39-3	1	mg/kg	<1	5 mg/kg	97.5	----	85	115	----	----
EG020: Cadmium	7440-43-9	0.2	mg/kg	<0.2	5 mg/kg	93.0	----	85	115	----	----
EG020: Cobalt	7440-48-4	1	mg/kg	<1	5 mg/kg	95.6	----	85	115	----	----
EG020: Copper	7440-50-8	1	mg/kg	<1	5 mg/kg	104	----	85	115	----	----
EG020: Lead	7439-92-1	1	mg/kg	<1	5 mg/kg	96.8	----	85	115	----	----
EG020: Manganese	7439-96-5	1	mg/kg	<1	5 mg/kg	87.6	----	85	115	----	----
EG020: Molybdenum	7439-98-7	1	mg/kg	<1	5 mg/kg	96.6	----	85	115	----	----
EG020: Nickel	7440-02-0	1	mg/kg	<1	5 mg/kg	99.6	----	85	115	----	----
EG020: Tin	7440-31-5	1	mg/kg	<1	5 mg/kg	102	----	85	115	----	----
EG020: Zinc	7440-66-6	1	mg/kg	<1	5 mg/kg	101	----	85	115	----	----
EG: Metals and Major Cations (QC Lot: 1232026)											
EG360: Hexavalent Chromium	18540-29-9	0.5	mg/kg	<1	40 mg/kg	101	----	85	115	----	----
EP-071HK: Total Petroleum Hydrocarbons (TPH) (QC Lot: 1230999)											
C6 - C8 Fraction	----	5	mg/kg	<5	3 mg/kg	100	----	51	147	----	----
EP-071HK: Total Petroleum Hydrocarbons (TPH) (QC Lot: 1231005)											
C9 - C16 Fraction	----	200	mg/kg	<200	31 mg/kg	89.5	----	48	112	----	----
C17 - C35 Fraction	----	500	mg/kg	<500	75 mg/kg	78.7	----	55	109	----	----
EP-074A: Monocyclic Aromatic Hydrocarbons (MAH) (QC Lot: 1230998)											
Benzene	71-43-2	0.04	mg/kg	<0.04	0.16 mg/kg	83.5	----	69	123	----	----



Matrix: SOIL		Method Blank (MB) Report			Laboratory Control Spike (LCS) and Laboratory Control Spike Duplicate (DCS) Report						
Method: Compound	CAS Number	LOR	Unit	Result	Spike Concentration	Spike Recovery (%)		Recovery Limits (%)		RPD (%)	
						LCS	DCS	Low	High	Value	Control Limit
EP-074A: Monocyclic Aromatic Hydrocarbons (MAH) (QC Lot: 1230998) - Continued											
Toluene	108-88-3	0.04	mg/kg	<0.04	0.16 mg/kg	84.2	----	61	124	----	----
Ethylbenzene	100-41-4	0.04	mg/kg	<0.04	0.16 mg/kg	88.0	----	63	121	----	----
meta- & para-Xylene	108-38-3 106-42-3	0.08	mg/kg	<0.08	0.32 mg/kg	90.6	----	71	116	----	----
ortho-Xylene	95-47-6	0.04	mg/kg	<0.04	0.16 mg/kg	91.2	----	68	119	----	----
EP-075B: Polyaromatic Hydrocarbons (PAHs) (QC Lot: 1226199)											
Naphthalene	91-20-3	0.5	mg/kg	<0.5	0.25 mg/kg	90.6	----	63	110	----	----
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	0.25 mg/kg	99.6	----	61	109	----	----
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	0.25 mg/kg	93.0	----	68	113	----	----
Fluorene	86-73-7	0.5	mg/kg	<0.5	0.25 mg/kg	95.0	----	70	112	----	----
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	0.25 mg/kg	81.8	----	75	110	----	----
Anthracene	120-12-7	0.5	mg/kg	<0.5	0.25 mg/kg	96.8	----	73	112	----	----
Fluoranthene	206-44-0	0.5	mg/kg	<0.5	0.25 mg/kg	98.6	----	77	109	----	----
Pyrene	129-00-0	0.5	mg/kg	<0.5	0.25 mg/kg	96.2	----	76	113	----	----
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	0.25 mg/kg	95.8	----	72	112	----	----
Chrysene	218-01-9	0.5	mg/kg	<0.5	0.25 mg/kg	101	----	73	114	----	----
Benzo(b) & Benzo(k)fluoranthene	205-99-2 207-08-9	1.0	mg/kg	<1	0.50 mg/kg	84.8	----	65	112	----	----
Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	0.25 mg/kg	89.2	----	64	102	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	0.25 mg/kg	69.8	----	56	102	----	----
Dibenz(a,h)anthracene	53-70-3	0.5	mg/kg	<0.5	0.25 mg/kg	69.0	----	53	95	----	----
Benzo(g,h,i)perylene	191-24-2	0.5	mg/kg	<0.5	0.25 mg/kg	68.4	----	51	99	----	----

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report

Matrix: SOIL				Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report						
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Spike Concentration	Spike Recovery (%)		Recovery Limits (%)		RPD (%)	
					MS	MSD	Low	High	Value	Control Limit
EG: Metals and Major Cations (QC Lot: 1232022)										
HK1001588-001	BH1 0.5M	EG036: Mercury	7439-97-6	0.1 mg/kg	85.0	----	75	125	----	----
EG: Metals and Major Cations (QC Lot: 1232025)										
HK1001588-001	BH1 0.5M	EG020: Antimony	7440-36-0	5 mg/kg	85.8	----	75	125	----	----
		EG020: Arsenic	7440-38-2	5 mg/kg	90.0	----	75	125	----	----
		EG020: Barium	7440-39-3	5 mg/kg	# Not Determined	----	75	125	----	----
		EG020: Cadmium	7440-43-9	5 mg/kg	93.8	----	75	125	----	----
		EG020: Cobalt	7440-48-4	5 mg/kg	95.0	----	75	125	----	----
		EG020: Copper	7440-50-8	5 mg/kg	# Not Determined	----	75	125	----	----



Matrix: SOIL				Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report						
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Spike Concentration	Spike Recovery (%)		Recovery Limits (%)		RPD (%)	
					MS	MSD	Low	High	Value	Control Limit
EG: Metals and Major Cations (QC Lot: 1232025) - Continued										
HK1001588-001	BH1 0.5M	EG020: Lead	7439-92-1	5 mg/kg	# Not Determined	----	75	125	----	----
		EG020: Manganese	7439-96-5	5 mg/kg	# Not Determined	----	75	125	----	----
		EG020: Molybdenum	7439-98-7	5 mg/kg	103	----	75	125	----	----
		EG020: Nickel	7440-02-0	5 mg/kg	89.9	----	75	125	----	----
		EG020: Tin	7440-31-5	5 mg/kg	86.5	----	75	125	----	----
		EG020: Zinc	7440-66-6	5 mg/kg	# Not Determined	----	75	125	----	----
EG: Metals and Major Cations (QC Lot: 1232026)										
HK1001588-001	BH1 0.5M	EG3060: Hexavalent Chromium	18540-29-9	40 mg/kg	78.1	----	75	125	----	----
EP-071HK: Total Petroleum Hydrocarbons (TPH) (QC Lot: 1230999)										
HK1001588-002	BH1 1.5M	C6 - C8 Fraction	----	3 mg/kg	98.5	----	50	130	----	----
EP-071HK: Total Petroleum Hydrocarbons (TPH) (QC Lot: 1231005)										
HK1001588-002	BH1 1.5M	C9 - C16 Fraction	----	31 mg/kg	85.6	----	50	130	----	----
		C17 - C35 Fraction	----	75 mg/kg	55.0	----	50	130	----	----

Surrogate Control Limits

Sub-Matrix: SOIL		Recovery Limits (%)	
Compound	CAS Number	Low	High
EP-080S: TPH(Volatile)/BTEX Surrogate			
Dibromofluoromethane	1868-53-7	80	120
Toluene-D8	2037-26-5	81	117
4-Bromofluorobenzene	460-00-4	74	121
EP-074S: VOC Surrogates			
Dibromofluoromethane	1868-53-7	80	120
Toluene-D8	2037-26-5	81	117
4-Bromofluorobenzene	460-00-4	74	121
EP-075S: Acid Extractable Surrogates			
2-Fluorophenol	367-12-4	25	121
Phenol-d6	13127-88-3	24	113
2,4,6-Tribromophenol	118-79-6	20	122
EP-075T: Base/Neutral Extractable Surrogates			
Nitrobenzene -d5	4165-60-0	23	120
2-Fluorobiphenyl	321-60-8	30	115
4-Terphenyl-d14	1718-51-0	20	137

Annex D

Trial Pit Log and Photographs from Site Investigation

Location: Regulation of Shenzhen River Stage IV – Environmental Impact Assessment Site Investigation Works		Trial pit No.: TP1		Sheet 1 of 1	
Logged by: LKM Checked by: AW		Excavation method: Hand Dug		Excavated: 21/1/2010	
Date: 21/1/2010		Coordinates: E 833679.521 N 845169.243		Backfilled: 22/1/2010	
Samples & Test	Depth (m)	Face A: width: 1.20 m	Face B: width: 1.20 m	Face C: width: 1.20 m	Face D: width: 1.20 m
	0.00	Datum line +9.30 mPD			
	0.50				
	1.00				
	1.50				
	2.00				
	2.50				
	2.90				
Remarks:					
Legend	Description	Grade	Plan (not to scale)		
	Grey, CONCRETE.				
	Loose, grey, silty SAND with many red brick & concrete fragments. (FILL.)				
	Extremely weak, reddish and yellowish grey, completely decomposed TUFF. (Firm, sandy SILT.)	V			
	Extremely weak, reddish and yellowish grey, completely decomposed TUFF. (Very dense, silty SAND with many fine to coarse quartz gravels.)	V			
	BOULDER.				
	Plate bearing test			Small disturbed sample	
	Insitu density test			Large disturbed sample	
	Moisture content test			Water sample	
	Photograph			Seepage	
	Undisturbed sample hor.			Bulk sample	
	Undisturbed sample ver.			Block sample	



