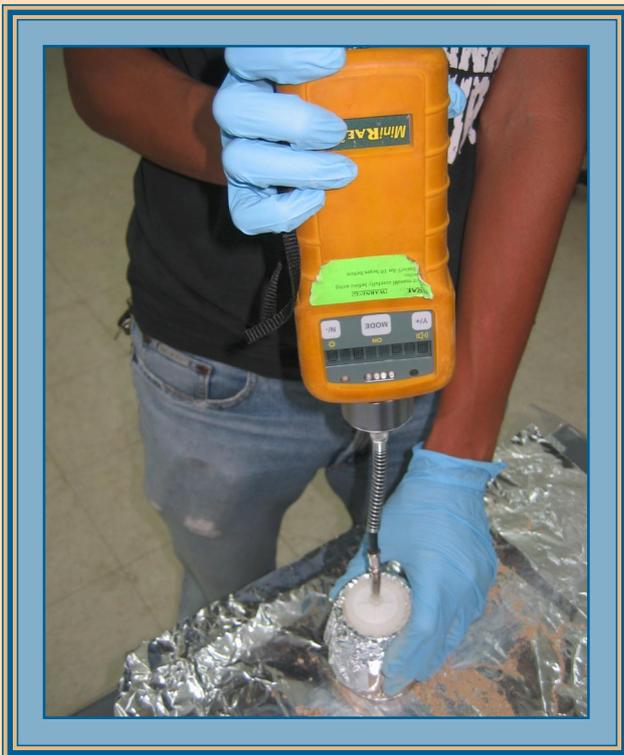


## GROUND INVESTIGATION GUIDELINES

### 7.1 - LAND CONTAMINATION INVESTIGATION

#### Introduction

Land contamination investigations are becoming more common in Hong Kong. Site contamination assessments are becoming a basic requirement before redevelopment of any site, which may have been contaminated due to former usage. This Ground Investigation Guideline (GIG) concentrates on the practical issues relating to the intrusive land contamination investigation (Phase II investigation), under the CAP and then the findings / results reported in the CAR.



#### EPD Requirements

The Environmental Protection Department (EPD) have issued two relevant documents:

- ◆ Practice Note for Professional Persons (ProPECC PN 3/94), which aims to provide guidance on the

requirements for proper assessment and management of contaminated site, guidelines on how site assessments should be conducted and suggests practical remedial measures that can be adopted for the cleanup of contaminated sites.

- ◆ Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol Filling Stations, Boatyards, and Car Repair / Dismantling Workshops (EPD/TR1/99), which details specific requirements for the contamination assessment and implementation of clean up measures. The design of land contamination investigation is clearly defined in Section 3.

The site contamination assessment is split into three well defined sections.

- ◆ Contamination Assessment Plan (CAP)
- ◆ Contamination Assessment Report (CAR)
- ◆ Remedial Action Plan (RAP)

#### Safety Issues

Safety requirements over and above those applicable for normal site investigations depend upon the possible likely contaminants, identified during the initial site assessment. Anticipated contaminants, which are likely to cause harm, should be clearly identified in the pre-work risk assessment and remedial measures put in place to minimise the risk. Remedial measures, in addition to standard personal protective equipment may compose disposable rubber gloves, disposable overalls, safety glasses, dust masks / respirators, creating dirty / clean areas, shower facilities, no smoking, no eating / drinking, etc.. and specific safety rules must be prepared.

#### Sampling (Soil, water and gas)

Depending upon the land contamination investigation goals, three matrices may need to be sampled (Soil, water and gas). Each matrix has different sampling requirements.



Matrix	Sampling Technique	Method / Equipment / Materials
Soil	<p>Inspection / Trial Pit (maximum practical depth 3m) – bulk disturbed sample.</p> <p>Drillhole – U76 / split spoon sample.</p>	<p>Hand excavation using labour with spade, pick axe and scoop.</p> <p>Mechanical boring using drill rig, casing, drill rods, U76 / split spoon sampling equipment and possibly core barrel with water flush if hard strata encountered.</p>
Groundwater / Gas	Monitoring well installed into drillhole. Groundwater sampling using pump or Teflon bailer	UPVC / HDPE perforated and plain pipe with pea gravel filter material and bentonite seal. Pipe diameter should be at least 50mm to allow for sampling.

## Good Practice Sampling Techniques

	Activity	Inspection
Inspection / Trial Pit	Excavate down to top of sampling depth.	Ensure actual sampling depth not disturbed by dirty tools.
	Clean sampling equipment with detergent, rinse with potable water and then distilled water.	Ensure equipment is free from mud and grease.
	Excavate bulk sample and place on plastic sheet.	Ensure no surrounding material is mixed with the sample.
	Wear rubber gloves and use ceramic tools to fill laboratory prepared containers with soil sample, ensure containers filled to the top to reduce any possible headspace.	Ensure containers for laboratory are clean, filled correctly and sealed correctly.
Drillhole	Dry drill down to top of sampling depth. Dry drilling using casing and / or borer / sand catcher.	Ensure casing does not disturb / pass the top of the proposed sampling depth.
	Attach clean U76 tube / split spoon with clean cutting shoe to drill rods and lower down drillhole. Attach slider hammer and penetrate 450mm. Extract U76 / split spoon sample.	Ensure U76 tube / split spoon and cutting shoe are clean and free from grease, prior to lowering down the drillhole.
	For U76 sample, wear rubber gloves and remove cutting shoe and seal using PVC end caps.	Ensure end caps are clean and sample is sealed quickly. Cutting shoe sample can be used for PID testing if required.
	For split spoon sample, wear rubber gloves and use ceramic tools to fill laboratory prepared containers with soil sample, ensure containers filled to the top to reduce any possible headspace.	Ensure containers for laboratory are clean, filled correctly and sealed correctly. Cutting shoe sample can be used for PID testing if required.
Testing	For photo ionisation detection (PID) testing, half fill a plastic tub with soil sample and seal for 2 minutes, then penetrate with probe and record reading.	Ensure tub is clean before use and is sealed fully while waiting to carry out test. The tub should only be half filled to allow space for the potential gas to escape into the space.
Well Installation	Lower uPVC / HDPE pipe into drillhole. Slotted section extends 0.5m – 1.0m above groundwater level in drillhole. Fill around pipe with pea gravel. Pea gravel extends 0.5m above slotted section of pipe. Place 1.0m bentonite seal above pea gravel and backfill to ground level with excavated material or cement / bentonite grout.	Ensure pipe and pea gravel is clean and threaded connections are tightened, no glue to be used. Check pipe diameter is large enough to accommodate water bailer / pump. Thickness of free product on groundwater surface can be measured.
	Develop the well by extracting 5 times the well volume, or until the well is dry. Wait 24 hours following development of well and then remove 3 the well volume or until well is dry and then sample.	Teflon bailer or pump to be used for developing wells. Groundwater should be stored and disposed of correctly. An interface meter can be used to check the thickness of any free product on the groundwater surface within the well. This should be done after development but before purging the well.

## Decontamination Procedures

Decontamination procedures are in place to prevent external contamination of the soil, groundwater and / or gas samples during the site investigation works. Cross contamination of samples occurs by sampling using dirty / contaminated equipment. The contamination can be in the form of grease, oil, remains of soil from a previous sampling depth, etc.

Standard decontamination procedures are as follows:

- ◆ Steam cleaning all equipment prior to mobilisation to site or bring steam cleaning equipment to site (drill rig, casing, drill rods, cutting shoes, U76 / Split spoon sampling tubes and hand tools for inspection / trial pit works). If U76 sampling is used then all sample tubes can be steam cleaned and wrapped ready for use.
- ◆ When equipment arrives on site visual inspection should be carried out to ensure all equipment is clean.

- ◆ Drill rig should be checked for obvious signs of leakage (diesel, oil, hydraulic fluid).
- ◆ Equipment to be repeatedly used for sampling should be cleaned with water and detergent, rinsed and then rinsed with distilled water between each sampling event (i.e. hand tools, cutting shoe of U76 sample, etc).
- ◆ Drilling casing and drill rods should be cleaned with water and detergent, rinsed and then rinsed with distilled water between each drillhole.
- ◆ When handling samples clean disposable rubber gloves should be worn.



## Sample Storage / Transportation

Bulk samples and groundwater samples should be placed in containers provided by the testing laboratory. Typical containers details are provided below. (Note: The actual volume of sample required could vary considerably depending upon which parameters are required for testing, especially for groundwater samples.)

Container per sample			Parameters	Preservation	Temperature
No. of Bottles	Size(mL)	Type			
<b>Soil Samples</b>					
1	500	Amber Glass	Metals (As, Ba, Cd, Cr, Co, Cu, Pb, Hg, Mo, Ni, Sn, Sb, Be, Se, Ag, Tl, V )	None	0 - 4°C
			TPH, BTEX, Aliphatic Chlorinated Hydrocarbon, Non-halogenated Solvents, Halogenated Solvents, PAH, PCB, Chlorobenzenes, Chlorophenols, Phenol, Cyanide		
1	300g	Zip-lock bag	TCLP	None	
<b>Groundwater Samples</b>					
1	250	Plastic bottle	Metals (As, Ba, Cd, Cr, Co, Cu, Pb, Hg, Mo, Ni, Sn, Sb, Be, Se, Ag, Tl, V )	HNO <sub>3</sub>	0 - 4°C
1	1000	Amber Glass	PAH	None	
1	1000	Amber Glass	PCB	None	
1	1000	Amber Glass	Chlorobenzenes	None	
1	1000	Amber Glass	Chlorophenols, Phenol	None	
1	500	Plastic bottle	Cyanide	NaOH	
1	1000	Amber Glass	TPH	None	
2	40	Amber Glass	BTEX, Aliphatic Chlorinated Hydrocarbon, Non-halogenated Solvents, Halogenated Solvents	HCl	

U76 samples provide significantly more sample than a split spoon sampler, so depending upon parameters to be tested a U76 sample is more suitable. Also due to the larger diameter of the U76 sample, the laboratory can extrude the sample and then remove the surface material, which has been in contact with the sides of the U76 tube, preventing any possible contamination. The U76 should be sealed immediately, following extraction with end caps. Sub-sampling can then be carried out in controlled conditions in the laboratory, which reduces the risk of any potential cross contamination resulting from sub-sampling in the field.

Once soil, water or gas samples are sealed and labelled they should be stored in cooler boxes between 0 - 4°C, but not frozen. A "Chain of Custody" (CoC) form should be completed to contain sample reference, location, matrix, depth, etc. The samples should be delivered to the laboratory at the end of each working day, or stored in an electric refrigerator between 0 - 4°C. Once delivered to the laboratory, they should confirm receipt of the samples by signing the CoC form.

### Quality Assurance / Quality Control (QA/QC)

QA/QC is used to confirm that no cross contamination of sampling has occurred either during sampling on site, transportation samples, or within the laboratory during

sample preparation / testing. QA/QC generally comprise the following types and are scheduled on the basis of 1 per 20 samples:

- ◆ Trip Blank – analyte-free water sample, which is delivered from the laboratory, held on site and then returned to the laboratory for testing, without having been exposed to sampling procedures (i.e. opened). To check no contamination of samples during transportation.
- ◆ Field Blank – analyte-free water sample, which is delivered from the laboratory, opened and closed on site and then returned to the laboratory for testing. To check for any external / environmental contamination on site (i.e. from the air, etc..).
- ◆ Reinstatement / Equipment Blank – analyte-free water poured over sampling equipment after cleaning and sent to the laboratory for testing. To check that sampling equipment is not introducing any possible contaminants.
- ◆ Duplicate – an additional soil or groundwater sample taken at the same time and depth of another sample, given a different identification reference and then sent to the laboratory for testing. The test results for the actual sample and duplicate sample can then be compared like for like.