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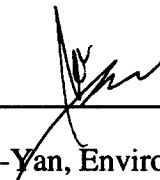


**ENVIRONMENTAL IMPACT ASSESSMENT (EIA) ORDINANCE, CAP. 499**

**ENVIRONMENTAL PERMIT NO. EP-248/2006**

**LAMMA POWER STATION UNITS L4 & L5  
FLUE GAS DESULPHURIZATION PLANT RETROFIT PROJECT**

**ENVIRONMENTAL MONITORING & AUDIT PROGRAMME**

Report Title	Proposal of Controlling Land Contamination and Handling of Excavated Contaminated Materials (Revision 1)
Date	11 April 2007
Certified by	 (Mr. IP Tat-Yan, Environmental Team Leader)

香港電燈有限公司  
The Hongkong Electric Co., Ltd.



**PROJECTS DIVISION**

**LAMMA POWER STATION**

**UNITS L4 & L5 FLUE GAS DESULPHURIZATION  
PLANT RETROFIT PROJECT**

**ENVIRONMENTAL PERMIT NO.  
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**PROPOSAL OF CONTROLLING LAND  
CONTAMINATION AND HANDLING OF EXCAVATED  
CONTAMINATED MATERIALS**

**April 2007**

**Revision 1**

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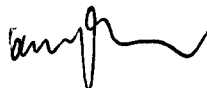
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**April 2007**

**Revision 1**

Prepared by:



Mr. Andy K.F. Fok  
Civil Engineer

Date:

11.4.07

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1 INTRODUCTION

The Hongkong Electric Company Ltd (HEC) has initiated a project to retrofit its two existing 350MW coal-fired generating Units L4 and L5 of Lamma Power Station with Flue Gas Desulphurization (FGD) Plant for reducing sulphur dioxide emission in support of Government policy objective to improve the air quality of the Pearl River Delta.

For installation of the FGD plants, two above ground oil storage tanks (No. 4 and No. 5 Light Oil Tanks) with associated pipelines and an oil separation sump are to be demolished to provide space for installation of the FGD plants. Contamination Assessment Plan (CAP) has been approved by EPD in November 2005 and site investigation (SI) was conducted in the area adjacent to the tanks and oil separation sump. The SI results indicated that total petroleum hydrocarbon (TPH) was detected at one soil sample and five groundwater samples exceeding Dutch B guideline for mineral oil (Table 1 refers). Results of SI and recommendations have been reported in the Contamination Assessment Report (CAR) and the Remedial Action Plan (RAP) (see Annex of the EIA Report). Remedial measures and procedure for TPH contamination are recommended in the RAP.

An Environmental Permit (No. EP-248/2006) dated 25 April 2006 for the project was issued by EPD which sets out the conditions and requirements for HEC to comply with during the decommissioning, construction and operation of the project. Clause 2.7 of the EP set out requirements with regard to the submission of a detailed proposal of controlling land contamination and handling of excavated contaminated materials as follows:-

*The Permit Holder shall, no later than one month before the commencement of excavation associated with the demolition of the Light Oil Tanks, submit to the Director for approval four hard copies and one soft copy of the detailed proposal of controlling land contamination and handling of excavated contaminated materials. The proposal shall include the following information:*

- (a) detailed arrangements of excavating, stockpiling, transporting and treating the excavated materials;*
- (b) detailed design and method statement of the bio-remediation treatment methods;*
- (c) detailed monitoring arrangements, including details of samplings, testings, evaluation criteria, to verify the completion of the treatment process and the suitability of the reuse or disposal of the excavated materials;*
- (d) locations of the reuse or disposal of the decontaminated materials; and*
- (e) other measures to prevent land contamination during the decommissioning of the Project.*

This document serves to fulfill the above EP condition with an objective as to formulate appropriate construction practices and precautionary measures for prevention of land contamination during the decommissioning of the Project.

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2 PREVIOUSLY APPROVED DOCUMENTS

This proposal has made reference to the following approved documents:

<u>Title</u>	<u>Reference No.</u>	<u>Time of Approval</u>
Environmental Impact Assessment Report (EIA Report) including Remediation Action Plan (RAP) & Contamination Assessment Report (CAR)	AEIAR-098/2006	24 March 2006
Environmental Permit	EP-248/2006	25 April 2006

3 CONTROLLING LAND CONTAMINATION AND HANDLING OF EXCAVATED CONTAMINATED MATERIALS

3.1 Detailed arrangements of excavating, stockpiling, transporting and treating the excavated materials

During the course of decommissioning of Light Oil Tanks and Oil Separation Sump, the detailed arrangements of excavating, stockpiling, transporting and treating the excavated materials are summarized as follows:-

- The excavation parcels for Light Oil Tanks (parcel 18x18 m<sup>2</sup>) and Oil Separation Sump (12x9 m<sup>2</sup>) are demarcated on site by surveying before excavation.
- Excavation will be carried out with conventional earthmoving equipment such as excavator.
- Stockpile area of excavated materials from No. 4 & 5 Light Oil Tanks and Oil Separation Sump is shown in figure 2 (Area D1).
- Impermeable liner will be placed at the bottom of the stockpile areas.
- Excavated soils will be loaded directly onto vehicles at the point of excavation to avoid stockpiling of contaminated soils, minimize double handling and any associated loss. They will then be transported in the containers which can contain any discharge or leakage arising during the transportation to the allocated areas for temporarily stockpiling.

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- Excavated materials from the three locations (Figure 1 refers) shall not be mixed during excavation, transportation and stockpiling.
- Excavated materials at stockpile area will be covered by impermeable sheeting against wind and rain.
- *Non-Contaminated Excavated Materials*

A total of approximately 2,300 m<sup>3</sup> (after applying a bulking factor of 1.2) of excavated soil materials (mainly soft materials, i.e. sand and clay) will be generated from the demolition of the No.4 and No.5 Oil Tanks, Oil Separation Sump and excavation for construction of foundations for new facilities. This volume does not include the volume of the existing in-ground tank foundations and sump structures, which were already included as part of demolition wastes. In addition, approximately 560 m<sup>3</sup> of soil and rock materials will be generated from the bored pile excavation.

- *Contaminated Excavated Materials*

A total of 600 m<sup>3</sup> (after applying a bulking factor of 1.2) of excavated soil materials (including soft soil materials, i.e. sand and clay and bored pile excavations) will be generated. This volume does not take into account existing in-ground No.5 tank foundation structures, which were already included as part of demolition wastes.

### 3.2 Sample testing plan

- Upon completing the excavation, verification sampling for Total Petroleum Hydrocarbon (TPH) contamination in soil around the excavated parcel will be conducted as below :

*No. 4 & 5 Light Oil Tanks :*

*Soil samples will be obtained at the north, west, south and east boundaries of the parcel at 0.5 and 1.5 m bgl; and in the middle of the parcel at the bottom of the excavation.*

*Oil Separation Sump :*

*Soil samples will be obtained at the north, west, south and east boundaries of the parcel at 0.5 and 1.65 m bgl; and in the middle of the parcel at the bottom of the excavation.*

- QA/QC samples will be collected. Soil samples from the inner layer of the side wall of excavated parcel will be collected and put in the

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preserved sample bottles provided by the laboratory. The soil samples will be preserved in 0 – 4 °C and sent to the laboratory for analysis. The samples will be tested for TPHs by the HOKLAS accredited laboratory.

### 3.3 Results interpretation

The TPH results in soil will be compared against the Dutch B standards (cleanup targets for biopile closure). The laboratory results are considered satisfactory when the levels of TPH in samples meet the cleanup target.

- *No. 4 Light Oil Tank & Oil Separation Sump*

As presented in Land Contamination : Remediation Action Plan (RAP), no TPH was detected in soil taken at No. 4 Light Oil Tank and Oil Separation Sump.

If the analytical results of the verification samples are below the Dutch B levels for TPHs, it is considered that the excavated materials from No. 4 Light Oil Tank and Oil Separation Sump are non-contaminated and will be handled in conventional way and no bio-remediation treatment is required.

If the analytical results of the verification samples exceed the Dutch B levels, additional soil shall be excavated either laterally or vertically, depending on the analytical results and the verification sampling and analysis process repeated until all confirmation samples are below the relevant action levels. The excavation will be limited to the Site area only.

- *No. 5 Light Oil Tank*

As presented in RAP, concentration of TPH in soil materials at borehole BH3 at 0.8 m bgl exceeded the Dutch B value but was below the Dutch C value while TPH in soil materials at BH4 was within the Dutch B value.

If the analytical results of the verification samples are below the Dutch B levels for TPHs, the removal of the contaminated material shall be considered complete.

If the analytical results of the verification samples exceed the Dutch B levels, additional soil shall be excavated either laterally or vertically, depending on the analytical results and the verification sampling and analysis process repeated until all confirmation samples are below the relevant action levels. The excavation will be limited to the Site area only.

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- Excavated contaminated materials will be treated by bio-remediation method “biopile”.

3.4 Detailed design and method statement of the bio-remediation treatment methods

*Preparation*

- HDPE impermeable liner will be placed on the base of biopile.
- Perforated leachate collection HDPE pipes will be installed on top of the baseliner to collect excess moisture from the treatment cell (i.e., leachate).
- The leachate collection pipes are covered with pea gravel (or coarse sand) and a geotextile liner.
- Leachate collection sump will be constructed along the perimeter of the biopile to prevent leachate from contaminating the underlying soil / ground water.
- A continuous and impermeable concrete bund of at least 200mm high will be constructed along the perimeter of biopiles to prevent the runoff coming out from the contaminated soil.
- All leachate collected shall be properly treated.

*Treatment*

- Soil required treatment will then be placed on top of the geotextile liner in lifts of 0.5 to 1m.
- Soil for biopile treatment will be stockpiled with a height no more than 3m.
- A nutrient mixture used to increase hydrocarbon-degrading bacteria will be sprayed on the impacted soils while they are being placed into the treatment cell.
- After each lift of soil is placed in the cell, slotted ventilation pipes and soil vapour monitoring probes are installed on top of the lift. The ventilation pipes are used to supply oxygen to the bacteria in the soil and the vapour monitoring probes are used to monitor gaseous concentration, e.g. oxygen and carbon dioxide, in the treatment cell.

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- Alternating additional lifts of soil and piping are then installed to the top of the cell. Once the cell is complete, it is covered with a liner that is anchored to the ground.
- The ventilation pipes are connected to a blower system to create airflow through the cell.
- Moisture will be periodically added to the soil.
- Monitoring the cell is conducted through measurement of carbon dioxide concentrations in vapour within the cell and hydrocarbon concentrations in air extracted from the treatment cell.
- As remediation progresses, both carbon dioxide and hydrocarbon concentrations will decrease until successful reduction of the chemical concentrations in the soil has been achieved.
- The biopile will be all times covered by impermeable sheeting to control air and water pollution.
- Typical arrangement is illustrated in figures 3 & 4.

### 3.5 Detailed monitoring arrangements

The biopile will be tested periodically for TPH level and carbon dioxide concentration to monitor its rate of degradation. The proposed sampling arrangement is summarized follow:

#### Before Treatment

- *1 soil sample (namely baseline sample) for every 100 m<sup>3</sup> biopile soil will be taken as initial record.*

#### During and After Treatment

- *Soil gas samples are collected as process monitoring monthly from the monitoring probes by use of a vacuum pump for testing oxygen and carbon dioxide concentrations.*
- *1 soil sample (namely monitoring sample) for every 100 m<sup>3</sup> biopile soil will also be taken monthly as process monitoring.*
- *Additional 1 soil sample (namely confirmation sample) for every 100 m<sup>3</sup> biopile soil will be taken for final verification.*

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Sampling locations will be determined based on the results of soil gas monitoring, typically from those locations showing the highest soil gas concentration.

Sampling locations will be documented accurately so that the analytical results can be correlated with locations within the biopile.

Extracting the soil samples will be accomplished using a hand auger or approved other method.

Frequency of samplings will be reviewed and adjusted according to the analytical results and progress of degradation.

Confirmation samples will be collected at representative locations distributed evenly throughout the biopile and at various depths with the biopile.

Upon completion of biopile treatment, concentration of TPH contamination will be below or equal to that of the Dutch B standard and the materials are considered to be suitable for reuse or disposal.

3.6 Locations of the reuse or disposal of the decontaminated materials

Pursuant to clause 2.3 of Environmental Permit, no excavated materials arising from the demolition of the Light Oil Tanks shall be stockpiled, treated or disposal of outside the Lamma Power Station and its Extension.

All excavated materials including those after biopile treatment are suitable for reuse as clean soil for backfilling. They will be stockpiled for this Project and future development at Lamma Power Station and its Extension.

3.7 Other measures for prevention of land contamination during decommissioning of the Project

- All oil tanks use for construction use if any will be equipped with drip tray to prevent oil spillage.
- Groundwater arising from the decommissioning of the Project will be recharged back to the Site. No groundwater will be used for any purposes.
- All wastewater or effluent arising from the stockpiling, transportation and treatment of the excavated contaminated materials will be properly collected and treated.

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- Surface run-off from the construction site will be directed into sand/silt removal facilities, such as sand/silt traps and sediment basins before discharge.

4 HEALTH AND SAFETY CONTROL MEASURES

The remediation work will involve soil excavation, soil stockpiling and soil sampling. In order to minimize the contacts of the workers with the contaminated materials and to ensure safe work environments during the remediation works, the following control measures are proposed.

- Prior to commence any remediation work, a health and safety risk assessment should be performed for the remediation work to identify potential work related hazards and prepare appropriate control measures.
- Appropriate personal Protective Equipment (PPE) such as safety hat, chemical protective gloves, masks, eye goggles, protective clothing and protective footwear shall be provided to staff who would be involved in the remediation works. No works should be allowed without the suitable PPE.
- Workers shall inspect and check their PPE before, during and after use. In cases where any of the PPE is impaired. The worker shall stop work immediately and inform their supervisor. The worker shall not be allowed to re-start his work until the impaired PPE is replaced.
- Workers shall always maintain basic hygiene standard (e.g. hand wash before leaving the contaminated work area). Workers shall also be responsible for cleaning and storing their own PPE in a secure place before leaving the site.
- Eating, drinking and smoking must be strictly prohibited within the contaminated site area.
- The designated site management representatives must be informed if any workers feel uncomfortable physically or mentally during the remediation works. All workers shall leave the work areas and the work shall be temporarily suspended until the reason for the uncomfortable feeling has been identified.
- The works shall be stopped or discontinued when any typhoon signal number 3; yellow, red or black storm signals are hoisted. All stockpile materials (if any) shall be covered immediately by tarpaulin or other similar protective and waterproof materials.

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- The use of bulk earth-moving excavator equipment would minimize construction workers' potential contact with contaminated materials.
- Earthmoving equipment and vehicles after the excavation will be properly decontaminated (wheel wash and high pressure spray of container and other parts that come in contact with the potentially contaminated materials) in designed areas before leaving the site.

The following cleaning procedures will need to be undertaken and repeated to avoid potential cross contamination.

Decontamination Procedures

- Manual washing and scrubbing with non-phosphate detergent;
- Distilled water rinse; and
- Air drying.

Where available, a steam cleaner or pressure washer could be used.

5 RECORD

Records on quantity of excavated non-contaminated and contaminated materials, samplings and results of laboratory will be documented.

6 REPORTING

Pursuant to clause 2.8 of EP, a decontamination verification report including the level of total petroleum hydrocarbon (TPH) in the excavated contaminated material before and after the treatment and total quantity of excavated contaminated materials arising from the demolition of the Light Oil Tanks and Oil Separation Sump shall be deposited with the Director of Environmental Protection.

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Soil and ground water criteria used in The Netherlands for contaminated land ("Dutch List")

Component	Soil (mg/kg dry soil)			Ground water (ug/L)			
	A	B	C	A	B	C	
<b>1. Metals</b>							
Cr	100	250	800	20	50	200	
Co	20	50	300	20	50	200	
Ni	50	100	500	20	50	200	
Cu	50	100	500	20	50	200	
Zn	200	500	3000	50	200	800	
As	20	30	50	10	30	100	
Mo	10	40	200	5	20	100	
Cd	1	5	20	1	2.5	10	
Sn	20	50	300	10	30	150	
Ba	200	400	2000	50	100	500	
Hg	0.5	2	10	0.2	0.5	2	
Pb	50	150	600	20	50	200	
<b>2. Inorganics</b>							
NH <sub>4</sub> (as N)	-	-	-	200	1000	3000	
F (total)	200	400	2000	300	1200	4000	
CN	(tot. free)	1	10	100	5	30	100
	(tot. comb.)	5	50	500	10	50	200
S (total)	2	20	200	10	100	300	
Br (total)	20	50	300	100	500	2000	
PO <sub>4</sub> (as P)	-	-	-	50	200	700	
<b>3. Aromatics Compounds</b>							
Benzene	0.01	0.5	5	0.2	1	5	
Ethylbenzene	0.05	5	50	0.5	20	60	
Toluene	0.05	3	30	0.5	15	50	
Xylenes	0.05	5	50	0.5	20	60	
Phenols	0.02	1	10	0.5	15	50	
Total	0.1	7	70	1	30	100	
<b>4. Polycyclic Hydrocarbons</b>							
Naphthalene	0.1	5	50	0.2	7	30	
Anthracene	0.1	10	100	0.1	2	10	
Fenanthrene	0.1	10	100	0.1	2	10	
Flouranthene	0.1	10	100	0.02	1	5	
Pyrene	0.1	10	100	0.02	1	5	
1,2 - benzopyrene	0.05	1	10	0.01	0.2	1	
Total	1	20	200	0.2	10	40	
<b>5. Chlorinated Hydrocarbons</b>							
<b>Aliphatics</b>							
	(Individual)	0.1	5	50	1	10	50
	(Total)	0.1	7	70	1	15	70
<b>Chlorobenzenes</b>							
	(Individual)	0.05	1	10	0.02	0.5	2
	(Total)	0.05	2	20	0.02	1	5

**Table 1** Dutch List  
(Extracted from Appendix IV of ProPECC PN 3/94)

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<u>Component</u>	<u>Soil (mg/kg dry soil)</u>			<u>Ground water (ug/L)</u>			
		<u>A</u>	<u>B</u>	<u>C</u>	<u>A</u>	<u>B</u>	<u>C</u>
<b>Chlorophenols</b>							
	(Individual)	0.01	0.5	5	0.01	0.05	1.5
	(Total)	0.01	1	10	0.01	0.5	2
<b>Chlor. PAHs (Tot.)</b>		0.05	1	10	0.01	0.2	1
<b>PCB's (Tot.)</b>		0.05	1	10	0.01	0.2	1
<b>EOCL (Tot.)</b>		0.1	8	80	1	15	70
<b>6. Pesticides</b>							
<b>Chlorinated organics</b>							
	(Individual)	0.1	0.5	5	0.5	0.2	1
	(Total)	0.1	1	10	0.1	0.5	2
<b>Pesticides</b>							
	(Total)	0.1	2	20	0.1	1	5
<b>7. Other Pollutants</b>							
<b>Tetrahydrofuran</b>		0.1	4	40	0.5	20	60
<b>Pyridine</b>		0.1	2	20	0.5	10	30
<b>Tetrahydrothiophene</b>		0.1	5	50	0.5	20	60
<b>Cyclohexanes</b>		0.1	6	60	0.5	15	50
<b>Styrene</b>		0.1	5	50	0.5	20	60
<b>Gasoline</b>		20	100	800	10	40	150
<b>Mineral Oil</b>		100	1000	5000	20	200	600

These values are not "standards" but rather guidelines for use in assessing the significance of contaminated land. A simplified explanation of the ABC levels : A - level implies unpolluted, B - level implies pollution present and further investigation required, C - level implies significant pollution present and cleanup (preferably back to the A - level ) required.

**Table 1** Dutch List (Con'td)  
 (Extracted from Appendix IV of ProPECC PN 3/94)

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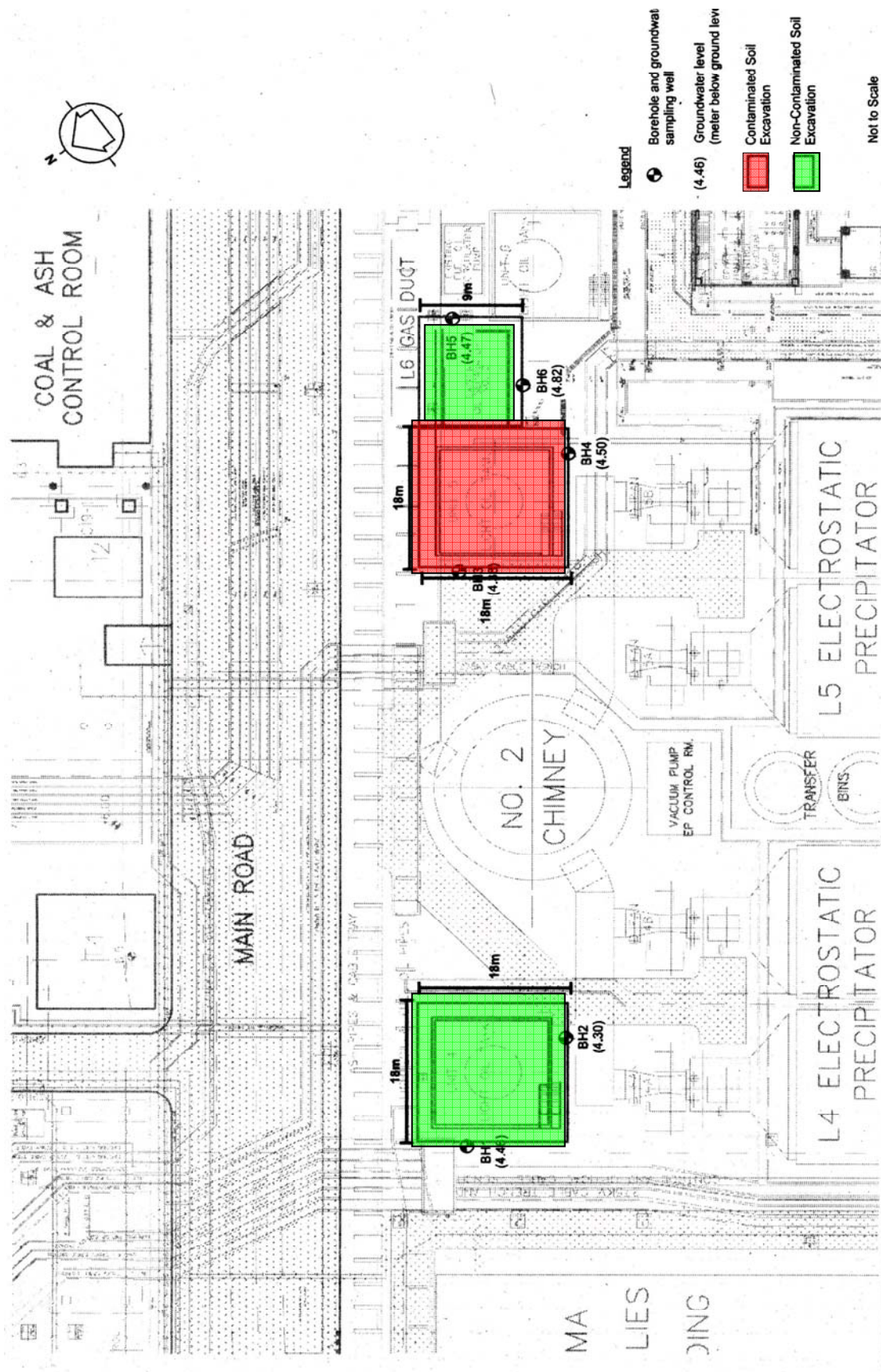
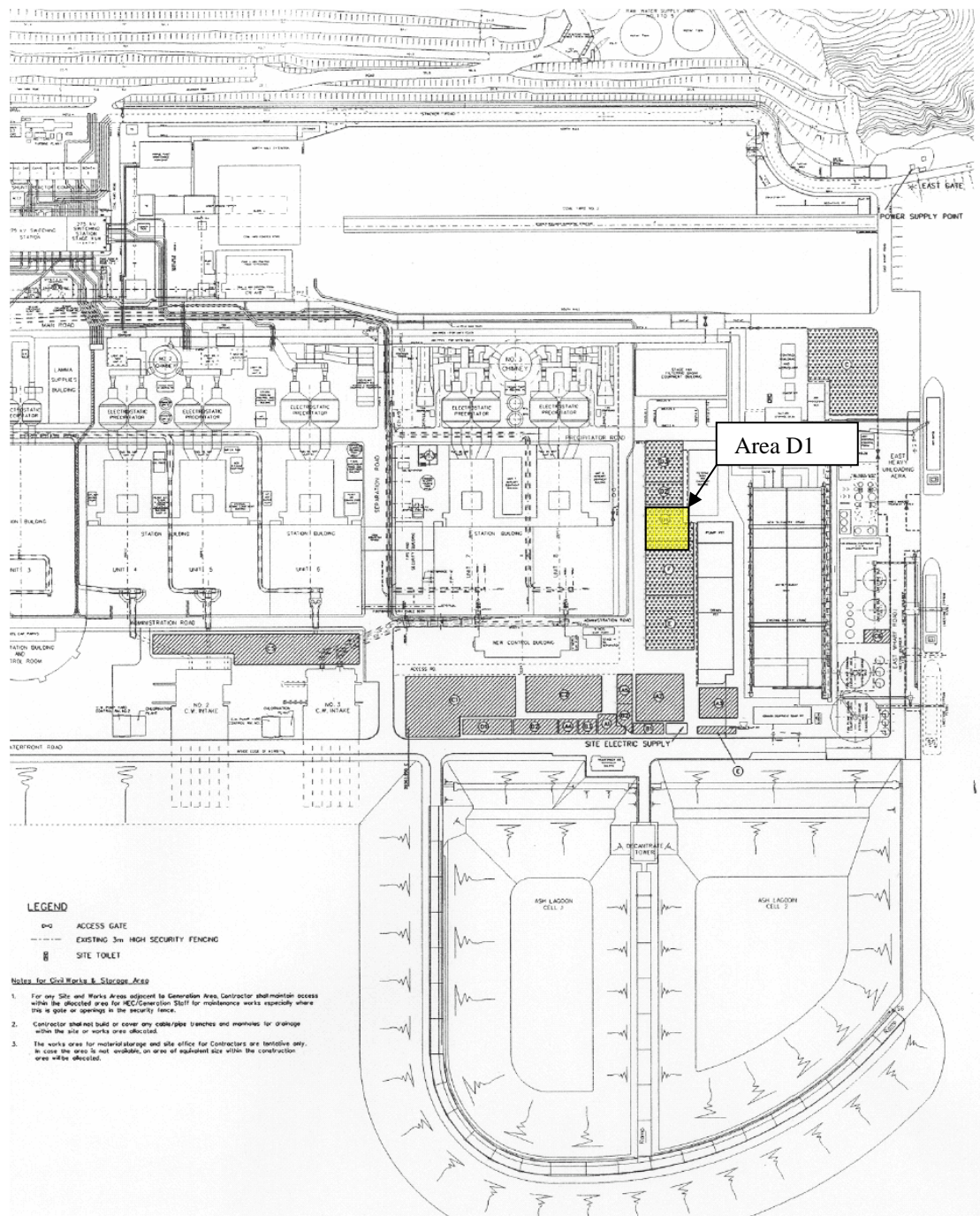


Figure 1 Location of Site Investigation Boreholes

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**Figure 2** Stockpile Area for Excavated Materials

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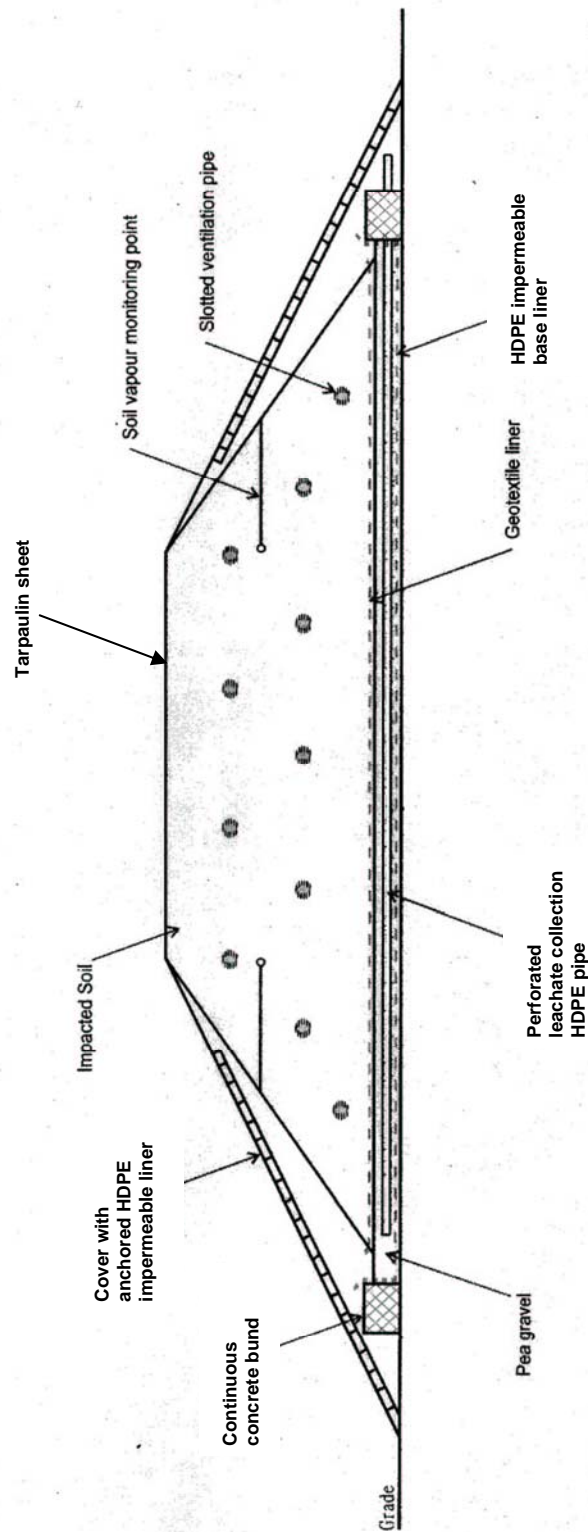
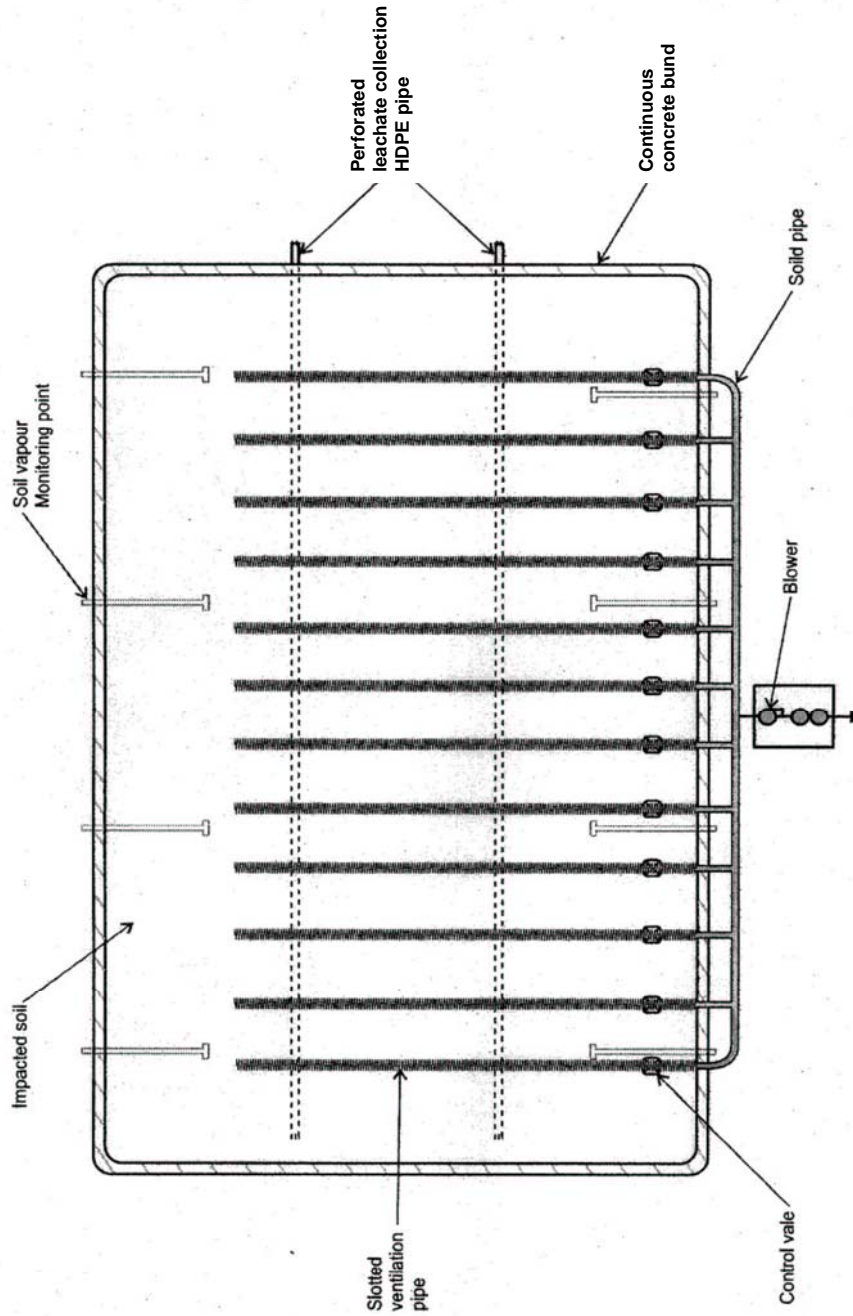


Figure 3 Typical Biopile Treatment Cross Section

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**Figure 4** Typical Biopile Treatment Cell Plan View