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

Lamma Power Station Units L4 & L5 Flue Gas Desulphurization Plant Retrofit Project

Environmental Impact Assessment Report

February 2006

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EIA REPORT

The Hongkong Electric Co. Ltd

Lamma Power Station Units L4 & L5 Flue Gas Desulphurization Plant Retrofit Project

Environmental Impact Assessment Report

February 2006

Reference : 0038824

For and on behalf of Environmental Resources Management	
Approved by:	Steve Duckworth
Signed:	Steve Duckworth
Position:	Deputy Managing Director
Date:	2 February 2006

CONTENT

1 INTRODUCTION

1.1 THE EIA STUDY

This Environmental Impact Assessment (EIA) Report addresses the potential environmental impacts associated with the construction and operational phases of a project entitled "Lamma Power Station Units L4&L5 Flue Gas Desulphurisation Plant Retrofit Project" (hereinafter referred to as the Project).

The Project is classified under EIAO as a material change to an exempted designated project, the Lamma Power Station as a *Public Utility Electricity Power Plant* (Item D.1 Part I Schedule 2 of the EIAO Chapter 499), because of the changes induced by the FGD operations to the types and quantities of emissions, wastes and effluents. In addition, the demolition of two existing Light Oil Tanks is a designated project under item 16 Part II (*Decommissioning Projects*) Schedule 2 of EIAO (i.e. *a store for oil with a storage capacity exceeding 200 tonnes*).

This report has been prepared by ERM-Hong Kong, Limited (ERM) in accordance with the *EIA Study Brief* (No. ESB-133/2005) [1] and the *Technical Memorandum of the Environmental Impact Assessment Process* (*EIAO-TM*). The *Study Brief* was issued in October 2005, following submission by the Hongkong Electric Co., Ltd (HEC) in September 2005 of the *Project Profile* (No. PP-261/2005) [2] for the retrofit.

1.2 OBJECTIVES OF THE STUDY

The *Study Brief* stipulates the following objectives for this EIA:

- to describe the Project and associated works together with the requirements and environmental benefits for carrying out the Project;
- to identify if there are other types of Designated Projects under Schedule 2 of the EIAO to be covered in the Project;
- to identify and describe the elements of the community and environment likely to be affected by the Project and/or to likely cause adverse impacts to the Project, including both the natural and man-made environment and the associated environmental constraints;
- to identify and quantify emission sources and determine the significance of impacts on sensitive receivers and potential affected uses;

(1) http://www.epd.gov.hk/eia/register/study/latest/esb-133.doc

(2) http://www.epd.gov.hk/eia/register/profile/latest/esb133.pdf

- to identify and quantify any potential land contamination caused, to determine the significance of the impact and to propose measures to mitigate the impact;

- to propose the provision of infrastructure or mitigation measures to minimize pollution, environmental disturbance and nuisance during construction, operation and decommissioning of the Project;

- to investigate the feasibility, practicability, effectiveness and implications of the proposed mitigation measures;

- to identify, predict and evaluate the residual environmental impacts (i.e. after practicable mitigation) and the cumulative effects expected to arise during the construction, operation and decommissioning phases of the Project in relation to the sensitive receivers and potential affected uses;

- to identify, assess and specify methods, measures and standards, to be included in the detailed design, construction, operation and decommissioning of the Project which are necessary to mitigate these environmental impacts and cumulative effects and reduce them to acceptable levels;

- to investigate the extent of the secondary environmental impacts that may arise from the proposed mitigation measures and to identify constraints associated with the mitigation measures recommended in the EIA study, as well as the provision of any necessary modification; and

- to design and specify the environmental monitoring and audit requirements to ensure the effective implementation of the recommended environmental protection and pollution control measures.

1.3 NEED FOR THE PROJECT

As stated in the 2002 HKSAR Government press release [1]: *The HKSAR Government and the Guangdong Provincial Government have agreed to aim to reduce, on a best endeavour basis, the regional emissions of sulphur dioxide, nitrogen oxides, respirable suspended particulates and volatile organic compounds by 40%, 20%, 55% and 55% respectively by 2010, using 1997 as the base year. To achieve these targets, the two Governments will study and consider in detail the various improvement measures recommended in the study, determine work priorities and draw up action plans having regard to the feasibility of the proposed improvement measures. The two Governments aim to strive to reduce the emissions from their own sources by the same levels in 2010. Achieving the emission reduction targets will*

(1) http://www.info.gov.hk/gia/general/200204/29/0429128.htm

enable Hong Kong to meet its current air quality objectives. At the same time, cities in the Region will meet the relevant national air quality objectives except for certain time periods and locations. The problem of smog will also be significantly improved.

The Project is proposed in response to the above Government emission reduction commitment with regard to SO_2 emissions and represents HEC contribution to that goal.

1.4 PROJECT DESCRIPTION

1.4.1 Background

The Hongkong Electric Company, Limited (HEC) is planning to retrofit the two existing 350MW coal-fired generating Units L4 and L5 of Lamma Power Station with Flue Gas Desulphurisation (FGD) plant for reducing sulphur dioxide emissions in support of Government policy to improve the air quality of the Pearl River Delta.

It is proposed to adopt the "Wet Limestone-Gypsum" process for the FGD plants, a technology which is already used in, and proved effective and reliable for the existing coal-fired units L6, L7 & L8.

The proposed FGD process involves directing the flue gas from the boilers of Units L4 and L5 to FGD plants, in which limestone slurry is introduced to react with flue gas for removal of SO_2, before discharging to the chimney. As a result, besides a significant reduction of the SO_2 concentration in the flue gas, the temperature of flue gas entering the chimney will be reduced, waste water from the FGD absorber will be produced and gypsum will also be produced as a by-product.

1.4.2 Purpose and Nature of the Project

Lamma Power Station has an installed capacity of 3,420MW comprising 3x250MW and 5x350MW coal-fire units, 1x365MW oil-fired combined cycle unit, and 1x55MW and 4x125MW oil-fired open cycle gas-turbine units. The latest three 350MW coal-fired units, Units L6, L7 & L8, are equipped with FGD plants. The proposed retrofit project will include the installation of FGD plants with flue gas desulphurization efficiency of 90% for the two 350MW coal-fired Units L4 & L5 to reduce the overall SO_2 emissions from Lamma Power Station.

Location of the Project is presented in *Figure 1.1.*

1.4.3 Consideration of Alternatives

A comprehensive study on FGD technologies were carried out in the EIA Study for Units L7 & L8 at Lamma Power Station in 1993 of which two study reports namely *Selection of FGD Process* and *Detailed Comparison of FGD Processes for Units L7 & L8 at Lamma Power Station* were prepared and submitted to the EPD. Various FGD technologies including wet, semi-dry, dry processes have been updated and evaluated by HEC in house studies and

were considered less advantageous in both environmental and economical considerations. Since the "Wet Limestone-Gypsum" is already used in Lamma Power Station for more than 10 years which has proved effective and reliable for the existing coal-fired units L6, L7 & L8, it is considered that Wet Limestone-Gypsum Process, in terms of maturity, cost, SO_2 removal performance, reagent availability, by-product quality, synergy benefits, is the most suitable process for the application in L4 & L5 FGD retrofit project.

1.4.4 Proposed Additions, Modifications and Alterations

As stated in the *Project Profile*, at present, the flue gas from Units 4&5 Boilers is directly discharged to the atmosphere via a 210 m high chimney. The retrofit work will involve demolishing the existing Nos. 4 & 5 Light Oil Tanks (each of 250m^3 capacity) and relocating some of the pipeworks located in front of the respective boiler to provide areas for installing FGD plant for each of Units L4 & L5.

The flue gas from the boiler will be directed to the FGD absorber inside which removal of SO_2 will take place by reaction with limestone slurry. After passing through the absorber, the treated flue gas will be heated up by a gas-gas heater to over 80°C at boiler rated capacity and directed back to the existing chimney for discharge to the atmosphere.

As majority of the existing common limestone powder/gypsum handling and storage facilities for Units L6, L7 & L8 FGD plants have spare capacity to cater for two more FGD units, the additional equipment required for Units L4 & L5 FGD retrofits will be limited to the extension of the existing gypsum dewatering system.

Figure 1.2 shows the additional equipment to be installed for the proposed retrofit project for Units L4 and L5 which includes:

- Two sets of FGD absorbers and associated ductworks
- Two sets of booster fans
- Two sets of gas-gas heaters
- FGD Switchgear and Equipment Building
- Gypsum dewatering system comprising two sets of hydrocyclones and belt filters

Figure 1.3 shows the layout of the two existing Light Oil Tanks to be demolished.

1.4.5 Project Programme

Based on the lead time required for design, delivery and construction, the targeted key dates for the proposed FGD retrofit project are as follows:

- Commencement of demolition of L.O. Tanks April 2006

- Commencement of civil works September 2006
- Commencement of plant erection for L5 Unit October 2007
- Commencement of plant erection for L4 Unit August 2008
- Commercial operation of L5 FGD Plant July 2009
- Commercial operation of L4 FGD Plant April 2010

1.4.6 Interaction with Other Projects

No other major project was identified to be carried out concurrently in the vicinity of the proposed Project.

1.5 OUTLINE OF THE FGD PROCESS

The "Wet Limestone - Gypsum" process being employed for Units L6, L7 and L8 of Lamma Power Station will be adopted for the proposed retrofit project. This technology has been proved reliable and effective, and the operating and maintenance (O&M) costs are low. Adopting the same technology for Units L4 & L5 will have synergy benefits on O&M and utilizing most of the common limestone/gypsum storage and handling facilities already in place for the existing FGD plants.

Figure 1.4 shows the schematic diagram of the FGD plant.

Limestone powder is mixed with water to form slurry and fed to the scrubber to absorb SO_2 from the flue gas. The by-product is withdrawn for dewatering to produce saleable gypsum. The clean flue gas is reheated before entering the chimney to regain buoyancy for better dispersion and to prevent acid condensation in the chimney.

Boiler flue gas is directed to the absorber tower inside which SO_2 reacts with the limestone slurry in the suspension to calcium sulphite which is oxidised to calcium sulphate in the absorber sump. Recycle slurry in the absorber sump is maintained in motion by agitators to enhance gypsum crystal growth, achieve a high degree of sulphite oxidation and promote limestone dissolution.

A booster fan is provided to overcome the draft loss of the flue gas passing through the FGD system. Three sets of dampers and a pair of guillotine shutters are used to bypass and isolate the FGD plant. Gas-gas heater is adopted to heat up the clean gas leaving the absorber to minimise the effect of condensation of flue gas and to ascertain its effective dispersion of the remnant pollutants to the atmosphere.

The reacted limestone slurry in the absorber sump, called gypsum slurry, which is no longer useful is bled off to a set of hydrocyclones and vacuum belt filters located inside the existing gypsum dewatering building for dewatering

and gypsum in cake form is produced as a result. The filtrate generated thereof is directed to the existing wastewater treatment system.

Gypsum discharged from the belt filters with a purity of 90%, moisture of 10% and chloride of 200ppm is carried through a set of belt conveyors into the existing gypsum silo for off-site industrial application/reuse by barges.

The FGD plants of the proposed retrofit project are capable of removing 90% of the SO_2 in the boiler flue gas.

1.6 SCOPING OF ENVIRONMENTAL ISSUES

The potential environmental impacts associated with the Project are summarised in *Table 1.1*.

Table 1.1 Potential Sources of Environmental Impacts

Type of Potential Impact	Construction	Operation	Remarks
Noise generation	✓	✓	See Section 6
Impacts on ecological resources	X	X	
Visual aspects	✓	✓	See Section 7
Gaseous emissions	✓	✓	See Section 3
Dust	✓	X	See Section 3
Liquid effluents	✓	✓	See Section 4
Disposal of spoil material	✓	X	See Section 5
Generation of waste or by-products	✓	✓	See Section 5
Disruption of water movement or bottom sediment	X	X	
Risk of accidents which would result in pollution or hazard	X	X	
Endangerment of cultural heritage resources	X	X	
Traffic generation	X	X	Minor increase in marine traffic

1.7 STRUCTURE OF THIS REPORT

The objective of the Project is to reduce the SO_2 emissions from the L4 and L5 units, which would lead to an improvement of environmental performance of the Lamma Power Station with regard to Air Quality. The Project may however create, both in the operational and construction phases, some impacts in other areas such as Water Quality or Waste Management. All the potential environmental impacts, of the Construction and Operational Phases

of the Project, as well as the Environmental Monitoring and Audit (EM&A) requirements (where necessary) are addressed in detail in the following sections which constitute the principal part of the main part of this report of the Environmental Impact Assessment Study.

The remainder of this EIA Report comprises the following sections.

Section 2 presents the findings of the land contamination assessment.

Section 3 presents the findings of the air quality impact assessment.

Section 4 presents the findings of the water quality impact assessment.

Section 5 presents the findings of the waste assessment.

Section 6 presents the findings of the noise impact assessment.

Section 7 discusses and illustrates the landscape and visual aspects of the project.

Section 8 addresses Environmental Monitoring and Audit (EM&A) issues and includes the Implementation Schedule for the proposed mitigation measures

Section 9 provides a summary of the conclusions and environmental outcomes drawn from the detailed assessment of the Project.

Annexes provide supplementary information

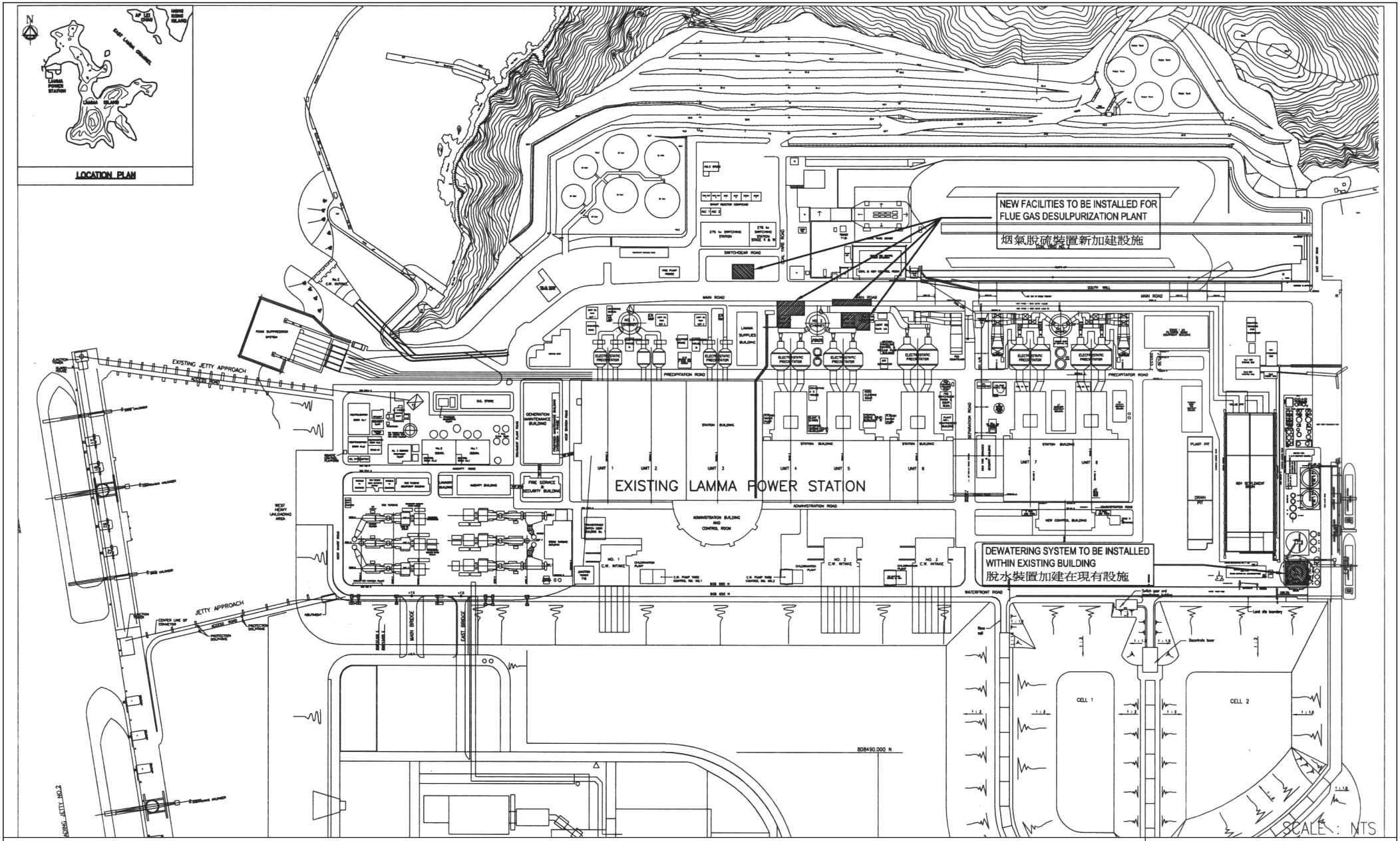

Figure 1.1

Location of Proposed New Facilities for L4 & L5 FGD Plant

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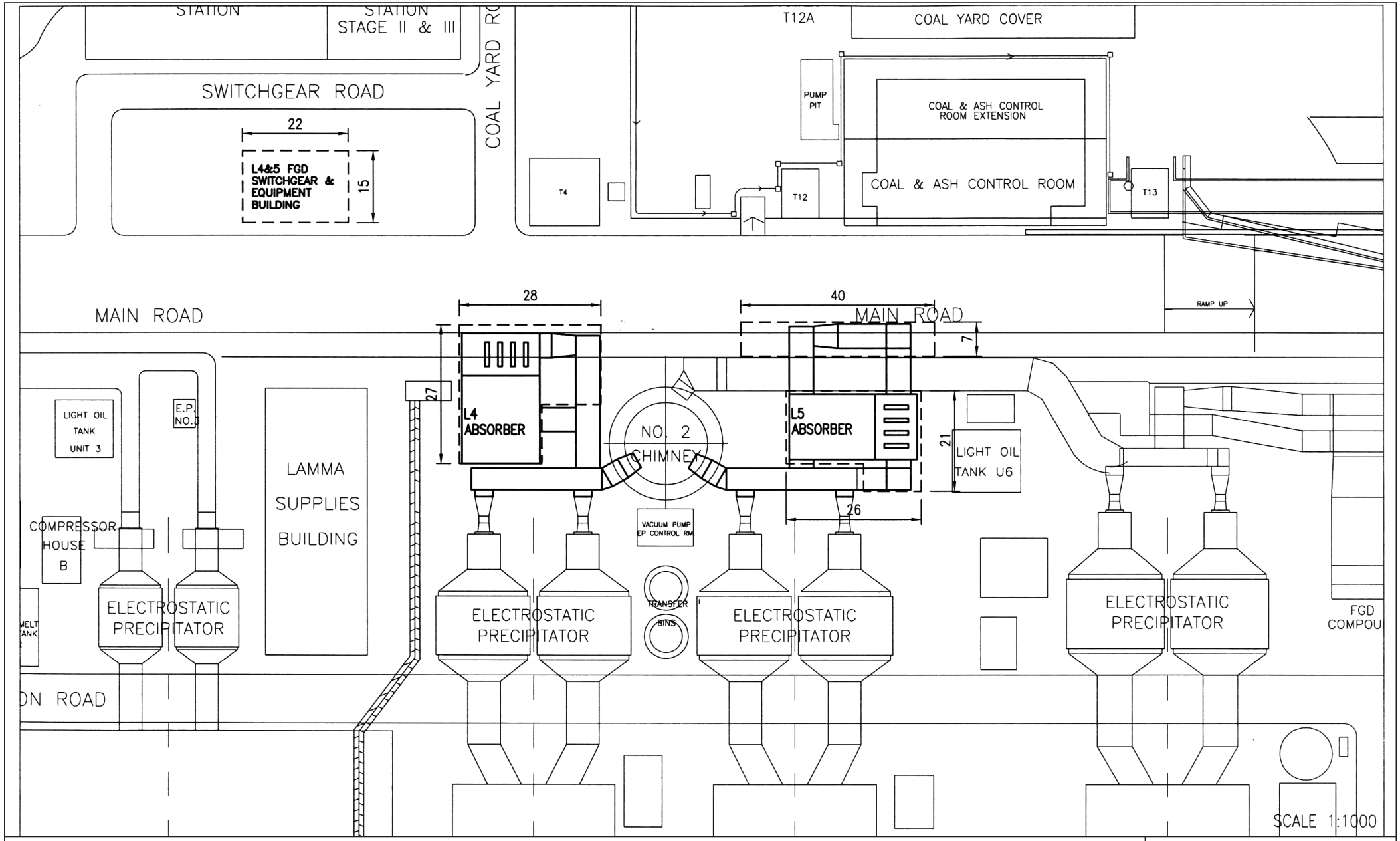

Figure 1.2

General Arrangement of the Additional Equipment for L4 & L5 FGD Plant

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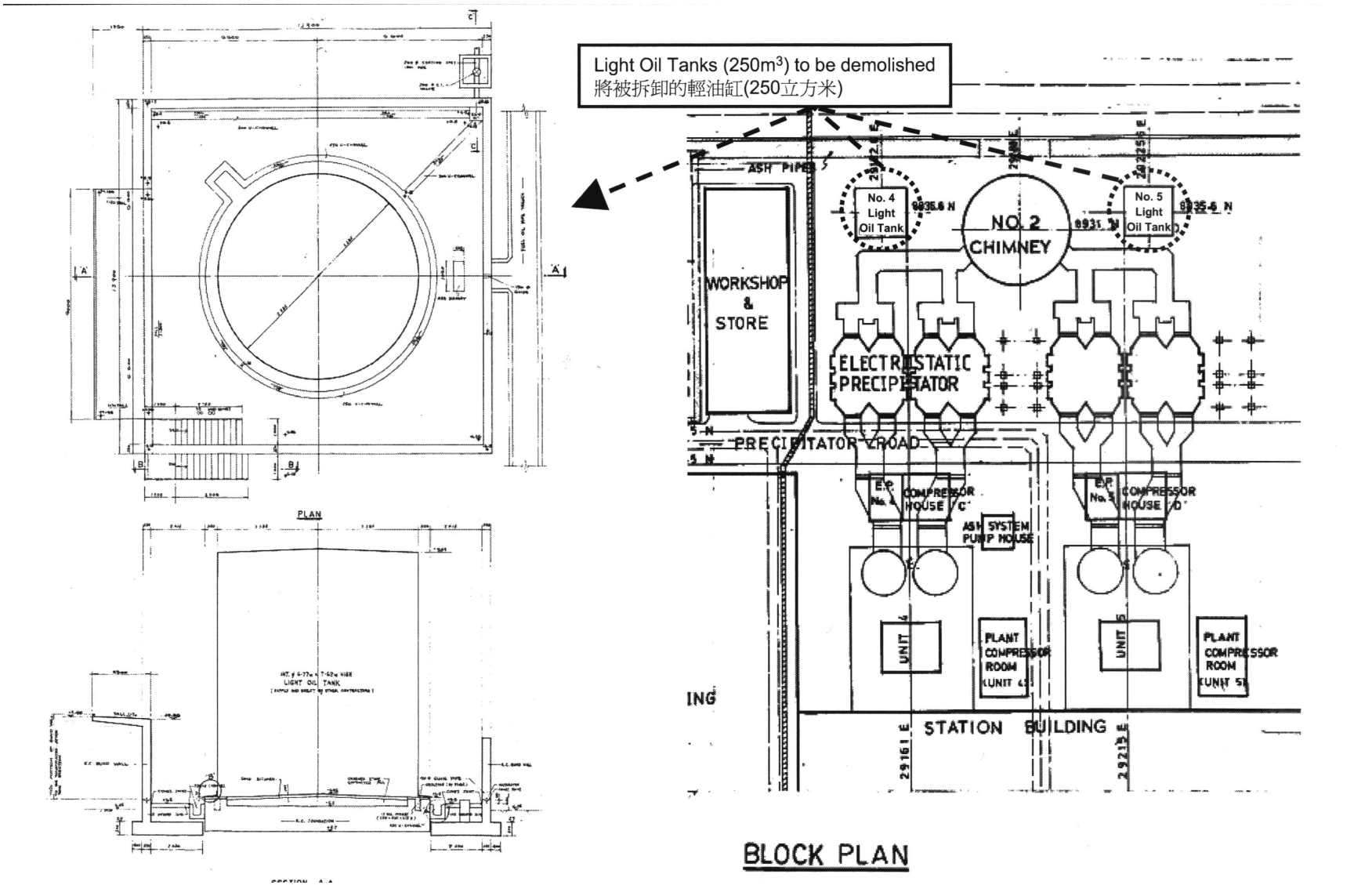

Figure 1.3

Arrangement of Existing Nos. 4&5 Light Oil Tanks (250m^3) to be demolished

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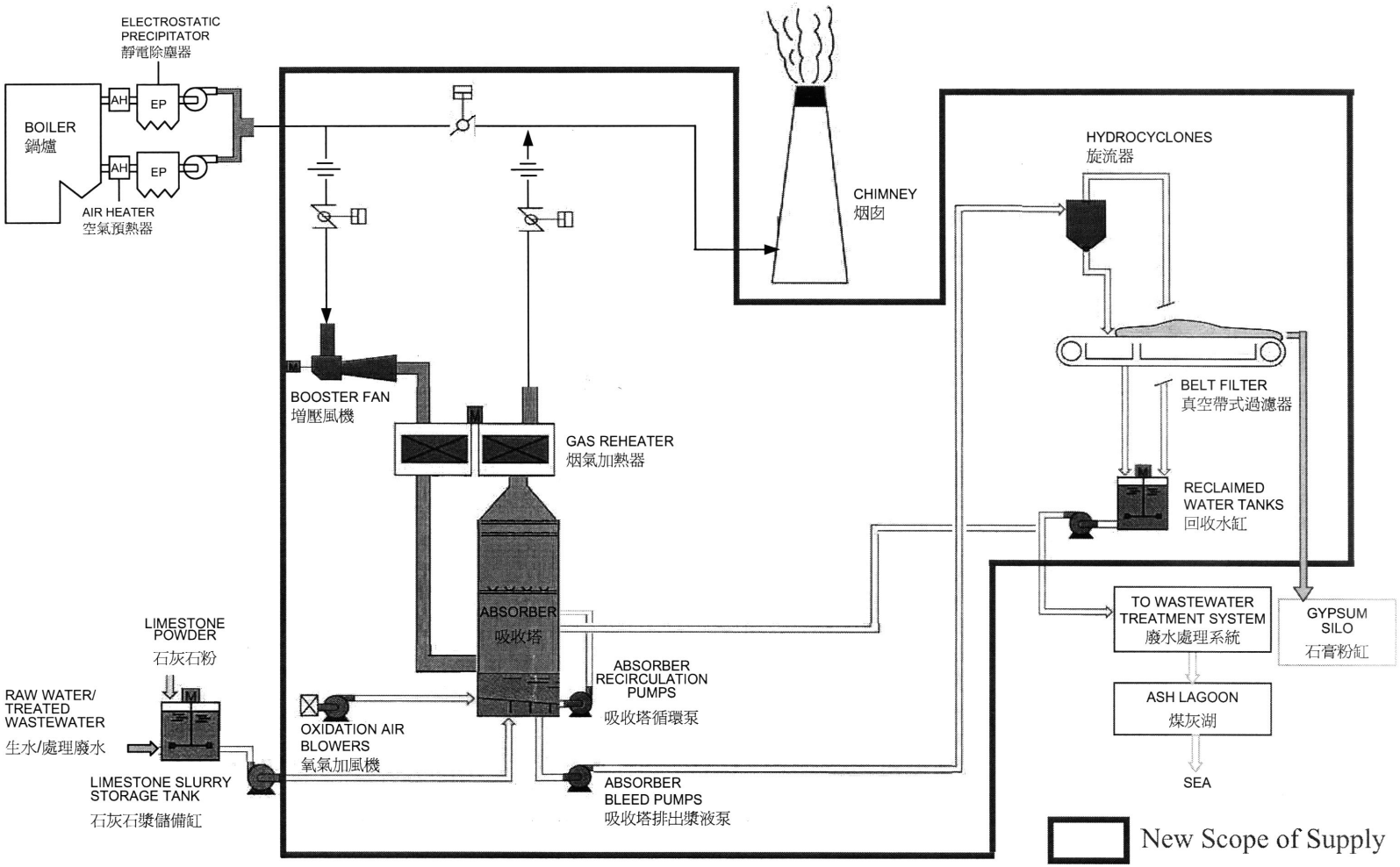

Figure 1.4

Schematic Diagram of Proposed FGD Plant

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2 LAND CONTAMINATION ISSUES

2.1 INTRODUCTION

Two above ground oil storage tanks (No. 4 and No. 5 Light Oil Tanks) with associated pipelines and one oil separation sump are to be demolished to provide space for installation of the FGD plants. A land contamination assessment was carried out at these areas to comply with the EIA study brief's requirements. This section briefly describes the land contamination assessment and makes a reference to the Contamination Assessment Plan (CAP), Contamination Assessment Report (CAR) and Remediation Action Plan (RAP) documents that were prepared under this EIA Study.

2.2 LAND CONTAMINATION ASSESSMENT

The land contamination assessment was carried out following the methodology and procedures prescribed in the contamination assessment plan (CAP) which made reference to EPD's *Practice Note for Professional Persons* (*ProPECC PN 3/94)* and *Guidance Notes for Investigation and Remediation Contaminated Site of Petrol Filling Stations, Boatyard and Car Repair/Dismantling Workshops*. The CAP was approved by the EPD in November 2005. A copy of CAP is included as *Annex A* of this report.

The land contamination assessment included soil and groundwater sampling, laboratory analyses for target parameters, preparation of contamination assessment report (CAR) and preparation of remediation action plan (RAP). A copy of the RAP, which also includes CAR as an appendix, is provided in *Annex B* of this report.

The Site Investigation (SI) for the land contamination assessment was conducted in the area adjacent to the tanks and oil separation sump between 14 to 19 November 2005. The SI consisted of drilling of six bore holes, soil sampling, installation of six groundwater sampling wells at drilling locations, groundwater sampling, and laboratory analyses for target parameters. The SI programmed also incorporated a field and laboratory QA/QC programme to ensure adequate sample results' quality. A total of 15 soil samples and six groundwater samples (exclusive of QA/QC samples) were collected from the Site areas for laboratory analysis of total petroleum hydrocarbons (TPHs), polycyclic aromatic hydrocarbons (PAHs), benzene, toluene, ethyl benzene and xylene.

2.3 RESULTS AND RECOMMENDATIONS

Total petroleum hydrocarbon (TPH) was detected in one out of 15 soil samples and five out of six groundwater samples at concentration exceeding the EPD Dutch B values for mineral oil and implied a TPH contamination at

the Site. Remediation measures and procedures for TPH contamination were recommended for the Site for the demolition operation, and the details are provided in the RAP.

The excavated contaminated soil will be remediated in accordance with the EPD's *Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol Filling Stations Boatyards, and Car/Repair/Dismantling Workshops, May 1999*. The remediation actions could involve excavation, testing, on-site treatment (ie soil venting/biopiling) and on-site reuse.

As groundwater is not used for either domestic or industrial purposes at the Site and in the adjacent areas and taking into consideration the absence of free-floating products and the relatively low concentrations of TPH detected in the groundwater, remediation of TPH in the groundwater of the Site is not considered necessary. Groundwater extraction is not anticipated during the demolition and/or construction programmes as the proposed excavations are at levels well above the site groundwater table. However, if groundwater is encountered during the demolition and/or construction programmes and groundwater dewatering from the work areas is required, the extracted groundwater will be collected, appropriately stored on-site and recharged back to the underlying ground.

With the implementation of the remedial measures in the RAP, the hazard and environmental impacts associated with the potential land contamination and handling and treatment of the contaminated soil and ground water are considered acceptable.

3 AIR QUALITY ASSESSMENT

3.1 INTRODUCTION

This section presents the air quality impact assessment for the Project during the construction and operation phases. Air Sensitive Receivers (ASRs) and the potential sources of impacts have been identified and the impacts evaluated. Mitigation measures are also recommended where necessary.

3.2 LEGISLATIVE REQUIREMENT AND EVALUATION CRITERIA

The principal legislation for the management of air quality in Hong Kong is the *Air Pollution Control Ordinance* (APCO) (Cap. 311). Under the APCO, the *Hong Kong Air Quality Objectives* (AQOs), see *Table 3.1*, stipulate the statutory limits for air pollutants and the maximum allowable numbers of exceedances over specific periods.

Table 3.1 Hong Kong Air Quality Objectives ($\mu g\ m^{-3}$) [a]

Air Pollutant	Averaging Time			
	1 Hour [b]	24 Hour [c]	3 Months [d]	1 Year [d]
Total Suspended Particulates (TSP)	-	260	-	80
Respirable Suspended Particulates (RSP) [e]	-	180	-	55
Sulphur Dioxide (SO_2)	800	350	-	80
Nitrogen Dioxide (NO_2)	300	150	-	80
Carbon Monoxide (CO)	30,000	-	-	-
Photochemical Oxidants (as ozone (O_3)) [f]	240	-	-	-
Lead (Pb)	-	-	1.5	-

Notes:

(a) Measured at 298K (25°C) and 101.325 kPa (one atmosphere)
(b) Not to be exceeded more than three times per year
(c) Not to be exceeded more than once per year
(d) Arithmetic means
(e) Suspended airborne particulates with a nominal aerodynamic diameter of 10 micrometres or smaller
(f) Photochemical oxidants are determined by measurement of ozone only

In addition, the *Technical Memorandum of Environmental Impact Assessment Ordinance* (EIAO-TM) also stipulates an hourly TSP criterion of 500 $\mu g\ m^{-3}$ for the construction dust impact.

3.3 EXISTING CONDITIONS, AIR SENSITIVE RECEIVERS AND BACKGROUND AIR QUALITY

3.3.1 Existing Condition

The L4 & L5 Flue Gas Desulphurisation Retrofit is at the existing HEC Lamma Power Plant. The existing air quality in the immediate vicinity is dominated by the gaseous emissions from the existing HEC Lamma Power Plant.

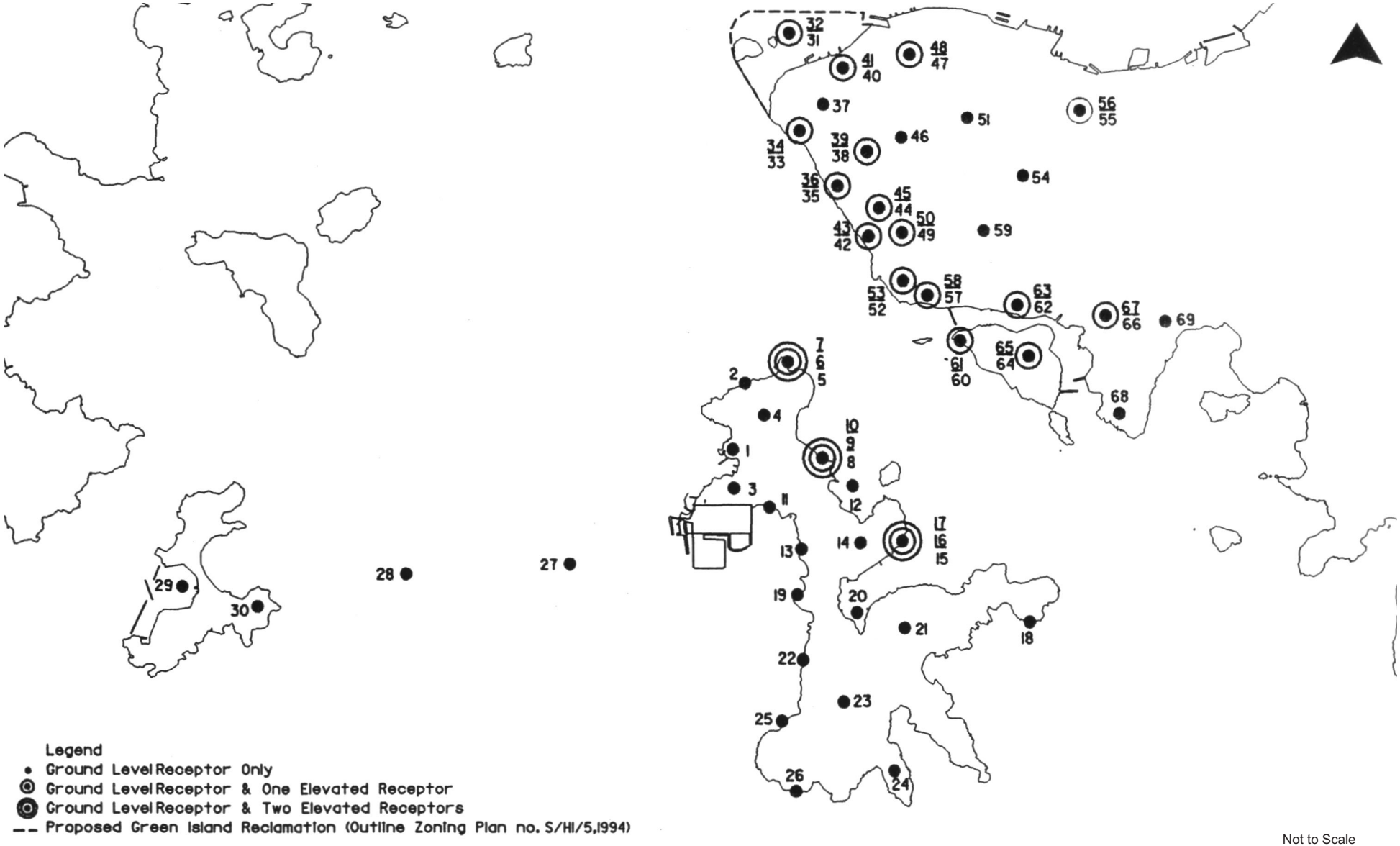

FIGURE 3.1

WIND TUNNEL MEASUREMENT LOCATION

(Reference : Project Profile of Lamma Power Station Conversion of Two Existing Gas Turbines into a Combined Cycle Unit)

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3.3.2 Air Sensitive Receivers (ASRs)

We are using the same set of 69 Wind Tunnel receptors/Air Sensitive Receivers (ASRs), including several co-located at different heights, as in the *EIA of a 1,800MW Gas-fired Power Station at Lamma Extension* [1] (hereafter called "Approved EIA (1999)") and the *Project Profile for Lamma Power Station Conversion of Two Existing Gas Turbines into a Combined Cycle Unit* (hereafter called "Project Profile (2000)") [2]. The full list is presented in *Table 3.2* and a map showing their locations covering the Lamma and Cheung Chau islands as well as relevant areas of the Southern and Central & Western Districts of Hong Kong Island is shown in *Figure 3.1*.

Table 3.2 Air Sensitive Receivers (ASRs)

No.	Location	Receptor Height[(a)]	No.	Location	Receptor Height[(a)]
1	Yung Shue Wan	30	36	HKU Quarters	145
2	Pak Kok San Tsuen	10	37	Mt Davies	220
3	Ko Long	50	38	Queen Mary Hospital	170
4	North Lamma	50	39	Queen Mary Hospital	255
5	Pak Kok Tsui,	10	40	Smithfield	90
6	Pak Kok Tsui	60	41	Smithfield	190
7	Pak Kok Tsui	110	42	Telegraph Bay	10
8	Lo Tik Wan	20	43	Telegraph Bay	110
9	Lo Tik Wan	70	44	Baguio Villa	70
10	Lo Tik Wan	120	45	Baguio Villa	130
11	Tai Wan To, Beach	10	46	High West	470
12	Lo Tik Wan, Sea	0	47	HKU	100
13	Kat Tsai Wan	10	48	HKU	200
14	Lamma Quarry W	70	49	Chi Fu Fa Yuen	130
15	Lamma Quarry E	30	50	Chi Fu Fa Yuen	245
16	Lamma Quarry E	80	51	Overthrope	490
17	Lamma Quarry E	130	52	Wah Fu estate	50
18	Ngai Tau	20	53	Wah Fu estate	120
19	Tit Sha Long	20	54	Sherwood's Bluff	430
20	Sok Kwu Wan	0	55	Admiralty	90
21	Ling Kok Shan	210	56	Admiralty	190
22	Sea shore, Lamma South	10	57	Wah Kwai Estate	50
23	Mt Stenhouse	320	58	Wah Kwai Estate	160
24	Tai Kok	110	59	Mt Kellet	400
25	Ha Mei Tsui	10	60	South Horizons	10
26	Sea shore, Lamma South	20	61	South Horizons	150
27	West Lamma Channel	0	62	Aberdeen Centre	40
28	West Lamma Channel	0	63	Aberdeen Centre	135
29	Sea, Cheung Chau West	10	64	Lei Tung Estate	50
30	Cheung Chau	50	65	Lei Tung Estate	155
31	Green Island	0	66	Wong Chuk Hang	30
32	West Lamma Channel	100	67	Wong Chuk Hang	90
33	Honey Villa	70	68	Ocean Park	70
34	Honey Villa	145	69	Ocean Park	30
35	HKU Quarters	50			

[1] http://www.epd.gov.hk/eia/register/report/eiareport/eia_00998/index.htm

[2] http://www.epd.gov.hk/eia/register/profile/latest/e_dir37.pdf

No.	Location	Receptor Height[(a)]	No.	Location	Receptor Height[(a)]

Note:

(a) metres above sea level

3.3.3 *Background Air Quality*

The *EPD Guidelines on Assessing Total Air Quality Impacts* [(1)], suggested using in the assessment of the cumulative concentrations the background levels of 21 μg m^{-3} and 59 μg m^{-3} for SO_2 and NO_2 , respectively in urban areas, and 13 μg m^{-3} and 39 μg m^{-3} for rural/new development sites. However, in the previous EIA studies for the Lamma Power Station, the *Approved EIA (1999)* and the *Project Profile (2000)* which form a basis for this assessment, a more conservative approach was adopted, based on a detailed analysis of the monitoring data from the HEC network on Hong Kong Island South and the EPD Air Quality Monitoring Station (AQMS) at Central/Western.

For the assessment of the maximum 1 hour average concentrations the background levels were assumed at 23 μg m^{-3} and 49 μg m^{-3} for SO_2 and NO_2, respectively, for ASRs located on Lamma, Cheung Chau and Hong Kong Island South, based on the maximum hourly average for a 'typical day' for data recorded at the HEC monitoring network, in 1993 -1996. Higher values of 33 μg m^{-3} and 80 μg m^{-3} for SO_2 and NO_2, based on the monitoring data from the EPD AQMS at Central/Western were adapted for a number of receptors located in urban areas.

In order to check whether the above assumptions made several years ago remain still valid, we checked the recent trends in the annual SO_2 and NO_2, concentrations at the Central/Western AQMS and from the HEC network available from the EPD [(2)]. The results are summarised in *Table 3.3.*

As can be seen, the levels of NO_2 have not significantly changed over the last several years, especially at the HEC network which is more relevant to this study, so the background values adopted in our previous studies remain valid. Note that the SO_2 background concentration is not used in the present study to demonstrate the AQO compliance but only for the comparison of the 'before' and 'after' cumulative concentrations.

Table 3.3 Trends in Air Quality, HEC Monitoring Network and the Central/Western AQMS

Average annual concentration (μg m^{-3})	1993-1996	1997	1998	1999	2000	2001	2002	2003
SO_2								
HEC	10	9	9	10	10	13	12	11
Central/Western	15[(a)]	18	14	17	18	21	20	18
NO_2								
HEC	28	28	25	26	27	29	26	25

(1) http://www.epd.gov.hk/epd/english/environmentinhk/air/guide_ref/guide_aqa_model_g2.html

(2) http://www.epd-asg.gov.hk/english/report/aqr.php

Average annual concentration (μg m^{-3})	1993-1996	1997	1998	1999	2000	2001	2002	2003
Central/Western	47(a)	58	52	56	53	54	46	52

Note (a): 1996 only

We will therefore use the following background levels (see *Approved EIA, 1999* & *Project Profile, 2000*):

- 33 μg m^{-3} and 80 μg m^{-3} for SO_2 and NO_2, for Receptors 31, 32, 40, 41, 47, 48, 55, and 56; and
- 23 μg m^{-3} and 49 μg m^{-3} for SO_2 and NO_2, respectively, at all other receptors.

It should be noted, that with the recent emission reduction commitments from the HKSAR and Guangdong Governments, an improvement of air quality is anticipated over the next several years, so our background levels assumptions, including the background ozone concentrations used for estimations of the NO_x to NO_2 conversion, will become even more conservative.

3.4 CONSTRUCTION AIR QUALITY IMPACT ASSESSMENT

Dust nuisance is the key concern during the construction of the Project. Demolition of the existing Nos 4 and 5 Light Oil tanks with each of 250m^3 storage capacity, civil works of the retrofitting of FGD Plants to two existing 350MW coal-fired Units L4 & L5 are the major construction works of the Project. Due to small scale of the Project and a distance from the ASRs, no dust impact is anticipated. In addition, only limited number of diesel-driven equipment will be operated on site, therefore, impact from construction equipment is not expected. Although dust emission and gaseous emission are not expected to affect the nearby ASRs during construction phase, the dust control measures stipulated in the *Air Pollution Control (Construction Dust) Regulation* should still be implemented to ensure compliance with the *Regulation*. Hence, no adverse air quality impact is envisaged from the construction of the Project.

3.5 OPERATIONAL AIR QUALITY IMPACT ASSESSMENT

3.5.1 Objective of the FGD Retrofit

The L4 & L5 Flue Gas Desulphurisation Retrofit is a project aiming at a significant improvement of air quality in the direct vicinity of the Lamma power station and in the wider region. Except for a slight increase of emissions associated with marine traffic due to increased reagent and by-product shipping, the operation of the project will not introduce any additional emissions of air pollutants, while the SO_2 and particulate emissions from units L4 and L5 will be reduced as a result of the project:

- SO_2 emission reduction by about 90%; and
- Particulate emission reduction by about 30%.

More details on the L4 & L5 emission levels before and after the retrofit are provided in *Section 3.5.2 (Table 3.6*).

A comparative assessment of the cumulative SO_2 worst-case hourly average concentrations at 69 ASRs will demonstrate the scale of anticipated improvements of air quality in the study area.

The NO_x emissions will not be reduced nor increased by the project, however changing of the stack exhaust parameters may result in a re-distribution of NO_x in the vicinity of the power station. The cumulative concentrations of NO_2 after the retrofit will also be estimated and their AQO compliance assessed at all ASR locations.

Since the project involves a reduction in particulate emissions, it can be expected that the RSP emissions from the Units L4 and L5 retrofitted with FGD will not result in any exceedance of AQOs for RSP. More details are presented in *Section 3.5.5.*

3.5.2 Assessment Methodology

The approach in the comparative study for SO_2 and the assessment of the project impact on the NO_2 concentrations is based on the wind tunnel test methodology, and involves a careful interpretation of the results obtained in the previous wind tunnel test studies for the Lamma Power Station.

Wind Tunnel Test Methodology

In general, wind tunnel air quality studies involve placing a physical model of the emission sources and surrounding terrain in a wind tunnel, emitting a passive tracer from the sources and measuring its concentrations at a number of receivers inside the wind tunnel for different wind speeds and directions. The raw results come in the form of *Concentration Ratios* expressing the rate of dilution of the pollutant from a source to the identified receptor for a given wind speed and direction. The concentration ratios depend on the source and receptor locations and the source characteristics, such as release height and exit temperature and velocity, but do not depend on the emission levels of particular pollutants.

The next step of a wind tunnel modelling study is a numerical analysis which, taking into account the emission levels and combining emissions from separately tested sources, translates concentration ratio values measured at each receptor to real-world concentrations of different air pollutants.

Previous Wind Tunnel Tests

A comprehensive set of wind tunnel tests was conducted in 1998 by ERM's sub-contractor, RWDI of Guelph, Ontario, Canada in support of the *Approved EIA (1999)*. The same test results formed also a basis for the Air Quality Assessment presented in the *Project Profile (2000)*. However, while the 1998 tests assumed that the whole Power Station operates at a load of 2,794 MW,

the results presented in the *Project Profile (2000)* were scaled up to a maximum load of 3,050 MW.

Emission Sources Tested in Wind Model

The parameters of sources tested in the 1998 RWDI wind tunnel tests and relevant to this study are listed in *Table 3.4.*

Table 3.4 Parameters of Exhaust Sources

Source ID	Units	SO_2 emissions mg/Nm³	NOx emissions mg/Nm³	PM emissions mg/Nm³	Efflux Temp °C	Efflux Velocity m/s
A	L1, L2, L3	1910	1200	125	120	15
B	L4, L5, L6	1910 (L4&L5) 191 (L6)	1200 (L4&L5) 660 (L6)	125 (L4&L5) 85 (L6)	80	15
C	L7 & L8	200	411	50	80	15
D1	GTs	290	185	12	390	32
D2	CC (GT5/7)	10	90	5	80	15

Source B, including units L4, L5 and L6 is of particular interest. Note that while the L4&L5 emissions listed in *Table 3.4* reflect the situation before the FGD retrofit, the Source B was, as stated in the original report (RWDI, 1998)[1], tested with the efflux temperature of 80 °C for all units, under a worst case assumption of using the lowest efflux temperature as per unit L6 in the previous assessment. This worst case assessment incidentally reflects the efflux temperature expected after the present FGD retrofit.

Load Scenario

For the comparison of the air quality impacts before and after the FGD retrofit we are assuming the Lamma Power Station operating at a maximum load of 3050MW, following the approach adopted for the *Project Profile (2000),* before the commissioning of the new units at Lamma Extension, with the distribution of the load between the units as shown in *Table 3.5.*

Table 3.5 Assumed Loading Schedule (MW)

Source C		Source B			Source A			Source D2	Source D1	Total
L8	L7	L6	L5	L4	L2	L1	L3	GT5/7	GTs	
350	350	350	350	350	250	250	250	365	185	3050

Note that this would be the worst-case scenario, since it is expected that by the time the FGD retrofit is completed, a part of the load from the coal-fired units will be shifted to the newly commissioned gas-fired units at Lamma Extension, which will result in a further reduction of air pollutant emissions.

[1] *Wind Tunnel Modelling for the Additional Generating Facilities at Lamma Power Station Hong Kong*. Report for ERM – Hong kong Ltd. RWDI, September 1998

Past Modelling Scenarios and their Relevance to the Present Study

Of the modelling scenarios tested in the past, The Scenario 2 presented in the *Project Profile (2000),* that included Exhaust Sources A, B, C, D1, and D2 (see *Table 3.4*) and assumed the total load of 3050MW distributed between units as shown in *Table 3.5* is most relevant to this assessment. All the assumptions and source parameters adopted in Scenario 2 for units L1-L3, L6-L8 and GT 2-7, are also valid for this study.

The only differences concern the parameters of Units L4 and L5 (Source B) and are summarised in *Table 3.6*.

Table 3.6 Assumed Parameters of Exhaust Source B (Units L4, L5 and L6)

Scenario	SO_2 emissions mg/Nm³	NOx emissions mg/Nm³	PM emissions[(a)] mg/Nm³	Efflux Temp °C	Efflux Velocity m/s
Before the Retrofit	1910 (L4&L5) 191 (L6)	1200 (L4&L5) 660 (L6)	125 (L4&L5) 85 (L6)	110 (L4&L5) 80 (L6)	15
After the Retrofit	200 (L4&L5) 191 (L6)	1200 (L4& L5) 660 (L6)	85	80	15
Scenario 2[(b)]	1910 (L4&L5) 191 (L6)	1200 (L4& L5) 660 (L6)	n/a	80[(b)]	15

Notes:
a: Particulate matter (PM) emissions are not used in this assessment and are included here for the sake of completeness only
b: Even that Scenario 2 of *Project Profile (2000)* was based on the Source B parameters before the FGD retrofit, in the actual wind tunnel testing (RWDI, 1998) the source B assumed the worst case efflux temperature of 80 °C.

The detailed results of the Scenario 2 are provided in *Tables A1-5c and A1-5d* of *Project Profile (2000*). They include the predicted cumulative concentrations of SO_2 and NO_2 at each receptor, contributions of each source (A, B, C, D1+D2) to the total and some other supplementary information. This will be the principal source of information for this assessment, subject to corrections accounting for different Source B emissions before and after the retrofit.

Marine Emissions

Besides the reductions in the SO_2 and particulate emissions, the project will result in a slight increase in the marine traffic, due to the increased needs for the limestone and gypsum transportation. Currently, the limestone shipments for the L6, L7 and L8 FGD plants involve about 44 barges of 700 to 3,000 tonnes per year. Similarly, the gypsum by-product is transported out by about 53 barges of 700 to 3,000 tonnes. With the L4 and L5 FGD plants operational, these transportation needs will increase by 66%. However, it is planned that the number of barge shipments per year will not increase, but only the barge sizes will increase to meet the additional demand. Note that the coal transport involves about 66 shipments per year using ships of 50,000 to 70,000 MT. Since the NO_x emission factors are roughly proportional to the ship engine power, assuming that it is proportional to the ship size, it can be estimated that the limestone/gypsum transport currently accounts for only about 1% of the total marine NOx emissions associated with the operation of

Lamma Power Station, and this contribution would remain below 2% after the L4&L5 FGD Plants become operational.

Therefore, in the context of much heavier existing marine traffic associated with other operations of the Lamma Power Station, the significant SO_2 and particulate emission reductions from the power plant and relatively low cumulative SO_2 and NO_2 concentrations predicted (See Tables C1 and C2) for the receptors located in the West Lamma Channel and close to the loading berths, the effects of the slightly increased emissions from the use of larger barges are considered insignificant.

3.5.3 Cumulative SO_2 Concentrations Before and After the Retrofit – A Comparative Study

Source B Corrections for Changes in Emissions

As explained above, our quantitative assessment is based on the results of Scenario 2 of *Project Profile (2000)* and involves appropriate scaling of the obtained during that study contributions of Source B to the total pollutant concentration at each ASR. The scaling coefficient used is explained below.

SO_2 before the Retrofit

As can be seen in *Table 3.6*, the SO_2 concentrations before the retrofit can be taken directly from the results of Scenario 2 (*Project Profile, 2000*) i.e. *Table A1-5c* of that report.

SO_2 after the Retrofit

The retrofit will result in significant reductions of L4 & L5 SO_2 emissions. Therefore the Source B contribution to the total at each receptor obtained from Table A1-5c needs to be appropriately scaled down. Based on the emission data provided in *Table 3.6*, the scaling coefficient is:

$(2 \times 200 + 191) / (2 \times 1910 + 191) = 0.147$

Results

The impacts of the L4&L5 FGD Retrofit on the Source B contribution and cumulative SO_2 concentrations at the ASRs listed in *Section 3.3.2* are summarised in *Table C1 in Annex C*.

As can be seen, the FGD retrofit will result in a significant reduction of the worst-case 1-hour average SO_2 concentrations. The reduction, of up to 263 μg m^{-3} and up to 55% of the total cumulative concentration will occur in the whole area studied with the exception of a few receptors located close to the power station, which are not affected by the Source B emissions.

Note that, as explained in *Section 3.5.2*, the concentrations before and after the retrofit were based on the same wind tunnel tests assuming the L4 & L5 efflux temperature of 80 ^oC, which reflects the conditions after the retrofit. Since the actual efflux temperature before the retrofit is higher, this assumption may

slightly affect the accuracy of our predictions of the SO_2 concentrations before (but not after) the retrofit. However, it is believed, that in general, the scale of the air quality improvements related to SO_2 has been predicted correctly.

3.5.4 Cumulative Concentrations of NO_2 After the Retrofit

The NO_x emissions will remain unchanged after the retrofit, so their redistribution due to the lower plume rise may result in the increase of the NO_2 concentrations at some receptors (and possibly their decrease at other locations). Therefore, the cumulative NO_2 concentrations at Air Sensitive Receivers after the retrofit needs to be predicted and their compliance with the relevant Air Quality Objective (AQO) assessed.

However, as explained in the previous sections, such assessment had already been performed in the past. As can be seen from *Table 3.6*, all NO_x emission and efflux parameters of Scenario 2 (*Project Profile, 2000*) are exactly the same as those reflecting the situation after the retrofit in the present study. Therefore the cumulative NO_2 concentrations predicted under Scenario 2 of *Project Profile (2000)*, included in Table A1-5d of that report, can be directly applied here.

Distance Correction

The original results of (RWDI, 1998) were obtained assuming a constant NO_x to NO_2 conversion factor of 0.20. When applying these in the *Project Profile (2000)*, in order to make the NO_2 prediction more accurate, a correction factor was introduced to account for a different distances between the source and receptors. The correction is based on the Janssen formula [(1)] that links the conversion rate to the prevailing meteorological conditions, distance to the receptor and the background ozone concentrations.

The set of average Janssen's formula coefficients used in the *Project Profile (2000)* assessment was applicable to summer conditions, wind speeds of 5 to 15 m/s and ozone concentrations ranging from 39 to 59 µg m^{-3}. In order to check if these 2000 assumptions remain valid, we have examined the recent ozone trends at two AQMS stations close to the project site, i.e. at Central/Western and Tung Chung. The annual average ozone concentrations at these locations are listed in *Table 3.7*. As can be seen, the concentrations at both stations are well within the range of applicability of our Janssen's formula coefficients. Note that also the background ozone level of 57 µg m^{-3} recommended for the rural/new development areas by the EPD's *Guidelines on Assessing the 'TOTAL' Air Quality Impact* included in Appendix B-2 of the *Study Brief* falls within the range of validity of these coefficients. Furthermore, Table 3.7 does not show a strong increasing trend in ozone concentrations, which in the coming years are expected to decrease due to the HKSAR and Guangdong commitments on reducing the NO_x and VOC emissions. Therefore, the same distance correction coefficients as used in *Project Profile (2000)* will be applied in this study as well.

(1) Janssen L.H.J.M. et al. *A Classification of NO Oxidation Rates in Power Plant Plumes Based on Atmospheric Conditions*. Atmospheric Environment, 22, 43-53, 1988

Table 3.7 Trends in Ozone Concentrations

Average annual concentration (μg m^{-3})	1996	1997	1998	1999	2000	2001	2002	2003
Central/Western	29	27	30	37	34	35	32	44
Tung Chung				43	37	41	42	43

Results

The cumulative NO_2 concentrations at each receptor, derived from the *Project Profile (2000)* data are listed in *Table C2 of Annex C*.

From the data presented in *Table C2* it is evident that the worst-case cumulative NO_2 concentrations after the FGD retrofit will remain well below the AQO of 300 μg m^{-3}, with the concentration at the worst-affected Receptor 29 at Cheung Chau within 88% of the AQO. It should be stressed that the retrofit does not cause an increase in NO_x emissions, but only different plume dispersion characteristics, i.e. the re-distribution and not increase of the pollution under the worst-case meteorological conditions. For the longer time scales and wider area, the FGD retrofit at units L4 and L5 would remain neutral with respect to the NO_2 pollution, so the quantitative assessment of averaging periods longer than 1 hour was not necessary. It was also confirmed in the *Approved EIA (1999)* that the one hour average is the more critical parameter to be considered when compared with the AQO.

3.5.5 RSP Assessment

Since neither the *Approved EIA (1999)* nor the *Project Profile (2000)* reports addressed the RSP concentrations which were considered of secondary importance, we cannot apply the same assessment methodology as for the SO_2 and NO_2 concentrations. The worst-case hourly particulate concentrations after the retrofit can however be estimated by appropriate scaling of the SO_2 results presented in Table A1-5c of *Project Profile(2000)*.

Since the resulting RSP concentrations are low, we will present such detailed estimates for the worst-case Receptor 29 only. For that receptor, the worst-case SO_2 hourly concentrations were reported in the *Project Profile (2000)* as 674 μg m^{-3} ,with sources A, B, C, D1 and D2 contributing 301, 262, 27, 74, and 9 μg m^{-3} , respectively. To convert these SO_2 concentrations to their particulate equivalents, appropriate scaling factors based on the stack emissions of SO_2, and RSP can be applied. As can be seen from *Table 3.6*, such a factor for Source B, equal to the ratio of PM emissions after the retrofit to SO_2 emissions before the retrofit is 3x85/(2x1910+191) = 0.064. In a similar way, using the data provided in *Table 3.4*, the coefficients for sources A, C, D1, and D2 can be calculated as 0.065, 0.25, 0.041, and 0.5, respectively. The worst case PM concentration at Receptor 29, resulting from the Lamma Power Station emissions can therefore be estimated as: 301x0.065 + 262x0.064 + 27x0.25 + 74x0.041 +9x0.5 = 50.6 μg m^{-3}. Assuming as the worst case that all the particles emitted are in the form of RSP (less than 10 μm in diameter) and taking the background RSP concentration as 53 μg m^{-3}, based on the 2003 annual average at Central/Western AQMS, we can obtain the worst case one hour RSP concentration at the worst-affected Receptor 29 as 103.6 μg m^{-3} which constitutes only 58% of the AQO for the 24 hour averages. The assumption

that all particulates emissions are in the form of RSP will make this result even more conservative .

Therefore, the RSP emissions from the Units L4 and L5 retrofitted with FGD, will not result in any exceedance of AQO for RSP.

3.6 MITIGATION MEASURES

3.6.1 Construction Phase

The following dust control measures stipulated in the *Air Pollution Control (Construction Dust) Regulation* are recommended:

- The area at which demolition work takes place should be sprayed with water prior to, during and immediately after the demolition activities so as to maintain the entire surface wet;
- Dust screens or sheeting should be provided to enclose the structure to be demolished to a height of at least 1 m higher than the highest level of the structure;
- Any dusty materials should be wetted with water to avoid any fugitive dust emission;
- All temporary stockpiles should be wetted or covered by tarpaulin sheet to prevent fugitive emissions;
- All the dusty areas and roads should be wetted with water;
- All the dusty materials transported by lorries should be covered entirely by impervious sheet to avoid any leakage; and
- The falling height of fill materials should be controlled.

3.6.2 Operational Phase

Since the project will significantly reduce SO_2 and Particulate emissions and the NO_x emissions from the L4 and L5 Units will remain unchanged, no mitigation measures are required. Nevertheless, it should be noted that HEC is conducting feasibility study to look into various options including the retrofit of low NO_x burners to Units 4&5 boilers to reduce the overall NO_x emissions from Lamma Power Station.

3.7 SUMMARY OF ENVIRONMENTAL OUTCOMES AND CONCLUSIONS

3.7.1 Construction Phase

Dust from demolition and construction activities is the key concern during the construction of the Project. Demolition of the existing Nos 4 and 5 Light Oil tanks with each of 250m^3 storage capacity, civil works of the retrofitting of FGD Plants to two existing 350MW coal-fired Units L4 & L5 are the major

construction works of the Project. Due to the small scale of construction works and with the implementation of the dust control measures stipulated in the *Air Pollution Control (Construction Dust) Regulation*, no adverse air quality impact is envisaged from the construction of the Project.

3.7.2 Operational Phase

The re-assessment of the previous wind tunnel modelling data has confirmed that the FGD retrofit project at units L4 and L5 of the Lamma Power Station will lead to significant reductions of the worst-case hourly SO_2 concentrations for most ASRs throughout the area studied.

Since the operation of the FGD plants will also result in reduction of emissions of particulate matter (PM), it is expected that the environmental benefits of the FGD retrofit with respect to the RSP concentrations would be similar in nature, but lower in magnitude than those for SO_2.

A quantitative assessment of the cumulative NO_2 concentrations after the retrofit demonstrated that they will remain AQO-compliant throughout the study area. The highest NO_2 concentration predicted after the retrofit, 264 $\mu g\ m^{-3}$ at Cheung Chau is still well below of the AQO of 300 $\mu g\ m^{-3}$.

3.7.3 Environmental Monitoring and Audit (EM&A) Requirements

Due to the small scale of the demolition and construction works of the Project, and no adverse impacts predicted, no EM&A is required for the Construction Phase.

Since the Project will bring a general air quality improvement, no additional EM&A activities are required, besides those already in place, such as those required by specific process licenses for the operation of the existing Lamma Power Station.

4 WATER QUALITY ASSESSMENT

4.1 INTRODUCTION

The project involves installation of FGD plants to the two existing coal-fired Units L4 and L5 and demolition of two existing light oil tanks on formed land. When the FGD plants are in operation, limestone slurry is introduced to react with flue gas for removal of SO_2 in the FGD plants before emission to the atmosphere. As a result, wastewater filtrated from the reacted limestone slurry, i.e. gypsum slurry, will be produced and it will be directed to the existing wastewater treatment system.

This section examines the potential water quality impact induced by the project and suggests the applicable mitigation measures to minimise the adverse impacts, if any, on the water quality.

4.2 LEGISLATION AND STANDARDS

The regulatory requirements and standards to protect water quality are as follows:

- *Water Pollution Control Ordinance (WPCO);*
- *Technical Memorandum Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters (TM);*
- *Environmental Impact Assessment Ordinance (Cap. 499. S.16), Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM), Annexes 6 and 14;*
- WPCO Licence on Decantrate Tower of the Ash Lagoon; and,
- *Practice Note for Professional Persons on Construction Site Drainage (PN 1/94).*

4.2.1 *Water Pollution Control Ordinance (WPCO)*

The *WPCO* is the legislation for the control of water pollution and water quality in Hong Kong. Under the *WPCO,* Hong Kong waters are divided into 10 Water Control Zones (WCZs). Each WCZ has a designated set of statutory Water Quality Objectives (WQOs). The WQOs set limits for different parameters that should be achieved in order to maintain the water quality within the WCZs.

The Project is located in the Southern WCZ. The boundary for the WCZ is shown in *Figure 4.1.* The WQOs for the marine waters of the Southern WCZ, which are presented in *Table 4.1,* are applicable as evaluation criteria for assessing compliance of any effects from the discharges of the Project.

Table 4.1 Water Quality Objectives for the Southern Water Control Zones

Water Quality Objectives		Part or parts of Zone
A.	ESTHETIC APPEARANCE	
(a)	Waste discharges shall cause no objectionable odours or discolouration of the water.	Whole Zone
(b)	Tarry residues, floating wood, articles made of glass, plastic, rubber or of any other substance should be absent.	Whole Zone
(c)	Mineral oil should not be visible on the surface. Surfactants should not give rise to a lasting foam.	Whole Zone
(d)	There should be no recognisable sewage-derived debris	Whole Zone
(e)	Floating, submerged and semi-submerged objects of a size likely to interfere with the free movement of vessels, or cause damage to vessels, should be absent.	Whole Zone
(f)	Waste discharges shall not cause the water to contain substances which settle to form objectionable deposits.	Whole Zone
B.	BACTERIA	
(a)	The level of Escherichia coli should not exceed 610 per 1000 mL, calculated as the geometric mean of all samples collected in one calendar year.	Secondary Contact Recreation Subzones and Fish Culture Subzones
(b)	The level of Escherichia coli should not exceed 180 per 100 mL, calculated as the geometric mean of all samples collected from March to October inclusive in one calendar year. Samples should be taken at least 3 times in a calendar month at intervals of between 3 and 14 days.	Bathing Beach Subzones
C.	DISSOLVED OXYGEN	
(a)	Waste discharges shall not cause the level of dissolved oxygen to fall below 4 milligrams per litre for 90% of the sampling occasions during the year; values should be calculated as the water column average (arithmetic mean of at least 3 measurements at 1 metre below surface, mid-depth, and 1 metre above seabed). In addition, the concentration of dissolved oxygen should not be less than 2 milligrams per litre within 2 metres of the seabed for 90% of the sampling occasions during the year.	Marine waters excepting Fish Culture Subzones
(b)	The dissolved oxygen level should not be less than 5 milligrams per litre for 90% of the sampling occasions during the year; values should be calculated as water column average (arithmetic mean of at least 3 measurements at 1 metre below surface, mid-depth and 1 metre above seabed). In addition, the concentration of dissolved oxygen should not be less than 2 milligrams per litre within 2 metres of the seabed for 90% of the sampling occasions during the year.	Fish Culture Subzones
(c)	Waste discharges shall not cause the level of dissolved oxygen to be less than 4 milligrams per litre.	Inland waters of the Zone
D.	pH	
(a)	The pH of the water should be within the range of 6.5-8.5 units. In Marine waters addition, waste discharges shall	Beach Subzones; Mui Wo (A), Mui Wo (B), Mui Wo

Water Quality Objectives		Part or parts of Zone
	not cause the natural pH range to be excepting Bathing extended by more than 0.2 units.	(C), Mui Wo (E), Mui Wo (F) Subzones
(b)	The pH of the water should be within the range of 6.0-9.0 units.	Mui Wo (D) Sub-zone and other inland waters.
(c)	The pH of the water should be within the range of 6.0-9.0 units for 95% of samples. In addition, waste discharges shall not cause the natural pH range to be extended by more than 0.5 units.	Bathing Beach Subzones
E.	TEMPERATURE	
(a)	Waste discharges shall not cause the natural daily temperature range to change by more than 2.0 degrees Celsius.	Whole Zone
F.	SALINITY	
	Waste discharges shall not cause the natural ambient salinity level to change by more than 10%.	Whole Zone
G.	SUSPENDED SOLIDS	
(a)	Waste discharges shall neither cause the natural ambient level to Marine waters be raised by 30% nor give rise to accumulation of suspended solids which may adversely affect aquatic communities.	
(b)	Waste discharges shall not cause the annual median of suspended solids to exceed 20 milligrams per litre.	Beach Subzones; Mui Wo (A), Mui Wo (B), Mui Wo (C), Mui Wo (E), Mui Wo (F) Subzones
(c)	Waste discharges shall not cause the annual median of suspended solids to exceed 25 milligrams per litre.	Mui Wo (D) Subzone and other Inland Waters
H.	AMMONIA	
	The ammonia nitrogen level should not be more than 0.021 milligram per litre, calculated as the annual average (arithmetic mean), as unionised form.	Whole Zone
I.	NUTRIENTS	
(a)	Nutrients shall not be present in quantities sufficient to cause excessive or nuisance growth of algae or other aquatic plants.	Marine waters
(b)	Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.1 milligram per litre, expressed as annual water column average (arithmetic mean of at least 3 measurements at 1 metre below surface, mid-depth and metre above seabed).	Marine waters
J.	5-DAY BIOCHEMICAL OXYGEN DEMAND	
Waste discharges shall not cause the 5-day biochemical oxygen demand to exceed 5 milligrams per litre.		Inland Waters of the Zone
K.	CHEMICAL OXYGEN DEMAND	
Waste discharges shall not cause the chemical oxygen demand to exceed 30 milligrams per litre.		Inland Waters of the Zone
L. DANGEROUS SUBSTANCES		
(a)	Waste discharges shall not cause the concentrations of	Whole Zone

Water Quality Objectives	Part or parts of Zone
dangerous substances in marine waters to attain such levels as to produce significant toxic effects in humans, fish or any other aquatic organisms, with due regard to biologically cumulative effects in food chains and to toxicant interactions with each other.	
(b) Waste discharges of dangerous substances shall not put a risk to any beneficial uses of the aquatic environment.	Whole Zone

4.2.2 *Technical Memorandum for Effluent Discharges into Drainage and Sewerage Systems, Inland and Coastal Waters*

All discharges from the Lamma Power Station, including those from the emission control facilities, are required to comply with the *Technical Memorandum for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters* (TM) issued under Section 21 of the *WPCO*. The TM defines discharge limits for different types of receiving waters. Under the TM, effluents discharged into the drainage and sewerage systems, inshore and coastal waters of the WCZs are subject to pollutant concentration standards for particular discharge volumes. Any new discharges within a WCZ are subject to licence conditions and the TM acts as a guideline for setting discharge standards for inclusion in the licence.

For the discharges from the Lamma Power Station it is appropriate to make reference to Table 10a Standards for Effluents Discharged into the Inshore Waters of Southern, Mirs Bay, Junk Bay, North Western, Eastern Buffer and Western Buffer Water Control Zones. Existing WPCO discharge licences have been issued for a number of wastewater discharges from the existing power station, including the cooling water systems, oil separators and wastewater treatment plant.

4.2.3 *Environmental Impact Assessment Ordinance (Cap. 499. S.16), Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM)*

Annexes 6 and *14* of the *EIAO-TM* provide general guidelines and criteria to be used in assessing water quality issues.

The *EIAO-TM* recognises that it may not be possible to achieve compliance with the WQOs in the vicinity of a wastewater discharge. In this area, where the initial dilution of pollutants takes place, there may be greater water quality impacts than would be allowed by the WQOs. Such an area may be termed a 'mixing zone' and within this area exceedence of the WQOs would not be deemed to be an adverse impact. In general, the criteria for acceptance of a 'mixing zone' are that it must not impair the integrity of the water body as a whole and must not damage the ecosystem or impact marine sensitive receivers.

Whilst the technical circulars are non-statutory, they are generally accepted as best guidelines in Hong Kong and have been adopted as relevant for this assessment.

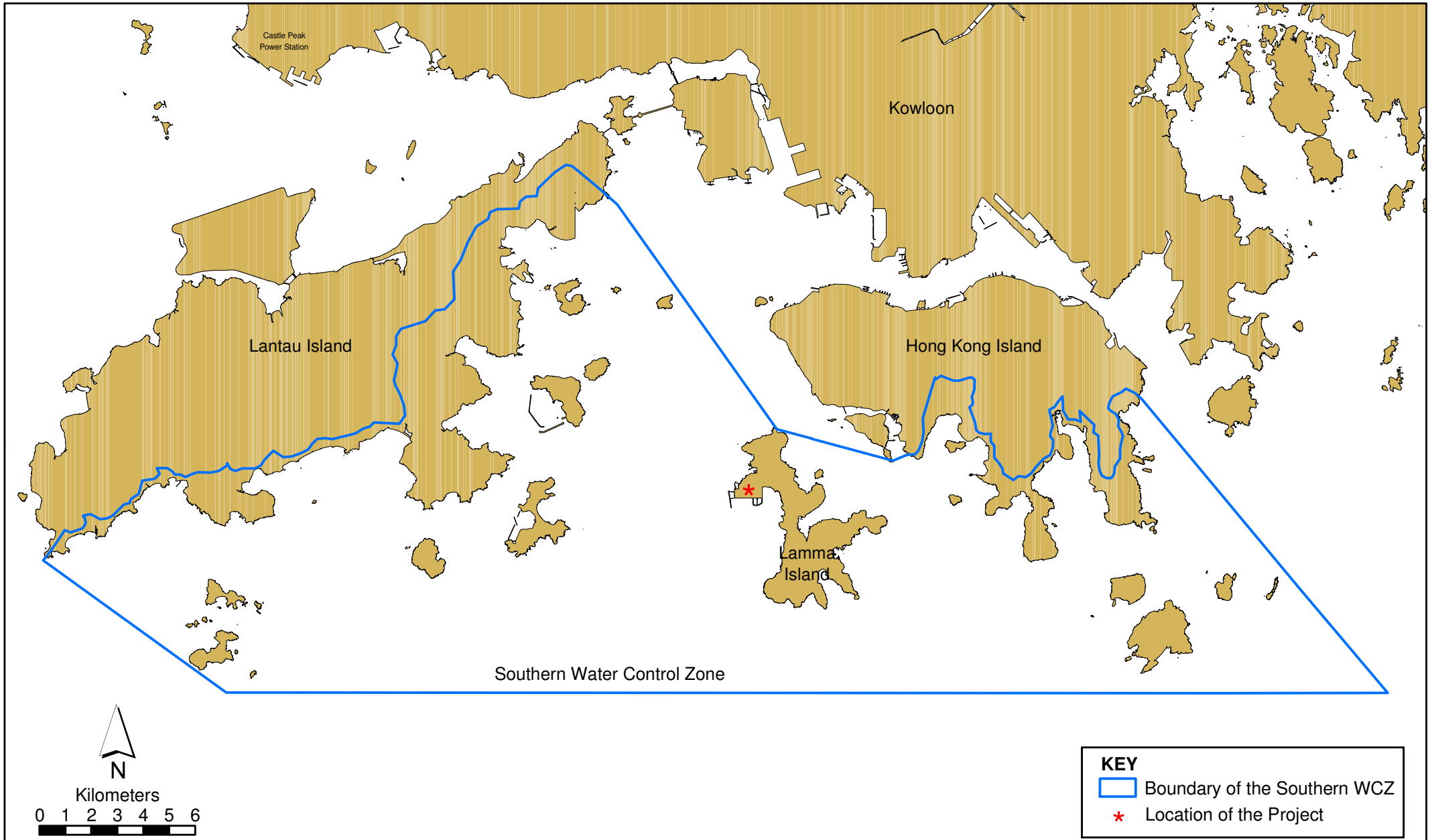

Figure 4.1

Location of the Southern Water Control Zone and the Project

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4.2.4 *WPCO Licence on Decantrate Tower of the Ash Lagoon*

The *WPCO* licence was issued to HEC in order to restrict the quality and quantity of the effluent of FGD Wastewater Treatment Plant (WWTP) discharged into the ash lagoon. The effluent discharge limits are applied for two situations, i.e. normal plant operation and during plant maintenance. *Tables 4.2* and *4.3* present the details.

Table 4.2 Effluent Discharge Limits for FGD WWTP during Normal Plant Operation

Parameters	Unit	Maximum
Flow Rate	cu.m day^{-1}	200
pH	(pH units)	6-9
Temperature	^{o}C	40
Suspended Solids	mg L^{-1}	30
COD	mg L^{-1}	80
BOD	mg L	20
Iron	mg L	4
Barium	mg L	1.5
Mercury	mg L	0.005
Cadmium	mg L	0.005
Other Toxic Metals (individually)	mg L	0.4
Total Toxic Metals	mg L	0.8
Cyanide	mg L	0.1
Phenols	mg L	0.2
Sulphide	mg L	5
Total Phosphorus	mg L	8
Total Nitrogen	mg L	400

Table 4.3 Effluent Discharge Limits for FGD WWTP during Plant Maintenance

Parameters	Unit	Maximum
Flow Rate	cu.m day^{-1}	500
pH	(pH units)	6-9
Temperature	^{o}C	40
Suspended Solids	mg L^{-1}	30
COD	mg L^{-1}	80
BOD	mg L	20
Iron	mg L	4
Barium	mg L	1.5
Mercury	mg L	0.003
Cadmium	mg L	0.003
Other Toxic Metals (individually)	mg L	0.4
Total Toxic Metals	mg L	0.8
Cyanide	mg L	0.1
Phenols	mg L	0.2
Sulphide	mg L	5
Total Phosphorus	mg L	8
Total Nitrogen	mg L	150

4.2.5 *Practice Note for Professional Persons on Construction Site Drainage (PN 1/94)*

The *ProPECC (PN 1/94)* issued by EPD provides some basic environmental guidelines for the handling and disposal of construction site discharges to prevent or minimise construction impacts on water quality.

4.3 ASSESSMENT METHODOLOGY

The retrofit methodology (see *Section 1.5)* has been reviewed to assess the remoteness of the proposed project to existing and committed Water Sensitive Receivers. The WSRs were identified according to guidance provided in *Hong Kong Planning Standards and Guidelines* (HKPSG).

Construction stages, sequence and duration were reviewed to identify activities likely to impact upon identified WSRs and other water courses. Following the identification of WSRs and potential water quality impacts, the scale, extent and severity of potential net (i.e. unmitigated) construction /operational impacts were evaluated, taking into account all potential cumulative effects including those of adjacent projects, with reference to the *WPCO* criteria.

Where net water quality impacts exceed the appropriate *WPCO* criteria, practical water pollution control measures/mitigation proposals will be identified to ensure compliance with reference to the *WPCO* criteria. Water quality monitoring and audit requirements will be subsequently developed, if necessary, to ensure the effectiveness of the water pollution control and mitigation measures.

4.4 BASELINE CONDITIONS AND WATER QUALITY SENSITIVE RECEIVERS

4.4.1 *Existing Conditions*

Construction will be carried out on formed land where the drainage system has been well established. During construction activities, the primary sources of water quality impacts will be from pollutants in site run-off. Pollutants, mainly suspended sediments, may also enter receiving waters if the run-off is not adequately controlled on-site. The potential sources of impacts to water quality may be readily controlled by appropriate on-site measures to minimise potential impacts as discussed in *Section 4.6.*

4.4.2 *Water Quality Sensitive Receivers*

In order to evaluate the water quality impacts resulting from the construction and/or operation of the FGD plants on Lamma Island, the water sensitive receivers (WSRs) have been identified in accordance with the HKPSG, which provides criteria for identifying environmental factors influencing the proposed development.

The identified water quality sensitive receivers close to (i.e. within 3 km) the Power Station and around Lamma Island *(Figure 4.2)* include:

- Gazetted Bathing Beaches: Hung Shing Ye Beach and Lo So Shing Beach.
- Water Intakes: HEC Lamma Power Station Intake.

- Fish Culture Zones: Lo Tik Wan Fish Culture Zone and Sok Kwu Wan Fish Culture Zone.

- Sites of Ecological Interest: Pak Kok (corals present), Shek Kok Tsui (corals present), Luk Chau (corals present), Ha Mei Wan (fish spawning ground) and southern Lamma waters (Finless Porpoise, Chinese White Dolphin, green turtles nesting site and proposed marine park). SW Lamma 1 and SW Lamma 2, which are situated to the south of the works area (*Figure 4.2*), have been selected to assess any potential water quality impacts of this Project on the southern Lamma waters. As long as the impact on this part of the water is acceptable, the impact on the other parts of the southern Lamma waters will be less and therefore also acceptable.

Table 4.4 shows that the site is remote (i.e. > 1 km) from the WSRs except for the HEC Lamma Power Station Intake.

Table 4.4 Distance of the Site from the Water Quality Sensitive Receivers

Water Quality Sensitive Receivers	Minimum Distance from the Site (m)	ID
Pak Kok (Coral)	3,020	SR1
Shek Kok Tsui (Coral)	1,800	SR2
Luk Chau (Coral)	3,110	SR3
Lo Tik Wan Fish Culture Zone	2,330	SR4
HEC Lamma Power Station Intake	200	SR5
Hung Shing Ye Beach	1,360	SR6
Lo So Shing Beach	2,010	SR7
Sok Kwu Wan Fish Culture Zone	2,480	SR8
Ha Mei Wan (Fish Spawning Ground)	1,500	SR9
SW Lamma 1	2,660	SR10
SW Lamma 2	3,920	SR11

4.4.3 FGD Waste Water Treatment (WWT) System

The existing WWT system is designed to treat the effluent from FGD plants by alkalization, precipitation and neutralization process without removal of heavy metals apart from zinc and manganese. The plant capacity has been designed based on 5x350MW FGD with a total capacity of 54 m^3 hr^{-1} (2 streams each of 27 m^3 hr^{-1}) which can also cater for supernatant from wastewater sludge centrifuge and other on-load equipment drains. The schematic diagram of the FGD WWT is illustrated in *Figure 4.3* and the design capacity of the WWT Plant is calculated as follows:

Constant flow from 5 x 350MW (5 x 6.3 m^3 hr^{-1}):	31.5 m^3
Supernatant from wastewater sludge centrifuge:	16 m^3
Other on-load equipment drains:	6.5 m^3
Total:	**54 m^3**

Wastewater from FGD process is conveyed to the underground wastewater

storage sump pits equipped with agitator for temporary storage. When high level is reached, the wastewater is pumped to the pH adjustment and coagulation tanks where caustic soda is dosed to bring the pH to 9-10 for precipitation of metals as hydroxides. After the pH adjustment and coagulation tank, the wastewater is dosed with a polymer and is brought to a thickener for settlement of suspended solids.

The water overflow from the thickeners is conveyed to a primary treated water storage tank for further neutralization by hydrochloric acid to decrease the pH to 6-9. In case the pH is not correct or the turbidity of the wastewater is above a preset limit, it would be recycled back to the storage sump pit for re-treatment.

The underflow sludge is conveyed to two centrifuge feed tanks for temporary storage before feeding into the centrifuges for dewatering. Dried sludge ejected from the centrifuges is temporarily stored and discharged to barge through conveyors. The sludge is then taken away by contractor for reuse in the building industry.

Neutralized wastewater is temporarily stored in Rejected Treated Water Storage Tanks and then is discharged to the existing Ash Lagoon. The Ash Lagoon will have sufficient capacity to store treated effluent from the FGD treatment process. The discharge point for effluent from the ash lagoon decantrate tower is presented in *Figure 4.4.* Its quantity and quality is closely monitored in accordance with the *WPCO* licence on Decantrate Tower of the Ash Lagoon.

The decanted water from the Ash Lagoon is then discharged through the Cooling Water Outfall into the marine water. The effluent of the Ash Lagoon is also monitored.

The details of the monitoring results are presented in *Section 4.5.2*.

4.5 WATER QUALITY IMPACT ASSESSMENT

4.5.1 Construction Phase

Potential sources of impacts to water quality from the construction activities are:

- Construction runoff; and
- Sewage effluents generated from the workforce.

Construction Runoff

Construction runoff from site areas may contain high loading of suspended solids (SS) and contaminants. Potential water pollution sources from construction site runoff include:

a) Runoff and erosion from site surfaces, earth working areas and

Figure 4.2

Location of Water Quality Sensitive Receivers

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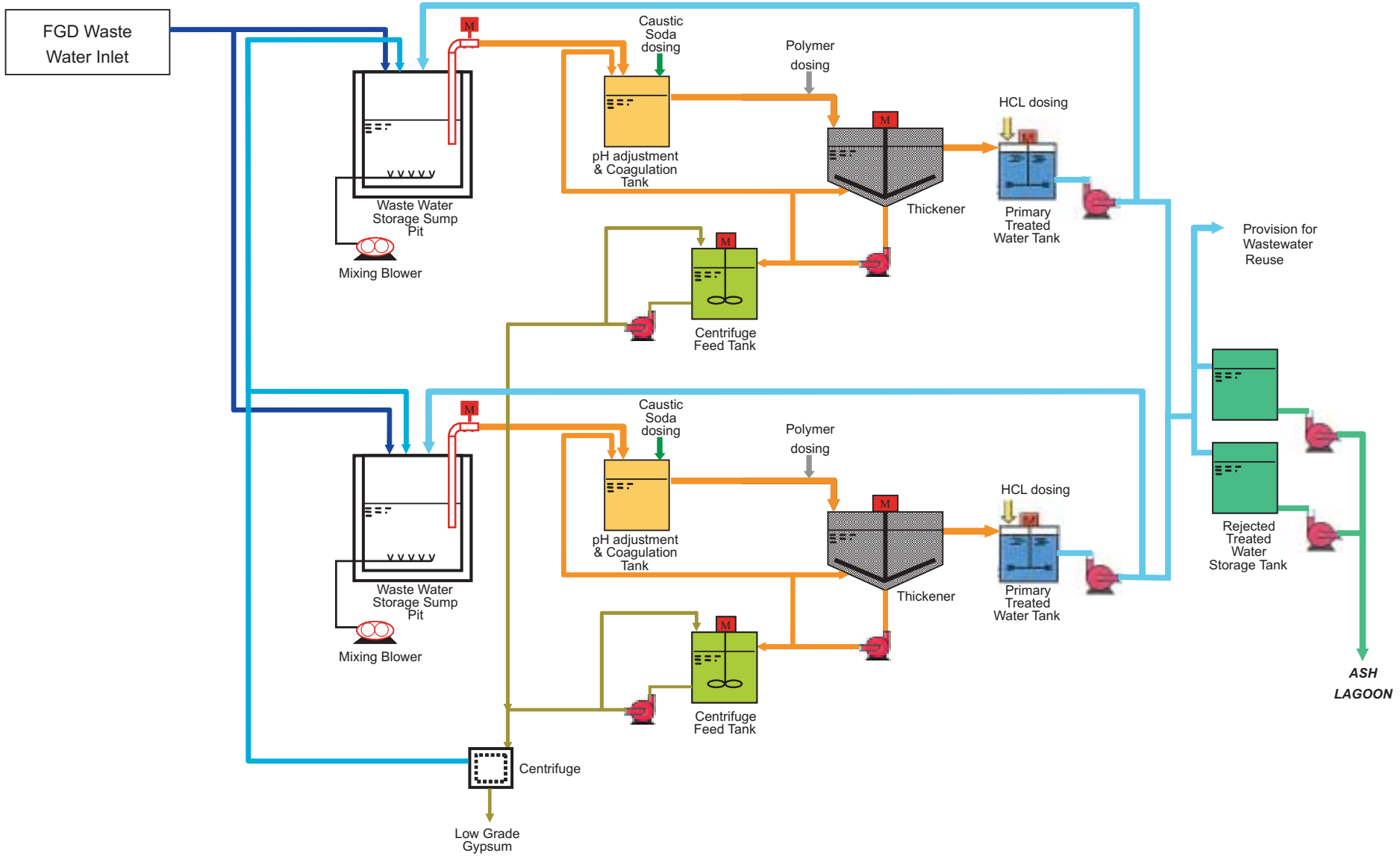

Figure 4.3

Simplified Schematic Diagram of FGD Wastewater Treatment Plant

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Environmental Resources Management

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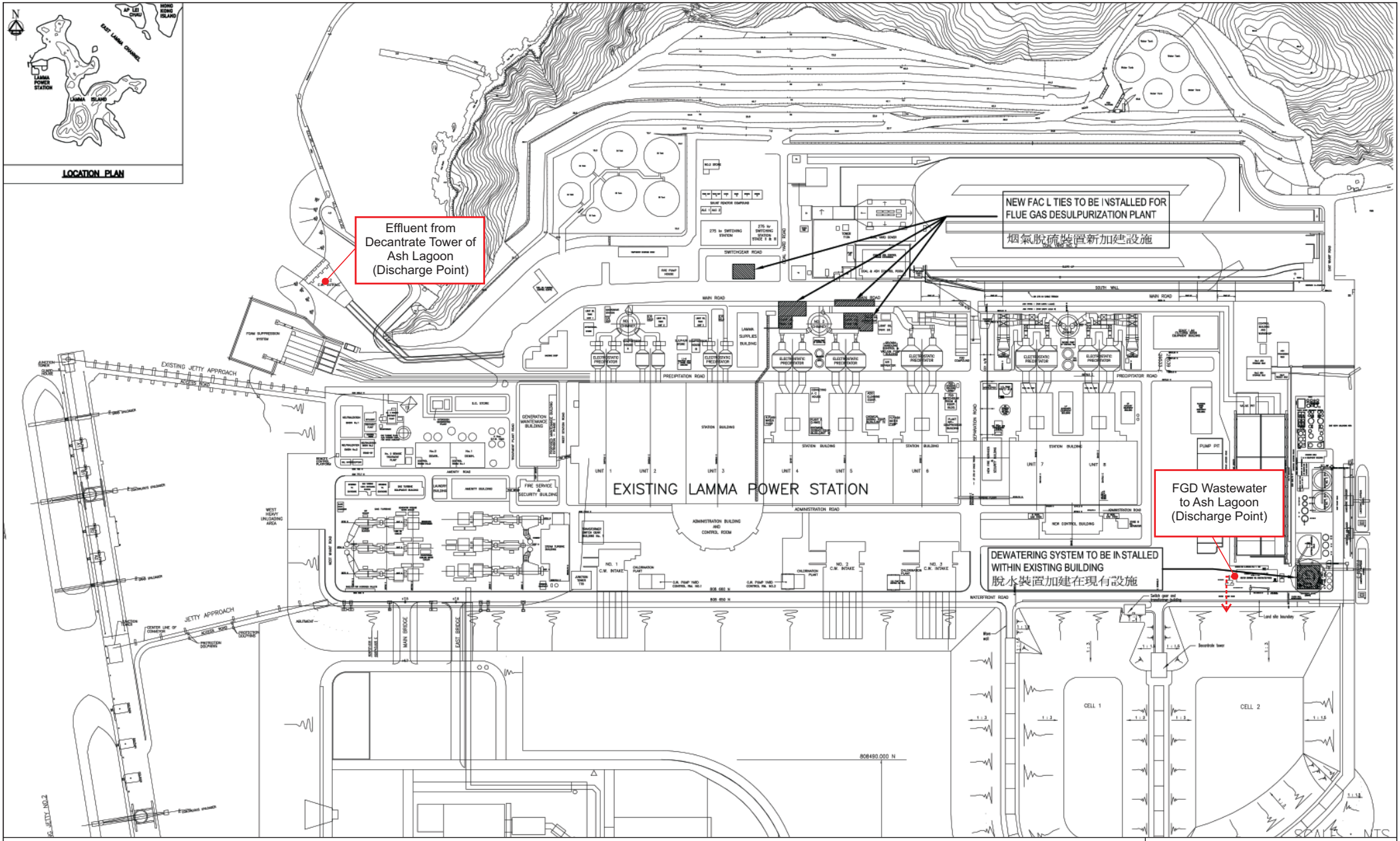

Figure 4.4

Wastewater Discharge Points from FGD Process

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stockpiles;

b) Used water from purging of the Light Oil Tanks; and

c) Fuel, oil, solvents and lubricants from maintenance of machinery and equipment.

Construction runoff may cause physical, biological and chemical effects. Its physical effect can cause blockage of drainage channels due to the deposits of increasing SS from the site. Chemical and biological effects are however highly dependent on its chemical and nutritional contents. Runoff containing significant amount of concrete and cement-derived materials would lead to increasing turbidity and discoloration, elevation in pH, and accretion of pH solids.

There will be no wastewater generated by the demolition of oil tanks. The excavated top soil will not be stored on site and will be removed offsite soon after the excavation due to limited site works area.

Excavation is necessary for the construction of the piled foundations of FGD booster fans, gas-gas heaters, gas ducts supports and the shallow foundation of the Switchgear and Equipment Building. It is anticipated that the construction runoff will not be significant. In addition, the existing storm drains could catch the runoff to prevent the run-off reaching the nearby marine water. With good practice of work, as stated in *ProPECC PN1/4*, and appropriate mitigation measures, the construction runoff should be minimal and unacceptable water quality impacts due to surface runoff are not expected.

Sewage Effluents generated from the Workforce

Sewage effluents will arise from the sanitary facilities provided for the on-site workforce. The characteristics of sewage would include high levels of 5-day Biochemical Oxygen Demand (BOD_5), Ammonia and *E.coli* counts.

The existing toilet facilities of the Power Station will be provided for use by the workforce. Additional sanitary facilities are therefore not required. Based on the above, adverse impacts to water quality as a result of the sewage effluent generated by the workforce are not expected to occur.

4.5.2 Operational Phase

Potential source of impacts to water quality from the operation of the FGD plants are as a result of filtrate generated from the dewatering of gypsum slurry.

The limestone slurry is introduced to react with flue gas for removal of SO_2. Water will filter out from the gypsum slurry after passing through the hydrocyclones. It is then retained in the reclaimed water tanks before discharging to the existing wastewater treatment plant (WWTP). The influent is characterised as pH of 5-6 and SS of approximately 7% of the whole volume.

In line with the existing practice adopted for the Units L6, L7 & L8 FGD plants, operational plant effluent from the proposed FGD plant will be reused as far as possible for preparation of limestone slurry, conditioning of PFA for offsite transportation, etc. to minimise discharge to the existing WWTP.

The WWTP is equipped with a number of storage tanks/pits and recirculation lines to temporary store the effluent for re-treatment if the action limit is triggered. Chemical tanks are usually sized based on 14 days usage for 5 x 350MW FGD Plants whereas the transfer/dosing pumps are with 100% standby capacity. The sizing of the storage pits/tanks are listed in *Table 4.5.*

Table 4.5 WWTP Plant Design Capacity

Equipment Capacity	Size	Design
Wastewater Storage Sump Pit	120 m^3 x 2	2x50% for 5x350MW
Rejected Treated Water Storage Tanks	260 m^3 x 2	2x50% for 5x350MW

Referring to the past record (October 2004 to September 2005) at the sampling point of the Rejected Treated Water Storage Tank *(Table 4.6),* the effluent generated is well below the licence limit. Note that not all parameters require monitoring in accordance with the WPCO licence. In addition, there is no normal and emergency plant maintenance discharge so far.

Table 4.6 Monitoring Records of FGD Wastewater Treatment Plant Discharge to Ash Lagoon

		Daily Average					Concentration (Daily Average)			
Month	**Volume**	**pH**	**S.S.**	**Ba**	**Hg**	**Cd**	**Fe**	**TP**	**TN**	**CN**
	(m^3 day^{-1})		**(mg L^{-1})**	**(μg L^{-1})**	**(μg L^{-1})**	**(μg L^{-1})**	**(μg L^{-1})**	**(mg L^{-1})**	**(mg L^{-1})**	**(mg L^{-1})**
Licence Limit	*200*	*6-9*	*30*	*1500*	*5*	*5*	*4000*	*8*	*400*	*0.1*
Oct 2004	43.4	8.3	17.7	69	<0.5	<1	240	<0.1	53	<0.01
Nov 2004	19.1	8.4	17.8	22	<0.5	<1	300	<0.1	200	<0.01
Dec 2004	24.9	8.1	18.7	31	<0.5	<1	440	0.2	150	0.02
Jan 2005	44.7	8.3	15.1	24	<0.5	<1	<50	0.2	130	<0.01
Feb 2005	26.6	8.3	18.4	138	<0.5	2	<50	<0.1	115	0.04
Mar 2005	53.6	8.3	19.3	280	<0.5	2	100	0.2	285	0.02
Apr 2005	56.1	8.4	19.1	741	<0.5	2	110	0.6	315	<0.01
May 2005	57.0	8.4	19.0	340	1.4	3.8	130	0.2	320	0.02
Jun 2005	42.1	8.4	17.9	313	<0.5	<1	<50	0.1	148	<0.01
Jul 2005	78.3	8.4	19.5	307	<0.5	<1	<50	<0.1	145	0.01
Aug 2005	89.8	8.4	18.6	273	<0.5	3	260	0.2	117	<0.01
Sep 2005	52.7	8.5	19.3	30	<0.5	<1	<50	0.3	87	<0.01

As the L4 & 5 FGD would adopt the same wet limestone-gypsum process, similar properties of effluent would be generated with the following properties and the expected influent and effluent are given in *Table 4.7.*

Table 4.7 Expected Influent and Effluent Characteristics on FGD Wastewater Treatment Plan

Constituents	Units	Designed Influent for 5x350MW FGD	Expected Influent for 5x350MW FGD	Effluent at sampling point
pH	pH	5~6	5~6	6~9
Temperature	°C	46	43~44	≤40
Suspended Solids	mg/L	71,800	64,400~66,200	≤30

Current design capacity of the existing WWTP is 54 m^3 hr^{-1}, which is designed to cater for effluent from 5 FGD plants each with a maximum effluent discharge rate of 6.3 m^3 hr^{-1}. As the existing WWTP has spare capacity to cater for the additional wastewater produced from the proposed retrofit project, it is expected that effluent from the WWTP to the Ash Lagoon will meet the requirements in the *WPCO* licence for the Ash Lagoon Decantrate Tower.

The decanted water discharged from the Ash Lagoon is closely monitored. The monitoring results of the decanted water discharged from the Ash Lagoon to the Cooling Water Outfall from October 2004 to September 2005 is presented in *Table 4.8*.

Table 4.8 Monitoring Records of Ash Lagoon Discharged to Cooling Water Outfall

Month	Volume (m^3 day^{-1})	SS (mg L^{-1})	Ba (µg L^{-1})	Hg (µg L^{-1})	Cd (µg L^{-1})	Fe (µg L^{-1})	TP (mg L^{-1})	TN (mg L^{-}	CN (mg L^{-1})
Licence Limit	20,000	30	200	1	1	600	5.0	20	0.01
Oct 2004	18589.7	19.0	62	<0.5	<1	190	<0.1	0.4	<0.01
Nov 2004	18581.3	18.9	22	<0.5	<1	360	<0.1	0.3	<0.01
Dec 2004	18594.2	19.6	33	<0.5	<1	410	0.1	0.5	<0.01
Jan 2005	7203.9	20.3	23	<0.5	<1	<50	0.1	0.1	<0.01
Feb 2005	0	*	*	*	*	*	*	*	*
Mar 2005	0	*	*	*	*	*	*	*	*
Apr 2005	0	*	*	*	*	*	*	*	*
May 2005	0	*	*	*	*	*	*	*	*
Jun 2005	7506.0	17.9	32	<0.5	<1	<50	0.2	2.1	<0.01
Jul 2005	14106.1	18.7	40	<0.5	<1	90	<0.1	1.3	<0.01
Aug 2005	14087.4	20.5	30	<0.5	<1	190	0.2	0.6	<0.01
Sep 2005	3756.0	16.1	27	<0.5	<1	50	<0.1	0.9	<0.01

Notes:
* No sampling was taken due to no discharge.

The monitoring results show that the concentrations of the effluent from Ash Lagoon are well below the limit. In overall, the effluent from Ash Lagoon is better in quality than that from the FGD WWTP. It has been shown that the additional flow from the FGD plants is in compliance with the license and is

environmentally acceptable. On the basis of the above results and the fact that the discharge point of the cooling water outfall for the ash lagoon decantrate is directed away from WSRs (see *Figure 4.4*), effluent from the Cooling Water Outfall is not expected to pose any unacceptable adverse impacts on the WSRs.

Based on the above, no unacceptable impacts to WSRs are expected to occur as a result of either the construction or operation of the FGD Retrofit.

4.6 MITIGATION MEASURES

4.6.1 Construction Phase

General

Any construction effluent discharge should be diverted away from embayed water such as the eastern waters of the working site where bathing beaches are found.

Construction Runoff

Exposed soil areas should be minimised to reduce the contamination of runoff and erosion. As mentioned in *Section 4.5.1,* excavation is necessary for the construction of the piled foundations of FGD booster fans, gas-gas heaters, gas ducts supports and the shallow foundation of the Switchgear and Equipment Building only. Silt removal facilities, channels and manholes should be maintained and the deposited silt and grit should be removed regularly to ensure they are functioning properly at all times. Temporary covers (i.e. tarpaulin) should also be provided to minimise the generation of high SS runoff.

A licensed waste collector will be standby on-site to collect the waste oils and other chemical waste collected from the demolition of oil tank and oil separator as well as the used water from diesel oil tank purging. The used water will then be transported to a facility licensed to receive chemical waste, such as Chemical Waste Treatment Centre at Tsing Yi.

In addition, control measures, including implementation of excavation schedules, lining and covering of excavated stockpiles and contaminated soil treatment areas, shall be implemented to minimize contaminated stormwater run-off from the site. The contaminated run-off water as well as leachate/seepage resulting from the contaminated soil stockpiles and treatment shall be collected and treated to meet the WPCO requirements prior to discharge.

Sewage Effluents

The existing toilet of the Power Station will be provided for the construction workforce. No additional sanitary facilities will be required and hence adverse impact is not anticipated.

Groundwater Discharge

According to the Land Contamination Assessment (*Section 2*), exceedances of TPH were detected in several groundwater samples. As groundwater is not used for either domestic or industrial purposes at the Site and in the adjacent areas, remediation of TPH in the groundwater of the Site is not considered necessary. Groundwater extraction is not anticipated during the demolition and/or construction programmes as the proposed excavations are at levels well above the site groundwater table. However, if groundwater is encountered during the demolition and/or construction programmes and groundwater dewatering from the work areas is required, the extracted groundwater will be collected, appropriately stored on-site and recharged back to the underlying ground.

4.6.2 Operational Phase

As mentioned in *Section 4.5.2*, the operational plant effluent from the FGD plants should be reused as much as possible in order to minimise discharge to the WWTP. Maintenance of the WWTP should be performed regularly to ensure the effluent from the WWTP would not exceed the current requirements stipulated in the WPCO license for Ash Lagoon.

Any operational effluent discharge should be discharged to the Ash Lagoon and the decanted water is then discharged through the Cooling Water Outfall, which is away from embayed water such as the eastern waters of the working site where bathing beaches are found

4.7 SUMMARY OF ENVIRONMENTAL OUTCOMES AND CONCLUSION

The potential water quality impacts from the retrofit of FGD plants have been assessed. Assessment results indicate that no unacceptable water quality impacts will arise from the construction activities provided that the recommended mitigation measures are implemented.

The operation of the FGD plants will not result in adverse water quality impacts on the water quality sensitive receivers as the existing WWTP has adequate capacity to deal with the additional FGD effluent.

4.7.1 Environmental Monitoring and Audit (EM&A) Requirements

Due to the small scale of the demolition and construction works of the Project, and no adverse impacts predicted, no EM&A is required for the Construction Phase.

Since the Project will not have any unacceptable water quality impacts, no additional EM&A activities are required, besides those already in place, such as those required by the operation of the existing WWTP at Lamma Power Station.

5 WASTE IMPACT ASSESSMENT

5.1 INTRODUCTION

The Project involves the demolition of two existing light oil tanks and retrofitting of FGD plant to two existing 350MW coal-fired generating units (L4 and L5) of Lamma Power Station. This section identifies the potential wastes arising from the Project and assesses the potential environmental impacts associated with waste handling and disposal. The main issues are:

- handling and treatment of contaminated soil ;
- disposal of construction and demolition (C&D) materials arising from the demolition, excavation and construction works; and
- management of by-products produced from the FGD process.

Opportunities for waste minimisation, recycling, storage, collection, transport and disposal have been examined and procedures for waste reduction and management have been proposed.

5.2 LEGISLATION REQUIREMENT AND EVALUATION CRITERIA

The following discussion on legislative requirements and evaluation criteria applies to both the construction and operational phases of the Project.

The criteria and guidelines for evaluating potential waste management implications are laid out in *Annexes 7* and *15* of the *EIAO-TM* under the *EIAO* (Cap 499).

The following legislation covers, or has some bearing upon, the handling, treatment and disposal of wastes in Hong Kong, and will also be considered in the assessment.

- *Waste Disposal Ordinance (Cap 354);*
- *Waste Disposal (Chemical Waste) (General) Regulation (Cap 354C);*
- *Land (Miscellaneous Provisions) Ordinance (Cap 28)*;
- *Public Health and Municipal Services Ordinance (Cap 132) - Public Cleansing and Prevention of Nuisances Regulation;* and
- *Dumping at Sea Ordinance (Cap 466)*.

5.2.1 Waste Disposal Ordinance (Cap 354)

The *Waste Disposal Ordinance* (WDO) prohibits the unauthorised disposal of wastes, with waste defined as any substance or article, which is abandoned. Under the *WDO*, wastes can only be disposed of at a licensed site. A breach of these regulations can lead to the imposition of a fine and/or a prison sentence. The *WDO* also provides for the issuing of licences for the collection and transport of wastes. Licences are not, however, currently issued for the collection and transport of construction waste or trade waste.

The *Waste Disposal (Charges for Disposal of Construction Waste) Regulation* defined construction waste as any substance, matters or things that is generated from construction work and abandoned, whether or not it has been processed or stockpiled before being abandoned, but does not include any sludge, screening or matter removed in or generated from any desludging, desilting or dredging works.

The Construction Waste Disposal Charging Scheme will come into operation on 1 December 2005. Processing of account applications by the EPD will start on the same day. Starting from 1 December 2005, main contractor who undertakes construction work under a contract with value of $1 million or above is required to open a billing account solely for the contract. Application shall be made within 21 days after the contract is awarded. Failing this will be an offence under the law.

For construction work under a contract with value less than $1 million, such as minor construction or renovation work, any person such as the owner of the premises where the construction work takes place or his/her contractor can open a billing account; the account can also be used for contracts each with value less than $1 million. The premises owner concerned may also engage a contractor with a valid billing account to make arrangement for disposal of construction waste.

Charging for disposal of construction waste will start on 20 January 2006 and from this day; any person before using waste disposal facilities for disposal of construction waste needs to open an account.

Construction work contracts awarded or tenders of which closed before 1 December 2005 are eligible for exemption from charges. Application for exemption account must be made on or before 22 December 2005. Depending on the percentage of inert materials in the construction waste, construction waste can be disposed at public fill, sorting facilities, landfills and outlying islands transfer facilities where different disposal cost would be applied. The scheme encourages reduce, reuse and sorting of construction waste such that the waste producer can minimise their disposal fee. *Table 5.1* summarises the government construction waste disposal facilities, types of waste accepted and disposal cost.

Table 5.1 Government Waste Disposal Facilities for Construction Waste

Government Waste Disposal Facilities	Type of Construction Waste Accepted	Charge Per Tonne
Public fill reception facilities	Consisting entirely of inert construction waste	$27
Sorting facilities	Containing more than 50% by weight of inert construction waste	$100
Landfills	Containing not more than 50% by weight of inert construction waste	$125
Outlying Islands Transfer Facilities	Containing any percentage of inert construction waste	$125

5.2.2 Waste Disposal (Chemical Waste) (General) Regulation

Chemical waste as defined under the *Waste Disposal (Chemical Waste) (General) Regulation* includes any substance being scrap material, or unwanted substances specified under *Schedule 1* of the *Regulation*, if such a substance or chemical occurs in such a form, quantity or concentration so as to cause pollution or constitute a danger to health or risk of pollution to the environment.

A person should not produce, or cause to be produced, chemical wastes unless he is registered with the EPD. Any person who contravenes this requirement commits an offence and is liable to a fine and imprisonment. Producers of chemical wastes must treat their wastes, utilising on-site plant licensed by the EPD or have a licensed collector take the wastes to a licensed facility. For each consignment of wastes, the waste producer, collector and disposer of the wastes must sign all relevant parts of a computerised trip ticket. The system is designed to allow the transfer of wastes to be traced from cradle-to-grave.

The *Regulation* prescribes the storage facilities to be provided on site including labelling and warning signs. To minimise the risks of pollution and danger to human health or life, the waste producer is required to prepare and make available written procedures to be observed in the case of emergencies due to spillage, leakage or accidents arising from the storage of chemical wastes. He/she must also provide employees with training in such procedures.

5.2.3 Land (Miscellaneous Provisions) Ordinance (Cap 28)

The inert portion of C&D materials (1) (also called public fill) may be taken to public filling areas. Public filling areas usually form part of land reclamation schemes and are operated by the Civil Engineering and Development Department (CEDD) and others. The *Land (Miscellaneous Provisions) Ordinance* requires that individuals or companies who deliver public fill to the

(1) "C&D materials" refers to materials arising from any land excavation or formation, civil/building construction, road works, building renovation or demolition activities. It includes various types of reusable materials, building debris, rubble, earth, concrete, timber and mixed site clearance materials. When sorted properly, materials suitable for land reclamation and site formation (known as public fill) should be reused at public filling area. The rock and concrete can be crushed and processed to produce aggregates for various civil and building engineering applications. The remaining C&D waste (comprising timber, paper, plastics, general refuse) are to be disposed of at landfills.

public filling areas obtain Dumping Licences. The licences are issued by the CEDD under delegated authority from the Director of Lands.

Individual licences and windscreen stickers are issued for each vehicle involved. Under the licence conditions, public filling areas will accept only inert building debris, soil, rock and broken concrete. There is no size limit on rock and broken concrete, and a small amount of timber mixed with inert material is permissible. The material should, however, be free from marine mud, household refuse, plastic, metal, industrial and chemical wastes, animal and vegetable matter and any other materials considered unsuitable by the public filling supervisor.

5.2.4 Public Cleansing and Prevention of Nuisances Regulation

This *Regulation* provides a further control on the illegal dumping of wastes on unauthorised (unlicensed) sites. The illegal dumping of wastes can lead to a fine and imprisonment.

5.2.5 Dumping at Sea Ordinance (Cap 466)

This *Ordinance* came into operation in April 1995 and empowers the Director of Environmental Protection to control the disposal and incineration of substances and articles at sea for the protection of the marine environment. Under the *Ordinance*, a permit from the Director of Environmental Protection is required for the disposal of regulated substances within and outside the waters of the Hong Kong SAR. The permit contains terms and conditions that includes the following specifications:

- Type and quantity of substances to be dumped;
- Location of the disposal grounds;
- Requirements of equipment for monitoring the disposal operations; and
- The need for environmental monitoring.

5.2.6 Other Relevant Guidelines

Other 'guideline' documents, which detail how the Contractor should comply with the regulations, are as follows:

- *Waste Disposal Plan for Hong Kong* (December 1989), Planning, Environment and Lands Branch Government Secretariat, Hong Kong Government;
- *Chapter 9 Environment (1999)*, Hong Kong Planning Standards and Guidelines, Hong Kong Government;
- *New Disposal Arrangements for Construction Waste* (1992), EPD & CED, Hong Kong Government;
- *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes* (1992), EPD, Hong Kong Government.

- *Works Branch Technical Circular (WBTC) No. 32/92, The Use of Tropical Hard Wood on Construction Site*; Works Branch, Hong Kong Government;
- *WBTC No. 2/93, Public Dumps.* Works Branch, Hong Kong Government;
- *WBTC No. 2/93B, Public Filling Facilities*, Works Branch, Hong Kong Government;
- *WBTC No. 16/96, Wet Soil in Public Dumps*; Works Branch, Hong Kong Government;
- *WBTC Nos. 4/98* and *4/98A, Use of Public Fill in Reclamation and Earth Filling Projects*; Works Bureau, Hong Kong SAR Government.
- *Waste Reduction Framework Plan, 1998 to 2007*, Planning, Environment and Lands Bureau, Government Secretariat, 5 November 1998;
- *WBTC Nos. 25/99, 25/99A* and *25/99C, Incorporation of Information on Construction and Demolition Material Management in Public Works Sub-committee Papers*; Works Bureau, Hong Kong SAR Government;
- *WBTC No. 12/2000, Fill Management*; Works Bureau, Hong Kong SAR Government;
- *WBTC No. 19/2001, Metallic Site Hoardings and Signboards;* Works Bureau, Hong Kong SAR Government;
- *WBTC Nos. 6/2002* and *6/2002A, Enhanced Specification for Site Cleanliness and Tidiness.* Works Bureau, Hong Kong SAR Government;
- *WBTC No. 11/2002, Control of Site Crusher.* Works Bureau, Hong Kong SAR Government;
- *WBTC No. 12/2002, Specification Facilitating the Use of Recycled Aggregates.* Works Bureau, Hong Kong SAR Government;
- *ETWBTC No. 33/2002, Management of Construction and Demolition Material Including Rock*; Environment, Transport and Works Bureau, Hong Kong SAR Government;
- *ETWBTC No. 34/2002, Management of Dredged/Excavated Sediment;* Environment, Transport and Works Bureau, Hong Kong SAR Government;
- *ETWBTC No. 15/2003, Waste Management on Construction Sites;* Environment, Transport and Works Bureau, Hong Kong SAR Government; and
- *ETWBTC No. 31/2004, Trip Ticket System for Disposal of Construction & Demolition Materials*, Environment, Transport and Works Bureau, Hong Kong SAR Government.

5.2.7 Landfill Disposal Criteria for Contaminated Soil

Excavated contaminated soil has to meet certain criteria before disposal to landfill is allowed. The criteria presented in the EPD's *Guidance Notes for*

Investigation and Remediation of Contaminated Sites of Petrol Filling Stations; Boatyards; and Car Repair/Dismantling Workshops are set primarily in terms of Toxicity Characteristic Leaching Procedure (TCLP) limits, as shown in *Table 5.2*.

Table 5.2 Landfill Disposal Criteria for Contaminated Soil

Parameters	TCLP Limit (ppm)
Cadmium (Cd)	10
Chromium (Cr)	50
Copper (Cu)	250
Nickel (Ni)	250
Lead (Pb)	50
Zinc (Zn)	250
Mercury (Hg)	1
Tin (Sn)	250
Silver (Ag)	50
Antimony (Sb)	150
Arsenic (As)	50
Beryllium (Be)	10
Thallium (Tl)	50
Vanadium (V)	250
Selenium (Se)	1
Barium (Ba)	1,000

5.3 ESTIMATED WASTE ARISINGS

5.3.1 Construction Phase

During the construction phase, the main activities, which will potentially result in the generation of waste, include demolition works, excavation, and construction of FGD Plant. The typical waste types associated with these activities include:

- Contaminated soil;
- Construction and Demolition (C&D) materials;
- Chemical wastes from the flushing/cleaning of two light oil tanks and oil/water separation sump prior to their demolition;
- Sewage; and
- General refuse.

If not properly managed, the handling and disposal of these wastes may cause adverse environmental impacts.

5.3.2 *Operational Phase*

The following wastes/by-products will be generated from the operation of the FGD Plant:

- Gypsum produced from the new FGD plant;
- Additional sludge from existing WWTP;
- Chemical waste;
- Sewage; and
- General refuse.

5.4 *ASSESSMENT METHODOLOGY*

The potential environmental impacts associated with the handling and disposal of waste arising from the construction and operation of the Project were assessed in accordance with the criteria presented in *Annexes 7* and *15* of the *EIAO-TM*, which are summarised as follows:

- estimation of the types and quantities of the wastes to be generated;
- assessment of the secondary environmental impacts due to the management of waste with respect to potential hazards, air and odour emissions, noise, wastewater discharges and traffic; and
- assessment of the potential impacts on the capacity of waste collection, transfer and disposal facilities.

5.5 *IMPACT ASSESSMENT*

5.5.1 *Construction Phase*

(a) Contaminated Soil

Two light oil tanks and the adjacent in-ground oil separator will be demolished and soil materials around and underlying the tank and oil separator will be excavated during the subsequent retrofit programme. Leakage and/or spillage (if any) of oil from operation of these facilities may cause land contamination to the underlying soil.

A Contamination Assessment Plan (CAP) has been prepared and agreed by EPD (see *Annex A*). It reviewed the historical land uses and existing conditions of the site and recommended a site investigation programme to determine if the site is contaminated and if so, the types and degree of contamination. Based on the finding of the site investigation and the extent of the excavation works, it is estimated that about 600 m^3 of excavated soil

materials (with bulking factor [1]) to be excavated near the No. 5 oil tank are potentially contaminated with Total Petroleum Hydrocarbon (TPH)). Details of the findings of the site investigation are reported in the Contamination Assessment Report (CAR) (see *Annex B*).

The excavated contaminated soil will be remediated in accordance with the EPD's *Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol Filling Stations Boatyards, and Car/Repair/Dismantling Workshops, May 1999*. The remediation actions could involve excavation, testing, on-site treatment (ie soil venting/biopiling) and on-site reuse.

A Remediation Action Plan (RAP), which has been submitted together with the Contamination Assessment Report (CAR) for EPD endorsement, has detailed the site clean up method (see *Annex B)*.

(b) C&D Materials

Demolition Materials

The Project involved demolishing of the following existing facilities to provide space for installing FGD plants for Generation Units L4 and L5.

- 2 existing 250m^3 light oil tanks and the associated fixtures/appendages/ foundations;
- An in-ground oil separator; and
- Bund walls surrounding the two light oil tanks.

The demolition works will take about 5 months and are scheduled to commence in April 2006.

A total of about 29 tonnes of scrap steel will be produced from the demolition of the oil tanks and the associated fixtures/ appendages such as pipeline, spiral stair and catwalk attached to the oil tanks. The steel sheet of the circular roof and sidewall will be cut into small panels in regular size for easy transportation. All the scrap steel will be transported off-site by barges for recycling.

A total of 660 m^3 uncontaminated reinforced concrete (after applying a bulking factor of 1.4) will be generated from demolition of the oil tanks foundation, concrete slabs, bund walls and oil separator structures. They are not contaminated and should be separated from other waste to avoid contamination. The reinforced concrete (public fill) will be reused on-site for reclamation of Lamma Power Station Extension or sent to public filling facilities /other reclamation site for reuse.

(1) Bulking factor of 1.2 and 1.4 were applied for excavated soil and concrete foundation, respectively. A total of 4,200m^3 of demolition concrete, inert C&D waste and excavated soil materials will be generated, of which a maximum of about 600 m^3 is potentially contaminated with TPH.

Excavated Materials

Excavation works would be required for the construction of the piled foundations of FGD booster fans, gas-gas heaters, gas ducts supports and the shallow foundation of the Switchgear and Equipment Building. A total of 2,860 m^3 (with bulking factors (1)) of excavation materials (mainly soft materials, ie sand and clay) will be generated.

After excavating the in-ground oil separator, the area will be backfilled with the excavated soil (about 190 m^3) to original ground level. About 2,670 m^3 of surplus excavation materials will be generated. The surplus excavated materials (public fill) will be reused on-site for reclamation of Lamma Power Station Extension or sent to public filling facilities/other reclamation site for reuse.

C&D Materials Arising from New Building Construction

C&D materials consisting of packing materials, plastics, metal, concrete, wood etc will be generated from the new building construction. The main structures to be constructed at the site would be the switchgear & equipment building for the L4 & L5 FGD plant with the gross floor area (GFA) of 750 m^2. Based on a generation rate of 0.1 m^3 per m^2 of GFA constructed (2), it is estimated that a total of about 75 m^3 of C&D materials will be generated. These materials should be sorted on-site for into public fill (inert portion) (about 60 m^3) and construction waste (15 m^3) in order to minimise the amount of construction waste to be disposed of at landfills and the cost for disposal of the C&D materials arising from the Project.

Public fill will be reused on-site for reclamation works of the Lamma Power Station Extension or sent to public fills area / other reclamation site for reuse. Construction waste will be transported to public pier by barge and transported by trucks to landfills for disposal.

C&D Materials - Summary

In view of the relative small of quantity of surplus public fill(3) (a total of 3,400m^3) and construction waste (about 15 m^3) to be generated, the potential environmental (ie dust water quality and noise) impacts arising from waste handling and disposal will be minimal. Detailed assessments of the potential air, water quality and noise impacts associated with the construction works are discussed in *Section 3*, *4* and *7*, respectively. The public fill will be reused on-site for the reclamation works of the Lamma Power Station and the off-site traffic will be minimal. About 1 barge trip and two truck trips will be required for the off-site disposal of the construction waste.

(1) Bulking factor of 1.2 and 1.4 were applied for excavated soil and concrete foundation respectively

(2) Reduction of Construction Waste Final Report (March 1993). Hong Kong Polytechnics.

(3) The total volume of surplus public fill is the sum of demolition concrete, inert C&D waste and excavated soil, reduced by the volume of on-site back filling and potentially contaminated materials.

(c) Chemical Wastes

Chemical waste, as defined under the *Waste Disposal (Chemical Waste) (General) Regulation*, includes any substance being scrap material, or unwanted substances specified under *Schedule 1* of the *Regulation*. A complete list of such substances is provided under the *Regulation*; however, substances likely to be generated from the construction of the FGD plants and the associated building will, for the most part, arise from the maintenance of construction plant and equipment. These may include, but need not be limited to the following:

- Scrap batteries or spent acid/alkali from their maintenance;
- Used paint, engine oils, hydraulic fluids and waste fuel;
- Contaminated oily water from the flushing and cleaning of the light oil tanks and the oil/water separation sump prior to their demolition;
- Spent mineral oils/cleaning fluids from mechanical machinery; and
- Spent solvents/solutions, some of which may be halogenated, from equipment cleaning activities.

Chemical wastes may pose environmental, health and safety hazards if not stored and disposed of in an appropriate manner as outlined in the *Waste Disposal (Chemical Waste) (General) Regulation* and the *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes*. These hazards may include:

- Toxic effects to workers;
- Adverse effects on air, water and land from spills; and
- Fire hazards.

It is estimated that about 30 m3 of oily water and oily sludge will be generated from the cleaning of the fuel oil tanks and oil separator sump. It is difficult to quantify the amount of chemical waste that will arise from other construction activities as it will be highly dependent on the Contractor's on-site maintenance activities and the quantity of plant and equipment utilized. However, it is anticipated that amount of chemical waste generated during the construction phase will be less than a hundred litres per month (mainly consists of lubricant oil). With the incorporation of suitable arrangements for the storage, handling, transportation and disposal of chemical wastes under the requirements stated in the *Code of Practice on the Packaging, Labelling and Storage of Chemical Waste*, the potential environmental impacts will be negligible.

(d) Sewage

Sewage will arise from the construction workforce and site office's sanitary facilities. If not properly managed, these materials could cause odour and potential health risks to the workforce by attracting pests and other disease vectors.

It is estimated that a maximum of about 60 construction workers will be working on site at any one time and the maximum quantity of sewage to be generated will be about 3.6 m^3 per day. All site workers will use the existing sanitary facilities at the Lamma Power Station. With respect to the small quantity (about 0.4% of existing WWTP capacity) of additional sewage to be generated, no adverse impacts are envisaged for the existing on-site wastewater treatment plant during construction phase.

(e) General Refuse

The presence of a construction site with workers and associated site office will result in the generation of a variety of general refuse requiring disposal. General refuse will mainly consist of food waste, aluminium cans and waste paper.

The storage of general refuse has the potential to give rise to adverse environmental impacts. These include odour if the waste is not collected frequently (for example, daily), windblown litter, water quality impacts if waste enters water bodies, and visual impact. The site may also attract pests, vermin, and other disease vectors if the waste storage areas are not well maintained and cleaned regularly. In addition, disposal of wastes at sites other than approved landfills, can also lead to similar adverse impacts at those sites.

It is estimated that a maximum of about 60 construction workers will be worked on site at any one time. The amount of general refuse to be generated will be about 39 kg per day. Recyclable materials (ie paper, plastic bottle and aluminium can) should be separated and disposed of at the recycling bins in order to minimise the amount of general refuse to be disposed of at landfills. General refuse generated from the construction workforce will be collected together with other general refuse generated from the existing Lamma Power Station by contractor and subsequently sent to landfill for disposal. With respect to the small quantity of general refuse to be generated, it is anticipated that no additional traffic will be generated due to its disposal.

Provided that the mitigation measures recommended in *Section 5.6.4* are adopted, the environmental impacts caused by the storage, handling, transport and disposal of general refuse are expected to be minimal.

Table 5.3 summarised the waste arising during construction of the Project.

Table 5.3 Waste Arising During Construction

Type	Quantity	Disposal / Treatment Site
Contaminated Soil	600 m^3	On-site treatment and reuse as fill materials at Lamma Power Station or Lamma Extension.
Scrap Steel	29 tonnes	Off-site recycling

Type	Quantity	Disposal / Treatment Site
Public Fill	3,400 m^3	Reuse on-site for the reclamation of the Lamma Power Station Extension or other reclamation /public filling facilities
Construction Waste	15 m^3	Landfills
General Refuse	39 kg/day	Transported together with other general refuse generated from the existing Lamma Power Station to landfills
Chemical Waste	30 m3 from fuel oil tanks and oil separator sump demolition. Less than 100 L/month from construction activities.	Chemical Waste Treatment Centre and/or other licensed lube oil recycling facility
Sewage	3.6 m^3/day	Existing on-site WWTP

5.5.2 Operational Phase

Solid Waste By-product from FGD Processes

Gypsum

The proposed retrofit works involves directing of the flue gas from the boilers of Unit L4 and L5 to new FGD plants, in which limestone slurry is introduced to react with flue gas for removal of SO_2 before discharging to the atmosphere via the stack. During these processes, wastewater from the FGD absorber will be produced and commercial gypsum will be generated as a by-product. It should be noted that high quality commercial grade gypsum is produced from the operation of the existing FGD plants at Lamma Power Station. The gypsum to be generated from the new FGD units will also be commercial grade.

Gypsum is a useful construction material in building industry and the demand for gypsum is high in both Hong Kong and mainland China. *Table 5.4* presents the specification of gypsum to be generated from the new FGD plant.

Table 5.4 Expected Gypsum Specification

Parameter	Value
Purity	more than 90% as $CaSO_4.2H_2O$ (dry basis)
Free Moisture	less than 15% (as received basis)
Chloride	less than 0.02% (as received basis)

A total of 46,000 tonnes gypsum will be produced per year during the operation of new FGD plants (L4 and L5). Under existing contract arrangement, the limestone suppliers are required to collect an equivalent amount of gypsum produced from the FGD Plants and no gypsum will be stored on-site. This arrangement has worked satisfactorily for the existing FGD plant. The same contract arrangement will therefore be used for the new FGD plant.

In line with the current practice, 70% of gypsum produced from the Unit L4 and L5 FGD plants will be sold to a local cement manufacturer and 30% will be taken back by the limestone suppliers to mainland China for reuse. Currently the quantity of gypsum supplied by HEC cannot meet the demand of the local user and mainland limestone supplier and they have to import gypsum from overseas suppliers. Therefore it is expected that the local and mainland users will be capable of off-taking the additional gypsum produced and no disposal or storage facilities is required.

Under normal operation, there is no off-specification gypsum produced which will otherwise cause operational problem such as chute blockage by wet gypsum. All FGD plants are under daily monitoring to ensure that the gypsum produced will meet the above specification.

Additional Sludge from WWTP

The existing WWTP has spare capacity to handle the additional wastewater produced from the new FGD plants. It is expected that a maximum 12 $m^3 hr^{-1}$ of wastewater will be produced from the new FGD plants and an additional 1,200 tonnes per year (or about 3.3 tonnes per day) of sludge will be produced from the WWTP. It is expected that the characteristics of the sludge will be similar to that currently generated from the WWTP (see *Table 5.5*).

Table 5.5 Sludge Characteristics

Parameter	Value
Purity	More than 80% as $CaSO_4.2H_2O$
Free Moisture	Less than 25 % (as received basis)

In line with current operation, the sludge generated from WWTP will be off-taken by the limestone suppliers together with the gypsum by barges. All sludges will be reused for production of building materials (ie plaster board) in China.

Industrial Waste

Industrial waste will arise from maintenance activities at the new FGD plants. The materials may include scrap materials from maintenance of plant and equipment and cleaning materials. Provided the scrap materials are collected regularly, it is not expected that storage, handling, transport and disposal of industrial waste will cause adverse environmental impacts. Scrap metal and plastics will be separated for recycling. Other industrial waste (woods, packaging materials, etc) will be collected together with the general refuse disposed of at landfills. From the operational experience of the existing FGD plant, the amount of waste generated from the maintenance of the FGD plant is minimal (in the order of a few kg per month).

Chemical Waste

Chemicals such as limestone and sodium hydroxide will be used during the FGD and wastewater treatment processes. Based on the operation

experience of the existing FGD plants and WWTP information, the quantity of additional chemicals to be used for the new FGD plants are summarized in *Table 5.6*.

Table 5.6 Types and Quantity of Chemical To Be Used for Unit L4 & L5 FGD

Chemicals	Facility Used	Quantity
Limestone	FGD Plant	26,000 tonnes/ year
30% HCl	WWTP	48,000 L/ year
50% NaOH	WWTP	106,000 L/year
Polymer	WWTP	500kg/year

With the existing chemical management system, there is no wastage chemical due to over-supply, expired chemicals and off-spec chemicals. No chemical waste was generated from the use of these chemicals. The management system will be extended to include the operation of the new FGD plant.

With reference to the operation of the existing FGD system at Lamma Power Station, a small quantity (in an order of several litres per month) of chemical waste will be generated from the maintenance of the FGD Plants. The chemical waste may include lubricants, engine oil, used batteries, coolants and solvents. The existing chemical waste management system, which is development based on the *Code of Practice on the Packaging, Labelling and Storage of Chemical Waste,* will be extended to include the chemical waste to be generated from the new FGD plant. No adverse environmental impacts are anticipated due to the handling and disposed of the small quantity of chemical waste from the operation of the new FGD system.

With reference to the operational experience of the existing FGD plant at Lamma Power Station, the amount of chemical waste to be generated from the maintenance of the plant is minimal (in the order of several liters per month)

Sewage

The operation of the new FGD plant will be managed by the existing staff. Therefore no additional sewage will be produced from the workforce.

General Refuse

The operation of the new FGD plant will be managed by the existing staff. Therefore no additional general refuse will be generated from the workforce.

Table 5.7 summarises the waste arising during operation of the Project.

Table 5.7 Waste Arising During Operation

Type	Quantity	Disposal / Treatment Site
Gypsum	46,000 tonnes per year	To be collected by the limestone supplier and used by users in Hong Kong and China.
Sludge	1,200 tonnes per year or about 3.3 tonnes per day	To be collected by the limestone supplier and used by users in China

Type	Quantity	Disposal / Treatment Site
Industrial waste	A few kg per month	To be disposed of together with other general refuse.
Chemical Waste	Several litre per month	Chemical Waste Treatment Centre or other licensed lube oil recycling facility

5.6 *MITIGATION OF ADVERSE IMPACTS*

There are no major waste management issues associated with the operation of the new FGD plant. This section recommends the mitigation measures to avoid or minimize potential adverse environmental impacts associated with handling, collection and disposal of waste arising from the construction of the new FGD plants.

It is the Contractor's responsibility to ensure that only licensed chemical waste collectors are used for collection and transportation of chemical waste to the licensed disposal facility and that appropriate measures are taken to minimize adverse environmental impacts, including windblown litter and dust from the transportation of wastes. In addition, the Contractor must ensure that all the necessary waste permits are obtained for the construction and operational phases.

5.6.1 *Contaminated Soil*

For excavated soil confirmed to be contaminated, mitigation measures recommended in *RAP, Annex B* should be implemented.

5.6.2 *Excavated Materials*

Wherever practicable, excavated materials should be segregated from other wastes to avoid contamination thereby ensuring that it can be used as fill for the reclamation works of the Lamma Power Station Extension and avoiding the need for disposal at landfills.

Measures taken in the Planning Design Stages to Reduce the Generation of C&DM

The various waste management options can be categorized in terms of preference from an environmental viewpoint. The options considered to be more preferable have the least impacts and are more sustainable in the long term. Hence, the waste management hierarchy is as follows:

- Avoidance and minimization, that is, reduction of waste generation through changing or improving practices and design;
- Reuse of materials, thus avoiding disposal (generally with only limited reprocessing);
- Recovery and recycling, thus avoiding disposal (although reprocessing may be required); and

- Treatment and disposal, according to relevant law, regulations, guidelines and good practice.

This hierarchy should be used to evaluate the waste management options, thus allowing maximum waste reduction and reduced disposal costs. Records of quantities of wastes generated, recycled and disposed (locations) shall be kept.

Recommended Construction Phase Measures for the Reduction of C&DM Generation

The Contractor should recycle as much of the C&DM as possible on-site. Public fill and construction waste should be segregated and stored in different containers or skips to facilitate reuse or recycling of materials and their proper disposal. Surplus public fill should be reuse on-site for reclamation, or delivered to public fills area /other reclamation site by barge for reuse. The construction waste should be collected by Contractor and transported to landfills for disposal.

The use of wooden hoardings shall not be allowed. An alternative material, which can be reused or recycled, for example, metal (aluminium, alloy, etc) shall be used.

5.6.3 Chemical Waste

The Contractor should register as a chemical waste producer with the EPD. Chemical waste, as defined by *Schedule 1* of the *Waste Disposal (Chemical Waste) (General) Regulation*, should be handled in accordance with the *Code of Practice on the Packaging, Handling and Storage of Chemical Wastes* as follows:

Containers used for storage of chemical wastes should:

- be suitable for the substance they are holding, resistant to corrosion, maintained in a good condition, and securely closed;
- have a capacity of less than 450 L unless the specifications have been approved by the EPD; and
- display a label in English and Chinese in accordance with instructions prescribed in Schedule 2 of the *Regulations*.

The storage area for chemical wastes should:

- be clearly labelled and used solely for the storage of chemical waste;
- be enclosed on at least 3 sides;
- have an impermeable floor and bunding, of capacity to accommodate 110% of the volume of the largest container or 20% by volume of the chemical waste stored in that area, whichever is the greatest;
- have adequate ventilation;

- be covered to prevent rainfall entering (water collected within the bund must be tested and disposed of as chemical waste, if necessary); and
- be arranged so that incompatible materials are appropriately separated.

Disposal of chemical waste should be:

- via a licensed waste collector; and
- to a facility licensed to receive chemical waste, such as the Chemical Waste Treatment Centre which also offers a chemical waste collection service and can supply the necessary storage containers.

5.6.4 General Refuse

General refuse should be stored in enclosed bins or compaction units separately from construction and chemical wastes. General refuse should be removed from the site, separately from construction and chemical wastes, on a daily basis to minimise odour, pest and litter impacts. Burning of refuse on construction site is prohibited by law.

Aluminium cans are often recovered from the waste stream by individual collectors if they are segregated and made easily accessible. As such, separate, labelled bins for their deposit should be provided if feasible.

Office wastes can be reduced through the recycling of paper if volumes are large enough to warrant collection. Participation in a local collection scheme should be considered if available. In addition, waste separation facilities for paper, aluminium cans, plastic bottles etc., should be provided.

5.6.5 Management of Waste Disposal

The Contractor should open a billing account with EPD in accordance with the *Waste Disposal (Charges for Disposal of Construction Waste) Regulation* for the payment of disposal charges. Every waste load transferred to Government waste disposal facilities such as public fill, sorting facilities, landfills or transfer station would required a valid "chit" which contains the information of the account holder to facilitate waste transaction recording and billing to the waste producer. A trip-ticket system should also be established in accordance with *Works Bureau Technical Circular No. 31/2004* to monitor the disposal of solid wastes at transfer station/landfills, and to control fly-tipping. The billing "chit" and trip-ticket system will be included as one of the contractual requirements and implemented by the contractor.

A recording system for the amount of waste generated, recycled and disposed of (including the disposal sites) should be established during the construction stage.

5.6.6 *Staff Training*

Training should be provided to workers on the concepts of site cleanliness and on appropriate waste management procedures, including waste reduction, reuse and recycling at the beginning of the Contract.

5.7 *RESIDUAL ENVIRONMENTAL IMPACTS*

With the implementation of the recommended mitigation measures, minimal residual impacts are anticipated from the construction and operation of the Project.

5.8 *CONCLUSIONS*

5.8.1 *Construction Phase*

The key potential impacts during the construction phase are related to management of demolition materials, excavated materials and construction waste.

A total of 600 m^3 contaminated soil will be excavated for on-site treatment (in accordance with the EPD's *Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol Filling Stations Boatyards, and Car/Repair/Dismantling Workshops, May 1999)* and reuse at the either Lamma Power Station Extension or Lamma Power Station.

A total of about 29 tonnes of scrap steel will be produced during demolition of oil tanks and the associated fixtures/ appendages. All the scrap steel will be delivered off-site by barge for recycling.

A total of 3,400 m^3 of surplus public fill will be generated from the demolition and construction works. The public fill will be reused as fill for the reclamation of the Lamma Power Station Extension or other reclamation/public filling facilities. About 15 m^3 of construction waste will be disposed of at landfills.

Small quantities of chemical wastes (less than 100 litres per month), sewage (a maximum of 3.6 m^3 per day) and general refuse (a maximum of 39 kg per day) will be generated during the construction phase.

With the implementation of the recommendations in *Section 5.6*, the potential environmental impacts arising from storage, handling, collection, transport and disposal of wastes should be able to meet the criteria specified in the *EIAO-TM*. No unacceptable waste management impact is anticipated.

5.8.2 *Operational Phase*

All the additional gypsum (about 46,000 tonnes per year) and sludge (about 1,200 tonnes per year) will be generated and reused in Hong Kong and/or in Mainland China and no disposal is required.

With the implementation of the recommended mitigation measures, the potential environmental impacts associated with the storage, handling, collection, transport and disposal of a small quantity of industrial and chemical wastes arising from the operation of the two new FGD units will meet the criteria specified in the *EIAO-TM* and no unacceptable waste management impact is anticipated.

6 NOISE

6.1 INTRODUCTION

This Section presents the potential noise impacts associated with the demolition of oil tanks, retrofitting of Flue Gas Desulphurisation (FGD) plant to two existing 350MW coal-fired generating units L4 and L5 of Lamma Power Station, construction of equipment building and the cumulative noise impacts associated with operation of proposed FGD plant and existing units.

6.2 RELEVANT LEGISLATION AND GUIDELINES

6.2.1 Construction Noise

The principal legislation relating to the control of construction noise is the *Noise Control Ordinance (Cap. 400)* (*NCO*). Various Technical Memoranda (TMs), which stipulate control approaches and criteria, have been issued under the *NCO*. The following TMs are applicable to the control of noise from construction activities:

- *Technical Memorandum on Noise from Percussive Piling* (*PP-TM*);
- *Technical Memorandum on Noise from Construction Work other than Percussive Piling* (*GW-TM*); and
- *Technical Memorandum on Noise from Construction Work in Designated Areas* (*DA-TM*).

Apart from the above, the *Environmental Impact Assessment Ordinance* (*EIAO*) *(Cap. 499)* also provides means to assess construction noise impacts. The *Technical Memorandum on Environmental Impact Assessment Process* (*EIAO-TM*), issued under the *EIAO*, provides guidelines and noise criteria for evaluating construction noise impacts.

General Construction Works

Under the *EIAO*, noise impact arising from general construction works during normal working hours (i.e. 0700 to 1900 hours on any day not being a Sunday or public holiday) at the openable windows of buildings is to be assessed in accordance with the noise criteria as given in the *EIAO-TM*. The *EIAO-TM* noise standards are presented in *Table 6.1*.

Table 6.1 EIAO-TM Daytime Construction Noise Standard ($L_{eq,\ 30\ min}$ dB(A))

Use	Noise Standard
Domestic Premises	75
Educational Institutions (normal periods)	70
Educational Institutions (during examination periods)	65

When assessing a CNP application for the use of Powered Mechanical Equipment (PME) during restricted hours, the Noise Control Authority will compare the ANLs, as promulgated in *GW-TM*, and the CNLs (after accounting for factors such as barrier effects and reflections) associated with the proposed PME operations. The ANLs are related to the noise sensitivity of the area in question and different Area Sensitivity Ratings have been established to reflect the background characteristics of different areas. The relevant ANLs are shown in *Table 6.2*.

The Noise Control Authority will consider a well-justified Construction Noise Permit (CNP) application, once filed, for construction works within restricted hours as guided by the relevant Technical Memorandum issued under the *NCO*. The Noise Control Authority will take into account adjoining land uses and any previous complaints against construction activities at the site before making a decision in granting a CNP. Nothing in this EIA Report shall bind the Noise Control Authority in making his decision. The Noise Control Authority may include any conditions in a CNP that it considers appropriate. Failure to comply with any such conditions may lead to cancellation of the CNP and prosecution action under the *NCO*.

Table 6.2 Acceptable Noise Levels (ANL, $L_{eq,\ 5\ min}$ dB(A))

Time period	**Area Sensitivity Rating**		
	A	B	C
All days during the evening (1900-2300 hours) and general holidays (including Sundays) during the day and evening (0700-2300 hours)	60	65	70
All days during the night-time (2300-0700 hours)	45	50	55

In addition to the general controls on the use of PME during restricted hours, the EPD has implemented a more stringent scheme via the *DA-TM*. The *DA-TM* regulates the use of five types of Specified Powered Mechanical Equipment (SPME) and three types of Prescribed Construction Work (PCW), which are non-PME activities, in primarily densely populated neighbourhoods called Designated Areas (DAs). The SPME and PCW are:

SPME:

- hand-held breaker;
- bulldozer;
- concrete lorry mixer;
- dump truck; and
- hand-held vibratory poker.

PCW:

- erection or dismantling of formwork or scaffolding;
- loading, unloading or handling of rubble, wooden boards, steel bars, wood or scaffolding material; and

- hammering.

A CNP will be required for works during the time between 1900 and 0700 hours and any time on a general holiday, including Sunday, and the noise criteria for evaluating noise impact laid down in relevant *TM* issued under the *NCO* must be met.

As the study area is located outside a designated area, the noise criteria stipulated under the DA-TM are not applicable in this study.

6.2.2 Operational Noise

The *EIAO-TM* and *Technical Memorandum on Noise From Places Other than Domestic Premises, Public Places or Construction Sites* (*IND-TM*) specifies the applicable Acceptable Noise Levels (ANLs) for the cumulative noise impacts from the operation of Project and existing power station equipment. The ANLs are dependent on the Area Sensitivity Rating (ASR) and the time of the day and are presented in *Table 6.3.*

Table 6.3 ANLs to be used as Operation Noise Criteria

Time Period	$L_{Aeq\ 30min}$ (dB(A))		
	ASR "A"	ASR "B"	ASR "C"
Daytime 0700-1900	60	65	70
Evening 1900-2300	60	65	70
Night-time 2300-0700	50	55	60

Fixed Plant Noise

Fixed plant noise is controlled under *Section 13* of the *NCO* and the predictions will be undertaken in accordance with the *IND-TM*. The criteria noise limits are set out in the *EIAO-TM* as follows:

- the total fixed source noise level at the facade of the nearest NSR is at least 5 dB(A) lower than the appropriate ANL (as shown in *Table 6.3*) as specified in the *Technical Memorandum on Noise from Places other than Domestic Premises, Public Places or Construction Sites* (*IND-TM*); or,

- where the prevailing noise level in the area is 5 dB(A) or more below the appropriate ANL, the total fixed source noise level must not exceed this noise level.

The criteria noise limits stipulated in the *IND-TM* are dependent on the Area Sensitivity Rating (ASR) of the NSRs as shown in *Table 6.3*.

As the site is located in a rural area and no influencing factors affect the NSRs, an ASR "A" has been assumed for the NSRs located at Ko Long and Hung Shing Ye. With the inclusion of façade correction, the measured prevailing noise level will be higher than the (ANL-5) criterion, and therefore the (ANL – 5) criterion, i.e. 45 dB(A) $L_{Aeq,\ 30min}$ for night-time period will be considered as the stipulated noise limit for the assessment of operational noise impact. Detail of the noise measurement will be further discussed in *Section 6.3.3*.

In any event, the Area Sensitive Rating assumed in this Report is for indicative assessment only given that there are currently no influencing factors assumed in the vicinity of the NSRs. It should be noted that fixed noise sources are controlled under Section 13 of the *NCO*. At the time of investigation, the Noise Control Authority shall determine noise impact from concerned fixed noise sources on the basis of prevailing legislation and practices being in force, and taking account of contemporary conditions / situations of adjoining land uses. Nothing in this Report shall bind the Noise Control Authority in the context of law enforcement against all the fixed noise sources being assessed.

6.3 BASELINE ENVIRONMENTAL CONDITIONS AND NOISE SENSITIVE RECEIVERS

6.3.1 Noise Sensitive Receivers

Settlement on the northern end of Lamma Island is largely concentrated around the harbour at Yung Shue Wan and in the adjacent villages of Yung Shue Long, Sha Po, Ko Long, Wang Long and Tai Wan San Tsuen. These residences are shielded from plant noise to varying degrees by the intervening hill (Kam Lo Hom) which defines the plant's northern site boundary. The villages of Long Tsai Tsuen and Hung Shing Ye, although lie outside the area which is shielded by the hill (Kam Lo Hom), are shielded from the new plants by the existing plants. The most affected NSRs are identified and summarised in *Table 6.4* and the locations of the NSRs are shown in *Figure 6.1*. No planned NSRs are identified within the study boundary.

Table 6.4 Identified Noise Sensitive Receivers

NSR	Location	Type of Use
NSR 1	Hung Shing Ye / Tai Wan To	Residential Use (3-storey)
NSR 2	Ko Long	Residential Use (3-storey)

6.3.2 Baseline Environmental Conditions

The proposed Project is located at the northern section of the existing Lamma Power Station. The residential buildings located to the north and north-east of the Lamma Power Station are screened by the existing equipment units and natural topography. Background noise is generally low and there are no private vehicles or industrial facilities within the Study Area. The major noise source is identified as the community noise from the residents and the construction of the extension to the existing Lamma Power Station.

6.3.3 Baseline Community Noise Monitoring

Existing local acoustic environment at the NSRs is currently affected by the construction activities of extension works conducted at the Lamma Power Station, and therefore to allow a worst case scenario, the ambient noise levels at the NSRs are made reference to *Sections 6.3.3* and *6.3.4* of the *Lamma Extension EIA Report* [1]. The ambient noise levels were contributed by the

[1] Environmental Impact Assessment of a 1,800 MW Gas-Fired Power Station at Lamma Extension, February 1999, ERM-Hong Kong.

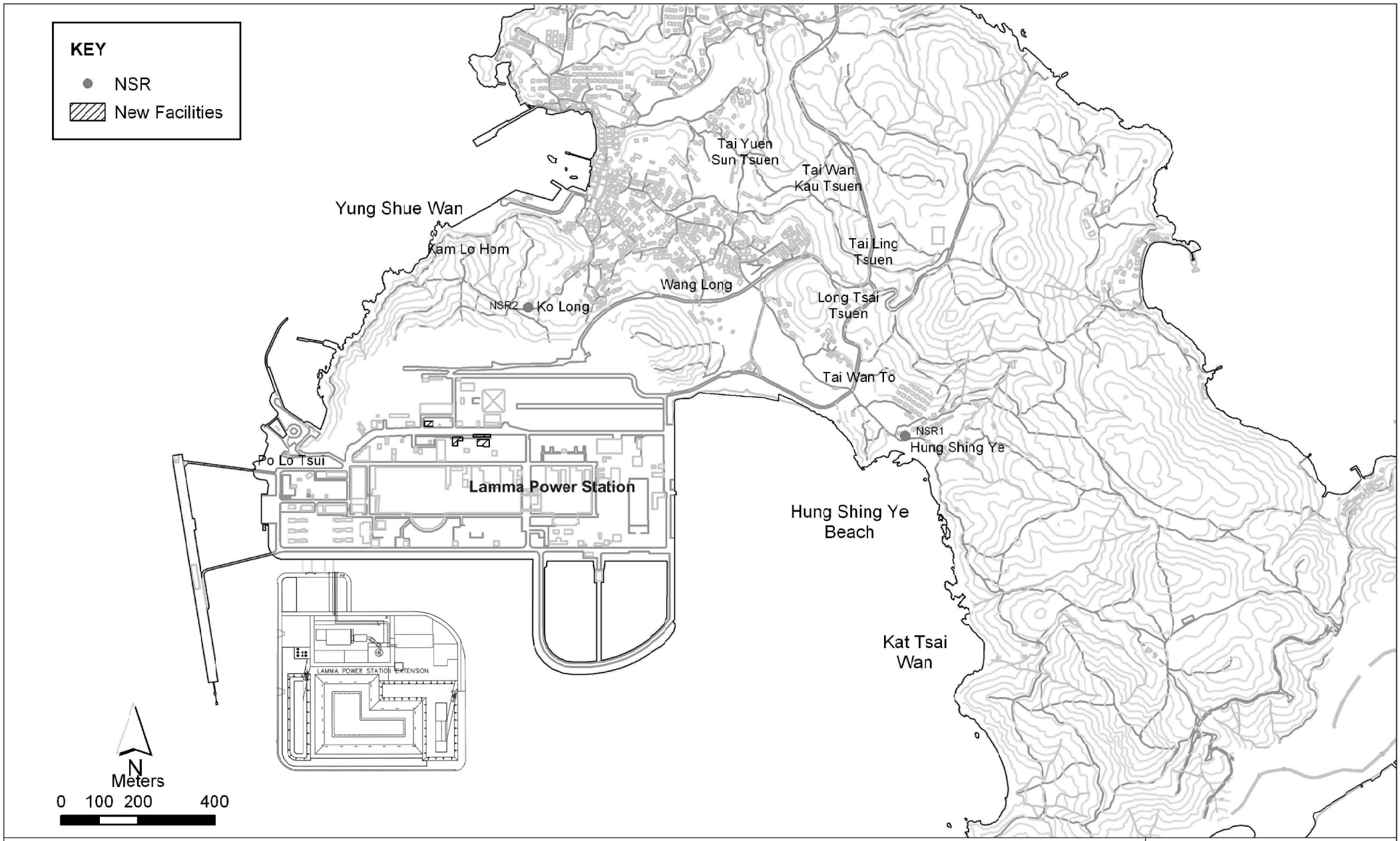

Figure 6.1

Locations of Noise Sensitive Receivers (NSRs)

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operational noise from the existing Lamma Power Station and the ambient community noise.

With reference to the noise monitoring conducted in 1997, the noise data collected at Tai Wan To (TWT) were considered to be a more stringent representation of the background as the results were manually screened to eliminate certain particular extraneous noise sources present in the environment. The background noise levels are summarised in *Table 6.5*.

Table 6.5 Seasonal Background Noise at TWT in 1997

Period	$L_{Aeq}^{(1)}$, 30min dB(A)	
	Summer	Winter
Daytime	52	49
Night-time	49	45

Remark:

(1) The measured noise levels were not affected by the construction noise from the Lamma Extension, and therefore the noise levels represent a quieter ambient condition and a more stringent noise limit for the operational assessment.

(2) There is no major change on site condition/environment of the study area so that the background noise levels obtained in 1997 can still be applicable

6.4 CONSTRUCTION NOISE ASSESSMENT

6.4.1 Potential Sources of Impact

The major construction activities associated with the Project that may cause noise impacts to the NSRs are:

- Demolition of two existing Nos. 4 & 5 Light Oil tanks, each of 50m^3; and
- Retrofit of FGD plants to two existing 350MW coal-fired Units L4 & L5 of the Lamma Power Station.

According to planned project programme, the demolition and retrofit works will be carried out in phases without overlapping.

6.4.2 Evaluation of Impacts

The proposed Project is in small scale. Additionally, in the view that the residential developments are shielded from construction noise to varying degrees by the intervening hill (Kam Lo Hom) and the existing plants, and considerable separation distance between the NSR and the Project, the noise generated during the construction stage is not expected to be a concern. In accordance with the EIA Study Brief, a quantitative construction noise assessment is therefore not required.

The normal working hours of the contractor will be between 0700 and 1900 hours from Monday to Saturday (except public holidays). Should evening and night works between 1900 and 0700 hours or on public holidays (including Sunday) be required, the contractor should submit a CNP

application and will be assessed by the Noise Control Authority. Conditions stipulated in CNPs should be strictly followed.

6.4.3 Mitigation Measures

In accordance with the EIA Study Brief, the following good site practice and noise management are recommended to ensure that construction noise is controlled within the relevant criteria:

- Use of quiet plants should be considered for replacing the use of noisy plant;
- Only well-maintained plant should be operated on-site and plant should be serviced regularly during the construction works;
- Machines and plant that may be use intermittently, such as vibratory poker, should be shut down between work periods or should be throttled down to a minimum;
- Plant known to emit noise strongly in one direction, should, where possible, be orientated to direct noise away from nearby NSRs; and
- Mobile plant should be sited as far away from NSRs as possible.

6.5 OPERATIONAL NOISE ASSESSMENT

6.5.1 Potential Sources of Impact

Additional equipments to be installed for the existing FGD plant at Lamma Power Station are given below:

- Two sets of FGD absorbers and associated duct works;
- Two sets of booster fans;
- Two sets of gas-gas heater;
- FGD switchgear and equipment building; and
- Gypsum dewatering system comprising two sets of hydrocyclones and belt filter.

With reference to the operation mode of existing FGD units in Lamma Power Station, the potential noise sources and their sound power levels are presented in *Table 6.6*.

To minimise the noise impact to the environment, most of the noise sources associated with the retrofit project will be housed within individual acoustic enclosure.

Table 6.6 Noise data Collected from Existing FGD Units

Equipment	No. of Unit for Each FGD Unit	Sound Power Level[1] per unit, dB(A) (with the provision of mitigation measures)	Mitigation Measures[2] Provided to the equipment
Absorber	1	107	-
Absorber Recirculation Pump	4	88	In enclosure
Oxidation Air Blower	2	100	In enclosure
Booster Fan	1	99	In enclosure
Booster Fan Motor	1	90	In enclosure
Gas-Gas Heater (untreated side)	1	95	Reinforced lagging
Gas-Gas Heater (treated side)	1	85	-
Total Sound Power Level		112 for L4 & L5 FGD Units	

Remark:
(1) Sound Power Levels of the equipment were provided by the FGD Suppliers.
(2) Mitigation measures will also be provided for the future equipment of the proposed Project.

The figures presented in above *Table 6.6* are guarantee figures from existing units provided by the FGD suppliers. For the new L4 & L5 FGDs, same guarantee would also be included in the FGD Supply Contract and the suppliers are required to provide enclosures to ensure noise emission comply with the above requirements.

The equipment that will be installed inside the switchgear equipment building and the gypsum dewatering house are of low noise levels. Certain equipment will also be fully enclosed inside concrete structures, and hence the equipment are of negligible noise impact and need not be included in the assessment.

6.5.2 Assessment Methodology

The methodology for the noise impact assessment is in accordance with the procedures outlined in the *ISO 9613*[1] and *IND-TM*, which is issued under the *NCO* and the *EIAO-TM*. The assessment will take into account the distance attenuation, atmospheric absorption and barrier correction.

6.5.3 Evaluation of Impacts

Based on the noise data collected from the existing operating units in the Lamma Power Station, the facade noise levels at the identified NSRs (Hung Shing Ye/Tai Wan To) are predicted and summarised in *Table 6.7*. Results indicate that the identified NSRs will be subject to noise level of up to 38 dB(A), which will comply with the stipulated noise criterion of 45 dB(A). For the NSR at Ko Long, which is located the north of the proposed plants, the existing buildings and terrain act as barriers and significantly reduce the noise levels due to the new plant, and therefore these NSRs will be subject to even lower noise level than the NSRs at Hung Shing Ye and Tai Wan To.

(1) ISO 9613 Acoustics - Attenuation of Sound during Propagation Outdoors.

Table 6.7 Predicted Facade Noise Levels at Hing Shing Ye/Tai Wan To and Ko Long

NSR	Total Sound Power Level, dB(A)	Horizontal Distance to the NSRs(1), m	Correction Factor, dB(A)				Predicted Facade Noise Level, dB(A)
			Distance	Barrier(2)	Facade	Air absorption(3)	
NSR1	112	1071	68.6	-5	+2.5	-3.0	38.0
NSR2	112	348	58.8	-20	+2.5	-1	35

Remark:
(1) For a worst case scenario assessment, the distance from the nearest plant to the NSR is used to assess the operational noise impact at the NSRs
(2) A negative correction of 5 dB(A) has been included for the NSR screened by the existing equipment units and 20 dB(A) has been included for the NSRs screened by the existing equipment units and natural topography (Kam Lo Hom).
(3) A sound absorption by the atmosphere (assumed at 500 Hz, 20°C, RH 70%) has been accounted for in accordance with *ISO 9613-1 Acoustics – Attenuation of Sound During Propagation Outdoors – Part 1: Calculation of the Absorption of Sound by the Atmosphere*.

As NSR 1 will be subject to highest facade noise level, the cumulative operational noise levels from the existing Lamma Power Station, Extension Plant and proposed Project at NSR 1 are predicted and summarised in *Table 6.8*.

Table 6.8 Predicted Cumulative Noise Levels at Hung Shing Ye / Tai Wan To

Period	Existing Plant and Extension Plant(1), $L_{eq, 30min}$ dB(A)	New L4 and L5, $L_{eq, 30min}$ dB(A)	Cumulative Noise Impact, ($L_{eq, 30min}$ dB(A)
Daytime	54.7 (summer)	38.0	55
	52.2 (winter)	38.0	52
Night-time	49.5 (summer)	38.0	50
	49.5 (winter)	38.0	50

Remark:
(1) Reference was made from the prediction results (Table 6.5b) of Environmental Impact Assessment of a 1,800 MW Gas-Fired Power Station at Lamma Extension, February 1999, ERM-Hong Kong.

The additional equipment to be installed will have insignificant contribution when compared with the cumulative operational noise of the Lamma Power Station. Therefore, the plant noise associated with the retrofit plant is not expected to give rise unacceptable environmental impacts.

6.5.4 Mitigation Measures

The noise assessment indicated that, based on a worst-case scenario, the predicted facade noise levels will comply with the daytime, evening and night-time noise criterion at all NSRs. In addition, most of the noise sources associated with the retrofit project will be housed within individual acoustic enclosure to minimise the noise impact to the environment (***Table 6.6***). Hence, no further mitigation measures are required.

6.6 *ENVIRONMENTAL MONITORING AND AUDIT*

In view of the anticipated insignificant noise impact in both construction and operational phases, additional noise monitoring work for this Project is considered not necessary.

6.7 *CONCLUSION*

The proposed Project is in small scale. Additionally, in the view that the residential developments are shielded from construction noise to varying degrees by the intervening hill (Kam Lo Hom) and the existing plants, and considerable separation distance between the NSR and the Project, it is envisaged that the construction noise of the Project will not be a concern for the NSRs located at a considerable distance from the proposed site. However, in order to ensure that the construction noise levels at the NSRs controlled within the relevant criteria, good site practice and noise management is recommended during the construction phase.

Based on a worst-case scenario, the operational noise levels due to additional equipment will comply with the noise criterion and will have insignificant contribution to the cumulative operational noise of the Lamma Power Station. Therefore, the plant noise associated with the retrofit plant is not expected to give rise to unacceptable environmental impacts.

In addition, most of the noise sources associated with the retrofit project will be housed within individual acoustic enclosure to minimise the noise impact to the environment.

In view of the anticipated insignificant noise impact in both construction and operational phases, additional noise monitoring work for this Project is considered not necessary.

7 VISUAL ILLUSTRATION

7.1 INTRODUCTION

As requested by the study brief in section *3.4.7 Visual Illustration*, this section reviews the potential visibility of the proposal.

The main components of this section of the report involve an analysis of the following:

- The existing site and surrounds;
- The proposed modifications to the development;
- The potential visibility of the retro-fit works.

7.1.1 *The existing site*

The existing site is located on the western side of Lamma Island as shown in *Figure 7.1*. The site is currently used as a power station and is characterised by large scale industrial infrastructure.

Figure 7.1 Location of the Proposed Retrofit

Figure 7.1 shows the existing site from the air. It is clear that the site is dominated by the existing power station. The site is surrounded by water to the east, south and west, with some shrub land and small buildings to the north.

7.1.2 The proposed modifications

The following works will be undertaken:

- The removal of two existing tanks approximately 7.6m high and 7.5 metres in diameter;
- The removal of associated pipes and infrastructure;
- The installation of two new Flue Gas Desulphurisation (FGD) units. Unit 4 FGD is approximately 28m(L) x 27m(W) x 45m(H) and the Unit 5 FGD approximately [26m (L) x 21m(W) x 45m(H) + 40m(L) x 7m(W) x 45m(H)]. Both are adjacent to an existing 210m high chimney;
- FGD Switchgear and electrical equipment building of approximately 22m(L) x 15m(W) x 12m(H) is to be installed in an open area between Switchgear road and Main road.

The layout of the proposed new facilities within the existing power station is shown in *Figures 1.1* and *1.2*.

Figure 7.2 shows the general location of the proposed FGD units, (the existing tanks are red in colour). The location is surrounded by heavy industrial infrastructure associated with electricity generation.

Figure 7.2 General Location of Proposed FGD Units

Proposed Colour Scheme

Figure 7.3 is a 3D model showing the location and size of the proposed retrofit. This shows the scale of the retrofit works which will be relatively small with respect to the existing facilities on the site.

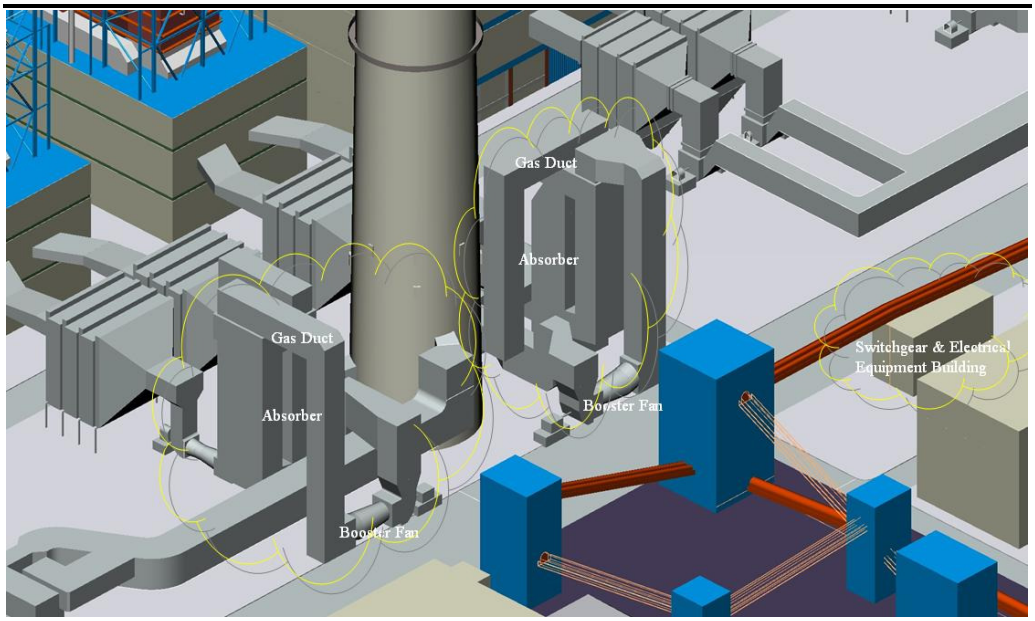


Figure 7.3 ***3D Model of the Proposed FGD Retrofit***

7.1.3 Proposed Colour Scheme

The absorber and ductwork would be enclosed by aluminium cladding that will complement the existing surrounding industrial facility. The new FGD Switchgear and Electrical Equipment Building will be finished in light grey colours that will complement with existing buildings.

7.1.4 Impact on the Surrounding Landscape

The proposed retrofit will have no impact on the surrounding landscape as all the works are contained within the boundary of the existing power station.

7.2 VISIBILITY OF THE PROPOSED WORKS

The potential visibility of the proposal was examined from two locations, from Hung Shing Yeh Beach (VP 1) and from the walking trail between Kat Tsai Wan and Tit Sha Long (VP2). These locations are shown below in Figure 7.4. The approximate distance to the site of the proposed retrofit works is about 1100 m from VP1 and 1700 m from VP2.

Figure 7.4 Selected ViewPoints towards Existing Site

Figure 7.5 View from VP1 towards Existing Site

Figure 7.5 above is a view towards the existing facility taken from VP 1, Hung Shing Yeh Beach. The retrofit facilities may be visible from this location, however, given the industrial surroundings within which the new facilities will be located, the visibility of the new facilities will be low.

Figure 7.6 shows the view towards the existing site when viewed from the south-east, VP2. This gives an indication of the scale of the existing facilities (the chimney stacks are 210 metres tall).

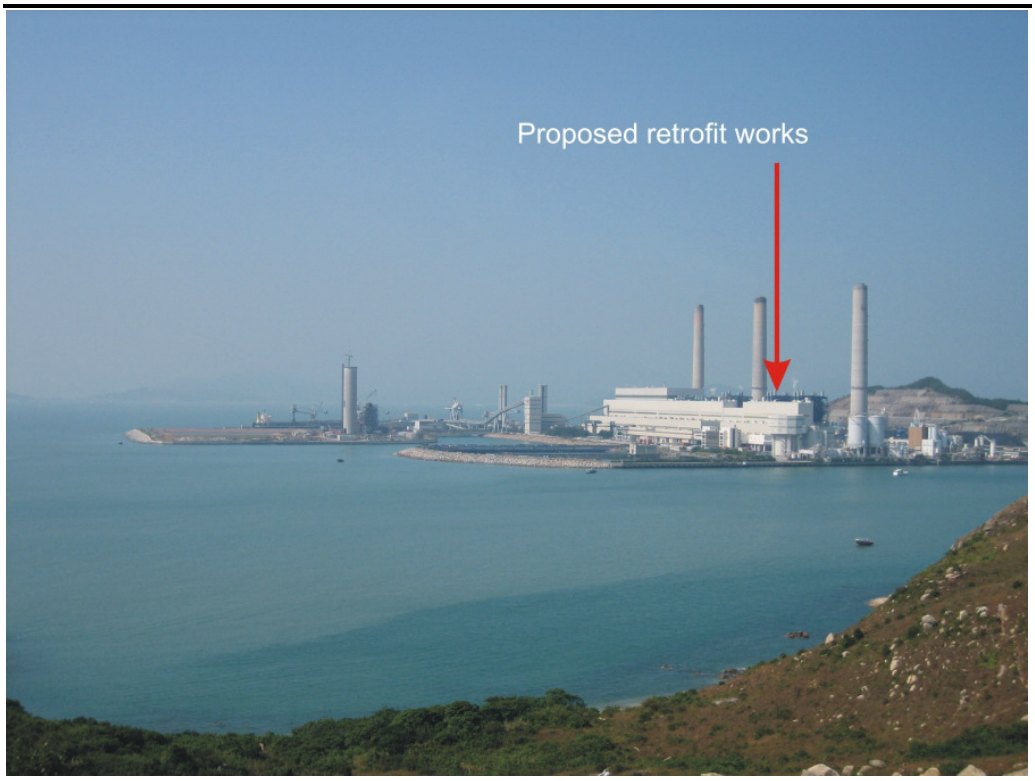


Figure 7.6 ***View from VP2 towards Existing Site***

The proposed works will be located adjacent to the middle chimney stack. The retrofit works will be hidden from view by the existing infrastructure and from this viewpoint they will not be visible.

The location of the retrofit within the existing infrastructure will be hidden from external views to the site. Therefore the visibility of the works will be insignificant.

7.3 *CONCLUSION*

The proposed retrofit works will not have any negative impact on the surrounding landscape, and will have a very low visibility for the following reasons:

- The location for the proposed retrofit works is within a large existing industrial facility;
- There will be no impacts on the surrounding landscape area;
- The new infrastructure will be finished to complement the existing industrial surroundings;
- The relatively small scale of the retrofit works within the existing facility means the works will have a low visibility.

8 IMPLEMENTATION OF MITIGATION MEASURES AND EM&A REQUIREMENTS

8.1 EM&A REQUIREMENTS

Environmental Monitoring and Audit (EM&A) requirements have been discussed in the relevant sections. In general, in view of the nature and relatively small scale of the project, the EM&A is not required for the Construction Phase, while environmental monitoring work required for the EM&A programmes of this project is already in place or will be implemented under Lamma Power Station Extension Environmental Permit or environmental licenses for the operation of the existing Lamma Power Station. Such monitoring works are considered adequate for this Project. Hence, no additional EM&A activities are required.

The current Lamma Power Station EM&A programs that are relevant to this project include:

Air

- Operation and maintenance of Continuous Emission Monitoring (CEM) System at stack to continuously monitoring the pollutants at the flue gas;
- Transmitting the on-line CEM data to EPD's office through the telemetry system;
- Manual stack particulate sampling (at least once a year for units L1 to L8);
- Operation and maintenance of an ambient air monitoring network on the southern part of Hong Kong Island (Mt. Austin Rd, Queen Mary Hospital, Victoria Rd, Ap Lei Chau, Chung Hom Kok) and north Lamma Island (Pak Kok San Tsuen);
- Operation and maintenance of dust monitoring stations around Lamma Power Station;
- Reporting the manual stack sampling result, emission data and validated CEM data to EPD;
- Monitoring dust contamination on vegetation at Lamma Village;
- Reporting the ambient air monitoring and dust monitoring results to EPD;

Water

- Monitoring the quality of wastewater discharged from the FGD WWTP plant and ash lagoon;
- Monitoring the quality of marine water around the ash lagoon;
- Reporting the waste water and marine water monitoring results to EPD.

Noise

- Operation and maintenance of on-line noise monitoring network and reporting results to EPD;
- Action/Limit levels set for the noise monitoring parameters.

8.2 MITIGATION MEASURES

Mitigation measures have been discussed in the relevant sections. They are summarised in the Implementation Schedule provided in *Table 8.1*

Table 8.1 Implementation Schedule

EIA Ref.	Environmental Protection Measures	Location/Duration of Measures/Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation & Guidelines
				Des	C	O	Dec	
LAND CONTAMINATION –CONSTRUCTION PHASE								
Annex B	• Cleaning of oil tanks, oil separator sump, associated pipelines, structures prior to demolition. Oily water and sludge collected from the cleaning shall be collected and disposed of as chemical waste at Government chemical waste treatment facility. (The storage and handling of the chemical waste shall follow requirements described in the Waste Management Section below)	Within the construction site/during the demolition activities	Contractor		✓			Waste Disposal Ordinance

EIA Ref.	Environmental Protection Measures	Location/Duration of Measures/Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation & Guidelines
				Des	C	O	Dec	
Annex B	Handling of contaminated soil shall follow the following control measures. • Segregate potentially contaminated soil excavated around Oil Tank No.5 and stockpiling. • Stockpile shall be contained (eg soil will be stored on a liner sheet and covered with HDPE sheets). • Vehicles containing any excavated materials shall be suitably covered to limit potential dust emissions or contaminated wastewater run-off, and truck bodies and tailgates shall be sealed to prevent any discharge during transport or during wet conditions. • Records of the quantities of wastes generated and disposed of will be maintained. Contaminated soil shall be treated in accordance with EPD's Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol Filling Stations Boatyards, and Car/Repair/Dismantling Workshops, May 1999 and reused at the Lamma Power Station & Lamma Extension areas.	Within the Lamma Power Station/Lamma Extension during excavation works	Contractor		✓			EPD's Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol Filling Stations Boatyards, and Car/Repair/Dismantling Workshops, May 1999
Annex B	Potentially contaminated ingress groundwater, run off in the tanks and sump area encountered during the demolition and construction shall be collected and recharged to the Site.	Within the construction site/during the demolition and construction periods	Contractor		✓			Water Pollution Control Ordinance

EIA Ref.	Environmental Protection Measures	Location/Duration of Measures/Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation & Guidelines
				Des	C	O	Dec	
Annex B	Control measures to minimise the contacts of the workers with the contaminated materials and to ensure safe work environments during the remediation works are proposed as follows: • Carry out health and safety risk assessment prior to commence any remediation work. • Provide and enforce uses of appropriate personal Protective Equipment (PPE) to staff who would be involved in the tanks and sump cleaning and contaminated area (BH3) remediation works. • Use bulk earth-moving excavator equipment to minimise construction workers' potential contact with contaminated materials. • Prepare appropriate control measures and procedures for entering a confined space when entering the tanks/excavation pits. • Maintain basic hygiene standards. • Establish reporting procedures if any workers fall ill during the remediation works. • 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.	Within the construction site/during the demolition and remediation activities	Contractor		✓			Health and safety controls as stipulated under the Factories And Undertakings Ordinance And Occupational Safety and Health Regulation
LAND CONTAMINATION –OPERATIONAL PHASE								
	• No land contamination envisaged during the operational phase and no mitigation measures required							

EIA Ref.	Environmental Protection Measures	Location/Duration of Measures/Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation & Guidelines
				Des	C	O	Dec	
AIR QUALITY – CONSTRUCTION PHASE The following dust control measures stipulated in the *Air Pollution Control (Construction Dust) Regulation* are recommended:								
S.3.6.1	• The area at which demolition work takes place should be sprayed with water prior to, during and immediately after the demolition activities so as to maintain the entire surface wet;	Within the construction site/Throughout the construction period	Contractor		✓			Air Pollution Control (Construction Dust) Regulation
S.3.6.1	• Dust screens or sheeting should be provided to enclose the structure to be demolished to a height of at least 1 m higher than the highest level of the structure;	Within the construction site/Throughout the construction period	Contractor		✓			Air Pollution Control (Construction Dust) Regulation
S.3.6.1	• Any dusty materials should be wetted with water to avoid any fugitive dust emission;	Within the construction site/Throughout the construction period	Contractor		✓			Air Pollution Control (Construction Dust) Regulation
S.3.6.1	• All temporary stockpiles should be wetted or covered by tarpaulin sheet to prevent fugitive emissions;	Within the construction site/Throughout the construction period	Contractor		✓			Air Pollution Control (Construction Dust) Regulation
S.3.6.1	• All the dusty areas and roads should be wetted with water;	Within the construction site/Throughout the construction period	Contractor		✓			Air Pollution Control (Construction Dust) Regulation
S.3.6.1	• All the dusty materials transported by lorries should be covered entirely by impervious sheet to avoid any leakage; and	Within the construction site/Throughout the construction period	Contractor		✓			Air Pollution Control (Construction Dust) Regulation
S.3.6.1	• The falling height of fill materials should be controlled.	Within the construction site/Throughout the construction period	Contractor		✓			Air Pollution Control (Construction Dust) Regulation
AIR QUALITY – OPERATIONAL PHASE Since the project will significantly reduce SO_2 and Particulate emissions and the NO_x emissions from the L4 and L5 Units will remain unchanged, no mitigation measures are required.								
WATER QUALITY – CONSTRUCTION PHASE The following mitigation measures should be implemented during the construction:								

EIA Ref.	Environmental Protection Measures	Location/Duration of Measures/Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation & Guidelines
				Des	C	O	Dec	
Construction Runoff and Drainage								
S 4.6.1	• Exposed soil areas should be minimised to reduce the contamination of runoff and erosion.	Within the construction site/Throughout the construction period	Contractor		✓			*EPD* Practice Note for Professional Persons, Construction Site Drainage *(ProPECC PN 1/94)*
S 4.6.1	• Silt removal facilities, channels and manholes should be maintained and the deposited silt and grit should be removed regularly to ensure they are functioning properly at all times.	Within the construction site/Throughout the construction period	Contractor		✓			*EPD* Practice Note for Professional Persons, Construction Site Drainage *(ProPECC PN 1/94)*
S 4.6.1	• Temporary covers (i.e. tarpaulin) should also be provided to minimise the generation of high SS runoff.	Within the construction site/Throughout the construction period	Contractor		✓			*EPD* Practice Note for Professional Persons, Construction Site Drainage *(ProPECC PN 1/94)*
S 4.6.1	• A licensed waste collector will collect the chemical waste as well as the used water from diesel tank purging. The used water will then be transported to a facility licensed to receive chemical waste, such as Chemical Waste Treatment Centre at Tsing Yi.	Within the construction site/Throughout the construction period	Contractor		✓			*EPD* Practice Note for Professional Persons, Construction Site Drainage *(ProPECC PN 1/94)*
WATER QUALITY – OPERATIONAL PHASE Although no unacceptable water quality impact is anticipated during the operational phase, the following measures are recommended:								
S 4.6.2	• The operational plant effluent from the FGD plants should be reused as much as possible in order to minimise discharge to the WWTP.	Control room/throughout the operational year	HEC			✓		-

EIA Ref.	Environmental Protection Measures	Location/Duration of Measures/Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation & Guidelines
				Des	C	O	Dec	
S 4.6.2	• Maintenance of the WWTP should be performed regularly to ensure the effluent from the WWTP would not exceed the current requirements stipulated in the *WPCO* licence for Ash Lagoon.	WWTP/throughout the operational year	HEC			✓		-
WASTE MANAGEMENT – CONSTRUCTION PHASE Wherever practicable, inert materials should be segregated from other wastes to avoid contamination thereby ensuring acceptability at public filling areas and avoiding the need for disposal at landfill.								
<u>C&D Materials</u>								
S 5.6.1	<u>Measures taken in the Planning Design Stages to Reduce the Generation of C&DM</u> • Avoidance and minimization, that is, reduction of waste generation through changing or improving practices and design; • Reuse of materials, thus avoiding disposal (generally with only limited reprocessing); • Recovery and recycling, thus avoiding disposal (although reprocessing may be required); and • Treatment and disposal, according to relevant law, regulations, guidelines and good practice.	Within the construction site/Throughout the construction period	Contractor		✓			Waste Disposal Ordinance WBTC No. 25/99 Incorporation of Information on Construction and Demolition Material management in PWSC Papers

EIA Ref.	Environmental Protection Measures	Location/Duration of Measures/Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation & Guidelines
				Des	C	O	Dec	
S 5.6.2	<u>Recommended Construction Phase Measures for the Reduction of C&DM Generation</u> • The Contractor should recycle as much of the C&DM as possible on-site. Public fill and construction waste should be segregated and stored in different containers or skips to facilitate reuse or recycling of materials and their proper disposal. Surplus public fill should be reuse on-site for reclamation, or delivered to public fills area /other reclamation site by barge for reuse. The construction waste should be collected by Contractor and transported to landfills for disposal. • The use of wooden hoardings shall not be allowed. An alternative material, which can be reused or recycled, for example, metal (aluminium, alloy, etc) shall be used.	Within the construction site/Throughout the construction period	Contractor		✓			Waste Disposal Ordinance WBTC 32/92, The Use of Tropical Hard Wood on Construction Site WBTC No. 2/93, Public Dumps
<u>Chemical Waste</u> The Contractor for the construction works should be registered with the EPD. Chemical waste should be handled in accordance with the *Code of Practice on the Packaging, Handling and Storage of Chemical Wastes* as follows.								
S 5.6.3	Containers used for storage of chemical wastes should: • be suitable for the substance they are holding, resistant to corrosion, maintained in a good condition, and securely closed; • have a capacity of less than 450 L unless the specifications have been approved by the EPD; and • display a label in English and Chinese in accordance with instructions prescribed in *Schedule 2* of the *Regulations*	Within the construction site/Throughout the construction period	Contractor		✓			Waste Disposal (Chemical Waste) (General) Regulation Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes

EIA Ref.	Environmental Protection Measures	Location/Duration of Measures/Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation & Guidelines
				Des	C	O	Dec	
S 5.6.3	The storage area for chemical wastes should: • be clearly labelled and used solely for the storage of chemical waste; • be enclosed on at least 3 sides; • have an impermeable floor and bunding, of capacity to accommodate 110% of the volume of the largest container or 20% by volume of the chemical waste stored in that area, whichever is the greatest; • have adequate ventilation; • be covered to prevent rainfall entering (water collected within the bund must be tested and disposed of as chemical waste, if necessary); and • be arranged so that incompatible materials are appropriately separated.	Within the construction site/Throughout the construction period	Contractor		✓			Waste Disposal (Chemical Waste) (General) Regulation Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes
S 5.6.3	Disposal of chemical waste should be: • via a licensed waste collector; and • to a facility licensed to receive chemical waste, such as the Chemical Waste Treatment Facility which also offers a chemical waste collection service and can supply the necessary storage containers	Within the construction site/Throughout the construction period	Contractor		✓			Waste Disposal (Chemical Waste) (General) Regulation Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes
<u>General Refuse</u>								

EIA Ref.	Environmental Protection Measures	Location/Duration of Measures/Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation & Guidelines
				Des	C	O	Dec	
S 5.6.4	• General refuse should be stored in enclosed bins separately from construction and chemical wastes. Recyclables (ie paper and aluminium can and plastic bottles) should be stored separately to facilitate subsequent recycling. A reputable waste collector should be employed by the Contractor to remove general refuse from the site, separately from construction and chemical wastes, on a daily basis to minimise odour, pest and litter impacts. The burning of refuse on construction sites is prohibited by law.	Within the construction site/Throughout the construction period	Contractor		✓			Waste Disposal Ordinance
S 5.6.4	• Aluminium cans are often recovered from the waste stream by individual collectors if they are segregated and made easily accessible. As such, separate, labelled bins for their deposit should be provided if feasible.	Within the construction site/Throughout the construction period	Contractor		✓			Waste Disposal Ordinance
S 5.6.4	• Office wastes can be reduced through the recycling of paper if volumes are large enough to warrant collection. Participation in a local collection scheme should be considered if available. In addition, waste separation facilities for paper, aluminium cans, plastic bottles etc., should be provided.	Within the construction site/Throughout the construction period	Contractor		✓			Waste Disposal Ordinance
<u>Management of Waste Disposal</u>								

EIA Ref.	Environmental Protection Measures	Location/Duration of Measures/Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation & Guidelines
				Des	C	O	Dec	
S 5.6.5	• The contractor should open a billing account with EPD in accordance with the *Waste Disposal (Charges for Disposal of Construction Waste) Regulation* for the payment of disposal charges. Every waste load transferred to government waste disposal facilities such as public fill, sorting facilities, landfills or transfer station would required a valid "chit" which contain the information of the account holder to facilitate waste transaction recording and billing to the waste producer. A trip-ticket system should also be established in accordance with *Works Bureau Technical Circular No. 21/2002* to monitor the disposal of solid wastes at transfer station/landfills, and to control fly-tipping. The billing "chit" and trip-ticket system will be included as one of the contractual requirements and implemented by the contractor.	Within the construction site/Throughout the construction period	Contractor		✓			Waste Disposal (Charges for Disposal of Construction Waste) Regulation, December 2005 WBTC No 5/99, Trip-ticket System for Disposal of Construction and Demolition Material
S 5.6.5	• A recording system for the amount of waste generated, recycled and disposed of (including the disposal sites) should be established during the construction stage.	Within the construction site/Throughout the construction period	Contractor		✓			WBTC No 5/99, Trip-ticket System for Disposal of Construction and Demolition Material
<u>Staff Training</u>								
S 5.6.6	• Training should be provided to workers on the concepts of site cleanliness and on appropriate waste management procedures, including waste reduction, reuse and recycling at the beginning of the Contract.	Within the construction site/Throughout the construction period	Contractor		✓			-
NOISE – CONSTRUCTION PHASE In the view that the proposed Project is in small scale, and in addition to the residential developments shielded from construction noise to varying degrees by the intervening hill (Kam Lo Hom) and the existing plants, and considerable separation distance between the NSR and the Project, the noise generated during the construction stage is not expected to be a concern. Hence, no further mitigation measures are required.								

EIA Ref.	Environmental Protection Measures	Location/Duration of Measures/Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation & Guidelines
				Des	C	O	Dec	
NOISE – OPERATIONAL PHASE Based on a worst-case scenario, the operational noise levels due to additional equipment will comply with the noise criterion and will have insignificant contribution to the cumulative operational noise of the Lamma Power Station. Therefore, the plant noise associated with the retrofit plant is not expected to give rise to unacceptable environmental impacts. Hence, no further mitigation measures are required.								
VISUAL – CONSTRUCTION AND OPERATIONAL PHASES No mitigation measures are required.								

9 CONCLUSION: SUMMARY OF ENVIRONMENTAL OUTCOMES

The L4 & L5 FGD Retrofit Project will result in significant reductions of the SO_2 and particulate emissions which will lead to improvements of the local and regional air quality.

Despite the net environmental benefits, the construction and operation of the Project could also result in some negative environmental impacts which have been subject of a detailed assessment under this Study. They are summarised and discussed in the following sub-sections.

9.1 AIR QUALITY

9.1.1 Construction Phase

Dust nuisance is the key concern during the construction of the Project. Demolition of the existing Nos 4 and 5 Light Oil tanks, civil works of the retrofitting of FGD Plants to two existing 350MW coal-fired Units L4 & L5 are the major construction works of the Project. Due to small scale of the Project and a distance from the ASRs, no dust impact is anticipated. In addition, only limited number of diesel-driven equipment will be operated on site, therefore, impact from construction equipment is not expected.

9.1.2 Operational Phase

Except for a slight increase of emissions associated with marine traffic due to increased reagent and by-product shipping, the operation of the project will not introduce any additional emissions of air pollutants, while the SO_2 and particulate emissions will be significantly reduced.

The following reductions of emissions from units L4 and L5 are anticipated as a result of the project:

- SO_2 emission reduction by about 90%; and
- Particulate emission reduction by up to 30%.

Results of a comparative assessment of the cumulative SO_2 worst-case hourly average concentrations at 69 ASRs demonstrate the scale of anticipated improvements of air quality in the study area.

Since the project involves a reduction in particulate emissions, it can be expected that the RSP concentrations will be decreased throughout the study area as a result of the project, and that the reductions will be similar in nature but smaller in magnitude than those predicted for SO_2.

The NO_x emissions will not be reduced nor increased by the project, however changing of the stack exhaust parameters may result in a re-distribution of NO_x in the vicinity of the power station. The cumulative concentrations of

NO_2 after the retrofit have been estimated and their AQO compliance demonstrated for at all ASR locations.

9.2 LAND CONTAMINATION

Two above ground oil storage tanks with associated pipelines and one oil separation sump are to be demolished to provide space for installation of the FGD plants. A land contamination assessment was carried out at these areas following the methodology and procedures prescribed in the contamination assessment plan (CAP) by the EPD. The land contamination assessment included soil and groundwater sampling, laboratory analyses for target parameters, preparation of contamination assessment report (CAR) and preparation of remediation action plan (RAP).

Total petroleum hydrocarbon (TPH) was detected in one out of 15 soil samples and five out of six groundwater samples at concentration exceeding the EPD Dutch B value for mineral oil and implied a TPH contamination at the Site. Remediation measures and procedures for TPH contamination were recommended for the Site for the demolition operation, and the details are provided in the RAP.

Depending on the results of confirmation soil samples collected for remediation, the recommended remediation measures for soil include excavation, testing, in-situ treatment (ie soil venting/biopiling) and on-site reuse. As groundwater is not used for either domestic or industrial purposes at the Site and in the adjacent areas, remediation of TPH in the groundwater of the Site is not considered necessary. However, the groundwater encountered and /or abstracted during the demolition programme should be collected, appropriately stored on-site and recharged back to the underlying ground.

With the implementation of the remedial measures in the RAP, the hazard and environmental impacts associated with the potential land contamination and handling and treatment of the contaminated soil and ground water are considered acceptable.

9.3 WATER QUALITY

9.3.1 Construction Phase

Since there will be no wastewater generated by the demolition of oil tanks and the excavated top soil will not be stored on site and will be removed offsite soon after the excavation due to limited site works area, it is anticipated that the construction runoff will not be significant. Therefore unacceptable water quality impacts due to surface runoff are not expected.

Similarly, as the existing toilet facilities of the Power Station will be provided for use by the workforce, adverse impacts to water quality as a result of the sewage effluent generated by the workforce are not anticipated.

9.3.2 Operational Phase

Potential source of impacts to water quality from the operation of the FGD plants are as a result of filtrate generated from the dewatering of gypsum slurry.

In line with the existing practice adopted for the Units L6, L7 & L8 FGD plants, operational plant effluent from the proposed FGD plant will be reused as far as possible for preparation of limestone slurry, conditioning of PFA for offsite transportation, etc. to minimise discharge to the existing WWTP.

Referring to the past record (October 2004 to September 2005) at the sampling point of the Rejected Treated Water Storage Tank, the effluent generated is well below the licence limit.

As the L4 & 5 FGD would adopt the same wet limestone-gypsum process, similar properties of effluent would be generated. Since the existing WWTP has spare capacity to cater for the additional wastewater produced from the proposed retrofit project, it is expected that effluent from the WWTP to the Ash Lagoon will meet the requirements in the *WPCO* licence for the Ash Lagoon Decantrate Tower.

9.4 WASTE MANAGEMENT

9.4.1 Construction Phase

The key potential impacts during the construction phase are related to management of demolition materials, excavated materials and construction waste.

A total of about 600 m^3 contaminated soil will be excavated for on-site treatment and disposal in accordance with the EPD's *Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol Filling Stations Boatyards, and Car/Repair/Dismantling Workshops, May 1999*. The remediation actions could involve excavation, testing, on-site treatment (ie soil venting/biopiling) and on-site reuse.

A total of about 29 tonnes of scrap steel will be produced during demolition of oil tanks and the associated fixtures/ appendages. All the scrap steel will be delivered off-site by barge for recycling.

A total of about 3,400 m^3 of surplus public fill will be generated from the demolition and construction works. The public fill will be reused as fill for the reclamation of the Lamma Power Station Extension. About 15 m^3 of construction waste will be disposed of at landfills.

Small quantities of chemical wastes (less than 100 litres per month), sewage (a maximum of 3.6 m^3 per day) and general refuse (a maximum of 39 kg per day) will be generated during the construction phase.

With the implementation of the mitigation measures recommended, the potential environmental impacts arising from storage, handling, collection, transport and disposal of wastes should be able to meet the criteria specified in the *EIAO-TM*. No unacceptable waste management impact is anticipated.

9.4.2 Operational Phase

Gypsum

During the FGD operation wastewater from absorber will be produced and gypsum will be generated as a by-product. It should be noted that high quality commercial grade gypsum is produced from the operation of the existing FGD plants at Lamma Power Station. The gypsum to be generated from the new FGD units will also be commercial grade.

Gypsum is a useful construction material in building industry and the demand for gypsum is high in both Hong Kong and mainland China.

A total of 46,000 tonnes gypsum will be produced per year during the operation of new FGD plants (L4 and L5). Under existing contract arrangement, the limestone suppliers are required to collect an equivalent amount of gypsum produced from the FGD Plants and no gypsum will be stored on-site. This arrangement has worked satisfactorily for the existing FGD plant. The same contract arrangement will therefore be used for the new FGD plant.

Additional Sludge from WWTP

The existing WWTP has spare capacity to handle the additional wastewater produced from the new FGD plants. It is expected that a maximum 12 $m^3 hr^{-1}$ of wastewater will be produced from the new FGD plants and an additional 1,200 tonnes per year (or about 3.3 tonnes per day) of sludge will be produced from the WWTP.

In line with current operation, the sludge generated from WWTP will be off-taken by the limestone suppliers together with the gypsum by barges. All sludges will be reused for production of building materials (ie plaster board) in China.

Industrial Waste

From the operational experience of the existing FGD plant, the amount of waste generated from the maintenance of the FGD plant is minimal (in the order of a few kg per month).

Chemical Waste

With reference to the operational experience of the existing FGD plant at Lamma Power Station, the amount of chemical waste to be generated from the maintenance of the plant is minimal (in the order of several litres per month).

9.5 NOISE

9.5.1 Construction Phase

The proposed Project is in small scale. Additionally, in the view that the residential developments are shielded from construction noise to varying degrees by the intervening hill (Kam Lo Hom) and the existing plants, and considerable separation distance between the NSR and the Project, the noise generated during the construction stage is not expected to be a concern.

9.5.2 Operational Phase

Based on the noise data collected from the existing operating units in the Lamma Power Station, the facade noise levels at the identified NSRs (Hung Shing Ye/Tai Wan To) have been predicted. Results indicate that the identified NSRs will be subject to noise level of 38 dB(A), which will comply with the stipulated noise criterion of 45 dB(A). For the NSR at Ko Long, which is located the north of the proposed plants, the existing buildings and terrain act as barriers and significantly reduce the noise levels due to the new plant, and therefore these NSRs will be subject to even lower noise level than the NSRs at Hung Shing Ye and Tai Wan To.

The additional equipment to be installed will have insignificant contribution when compared with the cumulative operational noise of the Lamma Power Station. Therefore, the plant noise associated with the retrofit plant is not expected to give rise unacceptable environmental impacts.

9.6 LANDSCAPE AND VISUAL CONSIDERATIONS

Since its location within a large existing facility, the proposed retrofit works will not have any negative impact on the surrounding landscape, and will have a very low visibility.

9.7 CONCLUSION

The Project will result in significant reductions of the SO_2 and particulate emissions which will lead to improvements of the local and regional air quality.

The detailed impact assessment concluded that both during the construction and operational phases, no adverse environmental impacts are envisaged in the areas of air and water quality, waste management, noise impacts and visibility.

Planned demolition of two above ground oil storage tanks with associated pipelines and one oil separation sump raised concerns of possible land contamination issues. Their investigation is the subject of the separate documents Contamination Assessment Plan (CAP), Contamination Assessment Report (CAR) and Remediation Action Plan (RAP) that are included in Annexes to this Report.

Annex A

Land Contamination: Contamination Assessment Plan

CONTENTS

ANNEXES

1 INTRODUCTION

1.1 BACKGROUND TO THE STUDY

Hongkong Electric Company Ltd (HEC) is planning to retrofit the 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.

Having considered the site constraints and current development of the emission control technologies, HEC proposes to adopt the "Wet Limestone-Gypsum" process for Units L4 & L5 FGD plant retrofit project. This technology has been proved reliable and effective based on operating records of FGD plants of the same technology installed for exiting coal-fired Units L6, L7 & L8.

To provide space for installing the proposed FGD plants, two existing No. 4 and No. 5 Light Oil Tanks each of 250m^3 capacity located in front of Units L4 & L5 boiler will be demolished. This is a designated project under the Schedule 2 – Part II of the EIA Ordinance. A project profile (PP) was prepared and submitted to the EPD on 21 September 2005 to apply for a Study Brief to conduct an Environmental Impact Assessment (EIA) for Lamma Power Station Units L4 & L5 FGD Plant Retrofit Project. The PP highlights the potential land contamination issues arising from the demolishing of the two oil tanks and requires land contamination assessment to be carried out to address the potential land contamination issues.

Environmental Resources Management (ERM) was commissioned by HEC in September 2005 to conduct a land contamination assessment of the Site, in accordance with the PP requirements.

Site inspection including sampling and analysis will be conducted to identify potential sources of soil and groundwater contamination from previous operation. Dismantling of the two oil storage tanks and associated facilities would potentially cause spillage of the fuel, if not properly managed. Special care will be exercised during the dismantling works in order to identify and record any contamination detected for possible assessment and sampling related to any future developments on the Site. The demolition of the oil tanks is scheduled to commence in March 2006 to coordinate with civil construction for the proposed FGD plants.

This report describes the Contamination Assessment Plan (CAP) for the land contamination assessment.

1.2 OBJECTIVE OF THE CAP

The purpose of the CAP is to provide information, guidance and instruction for characterising land contamination at the proposed project area prior to the site formation works. This CAP aims to provide systematic procedures for identifying any land contamination, carrying out the site investigation and evaluating the results to identify the nature and extent of the contamination. The specific tasks of the CAP include:

- Review of the land history of the Site in relation to possible land contamination;
- Identification of potential contamination and associated impacts, risks or hazards; and
- Preparation of a plan for the actual contamination assessment, which includes a proposal on soil and where appropriate, groundwater sampling and analysis, for agreement with the EPD prior to its implementation.

The findings of the site investigation will be evaluated and reported in the Contamination Assessment Report (CAR). If the findings confirm that the Site is contaminated, a Remediation Action Plan (RAP) will be prepared and submitted to EPD for approval.

1.3 ENVIRONMENTAL LEGISLATION AND NON-STATUTORY GUIDELINES

The assessment of land contamination sources and the potential impacts to particular development projects will be investigated in accordance with the guidelines set out in the Environmental Protection Department's (EPD) *Practice Note for Professional Person* (*ProPECC) PN3/94 "Contaminated Land Assessment and Remediation*"; and EPD's *Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol Filling Stations, Boatyards, and Car Repair/Dismantling Workshop* (Guidance Notes).

The *Dutch Indicative Index (Dutch ABC List)* as given in the *ProPECC PN 3/94* has been adopted by the EPD as the criteria for interpretation of the assessment results and determination the level of soil contamination.

Under the *Technical Memorandum on Environmental Impact Assessment Process* (*EIAO-TM*), *Annex 19: Guidelines for Assessment of Other Impacts*, consideration should be given during development and redevelopment projects to a number of potentially contaminating historical land uses, which have the potential to cause, or have caused, land contamination. This includes developing a CAP for the investigation where such land uses are identified, preparation of CAR after such investigation has been completed, and if contamination is confirmed, a RAP should be prepared.

2 SITE APPRAISAL

2.1 SITE APPRAISAL AND REVIEW OF HISTORICAL SITE INVESTIGATION DATA

ERM conducted a walkthrough of the proposed project area on 4 October 2005 and identified potential areas where fuel storage and transmission facilities were located, as follows:

- Two aboveground fuel storage tanks, aboveground steel structures of 250 m^3 underlain and surrounded with concrete bunding. Visual inspection of the concrete bunding showed no evidence of oil leakage or spillage;
- Fuel pipelines connecting between the fuel tanks and the fuel oil transmission pump houses. The pipes are located in underground trenches. Initial visual inspection of the areas showed no evidence of oil leakage or spillage;
- Stormwater collection and oil separation sump. The reinforced concrete tanks were located in ground. Visual inspection of the area showed no evidence of oil leakage;

Locations of these facilities are presented in site layout map (*Figure 2.1a*) attached. The Nos. 4 & 5 Light Oil Tanks were designed according to the Code of Practice issued by the Building Authority. The oil tanks foundations were made of concrete raft footing, the surrounding reinforced-concrete slabs with bund walls constructed of reinforced concrete. The bund walls were designed to provide containment volumes of not less than the maximum operating capacity of the oil tank and the containment was fitted with drain channels connecting to a sump pit, where the oil/oily drain will be further diverted (operated by manual valve) to the oil separator. An oil detector has been installed to detect any oil spillage and alarm will be generated at the control room for notification and further action. The oil separator was constructed with reinforced concrete.

Visual inspection of the tanks, pipeline trenches and oil separator areas identified no apparent evidence of oil staining on the concrete pavement or in the drainage trenches. HEC confirmed that no major spillage/leakage of oils or chemicals occurred at the Site since the commissioning of the tanks in 1990. Minor spills within the bund areas during maintenance were reportedly collected and then further processed in the oil separator.

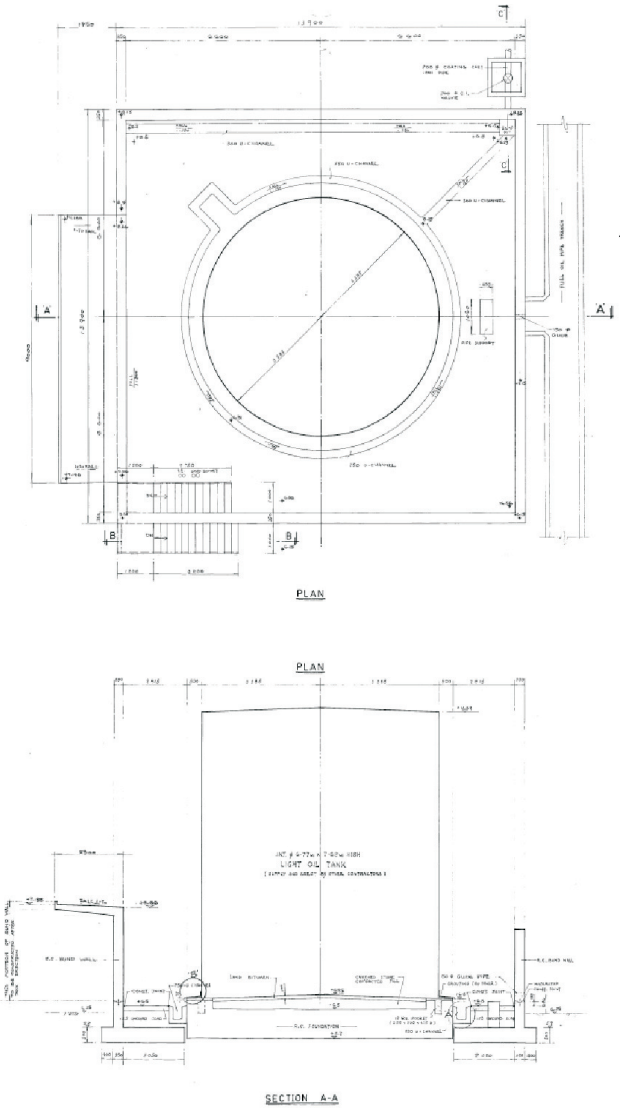
No soil and groundwater contamination studies have been conducted at the Site.

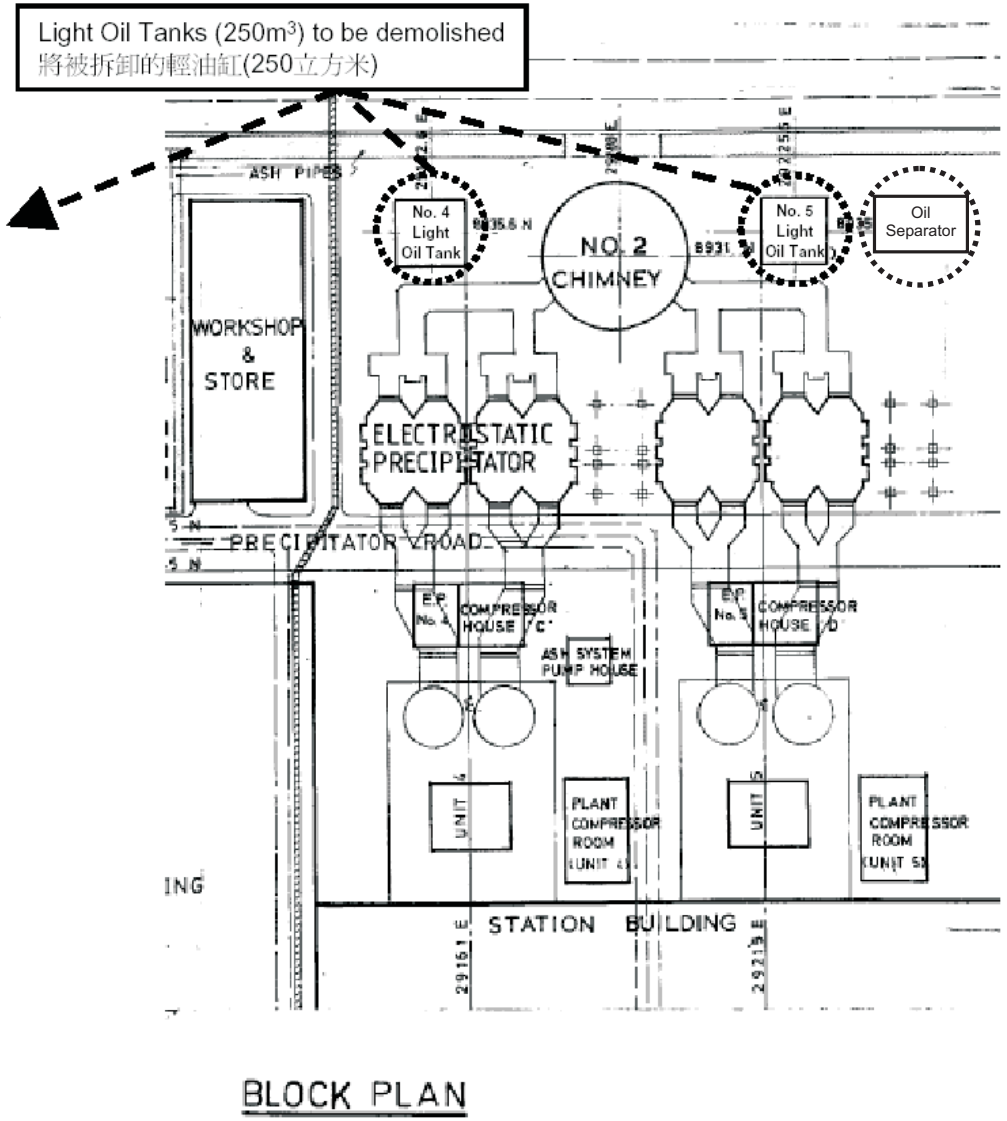
2.2 POTENTIAL SOIL AND GROUNDWATER CONTAMINATION

Based on the review of site information and the walkthrough the potential sources of soil and groundwater contamination from the Nos. 4 & 5 Light Oil Tanks and oil separator included the oil storage, transmission facilities and oil separator sump as described in *Section 2.1*. The facilities may be considered potential sources of land contamination due to the following reasons, but not limited to:

- Leakage and/or spillage from the oil tanks to the underlying soil and groundwater;
- Spillage of oils during the filling of the tanks which may enter the surrounding areas; and
- Leakage from the in-ground oil separator to the surrounding soil and groundwater.

The likely contaminants associated with the fuel storage facilities include, petroleum hydrocarbons (TPH), simple aromatic hydrocarbons (BTEX) and polycyclic aromatic hydrocarbons (PAHs).





BLOCK PLAN

Figure 2.1a

Site Layout Map

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DATE: 07/10/2005

Environmental Resources Management

ERM

3 PROPOSAL FOR SITE INVESTIGATION

3.1 SAMPLING STRATEGY

As presented in *Section 2*, the potential risk for soil and groundwater contamination at the project area is considered low. The potential contaminants associated with oil storage and oil separation facilities are hydrocarbons. The soil and groundwater sampling under this CAP aims to determine the present and/or extent of soil and groundwater contamination within and around the oil storage and oil separation facilities.

3.1.1 *Sampling Location and Sampling Depths*

The sampling locations and depths are recommended based on the findings of the site appraisal and have made reference to the guidelines on sampling and analysis recommended in the *Guidance Notes*.

The proposed site investigation programme is described in the following and in *Table 3.1a*.

- Six (6) boreholes (BH1 to BH6) shall be drilled to 2 m below the groundwater level;
- Sampling of soil for on-site investigation and screening using photo-ionisation detector (PID) from sub-surface (around 0.5m) and every 1.0m till end of drilling;
- Three soil samples shall be collected from each borehole to ascertain the vertical distribution of any detected contamination [1]. It is proposed that samples be taken at from the unsaturated zone to below the groundwater level (eg at between 0.5m to 1m bgl, at soil and groundwater interface, at 1m below groundwater level) or where visual evidence of contamination was observed;
- All boreholes will be converted into six (6) temporary groundwater monitoring wells to facilitate groundwater sampling;
- One (1) groundwater (GW) sample shall be collected from each monitoring well; and
- Free-floating products in groundwater, if observed, will also be collected for laboratory analysis.

(1) In accordance with the *ProPECC PN 3/94* and the *Guidance Notes.*

Table 3.1a Proposed Site Investigation Programme

Location	Rationale	Depth	Monitoring Well	# Soil Samples	# GW Samples
Borehole/Monitoring Well					
BH1	Located up-gradient from the No. 4 oil tank	2 m below Groundwater Level.	1	3	1
BH2	Located down-gradient from the No. 4 oil tank	2 m below Groundwater Level.	1	3	1
BH3	Located up-gradient from the No. 5 oil tank	2 m below Groundwater Level.	1	3	1
BH4	Located down-gradient from the No. 5 oil tank	2 m below Groundwater Level.	1	3	1
BH5	Located up-gradient from the oil separator	2 m below Groundwater Level.	1	3	1
BH6	Located down-gradient from the oil separator	2 m below Groundwater Level.	1	3	1
(To be selected on Site)				1 Duplicate Soil Sample	1 Duplicate GW Sample
Trip blank					2 (water samples)
Equipment rinsate					1 (water sample)
			Total	19	10

Figures 3.1a shows the proposed soil and groundwater sampling locations.

3.2 *ANALYTICAL PARAMETERS*

With respect to the nature of the substance stored and used at the project area (diesel oil) it is proposed that the soil and groundwater samples collected will be analysed for BTEX (benzene, toluene, ethylbenzene and xylene), TPH (total petroleum hydrocarbon) and polycyclic aromatic hydrocarbon (PAHs).

Extra soil samples will be collected during the site investigation and stored in the laboratory for possible Toxic Characteristic Leaching Procedure (TCLP) testing. The TCLP tests will be conducted for the samples with pollutant concentrations exceeding Dutch "B" guideline values.

3.3 *SAMPLING METHOD*

A site utility scan will be conducted prior to the commencement of any excavation/drilling. At each of the sampling locations, a trial pit will be excavated to 1.2 m bgl. Trial pits will be dug manually using hand tools and necessary concrete breaking hand operated mechanical tools to ensure no interference with underground utilities. Sampling below trial pit levels, will

be conducted using drilling rig. Drilling rigs, drilling equipment that do not come in contact with samples and hand breakers will be steam cleaned prior to mobilisation to the Site. Prior to sampling, all sampling equipment and well materials will be steam cleaned, scrubbed with a non-phosphate soap solution, washed with tap water and rinsed with distilled water. This procedure will be repeated after use at each sampling location to avoid potential cross contamination, and between samples to ensure that any contamination from the surface of the Site does not affect deeper substrata or the groundwater.

In addition to taking samples for analysis, the strata log will be recorded. This includes recording the general structure of the ground and the depth and thickness of each band of material. The depths at which samples are taken will be recorded with a description of each sample such as grain size, colour, and wetness. Extreme care will be exercised when toxic gases or hazardous materials are suspected. Photographs will be taken during the site investigation and for each sample.

3.3.1 Sample Collection

The soil or groundwater sampling will be undertaken following appropriate protocols so as to minimise the potential for cross-contamination between sampling locations and depths. The soil sampling methodologies are based on methods developed by US Environmental Protection Agency (US EPA), as outlined below.

Decontamination Procedures

Sampling equipment used during the course of the site investigation programme will be decontaminated using the following procedures:

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

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

During the sampling and decontamination activities, disposable latex gloves will be worn to prevent transfer of contaminants from other sources. Any disposable equipment such as latex gloves will be disposed of as general waste after each use. Provisions will be made to containerise any decontamination fluids, although the volume of fluids to be produced is expected to be low.

Soil Sample Collection

Soil samples will be taken by ERM staff and placed into appropriate clean glass bottles or sampling containers (provided by the laboratory) immediately after collection. Before sampling commences, the laboratory will be consulted on the particular sample size and preservation procedures that are

necessary for each chemical analyses. The sample containers will be laboratory cleaned, made of glass or other suitable materials with aluminium or teflon-lined lids, so that the container surface will not react with the sample or adsorb contaminants. The containers will be labelled with the sampling location codes and the depths at which the samples are taken. They will then be transferred to an icebox or cooler container. Samples will be kept between 0 to 4°C but not frozen.

Groundwater, if encountered, will be sampled from the monitoring wells using disposable teflon bailers.

Sampling Management

Samples will be dispatched to the analytical laboratory for analysis as soon as practicable following sampling. All samples will be handled under chain of custody protocols and relinquished to the laboratory representative at the Site or at a location specified by the laboratory.

3.4 ANALYTICAL METHOD

The parameters as described in *Section 3.2* will be analysed using the methods stated in *Table 3.4a*.

Table 3.4a Analytical Methods for Contaminants in Soil and Groundwater Samples

Contaminant	Analytical Methods
BTEX (benzene, toluene, ethylbenzene, xylene)	• US EPA Method 8260
TPH	• US EPA 8260 & 8015
PAH	• US EPA Method 8260
TCLP	• EPA SW-846 (Method 1311)

3.5 QUALITY CONTROL AND QUALITY ASSURANCE (QC/QA)

Samples collected should be representative of field conditions. At each sampling location, soil (and groundwater, if encountered) samples will be collected using pre-cleaned sampling equipment. All sample containers will be provided by the contracted laboratory who guarantees their sterilisation and preservative contents.

Appropriate QC/QA samples will also be collected during the field investigation, including:

- Equipment (rinsate) blank for the full suit of target parameters, in order to assess the adequacy of the decontamination procedures;

- Trip blank for the full suit of target parameters in order to assess the potential contamination of the sample handling and transportation processes; and

- Groundwater and soil duplicates for the full suite of analyses to assess the precision of the procedures.

Precision will be calculated as the relative percent difference (RPD) between the original sample and the blind duplicate. For water and soil, the acceptance criteria for precision are 20% RPD and 30% RPD, respectively. Accuracy will be assessed by analysis of blank samples to ensure that no bias is present in the analytical data.

3.6 ANALYTICAL LABORATORY

Analysis of samples will be carried out by an appropriate, HOKLAS-certified (or other equivalent scheme approved by the EPD) analytical laboratory. The laboratory should maintain high standards of analytical and technical services for the detection of trace organic contaminants. All analysis will be conducted according to standard procedures set by the US EPA, along with internal QC/QA procedures.

4 PROGRAMME SCHEDULE & REPORTING

4.1 PROGRAMME SCHEDULE

It is anticipated that site investigation and laboratory analysis will be completed within four to five weeks from the date of approval of the CAP. The CAR will be submitted to the EPD for approval within three weeks after the completion of the laboratory analysis.

The overall assessment will comprise the following activities:

- Required revision and endorsement of the CAP by EPD (2 weeks);
- Mobilisation of the subcontractor and contracting analytical laboratory (about two weeks);
- Field sampling programme (about seven days);
- Analytical programme/laboratory turnaround (normal turnaround time is expected two weeks);
- Assessment and reporting of results in a CAR, including, if required, development of a remedial action plan (RAP). The CAR will include all laboratory testing results of chemical analyses and TCLP testing; and
- In the event that landfill disposal is proposed for contaminated soil materials, prior agreement will need to be reached with the EPD and the application accompanied by the RAP and the TCLP test results.

No demolition works involving excavation will be conducted at the project area before the assessment and the necessary remediation works have been completed.

4.2 ASSESSMENT AND REPORTING

A CAR will be prepared after obtaining analytical results from the laboratory. The report will present the findings of the CAP and site investigation assessment (including the methodology used during the soil and groundwater sampling and details of field observations such as visual observations made during the investigation).

As there are currently no legislative standards requiring clean up of soil and groundwater contamination in Hong Kong, the analytical results will be compared against international standards for soil and groundwater contamination (ie Dutch Guideline Values). Of note is that the Dutch "B" values are currently being used as the soil cleanup target for most cases in Hong Kong. Soil with contaminants exceeding such values is considered as contaminated and needs to be remediated to below that level. Based on the

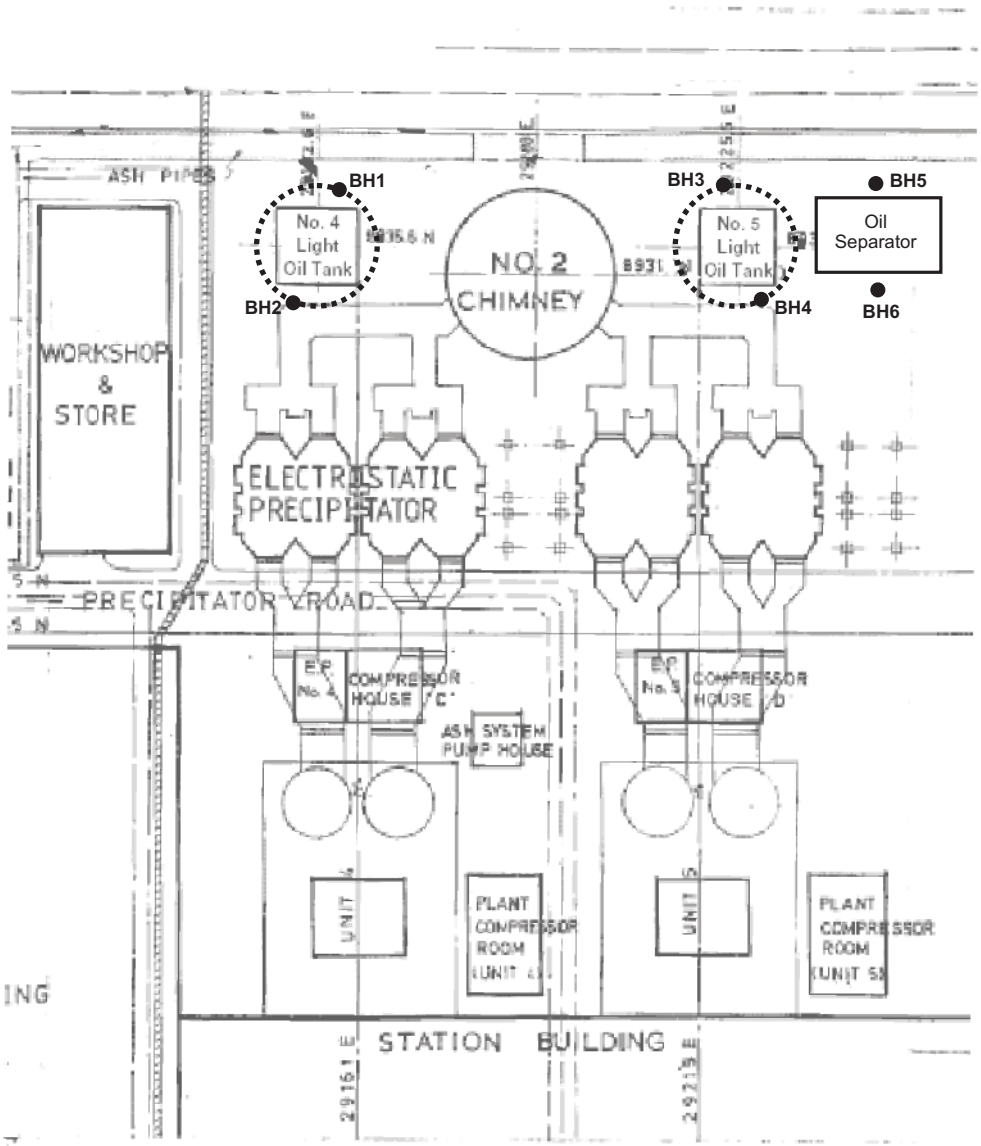

Figure 3.1a

Proposed Sampling Location

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on-site observations and the quantitative sampling results received, professional judgement will be provided regarding soil and groundwater contamination, and the necessity of any mitigation measures.

The CAR will be prepared and submitted to the EPD.

If necessary, a RAP will be prepared in consultation with the EPD, with the objective of mitigating the Site to an agreed upon condition. Any proposed mitigation recommendations will be considered under several factors including nature of the contamination, degree of the contamination, the potential receiver, time allocation, treatment cost and availability of local expertise for undertaking the treatment in accordance with the *ProPECC PN 3/94*. The RAP will also outline requirements for construction workers to follow to limit potential future exposures.

The results of the sampling programme, the report, and the objectives of the RAP will be submitted to EPD. It should be noted that no estimate of the time frame for any mitigation is presented at this time.

Annex A

Selected Site Photographs

1 SITE PHOTOGRAPHS

Photo P1 – No.4 Light Oil Tank

Photo P2 - No.5 Light Oil Tank

Photo P3 – No.5 Light Oil Tank, Oil Separator and No.6 Light Oil Tank

Annex B

Landfill Disposal Criteria

1 LANDFILL DISPOSAL CRITERIA

Table1.1 Landfill Disposal Criteria for Contaminated Soil

Parameter	TCLP Limit (ppm)*
Cadmium	10
Chromium	50
Copper	250
Nickel	250
Lead	50
Zinc	250
Mercury	1
Tin	250
Silver	50
Antimony	150
Arsenic	50
Beryllium	10
Thallium	50
Vanadium	250
Selenium	1
Barium	1000

Note: Soil samples should be stored at 0-4 °C. This allowable storage time for mercury in soil samples is 8 days while the storage time for the rest of the parameters (above) in soil samples can be up to 6 months. Soil samples, if stored beyond the allowable storage time, are not considered representative of the actual site conditions (ASTM-E1391-90).

**Reference to EPDs Guidance Notes for Investigation and Remediation of Contaminated Sites of: Petrol Filling Stations, Boatyards, Car Repair/Dismantling workshops.*

Annex C

Dutch List

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

Component		Soil (mg/kg dry soil) A	B	C	Ground water (ug/L) A	B	C
1. Matals							
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
2. Inorganics							
NH_4 (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_4 (as P)		_	_	_	50	200	700
3. Aromatics Compounds							
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
4. Polycyclie Hydrocarbons							
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
5. Chlorinated Hydrocarbons							
Aliphatics							
	(Individual)	0.1	5	50	1	10	50
	(Total)	0.1	7	70	1	15	70
Chlorobenzenes							
	(Individual)	0.05	1	10	0.02	0.5	2
	(Total)	0.05	2	20	0.02	1	5

Component		Soil (mg/kg dry soil) A	B	C	Ground water (ug/L) A	B	C
1. Matals							
Chlorophenols							
	(Individual)	0.01	0.5	5	0.01	0.03	1.5
	(Total)	0.01	1	10	0.01	0.5	2
Chlor. PAHs (Tot.)		0.05	1	10	0.01	0.2	1
PCB's (Tot.)		0.05	1	10	0.01	0.2	1
EOCL (Tot.)		0.1	8	80	1	15	70
6. Pesticides							
Chlorinated organics							
	(Individual)	0.1	0.5	5	0.5	0.2	1
	(Total)	0.1	1	10	0.1	0.5	2
Pesticides							
	(Total)	0.1	2	20	0.1	1	5
7. Other Polutants							
Tetrahydrofuran		0.1	4	40	0.5	20	60
Pyridine		0.1	2	20	0.5	10	30
Tetrahydrothiofene		0.1	5	50	0.5	20	60
Cyclohexanes		0.1	6	60	0.5	15	50
Styrene		0.1	5	50	0.5	20	60
Gasoline		20	100	800	10	40	150
Mineral Oil		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.

Annex B

Land Contamination: Remediation Action Plan

Also including:

Contamination Assessment Report

CONTENTS

ANNEXES

1 INTRODUCTION

1.1 BACKGROUND TO THE STUDY

Hongkong Electric Company Ltd (HEC) has initiated a project to retrofit its two existing 350MW coal-fired generating Units L4 and L5 on 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.

Two above ground oil storage tanks (No. 4 and No. 5 Light Oil Tanks) with associated pipelines and an oil separation sump are proposed to be demolished to provide space for installation of the FGD plants. In accordance with the requirement of Environmental Impact Assessment Study Brief (No. ESB-133/2005) issued by the Environmental Protection Department (EPD) to the retrofit project and as a part of environmental impact assessment (EIA) requirement, a land contamination assessment was proposed at the locations of the No.4 and No. 5 Light Oil Tanks and the oil separation sump (the Site).

ERM Hong Kong Limited was commissioned by HEC to conduct the land contamination assessment of the Site for the project. A Contamination Assessment Plan (CAP) was prepared by ERM and was approved by EPD in November 2005.

An intrusive soil and groundwater contamination investigation was conducted by ERM from November 14 to 19, 2005. The field investigation was performed in accordance with the procedures and requirement set out in the CAP.

A Contamination Assessment Report (CAR) summarising the results of the SI and recommending delineation investigation and remediation actions to be carried out at the Site was prepared by ERM, and was submitted to EPD in December 2005.

1.2 OBJECTIVES OF THE ACTION PLAN

This Remediation Action Plan (RAP) presents the results obtained during the contamination delineation investigation at the site and proposes remediation actions accordingly. The objective of the plan is to recommend remediation actions in these areas so as to reduce the opportunity for exposure to land contamination risks by current/future occupants of the Site.

1.3 SCOPE OF THE REMEDIATION

The scope of the remediation will include:

- Demolition of the No.4 and No. 5 light oil tanks and the oil separation sump and excavate soil materials to facilitate construction of the FGD plant as necessary;
- Conducting confirmation and verification sampling underneath and around the demolition area parcel;
- Sampling, testing, treatment and handling/management of the contaminated soils excavated; and
- Preparation of a decontamination verification report upon completion of the demolition, construction and decontamination works.

1.4 STRUCTURE OF THE RAP

The remainder of this report is structured as follows:

Section 2 summarises the site investigation results; and

Section 3 presents contamination remediation action plan for No.4 and No. 5 light oil tanks and the oil separation sump.

The report is accompanied by the following set of annexes:

Annex A presents the CAR; and

Annex B presents selected photographs of the Site area.

2 CONTAMINATION ASSESSMENT BACKGROUND INFORMATION

This *Section* presents the summary of the results of the contamination site investigation conducted. The full details of the methodology used during the soil and groundwater sampling work, details of field observations such as visual observations made during the investigation programme, analytical results from soil and ground water sample analyses are provided in the CAR, *Annex A*.

2.1 SITE INVESTIGATION PROGRAMME

The Site Investigation (SI) was conducted during 14 to 19 November 2005, as described in the CAR and consisted of drilling of six boreholes (BH-1 to 6), installation groundwater sampling wells where groundwater was encountered (BH-1 to 6), soil and groundwater sampling, laboratory sample analysis and field QA/QC programme. The locations of the boreholes installed in the SI are presented in *Figure 2.1a*.

The SI programme was designed and carried out in accordance with the EPD's *Practice Notes for Professional Persons: Contaminated Land Assessment and Remediation ProPECC PN 3/94* and the *Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol Stations, Boatyards, and Car Repair/Dismantling Workshops, 1999*.

2.1.1 *Field Observations*

The underground soil profiles observed during the exploration were recorded using boring logs (*see CAR*). No obvious sign of hydrocarbon staining, discoloration or odour was observed in any underlying soil sample and/or groundwater sample during the borehole drilling and soil and groundwater sampling. No free oil product was observed on the groundwater surface.

2.1.2 *Soil Sample Results*

A soil sample taken from BH3, near the No. 5 oil tank, at depth 0.8 m below ground level (m bgl) contained total TPH at concentration of (2,745 mg/kg) (sum of light diesel (C10-C14) (78 mg/kg), heavy diesel (C15-C28) (1,800 mg/kg) and heavy oil (C29-C36) (945 mg/kg)) exceeding the Dutch B level for mineral oil (1,000 mg/kg) and indicated potential TPH contamination. The concentration was below the Dutch C value for mineral oil of 5,000 mg/kg. No soil sample was collected at deeper level at this location as the underlying geology comprised of granite rock from 1.1 meter below ground level (m bgl) to the end of drilling at 7.1 m bgl. TPH was also detected at BH4 at 1.0m depth (201 mg/kg), the concentration was within the Dutch B level for mineral oil.

No exceedance to Dutch B values were detected for parameters other than TPH in other parameters analysed at BH3, and for all parameters analysed at BH1 to BH6.

2.1.3 Groundwater

The static groundwater levels measured at boreholes during the Site investigation for this project were between 4.3 to 4.8 m bgl. Based on the groundwater water levels measured and the local surface hydrology, the shallow groundwater in the Site area is anticipated to flow in a generally southern or south-westerly direction.

The total TPH concentrations detected in the groundwater samples collected from wells BH4 (421 µg/L) and BH6 (381 µg/L) (ie total of heavy diesel and heavy oils) exceeded the EPD Dutch B value of 200 µg/L but did not exceed the Dutch C Value of 600 µg/L for mineral oil. The total TPH concentrations detected in the groundwater sample from wells BH1 (1,185 µg/L), BH3 (1,424 µg/L) and BH5 (706 µg/L) exceeded the EPD Dutch C value of 600 µg/L for mineral oil.

No free-floating oil product was observed on the groundwater surface.

BTEX and PAHs listed in the Dutch List were not detected in the groundwater samples collected.

2.2 ASSESSMENT OF LAND CONTAMINATION EXTENT

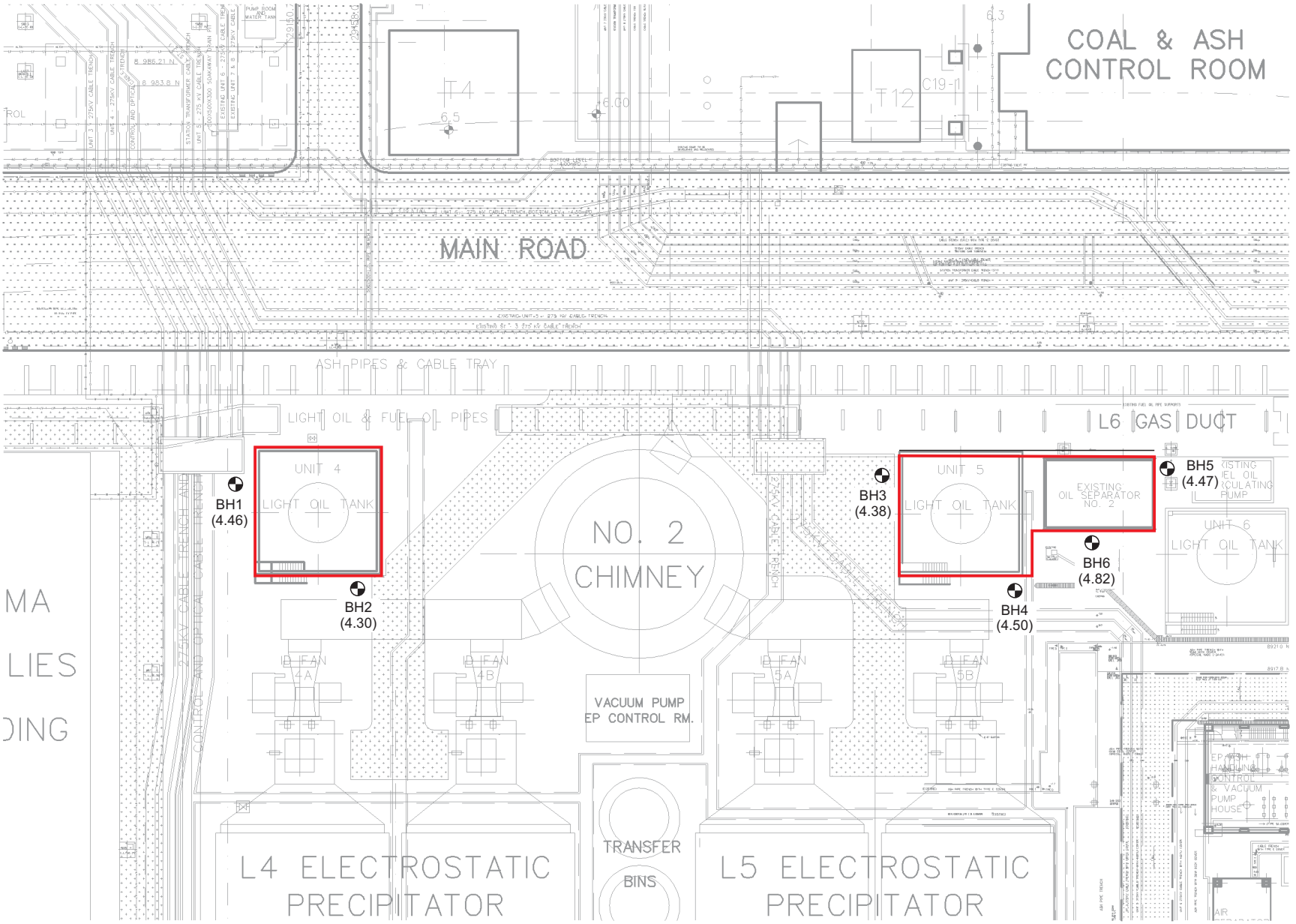
TPH in Soil at BH3

Concentrations of TPH (light diesel (C10-C14), heavy diesel (C15-C28) and heavy oil (C29-C36)) in soil materials at the BH3 at 0.8 m bgl exceeded the Dutch B value but was below the Dutch C value. At this location, the soil stratum ended at 1.1 m bgl where bedrock was encountered. TPH was also detected at BH4 but was within the Dutch B value.

No. 5 oil tank was located above the ground and had been provided with a secondary containment system for potential oil spills or leakages. No spills or leakages of oil have been reported for this tank, and no visual evidence of spills or leakage was observed during the Site investigation. The potential source of the TPH contamination at location BH3 and BH4 was not confirmed at this stage.

The vertical transport of TPH in the soil material, if any, is anticipated to cease where the head rocks are located.

As no TPH was detected in soil at other sampling locations, the TPH detected at the two sampling locations, therefore, was considered to be localized. Based on the finding of the site investigation and the extent of the excavation



Legend

Borehole and groundwater sampling well

(4.46) Groundwater level (meter below ground level)

Not to Scale

Figure 2.1a

Site Layout

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works, it is estimated that about 600 m^3 of contaminated excavated soil [1] will be generated at the No. 5 oil tanks. The extent of the horizontal transport of contamination shall be further investigated during the demolition of the tanks and sump as described in *Section 3*. No contaminated excavated soil is anticipated to be generated at the No.4 oil tank or the oil separator sump.

TPH in Groundwater

TPH (heavy diesel and heavy oils) contamination at above Dutch B and C levels has been reported in the groundwater samples (BH1, BH3, BH4, BH5 and BH6). The higher TPH concentrations were detected in the samples from wells BH1 and BH3 and were primarily contributed by heavy diesel fraction.

As both oil tanks were located above the ground and have been provided with secondary containment systems. No oil spills and leakages have been reported or observed during the Site investigation for both tanks. The oil separation sump, was built with waterproof concrete. No spills or leakages have been reported for the oil separation sump. The source of TPH contaminations in the groundwater of the Site area could not be confirmed at this stage.

As groundwater is not used as a potable water supply source in Hong Kong and taking into consideration the absence of the free-floating oil products and the relatively low concentrations of TPH detected in the groundwater, no potential adverse impacts are anticipated from the demolition of the tanks and sump.

2.3 EVALUATION OF CONSTRUCTION METHODS FOR FGD PLANT

2.3.1 *Tanks and Oil/Water Separator Sump Demolition*

The construction of the proposed FGD plants for Generation Units L4 and L5 will involve demolishing of the 2 existing 250 m^3 No.4 and No. 5 Light Oil Tanks and the associated fixtures/appendages/ foundations/bund walls and the in-ground oil separator to provide space for the proposed installations.

The demolition works will take about 5 months and are scheduled to commence in April 2006.

A top-down approach will be adopted for the demolition of the facilities.

Tanks, foundations, other concrete structures and oil separator sump will be washed/decontaminated prior to demolition rendering the tanks and sump

[1] The volume of the excavated contaminated soil at No. 5 oil tank was estimated assuming the contaminated area to be at base of the tank plus 2m each side (18x18 m^2) to 1.5m below ground level. The calculation includes soil around the foundations, 0.5m of soil underneath the foundations, up to 3m of bore piles and pile caps in the area, plus bulking factors of 1.2 was applied for excavated soil. The calculation does not include the tank and bund wall foundations which are not anticipated to be contaminated and will be demolished and handled in a similar manner as other tank structures and disposed of as fill materials.

structures cleaned. This will also enable the materials to be disposed of as non-contaminated construction wastes.

A total of about 29 tonnes of scrap steel will be produced from the demolition of the oil tanks and the associated fixtures/ appendages such as pipeline, spiral stair and catwalk attached to the oil tanks. The steel sheet of the circular roof and sidewall will be cut into small panels (about 1.5m x 1.5m) for easy transportation. All the scrap steel will be transported off-site by barges for recycling.

A total of 660 m^3 uncontaminated reinforced concrete (after applying a bulking factor of 1.4) will be generated from demolition of the oil tanks foundation, oil separator and bund walls. The reinforced concrete is not contaminated and will be separated from other waste to avoid contamination. The reinforced concrete (public fill) will be reused on-site for reclamation of Lamma Power Station Extension or sent to public filling facilities /other reclamation site for reuse.

2.3.2 Excavated Materials

Non-Contaminated Excavated Materials

Excavation works would be required for the construction of the foundations of FGD absorber units (booster fans, gas-gas heaters, gas ducts supports) and the shallow foundation of the switchgear and equipment building. A total of 2,300 m^3 (after applying a bulking factor of 1.2) of excavated soil materials (mainly soft materials, ie sand and clay) will be generated from the demolition of the No. 4 and No.5 Oil Tanks and oil/water separation sump areas 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 included as part of the demolition wastes in the *Section 2.3.1*.

In addition, approximately 560 m^3 of soil and rock materials will be generated from the bore pile excavation. Pre-bored socketted H-pile/Miround oni-pile piling method was adopted over an alternative driven pile method due to the fact that the construction will occur amongst existing power generating facilities sensitive to vibrations. The bore pile method will reduce the vibration impacts to the facilities. In addition, the geological investigation of the Site showed the underlying soil strata to contain significant amount of boulders which also will affect driven piling activities.

After excavating the in-ground oil separator, the area will be backfilled with the excavated soil (about 190 m^3) to original ground level. About 2,670 m^3 [(1)] of surplus excavation materials will therefore be generated. The surplus excavated materials (public fill) will be reused on-site for reclamation of

(1) The volume included volumes of all non contaminated excavated soil materials for the construction of foundations and piling works proposed in the project area, excluding existing foundations and other concrete structures.

Lamma Power Station Extension or sent to public filling facilities/other reclamation site for reuse.

Contaminated Excavated Materials

Excavation works would be required at the No.5 Light Oil Tank area for the construction of the foundations of a FGD absorber unit. A total of 600 m^3 (after applying a bulking factor 1.2) of excavated soil materials (including soft soil materials, ie sand and clay and bore 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 the demolition wastes in the *Section 2.3.1*.

The contaminated soil will be remediated on-site in accordance with the EPD's *Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol filling Stations, Boatyards, and Car/Repair/Dismantling Workshops, May 1999*. Proposed strategy for the excavation, testing, and remediation works is presented in the following *Section 3*.

3 REMEDIATION ACTIONS

Following the completion of the land contamination site investigation at the Site, the following remediation programs are proposed.

The scope of work for soil remediation shall include:

3.1 DEMOLITION OF THE NO.4 AND NO. 5 LIGHT OIL TANKS AND THE OIL SEPARATION SUMP, SOIL EXCAVATION AND CONFIRMATION/VERIFICATION SAMPLING

No. 4 and 5 Light Oil Tanks and the oil separation sump will be demolished and soil materials around and underlying the tank and sump will be excavated during the retrofit programme.

3.1.1 *No. 5 Light Oil Tank*

For the remediation of light petroleum hydrocarbon contaminated soil around the No.5 Light Oil Tank (TPH detected at BH3 0.8 m bgl above Dutch B level), the following steps are proposed.

- Cleaning of the tank prior to demolition. Oily water and sludge collected from the cleaning shall be collected and disposed of as chemical waste at Government chemical waste treatment facility.

- Only licensed waste contractors shall be used to collect and transport any chemical waste. The necessary waste disposal permits will be obtained, as required, from the appropriate authorities, in accordance with the *Waste Disposal Ordinance (Cap 354C)* and *Waste Disposal (Chemical Waste) (General) Regulation (Cap 35)*, as required.

- Excavation of the No. 5 Light Oil Tank and bund wall foundations (parcel 18x18 m^2) and underlying soil strata from 0 to 1.5 m bgl or to the rock head for temporary stockpile. The proposed initial excavated parcel at the No.5 Light Oil Tank is shown in *Figure 3.1a*.

- Stockpile shall be contained (eg soil will be stored on a liner sheet and covered with HDPE sheets).

- Conduct verification sampling for TPH contamination in soil around the excavated parcel. The soil samples shall 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. Soil samples shall be taken using excavator and hand tools.

- 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 completed.

- 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 processes repeated until all confirmation samples are below the relevant action levels. The excavation will be limited to the Site area only.

- The excavated contaminated soil will be remediated to remove volatile and semi-volatile fractions of TPH and bio-remediate the contaminated soil respectively in accordance with the EPD's *Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol Filling Stations Boatyards, and Car/Repair/Dismantling Workshops, May 1999*. The treatment will be carried out either at the Site or at the Lamma Power Station Extension area.

- Remediation of hydrocarbon impacted soils can be conducted through the use of enhanced bioremediation in a 'biopile'. The soil treatment is accomplished by stimulating naturally occurring hydrocarbon-degrading bacteria in the soils by providing optimal conditions for the bacteria within the biopile. The method for construction of a typical biopile treatment cell is presented below and diagrams of a typical biopile cell are presented in *Figures 3.1b* and *c* (1). A method statement for the on-site treatment of contaminated soil will be prepared and submitted to EPD prior to the commencement of the treatment work.

- Periodic sampling and analysis of the soil materials during the treatment shall be carried out to monitor the progress of the treatment. The number, frequency and testing methods for the treatment monitoring will be specified in detail in the treatment method statement.

- Where the treated soil showed TPH concentrations below the Dutch B value, the treatment is considered completed and the soil can be used as fill materials on-site, at the Lamma Extension area.

(1) Note: Typical configurations of biopile treatment method is described in the following.
The base of the treatment cell is constructed by placing a liner (such as tarpaulin) on a flat graded surface. Bunds such as hay bales or concrete blocks are then placed along the perimeter of the liner to create a containment berm for the treatment cell. Perforated collection pipes are then installed on top of the base liner to collect excess moisture from the treatment cell (ie, leachate). The leachate collection pipes are covered with pea gravel (or coarse sand) and a geotextile liner. Soil requiring treatment is then placed on top of the geotextile liner in lifts of typically 2 to 3 feet. A nutrient mixture used to increase hydrocarbon-degrading bacteria is 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 points 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 points are used to monitor carbon dioxide in the treatment cell (carbon dioxide is one of the primary by-products of the hydrocarbon biodegradation process). 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. As necessary, the air discharge from the blower can be connected to a treatment system to reduce emissions to the atmosphere. Monitoring of the cell is conducted through measurement of carbon dioxide concentrations in vapours 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. Confirmation samples are then collected from the formerly impacted soils to confirm the remedial goals have been reached.

- Vehicles containing any excavated materials shall be suitably covered to limit potential dust emissions or contaminated wastewater run-off, and truck bodies and tailgates shall be sealed to prevent any discharge during transport or during wet conditions.

- Records of the quantities of wastes generated and disposed of will be maintained.

- Excavated area will be backfilled with clean filled materials and the surface reinstated.

- A decontamination verification report shall be prepared upon completion of the decontamination works.

3.1.2 No. 4 Light Oil Tank and Oil Separation Sump

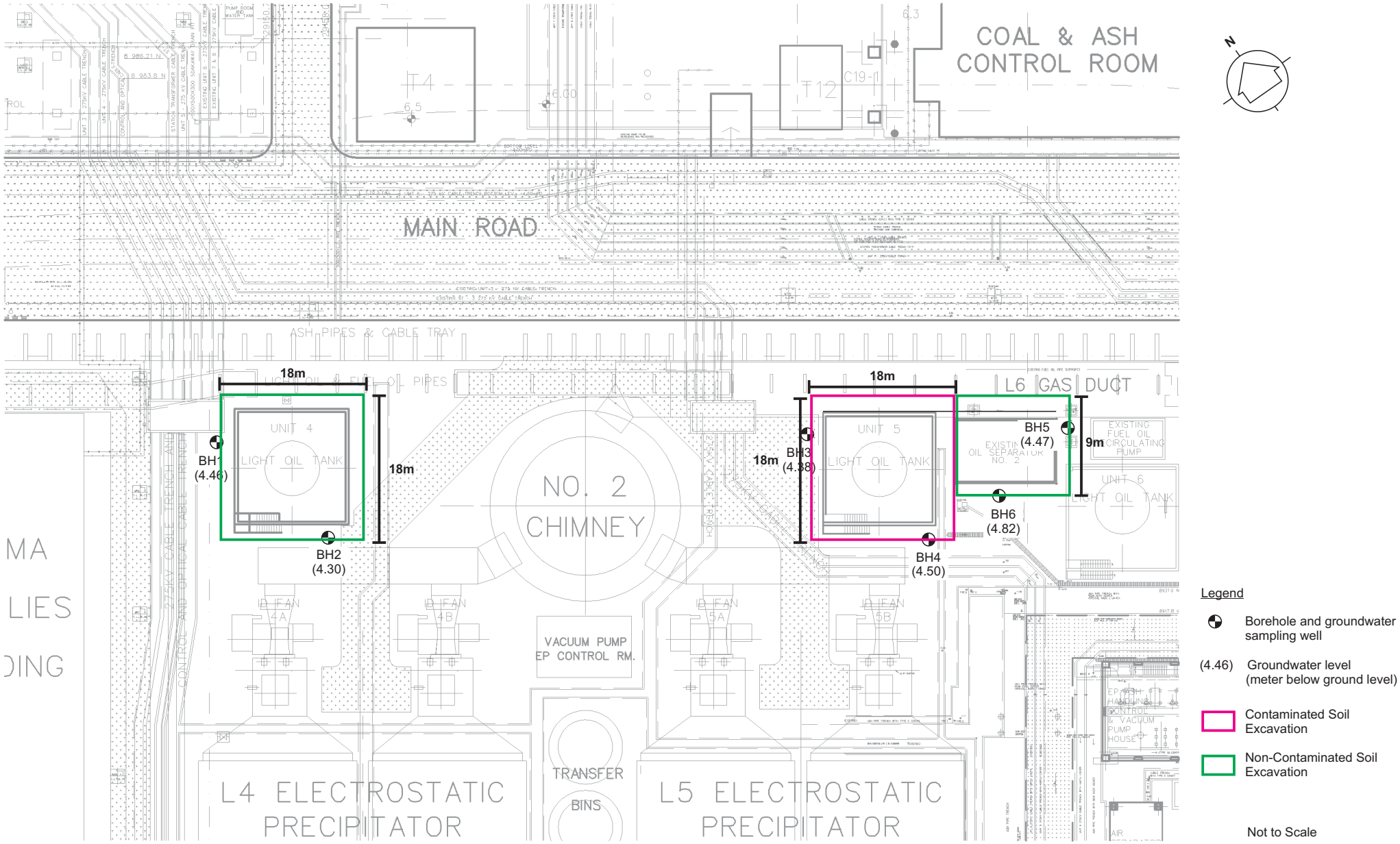
Groundwater was found to be contaminated in the groundwater samples collected from the wells in the No. 4 Light Oil Tank and Oil Separation Sump. These included the groundwater from BH1 with the total TPH at concentration 1,185 µg/L, from BH3 with the total TPH at concentration 1,424 µg/L, BH4 with total TPH at concentration 421 µg/L, BH5 with total TPH at concentration 706 µg/L and BH6 with total TPH at concentration 381 µg/L. As such, it is proposed to sample and test the soil materials on all bottoms and all sides of the No.4 Light Oil Tank and oil separation sump after demolition and excavation to identify potential TPH contamination. The following steps are proposed.

- Cleaning of tanks and sumps prior to demolition. Oily water and sludge collected from the cleaning shall be treated at the on-site wastewater treatment facility. Oily water and sludge collected from the cleaning shall be collected and disposed of as chemical waste at Government chemical waste treatment facility.

- Only licensed waste contractors shall be used to collect and transport any chemical waste. The necessary waste disposal permits will be obtained, as required, from the appropriate authorities, in accordance with the *Waste Disposal Ordinance (Cap 354C)* and *Waste Disposal (Chemical Waste) (General) Regulation (Cap 35)*, as required.

- Excavation of the No. 4 Light Oil Tank and bund wall foundations (parcel 18x18 m^2) and excavation of oil separation sump structures (parcel 12x9 m^2 to the sump depth of about 1.65 m). The proposed initial excavated parcels at the No.4 Light Oil Tank and oil separation sump are shown in *Figure 3.1a*.

- Conduct verification sampling for TPH contamination in soil around the excavated parcels. The soil samples shall be obtained at the north, west, south and east boundaries of the parcels at 0.5 and 1.5 m bgl for the No. 4 tank; at the north, west, south and east boundaries of the parcels at 0.5 and 1.65 m bgl for the sump; and in the middle of each of the parcels at the



Legend

- Borehole and groundwater sampling well
- (4.46) Groundwater level (meter below ground level)
- Contaminated Soil Excavation
- Non-Contaminated Soil Excavation

Not to Scale

Figure 3.1a

Proposed Initial Excavation

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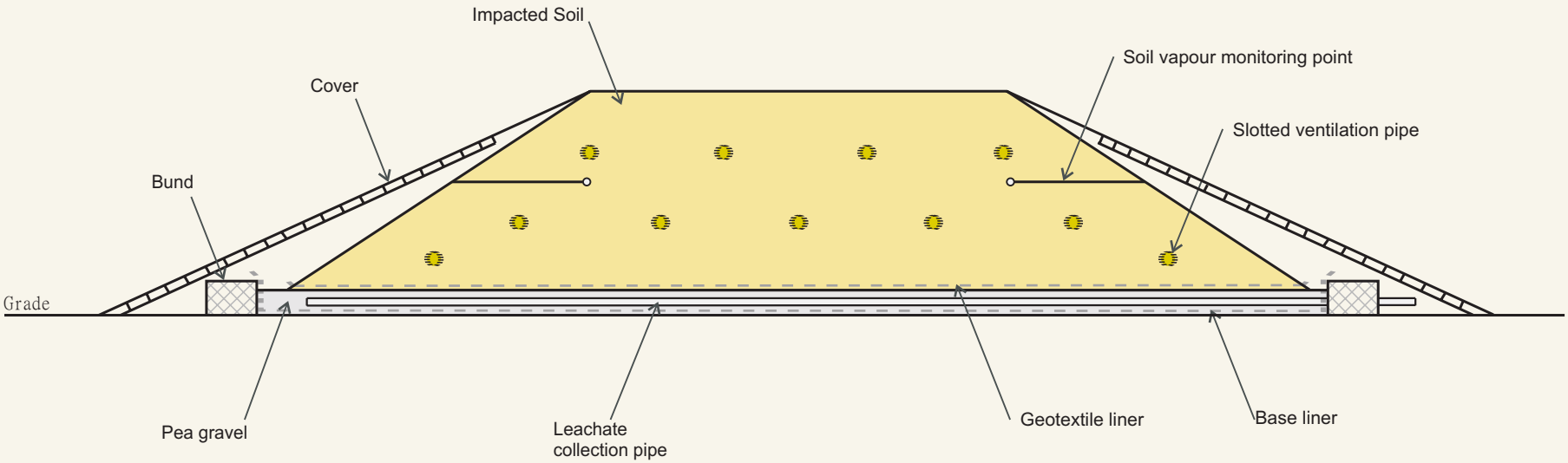

Figure 3.1b

Typical Biopile Treatment Cell Cross Section

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DATE: 20/01/2006

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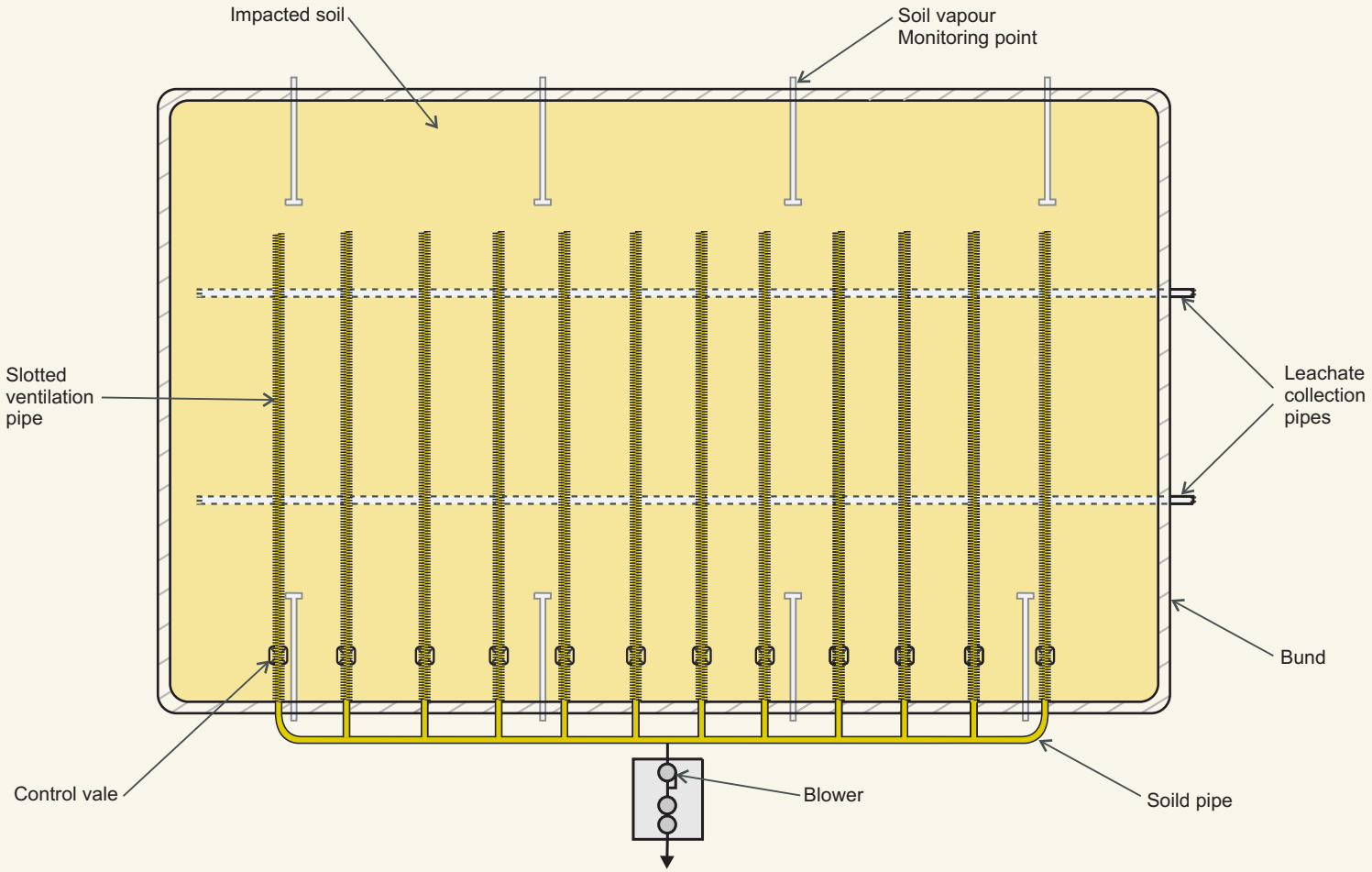

Figure 3.1c

Typical Biopile Treatment Cell Plan View

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bottom of the excavation. Soil samples shall be taken using excavator and hand tools.

- Stockpiling, sampling, testing, further excavation and disposal of soil materials shall follow the same procedures as described in the *Section 3.1.1*.

3.2 GROUNDWATER HANDLING

As groundwater is not used for either domestic or industrial purposes at the Site and in the adjacent areas, remediation of TPH detected in the groundwater of the Site is not considered necessary. No groundwater pumping is anticipated during the construction of the foundation of the project as the proposed excavation during the demolition and construction are at levels well above the measured groundwater table at the Site. However, if the groundwater is encountered during the retrofit programme, the groundwater abstracted or collected should be recharged back to the Site.

3.3 HEALTH AND SAFETY CONTROL MEASURES

The remediation work will involve tank cleaning, oil tank and oil separation demolition, soil excavation, soil stockpiling, and soil sampling. The tanks will be cleaned by an explosive-proof, manual operated steam or water cleaner then by manual wiping. In order to minimise 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 (for both dust and vapour), eye goggles, protective clothing and protective footwear shall be provided to staff who would be involved in the tank cleaning and contaminated area (BH3) 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.

- As the oil tank is defined as a confined space, appropriate control measures and procedures for entering a confined space should be provided and followed when entering the tanks during the remediation.

- 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.

- The use of bulk earth-moving excavator equipment would minimise construction workers' potential contact with contaminated materials.

Annex A

Contamination Assessment Report

CONTENTS

1 INTRODUCTION

1.1 BACKGROUND TO THE STUDY

The Hongkong Electric Company Limited (HEC) has initiated a project to retrofit its two existing 350MW coal-fired generating Units L4 and L5 on 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.

Two above ground oil storage tanks (No. 4 and No. 5 Light Oil Tanks) with associated pipelines and one oil separation sump are proposed to be demolished to provide space for installation of the FGD plants. In accordance with the requirement of Environmental Impact Assessment Study Brief (No. ESB-133/2005) issued by the Environmental Protection Department (EPD) for the retrofit project and as a part of environmental impact assessment (EIA) requirement, a land contamination assessment was carried out for the locations of No. 4 and No. 5 light oil tanks and the oil separation sump (the Site). A land contamination assessment plan (CAP) for the Site has been submitted on 9 November 2005 and approved by the EPD for preparation of the contamination assessment report (CAR).

ERM Hong Kong Limited (ERM) was commissioned by HEC to prepare the CAR of the Site for the project.

1.2 OBJECTIVES OF THE LAND CONTAMINATION ASSESSMENT

The main objectives of the contamination assessment were to assess the presence or absence of soil and groundwater contamination and the degree and extent of soil and groundwater contamination, if present, through soil and groundwater sampling at a number of strategic locations in the vicinities of the tanks and oil separation sump.

1.3 SCOPE OF THE LAND CONTAMINATION ASSESSMENT

The scope of the assessment included the following:

- to review the available land use history of the Site in relation to potential land contamination;
- to review the available geology and hydrogeology information of the Site;
- to conduct a site investigation programme through soil and groundwater sampling at six strategic locations;
- to perform samples laboratory analyses for the target analytical parameters; and

- to report on the findings of the available information reviewed, the field observations, the interpretation of laboratory analytical results, and the assessment of potential land contamination.

1.4 STRUCTURE OF THE CAR

The remainder of this report is structured as follows:

- *Section* 2 summarises the background information, including historical land uses, geology, hydrogeology, of the Site and results of previous investigation at the Site, if any;

- *Section 3* summarises the site investigation programme and field observations;

- *Section 4* presents the laboratory analytical results for the samples collected; and

- *Section 5* provides the conclusions and recommendations.

2 THE SITE

2.1 SITE DESCRIPTION

No.4 and No. 5 Light Oil Tanks and the oil separation sump (the Site) are located in the HEC Lamma Power Station which is situated on the south-western coast of Lamma Island. The land of Lamma Power Station was granted by the Hong Kong Government in 1978, and the Site was reportedly formed with filling of materials from massive excavation of the promontory in the area.

The Site contains two above ground oil storage tanks, each with 250 m^3 capacity and one oil separation sump. No. 4 and 5 oil tanks adjoined the Units L4 & L5 boilers to the northeast respectively. The oil separation sump was located adjacent to the No. 5 oil tank. Both tanks were reportedly designed and constructed around 1991 and in compliance with the Code of Practice issued by the Building Authority. The foundations of the tanks were made of concrete raft footing, surrounded by reinforced-concrete slabs and reinforced concrete bund walls. Storm water drain channels were connected to a sump pit where they could be further diverted manually to the oil separator. The oil separation sump was constructed around 1991 to a depth of 2.05 meter below ground level (m bgl). The capacity of sump was 72.45 m^3 [3.45m (b) x 1.05m (d) x 20m (l)] and was constructed with water proof concrete. The whole area of the Site was flat with concrete pavement. The approximate Site layout is shown in *Figure 1, Annex A.*

2.2 SURROUNDING LAND USE

The Site was located within the HEC Lamma Power Station. The immediate surroundings are shown in *Figure 1, Annex A*, and primarily these include:

North: Main road, beyond which were HEC oil tank farm, switching station and coal yard;

South: Various HEC facilities including electrostatic precipitators, oil tank No. 6, vacuum pump building, and air separator;

East: Main road, beyond which were a coal yard and a coal and ash control building; and

West: L4 and L5 electrostatic precipitators and unit 3 and 4 boilers.

2.3 SITE HISTORY

The review of land use history was based on information provided by HEC, and the history is outlined below:

- Prior to 1978 – undeveloped (sea shore).
- End of 1978 – reclamation.
- 1984 to Present – HEC Lamma Power Station with construction of Stage I completion in 1984, construction of Stage II completion in 1991 and construction of Stage III completion in 1997.

2.4 PREVIOUS INVESTIGATIONS

No previous soil and groundwater contamination investigations had reportedly been carried out at the Site.

2.5 ENVIRONMENTAL SETTING

2.5.1 Geology

Three borehole logs were provided by HEC for review. The boreholes were located within the Site area and the drilling was carried out for geotechnical purpose on 23 February 1983 by Intrusion–Prepakt. According to the information provided by HEC, the Site was located on reclaimed land. Formation of the Site involved cut and fill, which included formation of a platform in the sea contained by a sea wall, and levelling of the rocky seashore area with excavation materials from the promontory of the area.

Based on the borehole logs of geotechnical drilling carried out in the Site area, the ground profile of the Site included brown silty clayey fine to coarse sand with boulders, cobbles and gravels down to depths about 8 to 9 m bgl and then followed by pinkish brown and pinkish grey sand with weathered granite to approximate depths of 13 to 21 m bgl. Rock (granite) head was found at depths around 14 to 22 m bgl.

2.5.2 Hydrogeology

HEC Lamma Power Station is located on the south-western coast of Lamma Island. The coast line was located approximately 200 to 500 meters to the north, and south and west of the Site. The direction of groundwater flow underlying the Site area was anticipated to be affected by the nearby tidal motion. Groundwater was probably being recharged by sea water during high tide and discharged to the sea during low tide. Static groundwater was measured in the groundwater wells installed for the project at depths between 4.3 to 4.8 m bgl.

The surrounding properties received their water supply from Water Supplies Department (WSD). Groundwater is not used for either domestic or industrial purposes at the Site and the adjacent areas.

3 SITE INVESTIGATION PROGRAMME

3.1 GENERAL

The field work for preparation of the CAR was carried out through intrusive soil and groundwater investigation between 14 and 19 November 2005. The investigation programme was designed in accordance with Environmental Protection Department (EPD)'s *Practice Notes for Professional Persons: Contaminated Land Assessment and Remediation ProPECC PN 3/94* (*ProPECC PN3/94*) and *Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol Filling Stations, Boatyards, and Car Repair/Dismantling Workshops* (*Guidance Notes*).

In addition, a QA/QC programme was developed and implemented for the investigation. Details of the Site investigation programme are presented in the following sections.

3.2 UNDERGROUND SOIL BORING AND SAMPLING

Soil boring and sampling were carried out at six locations at the Site using three rotary drilling rigs. The approximate drilling locations are shown on *Figure 1, Annex A*. Prior to drilling, all drilling location with exception of drilling location BH3 were manually excavated to 1.5 or 2.0 m bgl for underground structure clearance. In order to clear the underground structures for drilling location BH3, two inspection pits were manually excavated in the proposed drilling area for BH3. Both inspection pits were dug to a depth of 1.1 m bgl where a hard strata (ie rock head) was encountered, and one of the pits was selected as BH3 for the subsequence drilling.

Sampling of the soil between 0.5 to 1 m bgl at all six locations was carried out manually using a stainless steel scoop. The borehole drilling at each sampling location was commenced from the bottom of excavation pit, and sampling of soil during the drilling was conducted using split barrels following the standard penetration testing (SPT) procedures.

At each location soil materials were recovered at depths of 0.5 m bgl and every one meter until the completion of drilling for on-site photo-ionisation detector (PID) testing. The samples were also visually inspected to determine the soil geological classification and observe signs of contamination. As bed rock, boulders or cobbles were encountered during the drilling for locations BH3 and BH6, only one soil sample and two soil samples were collected from these boreholes, respectively.

Soil samples for laboratory testing were collected from each borehole at designated depths where soil was encountered. Soil sampling was not performed at depths where boulders, cobbles or bedrocks were encountered.

All soil sampling equipment was decontaminated using the cleaning procedures described in the CAP prepared for the CAR on 9 November 2005 prior to and between each time of use.

The underground soil profiles observed during the drilling were recorded in the *Borehole Logs, Annex B*. The details of the soil boring and sampling are summarized in *Table 3.2a*. The PIDs measured on-site for the soil from each borehole are provided in *Borehole Log*, in *Annex B*.

All soil samples collected from the boreholes were placed immediately into laboratory pre-cleaned sample bottles and stored with ice in a cooler on-site before delivery.

Table 3.2a Soil Boring and sampling for HEC Units 4&5 FGD Retrofit

Bore hole	No. of soil sample for laboratory testing	Soil Sampling depth (m bgl)	Total drilling depth (m bgl)	Groundwater level observed during drilling (m bgl)
BH1	3	1.0, 5.0 and 6.0	7.0	5.0
BH2	3	1.0, 5.0 and 6.0	7.5	4.45
BH3	1	0.8	7.15	4.15
BH4	3	1.0, 5.0 and 6.0	7.2	5.0
BH5	3	1.0, 6.0 and 6.8	7.5	4.42
BH6	2	1.0, and 5.0*	7.0	5.0

Note: *one soil field duplicate sample (BH7) was collected from this location.

At the six boring locations, the ground surface comprised a 0.2 m of concrete pavement underlain by a thin layer of gravel fill (thickness varied from 0 to 0.3 m). Yellowish brown medium to coarse grained sands with occasional gravels and/or boulders were generally encountered at most boring locations and the depths started from 0.3 to 0.5 m bgl and extended to the end of drilling depth (ie 7.0 to 7.5 m bgl). Granite boulders or bedrock was encountered at location BH3 starting from 1.3 m bgl to the end of drilling (7.0 m bgl).

No evidence of soil contamination such as staining, discoloration or abnormal odour was observed during the soil drilling and sampling.

3.3 GROUNDWATER WELL INSTALLATION AND SAMPLING

Groundwater was encountered at all boreholes during the drilling. The six boreholes were converted into six groundwater monitoring wells to facilitate groundwater sampling. Groundwater wells were installed to approximate 2 m below the groundwater level using perforated u-PVC pipes. Diagrams showing details of the installed groundwater wells are provided in *Borehole Log, Annex B*.

After groundwater well installation, each well was developed by removing five times the well volume water by hand bailing. Groundwater samples were collected using dedicated Teflon bailers, and all bailers were

decontaminated using the cleaning procedures described in the CAP prepared for the CAR on 9 November 2005 prior to the usage.

All groundwater samples collected from the wells were placed immediately into laboratory pre-cleaned and pre-preserved sample bottles and stored with ice in a cooler on-site before delivery to the laboratory.

The number of groundwater samples collected and a record of the groundwater level measured at an equilibrium condition are summarized in *Table 3.3a.*

Table 3.3a ***Groundwater Sampling and level measured at equilibrium condition***

Sampling well	No. of sample	Groundwater Level measured on 19 November 2005
BH1	1	4.46 m bgl
BH2	1	4.3 m bgl
BH3	1	4.38 m bgl
BH4	1	4.5 m bgl
BH5	1	4.47 m bgl
BH6	2*	4.82 m bgl

Note: * one groundwater field duplicate sample (BH7) was collected from this location.

Based on the groundwater water levels measured and the local surface hydrology, the shallow groundwater in the Site area is anticipated to flow in a generally southern or south-westerly direction.

3.4 FIELD QA/QC PROGRAMME AND SAMPLE DELIVERY

A field QA/QC program was incorporated into the land contamination investigation. The program included collection of one soil and one groundwater field duplicate sample, one equipment blank sample, and two trip blank samples.

The field duplicate samples were collected from borehole BH6 at a depth 5.0 m bgl for soil (labelled as BH7) and from well BH6 for groundwater (labelled as BH7). One equipment blank sample (EQ Blank) was collected for the sampling equipment on 19 November 2005. Two trip blank samples (Trip Blank 1 and Trip blank) were pre-prepared in the laboratory, stored with the samples in a cooler, and delivered on 16 and 19 November 2005, respectively to the laboratory. All field QA/QC samples were collected/prepared for analysis for the same suite of parameters as for the other samples.

All soil and groundwater samples along with the field QA/QC samples were delivery to the laboratory on ice in coolers on each sampling day. Copies of Chain of Custody for the sample deliveries are provided in *Annex C*.

ERM supervised the field drilling, soil sampling, and groundwater sampling to meet the requirements of the project QA/QC and the decontamination procedures described in the CAP of the project.

3.5 *LABORATORY ANALYSES*

All soil and groundwater samples along with field QA/QC samples were collected for analysis of polycyclic aromatic hydrocarbon (PAH), total petroleum hydrocarbon (TPH) and benzene, toluene, ethylbenzene and xylene (BTEX).

The PAH analyses for the samples were performed by Lam Geotechnics Ltd, and TPH and BTEX analyses were performed by ALS Technichem Hong Kong Pty Ltd (ALS). Both laboratories conducted the sample analyses in accordance with USEPA standard methods and procedures, including the requirements on laboratory internal QA/QC samples and procedures.

The soil and groundwater samples were analysed through the following the standard methods:

- total petroleum hydrocarbons (TPH) by US EPA 8260 & 8015 for all samples;
- polycyclic aromatic hydrocarbon (PAHs) by US EPA Method 8260 for all samples; and
- benzene, toluene, ethyl benzene, and xylene (BTEX) by US EPA Method 8260 for all samples.

4 ANALYTICAL RESULTS

The analytical results for the soil and groundwater samples collected from the Site are summarised in *Tables 4.1a* and *4.1b*, respectively, and are discussed in the following sections. The detailed results of the laboratory analyses along with the QA/QC information are presented in *Annex D*.

4.1 CRITERIA FOR ASSESSMENT

The EPD's *ProPECC PN 3/94* has adopted the *Dutch Ministry of Housing, Planning and Environment Soil and Groundwater Standards* (the 'Dutch List') as the criteria for assessing soil and groundwater contamination in Hong Kong. The Dutch List was used as the reference against the analytic results of the samples collected.

As an initial screening tool for establishing a general understanding of the degree and extent of soil and groundwater contamination, the Dutch List defines three different levels, ie 'A', 'B' and 'C', for the concentration of contaminants found in soil and groundwater. The interpretation of the contaminant concentrations is as follows:

- Concentrations below 'A' and/or 'B' values refer to a situation in which the soil and/or groundwater is considered 'unpolluted' and can fulfil all possible functions and no further actions are required.

- Concentrations above 'B' but below 'C' values refer to a situation in which the soil and/or groundwater is potentially contaminated and requires further investigation. In Hong Kong, the Dutch 'B' values are currently used as the soil cleanup target for most cases and soil with contaminant concentrations exceeding such values is considered contaminated and needs to be remediated to below this level.

- Concentrations above 'C' refer to a case of significant contamination and cleanup action is required.

The guideline values in the Dutch List are presented in *Annex E.*

Table 4.1a Analytical Results for Soil Samples (all results in mg/ kg- dry weight)

Parameter	Dutch 'A'	Dutch 'B'	Dutch 'C'	Report Limit	BH1 1.0 m	BH1 5.0 m	BH1 6.0 m	BH2 1.0 m	BH2 5.0 m	BH2 6.0 m	BH3 0.8 m
Moisture Content (%)				0.1	9.2	13.6	16.4	7.7	15.5	8.7	11.7
TPH											
Gasoline (C6-C9)	20	100	800	2	ND	ND	ND	ND	ND	ND	ND
Light Diesel (C10-C14)	N/A	N/A	N/A	50	ND	ND	ND	ND	ND	ND	78
Heavy Diesel (C15-C28)	N/A	N/A	N/A	50	ND	ND	ND	ND	ND	ND	1,800
Heavy Oi (C29-C36)	N/A	N/A	N/A	50	ND	ND	ND	ND	ND	ND	945
Mineral Oil[a]	100	1,000	5,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	**2,745**
PAHs											
Naphthalene	0.1	5	50	2.0	ND	ND	ND	ND	ND	ND	ND
Anthracene	0.1	10	100	2.0	ND	ND	ND	ND	ND	ND	ND
Fenanthrene	0.1	10	100	2.0	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	01	10	100	2.0	ND	ND	ND	ND	ND	ND	ND
Pyrene	0.1	10	100	2.0	ND	ND	ND	ND	ND	ND	ND
1,2-benzopyrene	0.05	1	10	1.0	ND	ND	ND	ND	ND	ND	ND
Total	1	20	200	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
BTEX											
Benzene	0.01	0.5	5	0.2	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	0.05	2	20	0.2	ND	ND	ND	ND	ND	ND	ND
Ethyl-benzene	0.05	5	50	0.2	ND	ND	ND	ND	ND	ND	ND
m,p-Xylene	N/A	N/A	N/A	0.4	ND	ND	ND	ND	ND	ND	ND
o-Xylene	N/A	N/A	N/A	0.2	ND	ND	ND	ND	ND	ND	ND
Xylene [b]	0.05	5	50	N/A	ND	ND	ND	ND	ND	ND	ND
Toluene	0.05	3	30	0.2	ND	ND	ND	ND	ND	ND	ND

Notes:

Underlined and **Bold** Results = concentrations that exceed the Dutch "B" values; Underlined, **Bold**, and *Italic* Results = concentrations that exceed the Dutch "C" values; N/A = not available; ND = not detectable.

a - Mineral oil for each sample were estimated by calculation of total detected results of light diesel, heavy diesel and heavy oil.

b – The standard for xylene is total xylene which is the total of m,p-xylene and o-xylene.

c – Duplicate samples were analysed for this sampling location. Higher results were selected for presenting in the table where the two sample results differ from each other.

Table 4.1a Analytical Results for Soil Samples (all results in mg/ kg dry weight) (Cont.)

Parameter	Dutch 'A'	Dutch 'B'	Dutch 'C'	Report Limit	BH4 1.0 m	BH4 5.0 m	BH4 6.0 m	BH5 1.0 m	BH5 6.0 m	BH5 6.8 m	BH6 1.0 m	BH6 [c] 5.0 m
Moisture Content (%)				0.1	8.5	7.6	8.3	8.5	7.5	10.6	12.5	12.6
TPH												
Gasoline (C6-C9)	20	100	800	2	ND	ND	ND	ND	ND	ND	ND	ND
Light Diesel (C10-C14)	N/A	N/A	N/A	50	ND	ND	ND	ND	ND	ND	ND	ND
Heavy Diesel (C15-C28)	N/A	N/A	N/A	50	149	ND	ND	ND	ND	ND	ND	ND
Heavy Oil (C29-C36)	N/A	N/A	N/A	50	52	ND	ND	ND	ND	ND	ND	ND
Mineral Oil[a]	100	1,000	5,000	N/A	201	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PAHs												
Naphthalene	0.1	5	50	2.0	ND	ND	ND	ND	ND	ND	ND	ND
Anthracene	0.1	10	100	2.0	ND	ND	ND	ND	ND	ND	ND	ND
Fenanthrene	0.1	10	100	2.0	ND	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	01	10	100	2.0	ND	ND	ND	ND	ND	ND	ND	ND
Pyrene	0.1	10	100	2.0	ND	ND	ND	ND	ND	ND	ND	ND
1,2-benzopyrene	0.05	1	10	1.0	ND	ND	ND	ND	ND	ND	ND	ND
Total	1	20	200	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
BTEX												
Benzene	0.01	0.5	5	0.2	ND	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	0.05	2	20	0.2	ND	ND	ND	ND	ND	ND	ND	ND
Ethyl-benzene	0.05	5	50	0.2	ND	ND	ND	ND	ND	ND	ND	ND
m,p-Xylene	N/A	N/A	N/A	0.4	ND	ND	ND	ND	ND	ND	ND	ND
o-Xylene	N/A	N/A	N/A	0.2	ND	ND	ND	ND	ND	ND	ND	ND
Xylene [b]	0.05	5	50	N/A	ND	ND	ND	ND	ND	ND	ND	ND
Toluene	0.05	3	30	0.2	ND	ND	ND	ND	ND	ND	ND	ND

Notes:

Underlined and **Bold** Results = concentrations that exceed the Dutch "B" values; Underlined, **Bold**, and *Italic* Results = concentrations that exceed the Dutch "C" values;

N/A = not available; ND = not detectable.

a - Mineral oil for each sample were estimated by calculation of total detected results of light diesel, heavy diesel and heavy oil.

b – The standard for xylene is total xylene which is the total of m,p-xylene and o-xylene.

c – Field duplicate soil sample was collected and analysed for this sampling location. Higher results were selected for presenting in the table where the two sample results differ from each other.

Table 4.1b Analytical Results for Groundwater Samples (all results in µg/L)

Parameter	Dutch 'A'	Dutch 'B'	Dutch 'C'	Report Limit	BH1	BH2	BH3	BH4	BH5	BH6 [c]
TPH										
Gasoline (C6-C9)	10	40	150	20	ND	ND	ND	ND	ND	ND
Light Diesel (C10-C14)	N/A	N/A	N/A	25	ND	ND	ND	ND	ND	ND
Heavy Diesel (C15-C28)	N/A	N/A	N/A	25	1,150	32	1,080	365	681	311
Heavy Oil (C29-C36)	N/A	N/A	N/A	25	35	ND	344	56	25	70
Mineral Oil	20	200	600	N/A	***1,185***	***32***	***1,424***	**421**	***706***	**381**
PAHs[a]										
Naphthalene	0.2	7	30	1	ND	ND	ND	ND	ND	ND
Anthracene	0.1	2	10	1	ND	ND	ND	ND	ND	ND
Fenanthrene	0.1	2	10	1	ND	ND	ND	ND	ND	ND
Fluoranthene	0.02	1	5	1	ND	ND	ND	ND	ND	ND
Pyrene	0.02	1	5	1	ND	ND	ND	ND	ND	ND
1,2-benzopyrene	0.01	0.2	1	0.2	ND	ND	ND	ND	ND	ND
Total	0.2	10	40	N/A	ND	ND	ND	ND	ND	ND
BTEX										
Benzene	0.2	1	5	1	ND	ND	ND	ND	ND	ND
Ethyl-benzene	0.5	20	60	2	ND	ND	ND	ND	ND	ND
m,p-Xylene	N/A	N/A	N/A	4	ND	ND	ND	ND	ND	ND
o-Xylene	N/A	N/A	N/A	2	ND	ND	ND	ND	ND	ND
Xylenes [b]	0.5	20	60	N/A	ND	ND	ND	ND	ND	ND
Toluene	0.5	15	50	2	ND	ND	ND	ND	ND	ND

Notes:

Underlined and **Bold** Results = concentrations that exceed the Dutch "B" values; Underlined, **Bold**, and *Italic* Results = concentrations that exceed the Dutch "C" values; N/A = not available; ND = not detectable.

a - Mineral oil for each sample were estimated by calculation of total detected results of light diesel, heavy diesel and heavy oil.

b – The standard for xylene is total xylene which is the total of m,p-xylene and o-xylene.

c – Duplicate samples were analysed for this sampling location. Higher results were selected for presenting in the table where the two sample results differ from each other.

4.2 RESULTS FOR SOIL SAMPLES

4.2.1 Total Petroleum Hydrocarbons (TPH)

TPH in the fractions of light diesel, heavy diesel and heavy oil were detected at concentrations of 78, 1,800, and 945 mg/kg, respectively, in the soil samples collected from borehole BH3 at depth of 0.8 m bgl. The total of these three concentrations (2,745 mg/kg) exceeded the EPD Dutch B value of 1,000 mg/kg for mineral oil.

4.2.2 Polycyclic Aromatic Hydrocarbons (PAHs)

No PAHs were detected at concentrations exceeding the laboratory reporting limits in all soil samples collected from the Site.

4.2.3 Benzene, Toluene, Ethyl Benzene and Xylene (BTEX)

No BTEX compounds were detected above the laboratory reporting limits in all soil samples collected from the Site.

4.3 RESULTS FOR GROUNDWATER SAMPLES

4.3.1 Total Petroleum Hydrocarbons (TPH)

Heavy diesel and heavy oil were detected in almost groundwater samples collected from the six groundwater sampling wells installed for the project. Of which, the total of heavy diesel and heavy oil detected for the groundwater samples collected from BH1 (1,185 µg/L), BH3 (1,424 µg/L) and BH5 (706 µg/L) exceeded the EPD Dutch C value of 600 µg/L for mineral oil. The total of heavy diesel and heavy oil detected for the groundwater samples from BH4 and BH6 were 421 and 381 µg/L, respectively, and these concentrations exceeded the EPD Dutch B value of 200 µg/L for mineral oil.

4.3.2 Polycyclic Aromatic Hydrocarbons (PAHs)

No PAHs were detected at concentrations exceeding the laboratory reporting limits in all groundwater samples collected from the Site.

4.3.3 Benzene, Toluene, Ethyl Benzene and Xylene (BTEX)

No BTEX compounds were detected at concentrations exceeding the laboratory reporting limits in all groundwater samples collected from the Site.

4.4 QA /QC SAMPLE RESULTS AND DATA USABILITY

4.4.1 Field QA/QC Sample Results

Assessment of field QA/QC sample results included checking of relative percent difference (RPD) for field duplicate samples, equipment blank and trip blank samples.

The relative percent difference (RPD) is used to assess the sampling and laboratory reproducibility and precision. RPD is calculated from the detected results of field duplicate samples, which should be higher than two times the detection limits. The USEPA acceptable limits for RPD are less than 30% for groundwater and less than 50% for soil. No RPD is required where the sample result is below two times the method detection limits or below the method detection limits.

The analytical parameters were reported as non-detective for all analyzed parameters in the soil sample BH6 5.0m and duplicate sample BH7. As such, no RPD was calculated for these soil samples.

A RPD was calculated for the detected result of heavy diesel for the groundwater sample BH6 and duplicate sample BH7. The RPD calculated (20%) met the acceptable limit of 30% for groundwater sample. As the detected results of heavy oil (ie 42 µg/L) for BH7 was less than two times of laboratory reporting limit (25 µg/L), no RPD was calculated for heavy oil results for groundwater samples BH6 and BH7.

No target analytical parameters were detected in any of the equipment blank and trip blank samples.

4.4.2 Laboratory Internal QA/QC Sample Results

The assessment of laboratory QA/QC sample results included checking of surrogate recoveries, matrix spike sample, laboratory duplicate samples, method blanks, and sample holding times.

All above laboratory QA/QC sample results met their respective requirements.

4.5 DATA USABILITY

Based on the review of QA/QC sample results, all laboratory results for the soil and groundwater sample collected for the projects are considered useable for evaluating the Site environmental conditions within the scope of project.

5 CONTAMINATION ASSESSMENT FOR SOIL AND GROUNDWATER

5.1 SOIL

Elevated concentrations of light diesel, heavy diesel and heavy oil were detected in one soil sample collected from location (BH3), located near the north-western side of No. 5 oil tank, at a depth near the ground surface (ie 0.8 m bgl). Of which, the highest concentration (1,800 mg/kg) was detected for heavy diesel. The total concentration of light diesel, heavy diesel and heavy oil in the soil sample BH3 0.8m was 2,745 mg/kg and exceeded the respective EPD Dutch B value of 1,000 mg/kg. Low concentrations (below the EPD respective Dutch B value) of heavy diesel and heavy oil were also detected in the soil sample collected from the borehole BH4 near the south-western side of No. 5 oil tank at depth near the ground surface (1.0 m bgl).

5.2 GROUNDWATER

TPH including light diesel, heavy diesel, and heavy oil were identified in almost all groundwater samples collected from the wells installed at the Site and exceeded the EPD Dutch B or C values. These included the total of heavy diesel and heavy oil detected in the groundwater samples from BH1 (1,185 µg/L), BH3 (1,424 µg/L) and BH5 (706 µg/L) exceeded the EPD Dutch C value of 600 µg/L for mineral oil; and the total of heavy diesel and heavy oil detected in the groundwater samples from BH4 (421 µg/L) and BH6 (381 µg/L) exceeded the EPD Dutch B value of 200 µg/L for mineral oil. The higher TPH concentrations were detected in the samples from wells BH1 and BH3 and were primarily contributed by heavy diesel fraction.

5.3 QUALITATIVE RISK ASSESSMENT

5.3.1 Potential Source of TPH Contamination

HEC Lamma Power Station has operated at the Site area since 1984. The Site area was undeveloped land before Lamma Power Station. The No. 4 and 5 oil tanks were located above the ground and were constructed around 1991. Both tanks have been provided with secondary containment systems. No oil spills and leakages have been reported at the Site and Lamma Power Station, and no evidence of oil spills or leakages were observed during the Site investigation of the project.

The oil separation sump, which located adjacent to No. 5 oil tank, was reportedly built around 1991. It was constructed to a depth of around 2 m bgl with waterproof concrete. No oil spills or leakages have been reported for the oil separation sump, and no evidence of oil spills or leakages were observed during the Site investigation.

A potential source of the TPH contamination in the soil at location BH3 was not confirmed at this investigation stage.

A source of TPH contamination in the groundwater of the Site area was not confirmed at this investigation stage.

5.3.2 Chemicals of Concern

The chemicals of concern for the TPH contamination in the soil and groundwater underlying the Site area include light diesel (C10-C14), heavy diesel (C15-C28) and heavy oil (C29-C36).

5.3.3 Potential Migration and Exposure

The potential transport mechanism for the TPH contamination in surface soil at BH3 and in the groundwater in the Site area includes groundwater flow. The groundwater flow within the Site area is heavily influenced by tidal movements as the Site is located on a reclaim area more than 300 m from the water front.

As the Site area is paved, and groundwater is not used for either domestic or industrial purposes at the Site and in the adjacent areas, the potential exposure to the TPH contaminated groundwater in the Site only could take place during the ground excavation of the Site at the demolition or construction stages. The exposure pathway includes accidental ingestion of the soil and groundwater.

5.3.4 Potential Receptor

During the demolition of the facilities and the construction phases of the FGD project potential on-site receptors include workers involved in demolition, clean-up and construction actives who may be handling the contaminated materials. Mitigations measures are proposed in the remediation action plan (RAP) to minimise workers exposure during this period and no adverse impacts are anticipated after the proposed measures have been appropriately implemented.

The Site and the immediate surrounding areas is used by HEC Lamma Power Station. The Site area is fully paved and no potential direct human contact to the underlying soil materials is anticipated during the operation of the Site. As the groundwater is not used at the area for either domestic or industrial purposes, therefore, there is no on-site potential receptor of the TPH contaminated groundwater.

The off-site receptors of the TPH contaminated groundwater in the Site could include the water body and its ecosystem along the coastline located more than 300 m from the Site.

6 CONCLUSIONS AND RECOMMENDATIONS

A site investigation for land contamination assessment was completed and this CAR was prepared for the Site. The land contamination assessment was performed in accordance with the procedures and requirements set out in the CAP submitted on 9 November 2005 and approved by the EPD. The CAP made reference to EPD's *Practice Note for Professional Persons* (*ProPECC PN 3/94)* and *Guidance Notes for Investigation and Remediation Contaminated Site of Petrol Filling Stations, Boatyard and Car Repair/Dismantling Workshops*..

The conclusions of the focussed land contamination assessment are summarized below.

6.1 SOIL

TPH was detected at concentration (2,745 mg/kg) which exceeded the EPD Dutch B value for mineral oil (1,000 mg/kg) in a soil sample taken from one location (BH3), near the No. 5 oil tank, at depth close the ground surface (0.8 m bgl). The detected TPH was in the fractions of light diesel (78 mg/kg), heavy diesel (1,800 mg/kg) and heavy oil (945 mg/kg). The TPH contamination at location BH3 was found to be localized, however, no source of TPH contamination can be confirmed at this stage.

No. 4 and 5 oil tanks and the oil separation sump will be demolished and soil materials around and underlying the tank and sump will be excavated during the retrofit programme. It is recommended to conduct verification sampling at bottom and all sides of the excavation at the No. 5 Oil Tank area (location BH3). In addition, soil materials excavated from the excavations should also been sampled and tested for potential TPH contamination. Appropriate mitigation measures for the handling of contaminated materials to ensure health and safety of workers during the demolition and construction periods and to provide appropriate storage, treatment and disposal of contaminated materials will be evaluated and recommended based on the identified extent of TPH contamination and volume of contaminated soil materials. Details of the sampling locations, procedures and appropriate mitigation measures will be provided in a separate Remediation Action Plan (RAP).

When disposal of soil material is necessary, the soil materials should meet the Landfill Disposal Criteria for Contaminated Soil listed in the EPD's *Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol filling Stations, Boatyards, and Car/Repair/Dismantling Workshops, May 1999*.

6.2 GROUNDWATER

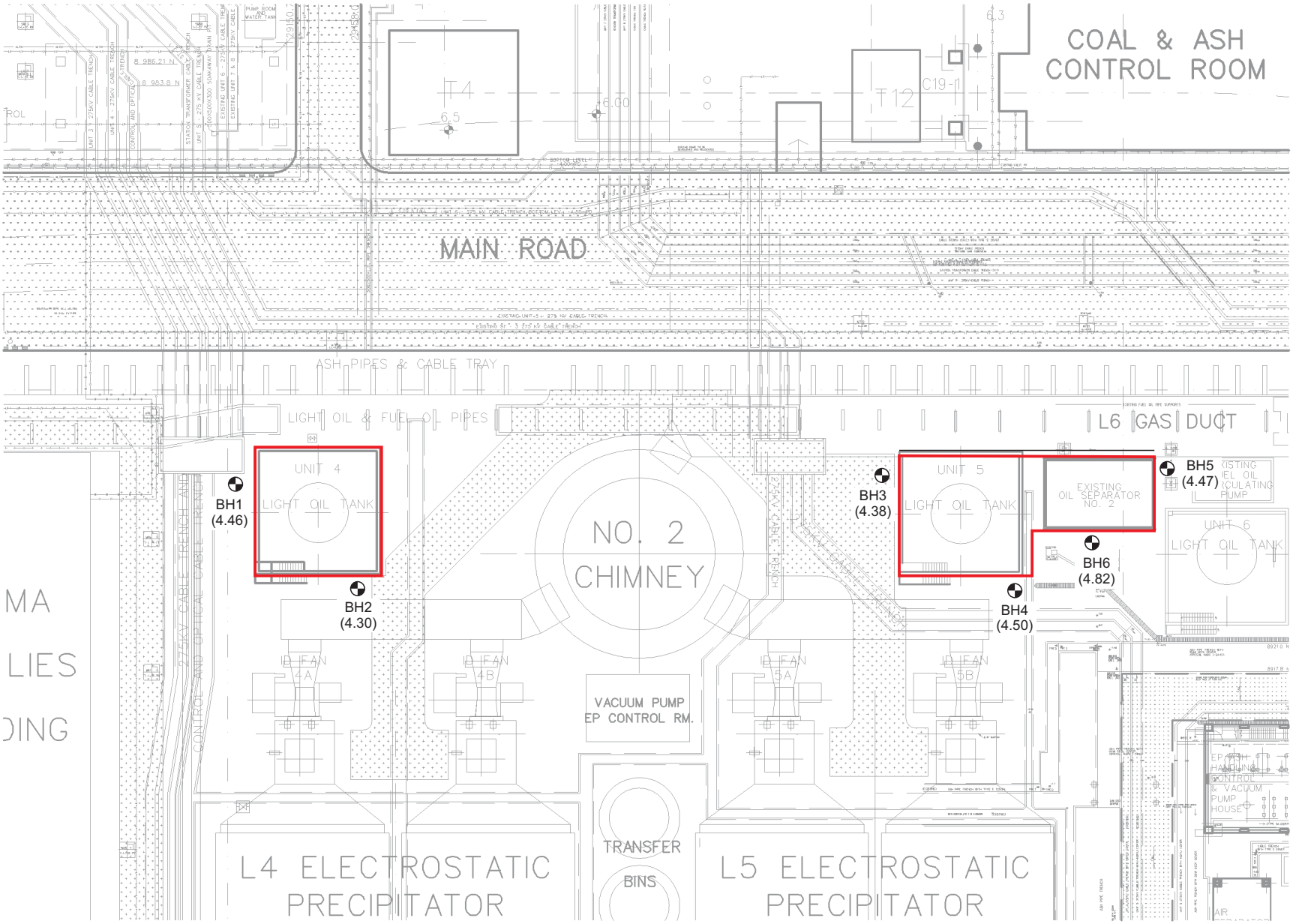
TPH in the fractions of heavy diesel and heavy oil were detected in five out six groundwater samples from the Site. Of which, the concentrations of TPH in three samples collected from wells BH1, BH3 and BH5 (ie 1,185, 1,424 and 706

µg/L, respectively) exceeded the EPD Dutch C value for mineral oil (600 µg/L). The concentration of TPH in two samples collected from wells BH4 and BH6 (421 and 381 µg/L, respectively) exceeded the EPD Dutch B value for mineral oil (200 µg/L). The detected TPH concentrations in these groundwater samples were primarily contributed by heavy diesel. The potential source of groundwater TPH contamination was not confirmed at this investigation stage.

As groundwater is not used for either domestic or industrial purposes at the Site and in the adjacent areas, remediation of TPH detected in the groundwater of the Site is not considered necessary. No groundwater pumping is anticipated during the demolition/construction activities of the project as the proposed excavations were well above the measured groundwater levels. However, if ingress groundwater is encountered during the demolition, foundation excavation and construction and dewatering of the excavated areas is required, the groundwater will be collected and treated at a purposed made petrol interceptor (to be provided by the demolition and construction contractors) prior to discharge, or the water will be recharged on-site.

Annex A

Site Layout and Sampling Locations



Legend

- Borehole and groundwater sampling well
- (4.46) Groundwater level (meter below ground level)

Not to Scale

Figure 1

Site Layout

FILE: 0038824d
DATE: 07/12/2005

Environmental Resources Management

ERM

Annex B

Boring Logs

FIELD BORING LOG

BORING NO.: BH1

SOIL DESCRIPTION	JOB TITLE 0038824 HEC Lamma SI	
LOCATION Lamma		DATE 14-18/ 11 / 2005
COORDINATES N : 8937.24	E : 29142.99	REFERENCE EL. +6.28 mRD
DRILL Rotory		
DRILLER Lam Geotechnics Ltd		LOG BY: Jane Lin

ERM

ELEVATION (mMSL)	WELL DIAGRAM	DEPTH (mbg)	GROUND-WATER	GRAPHIC LOG	SOIL DESCRIPTION	SAMPLE NUMBER	SAMPLE INTERVAL	PID READING (ppm)	MOISTURE D	M	W	S
		0			*Concrete*							
		0.5			*Fills (medium grained angular gravels).*							
		1			*Yellowish brown coarse to medium to grained slightly silty SAND with some medium gravels and occasional cobbles.*	(1)	1.0	0.0				
		1.5										
		2						0.0				
		2.5										
		3						0.3				
		3.5			*COBBLES / BOULDERS*							
		4			*Yellowish brown coarse and medium grained silty SAND with some silt and fine gravels.*			0.0				
		4.5	4.46 ▼									
		5	5.0 ▽			(2)	5.0	0.0				
		5.5			*Yellowish brown coarse to medium grained SAND.*							
		6				(3)	6.0	0.1				
		6.5										
		7						0.0				
		7.5			*End of drilling at 7.0m.*							
		8										

LEGEND

= BENTONITE = SAND PACK
= GROUT = SCREEN
= SEAL ▽ FIRST APPEARANCE LEVEL
▼ STATIC GROUNDWATER LEVEL

Well Development Record *Date : 19/11/2005* *Method : bailing*

Note:

- Hand excavation to 2.0 m bgl.

- Groundwater encountered at 5.0 m bgl during.

- Groundwater measured at 4.46 m bgl on 19/11/2005 9:00am.

0038824c.cdr

FIELD BORING LOG

BORING NO.: BH2

SOIL DESCRIPTION	JOB TITLE 0038824 HEC Lamma SI	
LOCATION Lamma		DATE 16-18/ 11 / 2005
COORDINATES N : 8925.93	E : 29159.15	REFERENCE EL. + 6.22 mRD
DRILL Rotory		
DRILLER Lam Geotechnics Ltd		LOG BY: Zoe Chan

ERM

ELEVATION (mMSL)	WELL DIAGRAM	DEPTH (mbg)	GROUND-WATER	GRAPHIC LOG	SOIL DESCRIPTION	SAMPLE NUMBER	SAMPLE INTERVAL	PID READING (ppm)	MOISTURE D	M	W	S
		0			*Concrete*							
		0.5			*Light grey anywater gravel fill.*							
					Yellowish brown medium to coarse slightly silty SAND with some medium to coarse gravels and boulders.							
		1				(1)	1.0	0.2				
		1.5										
		2						0.2				
		2.5										
		3						0.0				
		3.5										
		4						0.1				
			4.3 ▼		*Yellowish brown medium to coarse grained slightly silty clayey SAND with some medium to coarse gravels.*							
		4.5	4.45 ▽									
		5				(2)	5.0	1.0				
		5.5										
		6				(3)	6.0	0.4				
		6.5			*Yellowish brown medium to coarse SAND with some medium to coarse gravels and silts.*							
		7						1.1				
		7.5			*End of drilling at 7.5m.*							
		8										

LEGEND

= BENTONITE = SAND PACK
= GROUT = SCREEN
= SEAL ▽ FIRST APPEARANCE LEVEL
▼ STATIC GROUNDWATER LEVEL

Well Development Record *Date : 19/11/2005* *Method : bailing*

Note:

- Hand excavation to 19.4 m bgl.

- Groundwater first appearance at 4.45 m bgl during drilling.

- Groundwater measured at 4.3 m bgl on 19/11/2005 9:00am.

0038824c3.cdr

FIELD BORING LOG

BORING NO.: BH3

SOIL DESCRIPTION	JOB TITLE 0038824 HEC Lamma SI	
LOCATION Lamma		DATE 14-18/ 11 / 2005
COORDINATES N : 8938.13	E : 29212.83	REFERENCE EL. +6.28 mRD
DRILL Rotory		
DRILLER Lam Geotechnics Ltd		LOG BY: Jane Lin

ERM

ELEVATION (mMSL)	WELL DIAGRAM	DEPTH (mbg)	GROUND-WATER	GRAPHIC LOG	SOIL DESCRIPTION	SAMPLE NUMBER	SAMPLE INTERVAL	PID READING (ppm)	MOISTURE D	M	W	S
		0			*Concrete*							
		0.5			*Yellowish brown medium to coasrse grained silty SAND with some gravels and cobbles.*	(1)	0.8	0.0				
		1			*Black spotted grey GRANITE with fracture and joints at various depths. Yellow stains observed on the fracture / joints at depths 2.6 to 2.7m, 3.9m, 4.3m, 4.5m, 6.0m and 7.15m.*							
		1.5										
		2										
		2.5										
		3										
		3.5										
		4	4.15 ▽									
		4.5	4.38 ▼									
		5										
		5.5										
		6										
		6.5										
		7										
		7.5			*End of drilling at 7.15m.*							
		8										

LEGEND

= BENTONITE = SAND PACK
= GROUT = SCREEN
= SEAL ▽ FIRST APPEARANCE LEVEL
▼ STATIC GROUNDWATER LEVEL

Well Development Record *Date : 19/11/2005* *Method : bailing*

Note:

- Hand excavation to depth 1.10 m bgl.

- Groundwater encountered at 4.15 m bgl during drilling.

- Groundwater measured at 4.38 m bgl on 19/11/2005 9:00am.

0038824c2.cdr

FIELD BORING LOG

BORING NO.: BH4

SOIL DESCRIPTION	JOB TITLE 0038824 HEC Lamma SI	
LOCATION Lamma		DATE 14-18/ 11 / 2005
COORDINATES N : 8918.49	E : 29231.39	REFERENCE EL. +6.18 mRD
DRILL Rotory		
DRILLER Lam Geotechnics Ltd		LOG BY: Jane Lin

ERM

ELEVATION (mMSL)	WELL DIAGRAM	DEPTH (mbg)	GROUND-WATER	GRAPHIC LOG	SOIL DESCRIPTION	SAMPLE NUMBER	SAMPLE INTERVAL	PID READING (ppm)	MOISTURE D	M	W	S
		0			*Concrete*							
		0.5			*Yellowish brown coarse slightly silty SAND with some silt and accessional boulders and medium gravels.*			0.0				
		1				(1)	1.0	0.0				
		1.5										
		2			*COBBLES / BOULDERS*							
		2.5			*Brown coarse to medium grained slightly silty SAND with some medium gravels.*							
		3						1.0				
		3.5			*Redish brown coarse grained clayey SAND with some fine gravels.*							
		4			*Greyey brown coarse grained clayey SAND with some fine gravels.*			0.4				
		4.5	4.5 ▼									
		5	5.0 ▽		*Brown coarse and medium slightly silty grained SAND Boulders encountered at depth 7.0 to 7.1m.*	(2)	5.0	2.4				
		5.5										
		6				(3)	6.0	0.4				
		6.5										
		7						0.8				
		7.5			*End of drilling at 7.2m.*							
		8										

LEGEND

= BENTONITE = SAND PACK
= GROUT = SCREEN
= SEAL FIRST APPEARANCE LEVEL
STATIC GROUNDWATER LEVEL

Well Development Record *Date : 19/11/2005* *Method : bailing*

Note:

- Hand excavation to 2.0 m bgl.

- Groundwater encountered at 5.0 m bgl during drilling.

- Groundwater measured at 4.50 m bgl on 19/11/2005 9:00am.

0038824c1.cdr

FIELD BORING LOG

BORING NO.: BH5

SOIL DESCRIPTION	JOB TITLE 0038824 HEC Lamma SI	
LOCATION Lamma		DATE 14-17/ 11 / 2005
COORDINATES N : 8940.19	E : 29247.61	REFERENCE EL. +6.26 mRD
DRILL Rotory		
DRILLER Lam Geotechnics Ltd		LOG BY: Zoe Chan

ERM

ELEVATION (mMSL)	WELL DIAGRAM	DEPTH (mbg)	GROUND-WATER	GRAPHIC LOG	SOIL DESCRIPTION	SAMPLE NUMBER	SAMPLE INTERVAL	PID READING (ppm)	MOISTURE D	M	W	S
		0			*Concrete*							
		0.5			*Yellowish brown medium to coarse slightly silty SAND with occasional fragment of brick and medium to coarse gravels.*			2.5				
		1				(1)	1.0	0.2				
		1.5										
		2						0.9				
		2.5										
		3						0.3				
		3.5										
		4						0.6				
		4.5	4.42 ▽ 4.47 ▼									
		5			*Yellowish brown medium SAND with some medium to coarse gravels.*			3.4				
		5.5										
		6			*Brown coarse SAND.*	(2)	6.0	1.1				
		6.5			*COBBLE / BOULDER*							
		7			*Brown coarse SAND with some medium to coarse gravels and trace of shell fragments.*	(3)	6.8	1.2				
		7.5			*Yellow brown clayey SAND with occasional medium to coarse gravels.*							
		8			*End of drilling at 7.5m.*							

LEGEND

= BENTONITE
= SAND PACK
= GROUT
= SCREEN
= SEAL
FIRST APPEARANCE LEVEL
STATIC GROUNDWATER LEVEL

Well Development Record — *Date : 19/11/2005* — *Method : bailing*

Note:

- Hand excavation to 1.5 m bgl.

- Groundwater encountered at 4.42 m bgl during drilling.

- Groundwater measured at 4.47 m bgl on 19/11/2005 9:00am.

0038824c4.cdr

FIELD BORING LOG

BORING NO.: BH6

SOIL DESCRIPTION	JOB TITLE 0038824 HEC Lamma SI	
LOCATION Lamma		DATE 14-17/ 11 / 2005
COORDINATES N : 8933.08	E : 29238.43	REFERENCE EL. + 6.26 mRD
DRILL Rotory		
DRILLER Lam Geotechnics Ltd		LOG BY: Zoe Chan

ERM

ELEVATION (mMSL)	WELL DIAGRAM	DEPTH (mbg)	GROUND-WATER	GRAPHIC LOG	SOIL DESCRIPTION	SAMPLE NUMBER	SAMPLE INTERVAL	PID READING (ppm)	MOISTURE D	M	W	S
		0			*Concrete*							
		0.5			*Yellowish brown medium to coarse slightly silty SAND with occasional brick garment and medium to coarse gravels.*			3.2				
					Concrete							
		1			*Yellowish brown medium to coarse SAND with occasional medium to coarse gravels.*	(1)	1.0	0.4				
		1.5										
		2						0.0				
		2.5			*Yellowish brown medium to coarse SAND with occasional medium to coarse gravels.*							
		3			*COBBLE / BOULDER.*							
		3.5										
		4										
		4.5			*Yellowish brown medium to coarse SAND with some medium to coarse gravels.*							
			4.82 ▼									
		5	5.0 ▽			(2)	5.0	0.4				
		5.5			*Yellowish brown medium SAND with some medium to coarse gravels.*							
		6			*COBBLE / BOULDER.*							
		6.5										
		7			*End of drilling at 7.0m.*							
		7.5										
		8										

LEGEND

= BENTONITE
= SAND PACK
= GROUT
= SCREEN
= SEAL
FIRST APPEARANCE LEVEL
STATIC GROUNDWATER LEVEL

Well Development Record — *Date : 19/11/2005* — *Method : bailing*

Note:

- *Hand excavation to 0.9 m bgl.*
- *Groundwater encountered at 5.0 m bgl during drilling.*
- *Duplicate soil sample collected at 5.0 m bgl.*
- *Groundwater measured at 4.82 m bgl on 19/11/2005 9:00am.*

0038824c5.cdr

Annex C

Chain of Custody

Lam Environmental Services
Test Specialists & Environmental Analysts

CHAIN OF CUSTODY

VERSION: 1

CONSIGNOR:
ADDRESS: LAM SI TEL. / FAX.:
E-MAIL:
CONTACT PERSON: STEPHEN CHAN

PROJECT: LAMMA POWER STATION
LAB. JOB NO.:
LAB. BATCH NO.:
RESULTS DUE DATE:

SEND TO: Lam Geotechnics Limited
ADDRESS: 14/F Unit 3, Honour Industrial Centre, No. 6 Sun Yip Street, Chai Wan TEL. / FAX.: 2897 3282
E-MAIL:
CONTACT PERSON: Roy Fan

SAMPLE IDENTIFICATION (SAMPLING LOCATION / NO., DEPTH, ETC.)	SAMPLING INFORMATION (DATE, TIME. ETC.)	SAMPLE MATRIX	ANALYSIS REQUESTED: TPH	BTEX	PAH							Container
BH4 (1.00m)	15/11/05	SOIL	✓	✓	✓							500mL x 1, 250mL x 1
BH4 (5.00m)			✓	✓	✓							
BH5 (1.00m)			✓	✓	✓							
BH5 (6.00m)			✓	✓	✓							
BH2 (1.00m)			✓	✓	✓							
BH6 (1.00m)			✓	✓	✓							

RELINQUISHED BY:
PRINT NAME: STEPHEN CHAN
DATE & TIME: 15/11/05 , 17:30
SIGNATURE:

RECEIVED BY:
PRINT NAME: C.K. Cheung
DATE & TIME: 15/11/05 , 19:00
SIGNATURE:

Lam Environmental Services
Test Specialists & Environmental Analysts

CHAIN OF CUSTODY

VERSION: 1

CONSIGNOR: ADDRESS: LAM SI TEL. / FAX.: E-MAIL: CONTACT PERSON: STEPHEN CHAN	PROJECT: LAMMA POWER STATION LAB. JOB NO.: LAB. BATCH NO.: RESULTS DUE DATE:	SEND TO: Lam Geotechnics Limited ADDRESS: 14/F Unit 3, Honour Industrial Centre, No. 6 Sun Yip Street, Chai Wan TEL. / FAX.: 2897 3282 E-MAIL: CONTACT PERSON: Roy Fan

SAMPLE IDENTIFICATION (SAMPLING LOCATION / NO., DEPTH, ETC.)	SAMPLING INFORMATION (DATE, TIME, ETC.)	SAMPLE MATRIX	ANALYSIS REQUESTED: TPH	BTEX	PAH							Container
BH4 (6.00m)	16/11/05	SOIL	✓	✓	✓							500mL x 1, 250mL x 1
BH5 (6.80m)	"	"	✓	✓	✓							"
BH1 (1.00m)	"	"	✓	✓	✓							"
BH6 (5.00m)	"	"	✓	✓	✓							"
BH7 (- m)	"	"	✓	✓	✓							"
TRIP BLANK	16/11/05	WATER	✓	✓	✓							1LG x 2, 40mL x 2

RELINQUISHED BY: PRINT NAME: STEPHEN CHAN DATE & TIME: 16/11/05. 18:00 SIGNATURE:	RECEIVED BY: PRINT NAME: C. K. Cheung DATE & TIME: 16/11/05 19:00 SIGNATURE:

Lam Environmental Services
Test Specialists & Environmental Analysts

CHAIN OF CUSTODY

VERSION: 1

CONSIGNOR:
ADDRESS: LAM SI TEL. / FAX.:
E-MAIL:
CONTACT PERSON: STEPHEN CHAN

PROJECT: LAMMA POWER STATION
LAB. JOB NO.:
LAB. BATCH NO.:
RESULTS DUE DATE:

SEND TO: Lam Geotechnics Limited
ADDRESS: 14/F Unit 3, Honour Industrial Centre, No. 6 Sun Yip Street, Chai Wan TEL. / FAX.: 2897 3282
E-MAIL:
CONTACT PERSON: Roy Fan

SAMPLE IDENTIFICATION (SAMPLING LOCATION / NO., DEPTH, ETC.)	SAMPLING INFORMATION (DATE, TIME, ETC.)	SAMPLE MATRIX	ANALYSIS REQUESTED: TPH	BTEX	PAH							Container
BH3 (0.8m)	17/11/05.	SOIL	✓	✓	✓							500mL x 1, 250mL x 1
BH2 (6.0m)	↓	↓	✓	✓	✓							↓
BH2 (5.0m)	↓	↓	✓	✓	✓							↓

RELINQUISHED BY:
PRINT NAME: STEPHEN CHAN
DATE & TIME: 17/11/05 1 18:10
SIGNATURE:

RECEIVED BY:
PRINT NAME: C.K. Cheung
DATE & TIME: 17/11/05 1 19:00
SIGNATURE: KT

Lam Environmental Services
Test Specialists & Environmental Analysts

CHAIN OF CUSTODY

VERSION: 1

CONSIGNOR:

ADDRESS: LAM SI TEL. / FAX.:

E-MAIL:

CONTACT PERSON: STEPHEN CHAN

PROJECT: LAMMA POWER STATION

LAB. JOB NO.:

LAB. BATCH NO.:

RESULTS DUE DATE:

SEND TO: Lam Geotechnics Limited

ADDRESS: 14/F Unit 3, Honour Industrial Centre, No. 6 Sun Yip Street, Chai Wan TEL. / FAX.: 2897 3282

E-MAIL:

CONTACT PERSON: Roy Fan

SAMPLE IDENTIFICATION (SAMPLING LOCATION / NO., DEPTH, ETC.)	SAMPLING INFORMATION (DATE, TIME, ETC.)	SAMPLE MATRIX	ANALYSIS REQUESTED: TPH	BTEX	PAH							Container
BH1 (5-0m)	18/11/05	SOIL	✓	✓	✓							500mL x 1, 250mL x 1
BH1 (6-0m)	〃	〃	✓	✓	✓							〃

RELINQUISHED BY:

PRINT NAME: STEPHEN CHAN

DATE & TIME: 18/11/05 1

SIGNATURE:

RECEIVED BY:

PRINT NAME: C.K. Cheung

DATE & TIME: 18/11/05 19:00

SIGNATURE: KT

Lam Environmental Services
Test Specialists & Environmental Analysts

CHAIN OF CUSTODY

VERSION: 1

CONSIGNOR:

ADDRESS: LAM SI TEL. / FAX.:

E-MAIL:

CONTACT PERSON: STEPHEN CHAN

PROJECT: LAMMA POWER STATION

LAB. JOB NO.:

LAB. BATCH NO.:

RESULTS DUE DATE:

SEND TO: Lam Geotechnics Limited

ADDRESS: 14/F Unit 3, Honour Industrial Centre, No. 6 Sun Yip Street, Chai Wan TEL. / FAX.: 2897 3282

E-MAIL:

CONTACT PERSON: Roy Fan

SAMPLE IDENTIFICATION (SAMPLING LOCATION / NO., DEPTH, ETC.)	SAMPLING INFORMATION (DATE, TIME, ETC.)	SAMPLE MATRIX	ANALYSIS REQUESTED: TPH	BTEX	PAH							Container
BH1	19/11/05	WATER	✓	✓	✓							1LG x 2, 40mL x 2
BH2			✓	✓	✓							
BH3			✓	✓	✓							
BH4			✓	✓	✓							
BH5			✓	✓	✓							
BH6			✓	✓	✓							
BH7			✓	✓	✓							
TRIP BLANK	19/11/05	WATER	✓	✓	✓							1LG x 2, 40mL x 2
EB BLANK			✓	✓	✓							

RELINQUISHED BY:

PRINT NAME: STEPHEN CHAN

DATE & TIME: 19/11/05 15:10

SIGNATURE:

RECEIVED BY:

PRINT NAME: C.K. Cheung

DATE & TIME: 19/11/05 19:00

SIGNATURE: Kit

Annex D

Laboratory Report

CERTIFICATE OF ANALYSIS

CONTACT:	MS DORIS LEUNG	**Batch:**	HK47156
CLIENT:	LAM GEOTECHNICS LIMITED	**Sub Batch:**	1
ADDRESS:	RM 1412 14/F HONOUR IND CTR NO 6 SUN YIP ST CHAI WAN HONG KONG	**LABORATORY:**	HONG KONG
		DATE RECEIVED:	18/11/2005
		DATE COMPLETED:	02/12/2005
		SAMPLE TYPE:	SOIL
ORDER No.:	J471	**No. of SAMPLES:**	5
PROJECT:			

COMMENTS

Samples analysed on an as received basis. Results reported on a dry weight basis. Sample preparation techniques: Semivolatile - Separatory Funnel and Tumbler, Volatile - Purge & Trap. Sample analysis techniques: Semivolatile components - GC/MS; TPH - GC/FID; Volatile components - GC/MS; Pesticides - GC/ECD, GC/MS. Refer to the attached appendix for quality control data. The completion date of analysis is 29 November,2005.

NOTES

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All pages of this report have been checked and approved for release.

ISSUING LABORATORY: HONG KONG

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Email: hongkong@alsenviro.com

Signatory

Richard Fung
General Manager

Other ALS Environmental Laboratories

AUSTRALASIA		*AMERICAS*
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Melbourne	*Singapore*	*Santiago*
Sydney	*Kuala Lumpar*	*Antofagasta*
Newcastle	*Auckland*	*Lima*
Mumbai	*Bogor*	

Abbreviations:
% SPK REC Denotes percentage spike recovery
CHK denotes duplicate check sample
LOR denotes limit of reporting
LCS % REC denotes Laboratory Control Sample percentage recovery

Batch: HK47156
Sub Batch: 1
Date of Issue: 02/12/2005
Client: LAM GEOTECHNICS LIMITED
Client Reference:

CERTIFICATE OF ANALYSIS

				SAMPLE IDENTIFICATION									
		Laboratory I.D.		2	3	4	5	6					
		Date Sampled		16/11/2005	16/11/2005	16/11/2005	16/11/2005	16/11/2005					
METHOD	ANALYSIS DESCRIPTION	UNIT	LOR	BH1 1.00M	BH4 6.00M	BH6 5.00M	BH7	BH5 6.80M					
EA-055	Moisture Content (dried @ 103'C)	%	0.1	9.2	8.5	12.6	12.6	10.6					
EP-071-SS	**TOTAL PETROLEUM HYDROCARBONS**												
EP-071-SS	C6 - C9 Fraction	mg/kg	2	<2	<2	<2	<2	<2					
EP-071-SS	C10 - C14 Fraction	mg/kg	50	<50	<50	<50	<50	<50					
EP-071-SS	C15 - C28 Fraction	mg/kg	50	<50	<50	<50	<50	<50					
EP-071-SS	C29 - C36 Fraction	mg/kg	50	<50	<50	<50	<50	<50					
EP-080-SS	**BTEX**												
EP-080-SS	Benzene	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2	<0.2					
EP-080-SS	Toluene	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2	<0.2					
EP-080-SS	Ethylbenzene	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2	<0.2					
EP-080-SS	meta- & para-Xylene	mg/kg	0.4	<0.4	<0.4	<0.4	<0.4	<0.4					
EP-080-SS	ortho-Xylene	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2	<0.2					
EP-080S-SS	**VOLATILE TPH/BTEX COMPOUND SURROGATES**												
EP-080S-SS	Dibromofluoromethane	%	2	107	98	105	101	107					
EP-080S-SS	Toluene-d8	%	2	88	89	87	89	89					
EP-080S-SS	4-BFB	%	2	82	83	89	88	89					

Batch: HK47156
Sub Batch: 1
Date of Issue: 02/12/2005
Client: LAM GEOTECHNICS LIMITED
Client Reference:

QUALITY CONTROL REPORT

				SAMPLE IDENTIFICATION									
		Laboratory I.D.		200									
		Date Sampled											
METHOD	ANALYSIS DESCRIPTION	UNIT	LOR	BLANK									
				CHECKS AND SPIKES									
EA-055	Moisture Content (dried @ 103'C)	%	0.1	---									
EP-071-SS	**TOTAL PETROLEUM HYDROCARBONS**												
EP-071-SS	C6 - C9 Fraction	mg/kg	2	<2									
EP-071-SS	C10 - C14 Fraction	mg/kg	50	<50									
EP-071-SS	C15 - C28 Fraction	mg/kg	50	<50									
EP-071-SS	C29 - C36 Fraction	mg/kg	50	<50									
EP-080-SS	**BTEX**												
EP-080-SS	Benzene	mg/kg	0.2	<0.2									
EP-080-SS	Toluene	mg/kg	0.2	<0.2									
EP-080-SS	Ethylbenzene	mg/kg	0.2	<0.2									
EP-080-SS	meta- & para-Xylene	mg/kg	0.4	<0.4									
EP-080-SS	ortho-Xylene	mg/kg	0.2	<0.2									
EP-080S-SS	**VOLATILE TPH/BTEX COMPOUND SURROGATES**												
EP-080S-SS	Dibromofluoromethane	%	2	98									
EP-080S-SS	Toluene-d8	%	2	88									
EP-080S-SS	4-BFB	%	2	84									

ALS TECHNICHEM (HK) Pty Ltd

ALS Environmental

CERTIFICATE OF ANALYSIS

CONTACT:	MS DORIS LEUNG	**Batch:**	HK47159
CLIENT:	LAM GEOTECHNICS LIMITED	**Sub Batch:**	0
ADDRESS:	RM 1412 14/F HONOUR IND CTR NO 6 SUN YIP ST CHAI WAN HONG KONG	**LABORATORY:**	HONG KONG
		DATE RECEIVED:	18/11/2005
		DATE COMPLETED:	02/12/2005
		SAMPLE TYPE:	SOIL
ORDER No.:	J471	**No. of SAMPLES:**	3
PROJECT:			

COMMENTS

Samples were picked up from client by ALS Technichem (HK) staff in a chilled condition. Samples analysed on an as received basis. Results reported on a dry weight basis. Sample preparation techniques: Semivolatile - Separatory Funnel and Tumbler, Volatile - Purge & Trap. Sample analysis techniques: Semivolatile components - GC/MS; TPH - GC/FID; Volatile components - GC/MS; Pesticides - GC/ECD, GC/MS. Refer to the attached appendix for quality control data. The completion date of analysis is 29 November,2005.

NOTES

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Signatory

Richard Fung
General Manager

Other ALS Environmental Laboratories

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Melbourne	*Singapore*	*Santiago*
Sydney	*Kuala Lumpar*	*Antofagasta*
Newcastle	*Auckland*	*Lima*
Mumbai	*Bogor*	

Abbreviations:
% SPK REC Denotes percentage spike recovery
CHK denotes duplicate check sample
LOR denotes limit of reporting
LCS % REC denotes Laboratory Control Sample percentage recovery

Batch: HK47159
Sub Batch: 0
Date of Issue: 02/12/2005
Client: LAM GEOTECHNICS LIMITED
Client Reference:

CERTIFICATE OF ANALYSIS

				SAMPLE IDENTIFICATION									
		Laboratory I.D.		1	2	3							
		Date Sampled		17/11/2005	17/11/2005	17/11/2005							
METHOD	ANALYSIS DESCRIPTION	UNIT	LOR	BH2 5.0M	BH3 0.8M	BH2 6.0M							
EA-055	Moisture Content (dried @ 103'C)	%	0.1	15.5	11.7	8.7							
EP-071-SS	**TOTAL PETROLEUM HYDROCARBONS**												
EP-071-SS	C6 - C9 Fraction	mg/kg	2	<2	<2	<2							
EP-071-SS	C10 - C14 Fraction	mg/kg	50	<50	78	<50							
EP-071-SS	C15 - C28 Fraction	mg/kg	50	<50	1800	<50							
EP-071-SS	C29 - C36 Fraction	mg/kg	50	<50	945	<50							
EP-080-SS	**BTEX**												
EP-080-SS	Benzene	mg/kg	0.2	<0.2	<0.2	<0.2							
EP-080-SS	Toluene	mg/kg	0.2	<0.2	<0.2	<0.2							
EP-080-SS	Ethylbenzene	mg/kg	0.2	<0.2	<0.2	<0.2							
EP-080-SS	meta- & para-Xylene	mg/kg	0.4	<0.4	<0.4	<0.4							
EP-080-SS	ortho-Xylene	mg/kg	0.2	<0.2	<0.2	<0.2							
EP-080S-SS	**VOLATILE TPH/BTEX COMPOUND SURROGATES**												
EP-080S-SS	Dibromofluoromethane	%	2	106	106	95							
EP-080S-SS	Toluene-d8	%	2	86	85	87							
EP-080S-SS	4-BFB	%	2	82	83	84							

Batch: HK47159
Sub Batch: 0
Date of Issue: 02/12/2005
Client: LAM GEOTECHNICS LIMITED
Client Reference:

QUALITY CONTROL REPORT

				SAMPLE IDENTIFICATION										
		Laboratory I.D.		200										
		Date Sampled												
METHOD	ANALYSIS DESCRIPTION	UNIT	LOR	BLANK										
				CHECKS AND SPIKES										
EA-055	Moisture Content (dried @ 103'C)	%	0.1	----										
EP-071-SS	**TOTAL PETROLEUM HYDROCARBONS**													
EP-071-SS	C6 - C9 Fraction	mg/kg	2	<2										
EP-071-SS	C10 - C14 Fraction	mg/kg	50	<50										
EP-071-SS	C15 - C28 Fraction	mg/kg	50	<50										
EP-071-SS	C29 - C36 Fraction	mg/kg	50	<50										
EP-080-SS	**BTEX**													
EP-080-SS	Benzene	mg/kg	0.2	<0.2										
EP-080-SS	Toluene	mg/kg	0.2	<0.2										
EP-080-SS	Ethylbenzene	mg/kg	0.2	<0.2										
EP-080-SS	meta- & para-Xylene	mg/kg	0.4	<0.4										
EP-080-SS	ortho-Xylene	mg/kg	0.2	<0.2										
EP-080S-SS	**VOLATILE TPH/BTEX COMPOUND SURROGATES**													
EP-080S-SS	Dibromofluoromethane	%	2	100										
EP-080S-SS	Toluene-d8	%	2	88										
EP-080S-SS	4-BFB	%	2	82										

ALS TECHNICHEM (HK) Pty Ltd

ALS Environmental

CERTIFICATE OF ANALYSIS

CONTACT:	MS DORIS LEUNG	**Batch:**	HK47157
CLIENT:	LAM GEOTECHNICS LIMITED	**Sub Batch:**	0
ADDRESS:	RM 1412 14/F HONOUR IND CTR NO 6 SUN YIP ST CHAI WAN HONG KONG	**LABORATORY:**	HONG KONG
		DATE RECEIVED:	18/11/2005
		DATE COMPLETED:	02/12/2005
		SAMPLE TYPE:	SOIL
ORDER No.:	J471	**No. of SAMPLES:**	6
PROJECT:			

COMMENTS

Samples were picked up from client by ALS Technichem (HK) staff in a chilled condition. Samples analysed on an as received basis. Results reported on a dry weight basis. Sample preparation techniques: Semivolatile - Separatory Funnel and Tumbler, Volatile - Purge & Trap. Sample analysis techniques: Semivolatile components - GC/MS; TPH - GC/FID; Volatile components - GC/MS; Pesticides - GC/ECD, GC/MS. Refer to the attached appendix for quality control data. The completion date of analysis is 01 December,2005.

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Email: hongkong@alsenviro.com

Signatory

Richard Fung
General Manager

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Melbourne	*Singapore*	*Santiago*
Sydney	*Kuala Lumpar*	*Antofagasta*
Newcastle	*Auckland*	*Lima*
Mumbai	*Bogor*	

Abbreviations:
% SPK REC Denotes percentage spike recovery
CHK denotes duplicate check sample
LOR denotes limit of reporting
LCS % REC denotes Laboratory Control Sample percentage recovery

Batch: HK47157
Sub Batch: 0
Date of Issue: 02/12/2005
Client: LAM GEOTECHNICS LIMITED
Client Reference:

CERTIFICATE OF ANALYSIS

				SAMPLE IDENTIFICATION									
		Laboratory I.D.		1	2	3	4	5	6				
		Date Sampled		15/11/2005	15/11/2005	15/11/2005	15/11/2005	15/11/2005	15/11/2005				
METHOD	ANALYSIS DESCRIPTION	UNIT	LOR	BH5 1.00M	BH5 6.00M	BH2 1.00M	BH6 1.00M	BH4 1.00M	BH4 5.00M				
EA-055	Moisture Content (dried @ 103'C)	%	0.1	8.5	7.5	7.7	12.5	7.6	8.3				
EP-071-SS	**TOTAL PETROLEUM HYDROCARBONS**												
EP-071-SS	C6 - C9 Fraction	mg/kg	2	<2	<2	<2	<2	<2	<2				
EP-071-SS	C10 - C14 Fraction	mg/kg	50	<50	<50	<50	<50	<50	<50				
EP-071-SS	C15 - C28 Fraction	mg/kg	50	<50	<50	<50	<50	149	<50				
EP-071-SS	C29 - C36 Fraction	mg/kg	50	<50	<50	<50	<50	52	<50				
EP-080-SS	**BTEX**												
EP-080-SS	Benzene	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2				
EP-080-SS	Toluene	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2				
EP-080-SS	Ethylbenzene	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2				
EP-080-SS	meta- & para-Xylene	mg/kg	0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4				
EP-080-SS	ortho-Xylene	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2				
EP-080S-SS	**VOLATILE TPH/BTEX COMPOUND SURROGATES**												
EP-080S-SS	Dibromofluoromethane	%	2	108	105	107	103	109	102				
EP-080S-SS	Toluene-d8	%	2	87	87	89	87	86	88				
EP-080S-SS	4-BFB	%	2	82	87	87	85	85	86				

Batch: HK47157
Sub Batch: 0
Date of Issue: 02/12/2005
Client: LAM GEOTECHNICS LIMITED
Client Reference:

QUALITY CONTROL REPORT

				SAMPLE IDENTIFICATION									
		Laboratory I.D.		1	6	200							
		Date Sampled											
METHOD	ANALYSIS DESCRIPTION	UNIT	LOR	BH5 1.00M % SPK REC	BH4 5.00M DUPLICATE	BLANK							
				CHECKS AND SPIKES									
EA-055	Moisture Content (dried @ 103'C)	%	0.1	---	10.1	---							
EP-071-SS	**TOTAL PETROLEUM HYDROCARBONS**												
EP-071-SS	C6 - C9 Fraction	mg/kg	2	113%	<2	<2							
EP-071-SS	C10 - C14 Fraction	mg/kg	50	80%	<50	<50							
EP-071-SS	C15 - C28 Fraction	mg/kg	50	75%	<50	<50							
EP-071-SS	C29 - C36 Fraction	mg/kg	50	74%	<50	<50							
EP-080-SS	**BTEX**												
EP-080-SS	Benzene	mg/kg	0.2	---	<0.2	<0.2							
EP-080-SS	Toluene	mg/kg	0.2	---	<0.2	<0.2							
EP-080-SS	Ethylbenzene	mg/kg	0.2	---	<0.2	<0.2							
EP-080-SS	meta- & para-Xylene	mg/kg	0.4	---	<0.4	<0.4							
EP-080-SS	ortho-Xylene	mg/kg	0.2	---	<0.2	<0.2							
EP-080S-SS	**VOLATILE TPH/BTEX COMPOUND SURROGATES**												
EP-080S-SS	Dibromofluoromethane	%	2	---	111	106							
EP-080S-SS	Toluene-d8	%	2	---	87	86							
EP-080S-SS	4-BFB	%	2	---	84	83							

CERTIFICATE OF ANALYSIS

CONTACT:	MS DORIS LEUNG	**Batch:**	HK47309
CLIENT:	LAM GEOTECHNICS LIMITED	**Sub Batch:**	1
ADDRESS:	RM 1412 14/F HONOUR IND CTR NO 6 SUN YIP ST CHAI WAN HONG KONG	**LABORATORY:**	HONG KONG
		DATE RECEIVED:	25/11/2005
		DATE COMPLETED:	02/12/2005
		SAMPLE TYPE:	SOIL
ORDER No.:	J471	**No. of SAMPLES:**	2
PROJECT:			

COMMENTS

Samples analysed on an as received basis. Results reported on a dry weight basis. Sample preparation techniques: Semivolatile - Separatory Funnel and Tumbler, Volatile - Purge & Trap. Sample analysis techniques: Semivolatile components - GC/MS; TPH - GC/FID; Volatile components - GC/MS; Pesticides - GC/ECD, GC/MS. Refer to the attached appendix for quality control data. The completion date of analysis is 01 December,2005.

NOTES

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Signatory

Richard Fung
General Manager

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Melbourne	*Singapore*	*Santiago*
Sydney	*Kuala Lumpar*	*Antofagasta*
Newcastle	*Auckland*	*Lima*
Mumbai	*Bogor*	

Abbreviations:
% SPK REC Denotes percentage spike recovery
CHK denotes duplicate check sample
LOR denotes limit of reporting
LCS % REC denotes Laboratory Control Sample percentage recovery

Batch: HK47309
Sub Batch: 1
Date of Issue: 02/12/2005
Client: LAM GEOTECHNICS LIMITED
Client Reference:

CERTIFICATE OF ANALYSIS

				SAMPLE IDENTIFICATION									
		Laboratory I.D.		9	10								
		Date Sampled		18/11/2005	18/11/2005								
METHOD	ANALYSIS DESCRIPTION	UNIT	LOR	BH1 5.00M	BH1 6.00M								
EA-055	Moisture Content (dried @ 103'C)	%	0.1	13.6	16.4								
EP-071-SS	**TOTAL PETROLEUM HYDROCARBONS**												
EP-071-SS	C6 - C9 Fraction	mg/kg	2	<2	<2								
EP-071-SS	C10 - C14 Fraction	mg/kg	50	<50	<50								
EP-071-SS	C15 - C28 Fraction	mg/kg	50	<50	<50								
EP-071-SS	C29 - C36 Fraction	mg/kg	50	<50	<50								
EP-080-SS	**BTEX**												
EP-080-SS	Benzene	mg/kg	0.2	<0.2	<0.2								
EP-080-SS	Toluene	mg/kg	0.2	<0.2	<0.2								
EP-080-SS	Ethylbenzene	mg/kg	0.2	<0.2	<0.2								
EP-080-SS	meta- & para-Xylene	mg/kg	0.4	<0.4	<0.4								
EP-080-SS	ortho-Xylene	mg/kg	0.2	<0.2	<0.2								
EP-080S-SS	**VOLATILE TPH/BTEX COMPOUND SURROGATES**												
EP-080S-SS	Dibromofluoromethane	%	2	86	84								
EP-080S-SS	Toluene-d8	%	2	87	90								
EP-080S-SS	4-BFB	%	2	85	90								

Batch: HK47309
Sub Batch: 1
Date of Issue: 02/12/2005
Client: LAM GEOTECHNICS LIMITED
Client Reference:

QUALITY CONTROL REPORT

				SAMPLE IDENTIFICATION										
		Laboratory I.D.		200										
		Date Sampled												
METHOD	ANALYSIS DESCRIPTION	UNIT	LOR	BLANK										
				CHECKS AND SPIKES										
EA-055	Moisture Content (dried @ 103'C)	%	0.1	---										
EP-071-SS	**TOTAL PETROLEUM HYDROCARBONS**													
EP-071-SS	C6 - C9 Fraction	mg/kg	2	<2										
EP-071-SS	C10 - C14 Fraction	mg/kg	50	<50										
EP-071-SS	C15 - C28 Fraction	mg/kg	50	<50										
EP-071-SS	C29 - C36 Fraction	mg/kg	50	<50										
EP-080-SS	**BTEX**													
EP-080-SS	Benzene	mg/kg	0.2	<0.2										
EP-080-SS	Toluene	mg/kg	0.2	<0.2										
EP-080-SS	Ethylbenzene	mg/kg	0.2	<0.2										
EP-080-SS	meta- & para-Xylene	mg/kg	0.4	<0.4										
EP-080-SS	ortho-Xylene	mg/kg	0.2	<0.2										
EP-080S-SS	**VOLATILE TPH/BTEX COMPOUND SURROGATES**													
EP-080S-SS	Dibromofluoromethane	%	2	83										
EP-080S-SS	Toluene-d8	%	2	88										
EP-080S-SS	4-BFB	%	2	87										

ALS TECHNICHEM (HK) Pty Ltd

ALS Environmental

CERTIFICATE OF ANALYSIS

CONTACT:	MS DORIS LEUNG	**Batch:**	HK47156
CLIENT:	LAM GEOTECHNICS LIMITED	**Sub Batch:**	0
ADDRESS:	RM 1412 14/F HONOUR IND CTR NO 6 SUN YIP ST CHAI WAN HONG KONG	**LABORATORY:**	HONG KONG
		DATE RECEIVED:	18/11/2005
		DATE COMPLETED:	02/12/2005
		SAMPLE TYPE:	WATER
ORDER No.:	J471	**No. of SAMPLES:**	1
PROJECT:			

COMMENTS

Samples were picked up from client by ALS Technichem (HK) staff in a chilled condition. Sample analysed and reported on an as received basis. Sample preparation techniques: Semivolatile - Separatory Funnel and Tumbler, Volatile - Purge & Trap. Sample analysis techniques: Semivolatile components - GC/MS; TPH - GC/FID; Volatile components - GC/MS; Pesticides - GC/ECD, GC/MS. Refer to the attached appendix for quality control data. The completion date of analysis is 30 November,2005.

NOTES

This is the Final Report and supersedes any preliminary reports with this batch number.
All pages of this report have been checked and approved for release.

ISSUING LABORATORY: HONG KONG

Address
ALS Technichem (HK) Pty Ltd
11/F.,
Chung Shun Knitting Centre,
1-3 Wing Yip Street
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Phone: 852-2610 1044
Fax: 852-2610 2021
Email: hongkong@alsenviro.com

Signatory

Richard Fung
General Manager

Other ALS Environmental Laboratories

AUSTRALASIA		*AMERICAS*
Brisbane	*Hong Kong*	*Vancouver*
Melbourne	*Singapore*	*Santiago*
Sydney	*Kuala Lumpar*	*Antofagasta*
Newcastle	*Auckland*	*Lima*
Mumbai	*Bogor*	

Abbreviations:
% SPK REC Denotes percentage spike recovery
CHK denotes duplicate check sample
LOR denotes limit of reporting
LCS % REC denotes Laboratory Control Sample percentage recovery

Batch: HK47156
Sub Batch: 0
Date of Issue: 02/12/2005
Client: LAM GEOTECHNICS LIMITED
Client Reference:

CERTIFICATE OF ANALYSIS

				SAMPLE IDENTIFICATION									
		Laboratory I.D.		1									
		Date Sampled		16/11/2005									
METHOD	ANALYSIS DESCRIPTION	UNIT	LOR	TRIP BLANK 1									
EP-071-WS	**TOTAL PETROLEUM HYDROCARBONS**												
EP-071-WS	C6 - C9 Fraction	ug/L	20	<20									
EP-071-WS	C10 - C14 Fraction	ug/L	25	<25									
EP-071-WS	C15 - C28 Fraction	ug/L	25	<25									
EP-071-WS	C29 - C36 Fraction	ug/L	25	<25									
EP-080-WS	**BTEX**												
EP-080-WS	Benzene	ug/L	1	<1									
EP-080-WS	Toluene	ug/L	2	<2									
EP-080-WS	Ethylbenzene	ug/L	2	<2									
EP-080-WS	meta- & para-Xylene	ug/L	4	<4									
EP-080-WS	ortho-Xylene	ug/L	2	<2									
EP-080S-WS	**VOLATILE TPH/BTEX COMPOUND SURROGATES**												
EP-080S-WS	Dibromofluoromethane	%	2	106									
EP-080S-WS	Toluene-d8	%	2	91									
EP-080S-WS	4-BFB	%	2	88									

Batch: HK47156
Sub Batch: 0
Date of Issue: 02/12/2005
Client: LAM GEOTECHNICS LIMITED
Client Reference:

QUALITY CONTROL REPORT

				SAMPLE IDENTIFICATION										
		Laboratory I.D.		200										
		Date Sampled												
METHOD	ANALYSIS DESCRIPTION	UNIT	LOR	BLANK										
				CHECKS AND SPIKES										
EP-071-WS	**TOTAL PETROLEUM HYDROCARBONS**													
EP-071-WS	C6 - C9 Fraction	ug/L	20	<20										
EP-071-WS	C10 - C14 Fraction	ug/L	25	<25										
EP-071-WS	C15 - C28 Fraction	ug/L	25	<25										
EP-071-WS	C29 - C36 Fraction	ug/L	25	<25										
EP-080-WS	**BTEX**													
EP-080-WS	Benzene	ug/L	1	<1										
EP-080-WS	Toluene	ug/L	2	<2										
EP-080-WS	Ethylbenzene	ug/L	2	<2										
EP-080-WS	meta- & para-Xylene	ug/L	4	<4										
EP-080-WS	ortho-Xylene	ug/L	2	<2										
EP-080S-WS	**VOLATILE TPH/BTEX COMPOUND SURROGATES**													
EP-080S-WS	Dibromofluoromethane	%	2	107										
EP-080S-WS	Toluene-d8	%	2	92										
EP-080S-WS	4-BFB	%	2	86										

ALS TECHNICHEM (HK) Pty Ltd

ALS Environmental

CERTIFICATE OF ANALYSIS

CONTACT:	MS DORIS LEUNG
CLIENT:	LAM GEOTECHNICS LIMITED
ADDRESS:	RM 1412 14/F HONOUR IND CTR NO 6 SUN YIP ST CHAI WAN HONG KONG
ORDER No.:	J471
PROJECT:	

Batch:	HK47309
Sub Batch:	0
LABORATORY:	HONG KONG
DATE RECEIVED:	25/11/2005
DATE COMPLETED:	02/12/2005
SAMPLE TYPE:	WATER
No. of SAMPLES:	8

COMMENTS

Eight water samples were received in a chilled condition. Samples analysed on an as received basis. Results reported on an as received basis. Sample preparation techniques: Semivolatile - Separatory Funnel and Tumbler, Volatile - Purge & Trap. Sample analysis techniques: Semivolatile components - GC/MS; TPH - GC/FID; Volatile components - GC/MS; Pesticides - GC/ECD, GC/MS. Refer to the attached appendix for quality control data. The completion date of analysis is 01 December,2005.

NOTES

This is the Final Report and supersedes any preliminary reports with this batch number.
All pages of this report have been checked and approved for release.

ISSUING LABORATORY: HONG KONG

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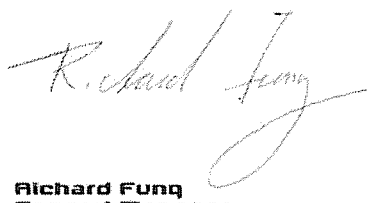
Signatory



Richard Fung
General Manager

Other ALS Environmental Laboratories

AUSTRALASIA		*AMERICAS*
Brisbane	*Hong Kong*	*Vancouver*
Melbourne	*Singapore*	*Santiago*
Sydney	*Kuala Lumpar*	*Antofagasta*
Newcastle	*Auckland*	*Lima*
Mumbai	*Bogor*	

Abbreviations:
% SPK REC Denotes percentage spike recovery
CHK denotes duplicate check sample
LOR denotes limit of reporting
LCS % REC denotes Laboratory Control Sample percentage recovery

Batch: HK47309
Sub Batch: 0
Date of Issue: 02/12/2005
Client: LAM GEOTECHNICS LIMITED
Client Reference:

CERTIFICATE OF ANALYSIS

				SAMPLE IDENTIFICATION									
		Laboratory I.D.		1	2	3	4	5	6	7	8		
		Date Sampled		19/11/2005	19/11/2005	19/11/2005	19/11/2005	19/11/2005	19/11/2005	19/11/2005	19/11/2005		
METHOD	ANALYSIS DESCRIPTION	UNIT	LOR	BH1	BH2	BH3	BH4	BH5	BH6	BH7	EQ BLANK		
EP-071-WS	**TOTAL PETROLEUM HYDROCARBONS**												
EP-071-WS	C6 - C9 Fraction	ug/L	20	<20	<20	<20	<20	<20	<20	<20	<20		
EP-071-WS	C10 - C14 Fraction	ug/L	25	<25	<25	<25	<25	<25	<25	<25	<25		
EP-071-WS	C15 - C28 Fraction	ug/L	25	1150	32	1080	365	681	254	311	<25		
EP-071-WS	C29 - C36 Fraction	ug/L	25	35	<25	344	56	25	70	42	<25		
EP-080-WS	**BTEX**												
EP-080-WS	Benzene	ug/L	1	<1	<1	<1	<1	<1	<1	<1	<1		
EP-080-WS	Toluene	ug/L	2	<2	<2	<2	<2	<2	<2	<2	<2		
EP-080-WS	Ethylbenzene	ug/L	2	<2	<2	<2	<2	<2	<2	<2	<2		
EP-080-WS	meta- & para-Xylene	ug/L	4	<4	<4	<4	<4	<4	<4	<4	<4		
EP-080-WS	ortho-Xylene	ug/L	2	<2	<2	<2	<2	<2	<2	<2	<2		
EP-080S-WS	**VOLATILE TPH/BTEX COMPOUND SURROGATES**												
EP-080S-WS	Dibromofluoromethane	%	2	114	114	118	102	118	107	116	97		
EP-080S-WS	Toluene-d8	%	2	88	89	93	90	87	89	93	93		
EP-080S-WS	4-BFB	%	2	99	95	92	101	90	96	86	91		

Batch: HK47309
Sub Batch: 0
Date of Issue: 02/12/2005
Client: LAM GEOTECHNICS LIMITED
Client Reference:

QUALITY CONTROL REPORT

				SAMPLE IDENTIFICATION									
		Laboratory I.D.		200									
		Date Sampled											
METHOD	ANALYSIS DESCRIPTION	UNIT	LOR	BLANK									
				CHECKS AND SPIKES									
EP-071-WS	**TOTAL PETROLEUM HYDROCARBONS**												
EP-071-WS	C6 - C9 Fraction	ug/L	20	<20									
EP-071-WS	C10 - C14 Fraction	ug/L	25	<25									
EP-071-WS	C15 - C28 Fraction	ug/L	25	<25									
EP-071-WS	C29 - C36 Fraction	ug/L	25	<25									
EP-080-WS	**BTEX**												
EP-080-WS	Benzene	ug/L	1	<1									
EP-080-WS	Toluene	ug/L	2	<2									
EP-080-WS	Ethylbenzene	ug/L	2	<2									
EP-080-WS	meta- & para-Xylene	ug/L	4	<4									
EP-080-WS	ortho-Xylene	ug/L	2	<2									
EP-080S-WS	**VOLATILE TPH/BTEX COMPOUND SURROGATES**												
EP-080S-WS	Dibromofluoromethane	%	2	102									
EP-080S-WS	Toluene-d8	%	2	94									
EP-080S-WS	4-BFB	%	2	90									

TEST REPORT

Project Name	:	Lamma Power Station Unit 4&5 Light Oil Tank Demolition Soil Contamination Investigation Works
Client Name	:	The Hong Kong Electric Company Limited
Client Address	:	Projects Division, Hong Kong Electric Centre, 44 Kennedy Road, Hong Kong
Contract No.	:	05/8239
Works Order No.	:	N/A
Lab.Job No.	:	J471
Lab. Sample Ref. No.	:	16286,16296,16305,16313
No. of Sample(s) & Description	:	16 samples said to be soil samples
Sample Receive Date	:	15 November 2005 - 19 November 2005
Test Date	:	16 November 2005 - 29 November 2005

Test Parameter(s)

1. Low Molecular Weight Polyaromatic Hydrocarbons, LMW PAHs

CODE	Parameter	Reporting Limits Sediment/Soil mg/kg	Test Method
NAP	Naphthalene	2.0	S/O/PAH-S
ANY	Acenaphtylene	2.0	S/O/PAH-S
ANA	Acenaphtene	2.0	S/O/PAH-S
FLU	Fluorene	2.0	S/O/PAH-S
PHE	Phenanthrene	2.0	S/O/PAH-S
ANT	Anthracene	2.0	S/O/PAH-S

2. High Molecular Weight Polyaromatic Hydrocarbons, HMW PAHs

CODE	Parameter	Reporting Limits Sediment/Soil mg/kg	Test Method
CHR	Chrysene	2.0	S/O/PAH-S
BaA	Benzo(a)anthracene	2.0	S/O/PAH-S
BbF	Benzo(b)fluoranthene	2.0	S/O/PAH-S
BkF	Benzo(k)fluoranthene	2.0	S/O/PAH-S
BaP	Benzo(a)pyrene	1.0	S/O/PAH-S
DBA	Dibenz(ah)anthracene	2.0	S/O/PAH-S
FLT	Fluoranthene	2.0	S/O/PAH-S
IPY	Indeno(1,2,3-cd)pyrene	2.0	S/O/PAH-S
PYR	Pyrene	2.0	S/O/PAH-S
BPE	Benzo(ghi)perylene	2.0	S/O/PAH-S

Notes :
1. Results relate to samples as received.
2. Results are based on dry sample weight.
3. < = less than
4. N/A = Not applicable
5. Test results satisfy all in-house QA/QC protocols as attached.
6. Test description (for in-house methods only) as follows:
   S/O/PAH-S:Ultra-Sonic extraction and GC-MS Quantification.

Approved Signatory : Y.T.Wong Date: 29 Nov. 2005

TEST REPORT

Project Name	:	Lamma Power Station Unit 4&5 Light Oil Tank Demolition Soil Contamination Investigation Works
Client Name	:	The Hong Kong Electric Company Limited
Contract No.	:	05/8239
Lab. Sample Ref. No.	:	16286,16296,16305,16313

1. Low Molecular Weight Polyaromatic Hydrocarbons, LMW PAHs

Client Reference	Sample					NAP	ANY	ANA	FLU	PHE	ANT
Drillhole No.	Depth, m			Time	Specimen						
	No.	From	To		Depth m	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
BH4	N/A	N/A	N/A		1.00m	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
BH4	N/A	N/A	N/A		5.00m	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
BH5	N/A	N/A	N/A		6.00m	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
BH2	N/A	N/A	N/A		1.00m	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
BH6	N/A	N/A	N/A		1.00m	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
BH5	N/A	N/A	N/A		1.00m	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
BH1	N/A	N/A	N/A		1.00m	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
BH4	N/A	N/A	N/A		6.00m	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
BH6	N/A	N/A	N/A		5.00m	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
BH5	N/A	N/A	N/A		6.80m	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
BH3	N/A	N/A	N/A		0.80m	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
BH2	N/A	N/A	N/A		6.00m	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
BH2	N/A	N/A	N/A		5.00m	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
BH1	N/A	N/A	N/A		5.00m	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
BH1	N/A	N/A	N/A		6.00m	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
BH7	N/A	N/A	N/A		N/A	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0

TEST REPORT

Project Name	:	Lamma Power Station Unit 4&5 Light Oil Tank Demolition Soil Contamination Investigation Works
Client Name	:	The Hong Kong Electric Company Limited
Contract No.	:	05/8239
Lab. Sample Ref. No.	:	16286,16296,16305,16313

2. High Molecular Weight Polyaromatic Hydrocarbons, HMW PAHs

Client Reference	Sample					CHR	BaA	BbF	BkF	BaP	DBA	FLT	IPY	PYR	BPE
Drillhole No.	Depth, m			Time	Specimen										
	No.	From	To		Depth m	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
BH4	N/A	N/A	N/A		1.00m	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0
BH4	N/A	N/A	N/A		5.00m	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0
BH5	N/A	N/A	N/A		6.00m	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0
BH2	N/A	N/A	N/A		1.00m	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0
BH6	N/A	N/A	N/A		1.00m	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0
BH5	N/A	N/A	N/A		1.00m	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0
BH1	N/A	N/A	N/A		1.00m	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0
BH4	N/A	N/A	N/A		6.00m	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0
BH6	N/A	N/A	N/A		5.00m	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0
BH5	N/A	N/A	N/A		6.80m	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0
BH3	N/A	N/A	N/A		0.80m	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0
BH2	N/A	N/A	N/A		6.00m	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0
BH2	N/A	N/A	N/A		5.00m	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0
BH1	N/A	N/A	N/A		5.00m	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0
BH1	N/A	N/A	N/A		6.00m	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0
BH7	N/A	N/A	N/A		N/A	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0

----------End of Results----------

QC REPORT

Project Name	:	Lamma Power Station Unit 4&5 Light Oil Tank Demolition Soil Contamination Investigation Works
Client Name	:	The Hong Kong Electric Company Limited
Contract No.	:	05/8239
Lab Sample Ref. No.	:	16286,16296,16305,16313

1. Low Molecular Weight Polyaromatic Hydrocarbons, LMW PAHs

1.1 Sample Duplicate

Client Reference	Sample					Batch	NAP	ANY	ANA	FLU	PHE	ANT
Drillhole No.	Depth, m			Time	Specimen Depth m		%	%	%	%	%	%
	No.	From	To									
BH7	N/A	N/A	N/A	15:50	1m	1	na*	na*	na*	na*	na*	na*
Control Limits							+/- 30 % of the mean					

1.2 Sample Spike (Spike Level = 5 ug)

Client Reference	Sample					Batch	NAP	ANY	ANA	FLU	PHE	ANT
Drillhole No.	Depth, m			Time	Specimen Depth m		%	%	%	%	%	%
	No.	From	To									
BH7	N/A	N/A	N/A	15:50	1m	1	85	90	79	102	90	98
Control Limits							70 - 130 %					

Notes :

1. na* = Relative deviation (RD) for duplicates cannot be evaluated as the value determined is lower than reporting limit.

Approved Signatory : Y.T.Wong Date : 29 Nov. 2005

Remarks :

QC REPORT

Project Name	:	Lamma Power Station Unit 4&5 Light Oil Tank Demolition Soil Contamination Investigation Works
Client Name	:	The Hong Kong Electric Company Limited
Contract No.	:	05/8239
Lab. Sample Ref. No.	:	16286,16296,16305,16313

2. High Molecular Weight Polyaromatic Hydrocarbons, HMW PAHs

2.1 Sample Duplicate

Client Reference	Sample					Batch	CHR	BaA	BbF	BkF	BaP	DBA	FLT	IPY	PYR	BPE
Drillhole No.	Depth, m			Time	Specimen Depth m		%	%	%	%	%	%	%	%	%	%
	No.	From	To													
BH7	N/A	N/A	N/A	15:50	1m	1	na*	na*	na*	na*	na*	na*	na*	na*	na*	na*
Control Limits							+/- 30 % of the mean									

2.2 Sample Spike (Spike Level = 5 ug)

Client Reference	Sample					Batch	CHR	BaA	BbF	BkF	BaP	DBA	FLT	IPY	PYR	BPE
Drillhole No.	Depth, m			Time	Specimen Depth m		%	%	%	%	%	%	%	%	%	%
	No.	From	To													
BH7	N/A	N/A	N/A	15:50	1m	1	101	87	95	93	85	99	91	86	96	95
Control Limits							70 - 130 %									

Notes :

1. na* = Relative deviation (RD) for duplicates cannot be evaluated as the value determined is lower than reporting limit.

Remark(s) :

QC REPORT

Project Name	:	Lamma Power Station Unit 4&5 Light Oil Tank Demolition Soil Contamination Investigation Works
Client Name	:	The Hong Kong Electric Company Limited
Contract No.	:	05/8239
Lab Sample Ref. No.	:	16286,16296,16305,16313

1. Low Molecular Weight Polyaromatic Hydrocarbons, LMW PAHs

1.3 QC Sample (SETOC 2002.3.3)

Client Reference	Sample					Batch	NAP	ANY	ANA	FLU	PHE	ANT
Drillhole No.	Depth, m			Type	Specimen Depth m		%	%	%	%	%	%
	No.	From	To									
SETOC 2002.3.3	N/A	N/A	N/A		N/A	1	90	99	120	100	80	81
Control Limits							70 - 130 % of nominal value					

1.4 Method Blank

Client Reference	Sample					Batch	NAP	ANY	ANA	FLU	PHE	ANT
Drillhole No.	Depth, m			Type	Specimen Depth m		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
	No.	From	To									
N/A	N/A	N/A	N/A		N/A	1	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Control Limits							Less than reporting limit					

Remark(s) :

QC REPORT

Project Name	:	Lamma Power Station Unit 4&5 Light Oil Tank Demolition Soil Contamination Investigation Works
Client Name	:	The Hong Kong Electric Company Limited
Contract No.	:	05/8239
Lab. Sample Ref. No.	:	16286,16296,16305,16313

2. High Molecular Weight Polyaromatic Hydrocarbons, HMW PAHs

2.3 QC Sample (SETOC 2002.3.3)

Client Reference	Sample					Batch	CHR	BaA	BbF	BkF	BaP	DBA	FLT	IPY	PYR	BPE
Drillhole No.	Depth, m			Type	Specimen											
	No.	From	To		Depth m		%	%	%	%	%	%	%	%	%	%
SETOC 2002.3.3	N/A	N/A	N/A		N/A	1	99	107	78	102	82	106	87	108	92	90
Control Limits							70 - 130% of nominal value									

2.4 Method Blank

Drillhole No.	Sample					Batch	CHR	BaA	BbF	BkF	BaP	DBA	FLT	IPY	PYR	BPE
Drillhole No.	Depth, m			Type	Specimen											
	No.	From	To		Depth m		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
N/A	N/A	N/A	N/A		N/A	1	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0
Control Limits							Less than reporting limit									

Remark(s) :

TEST REPORT

Project Name	:	Lamma Power Station Unit 4&5 Light Oil Tank Demolition Soil Contamination Investigation Works
Client Name	:	The Hong Kong Electric Company Limited
Client Address	:	Projects Division, Hong Kong Electric Centre, 44 Kennedy Road, Hong Kong
Contract No.	:	05/8239
Works Order No.	:	N/A
Lab.Job No.	:	J471
Lab. Sample Ref. No.	:	16296,16313
No. of Sample(s) & Description	:	10 liquid samples said to be water samples
Sample Receive Date	:	16 November 2005 - 19 November 2005
Test Date	:	17 November 2005 - 29 November 2005

Test Parameter(s)

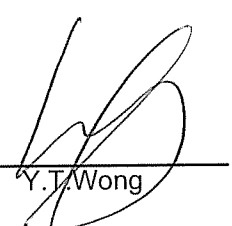
1. Low Molecular Weight Polyaromatic Hydrocarbons, LMW PAHs

CODE	Parameter	Reporting Limits Water ug/L	Test Method
NAP	Naphthalene	1	W/O/PAH
ANY	Acenaphtylene	1	W/O/PAH
ANA	Acenaphtene	1	W/O/PAH
FLU	Fluorene	1	W/O/PAH
PHE	Phenanthrene	1	W/O/PAH
ANT	Anthracene	1	W/O/PAH

2. High Molecular Weight Polyaromatic Hydrocarbons, HMW PAHs

CODE	Parameter	Reporting Limits Water ug/L	Test Method
CHR	Chrysene	1	W/O/PAH
BaA	Benzo(a)anthracene	1	W/O/PAH
BbF	Benzo(b)fluoranthene	1	W/O/PAH
BkF	Benzo(k)fluoranthene	1	W/O/PAH
BaP	Benzo(a)pyrene	0.2	W/O/PAH
DBA	Dibenz(ah)anthracene	1	W/O/PAH
FLT	Fluoranthene	1	W/O/PAH
IPY	Indeno(1,2,3-cd)pyrene	1	W/O/PAH
PYR	Pyrene	1	W/O/PAH
BPE	Benzo(ghi)perylene	1	W/O/PAH

Notes :
1. < = less than
2. N/A = Not applicable
3. Test results satisfy all in-house QA/QC protocols as attached.
4. Results relate to samples as received.
5. Test description (for in-house methods) as follows:
   W/O/PAH: Solvent extraction and GC-MS Quantification.

Approved Signatory :  Y.T.Wong

Date: 29 Nov. 2005

TEST REPORT

Project Name	:	Lamma Power Station Unit 4&5 Light Oil Tank Demolition Soil Contamination Investigation Works
Client Name	:	The Hong Kong Electric Company Limited
Contract No.	:	05/8239
Lab. Sample Ref. No.	:	16296,16313

1. Low Molecular Weight Polyaromatic Hydrocarbons, LMW PAHs

Client Reference / Drillhole No.	Sample					NAP	ANY	ANA	FLU	PHE	ANT
	Depth, m			Type	Specimen Depth m						
	No.	From	To			ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Trip Blank 1	N/A	N/A	N/A	16/11/2005	N/A	<1	<1	<1	<1	<1	<1
BH1	N/A	N/A	N/A		N/A	<1	<1	<1	<1	<1	<1
BH2	N/A	N/A	N/A		N/A	<1	<1	<1	<1	<1	<1
BH3	N/A	N/A	N/A		N/A	<1	<1	<1	<1	<1	<1
BH4	N/A	N/A	N/A		N/A	<1	<1	<1	<1	<1	<1
BH5	N/A	N/A	N/A		N/A	<1	<1	<1	<1	<1	<1
BH6	N/A	N/A	N/A		N/A	<1	<1	<1	<1	<1	<1
BH7	N/A	N/A	N/A		N/A	<1	<1	<1	<1	<1	<1
EQ Blank	N/A	N/A	N/A	19/11/2005	N/A	<1	<1	<1	<1	<1	<1
Trip Blank	N/A	N/A	N/A	19/11/2005	N/A	<1	<1	<1	<1	<1	<1

TEST REPORT

Project Name	:	Lamma Power Station Unit 4&5 Light Oil Tank Demolition Soil Contamination Investigation Works
Client Name	:	The Hong Kong Electric Company Limited
Contract No.	:	05/8239
Lab. Sample Ref. No.	:	16296,16313

2. High Molecular Weight Polyaromatic Hydrocarbons, HMW PAHs

Client Reference	Sample					CHR	BaA	BbF	BkF	BaP	DBA	FLT	IPY	PYR	BPE
Drillhole No.	Depth, m			Type	Specimen										
	No.	From	To		Depth m	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Trip Blank 1	N/A	N/A	N/A	16/11/2005	N/A	<1	<1	<1	<1	<0.2	<1	<1	<1	<1	<1
BH1	N/A	N/A	N/A		N/A	<1	<1	<1	<1	<0.2	<1	<1	<1	<1	<1
BH2	N/A	N/A	N/A		N/A	<1	<1	<1	<1	<0.2	<1	<1	<1	<1	<1
BH3	N/A	N/A	N/A		N/A	<1	<1	<1	<1	<0.2	<1	<1	<1	<1	<1
BH4	N/A	N/A	N/A		N/A	<1	<1	<1	<1	<0.2	<1	<1	<1	<1	<1
BH5	N/A	N/A	N/A		N/A	<1	<1	<1	<1	<0.2	<1	<1	<1	<1	<1
BH6	N/A	N/A	N/A		N/A	<1	<1	<1	<1	<0.2	<1	<1	<1	<1	<1
BH7	N/A	N/A	N/A		N/A	<1	<1	<1	<1	<0.2	<1	<1	<1	<1	<1
EQ Blank	N/A	N/A	N/A	19/11/2005	N/A	<1	<1	<1	<1	<0.2	<1	<1	<1	<1	<1
Trip Blank	N/A	N/A	N/A	19/11/2005	N/A	<1	<1	<1	<1	<0.2	<1	<1	<1	<1	<1

----------End of Report----------

QC REPORT

Project Name	:	Lamma Power Station Unit 4&5 Light Oil Tank Demolition Soil Contamination Investigation Works
Client Name	:	The Hong Kong Electric Company Limited
Contract No.	:	05/8239
Lab Sample Ref. No.	:	16296,16313

1. Low Molecular Weight Polyaromatic Hydrocarbons, LMW PAHs

1.1 Sample Duplicate

Client Reference	Sample					Batch	NAP	ANY	ANA	FLU	PHE	ANT
Drillhole No.	Depth, m			Type	Specimen							
	No.	From	To		Depth m		%	%	%	%	%	%
15286/2	N/A	N/A	N/A		N/A	1	na*	na*	na*	na*	na*	na*
Control Limits							+/- 30 % of the mean					

1.2 Sample Spike (Spike Level = 5 ug)

Client Reference	Sample					Batch	NAP	ANY	ANA	FLU	PHE	ANT
Drillhole No.	Depth, m			Type	Specimen							
	No.	From	To		Depth m		%	%	%	%	%	%
15286/2	N/A	N/A	N/A		N/A	1	93	93	87	107	87	82
Control Limits							70 - 130 %					

Notes :

1. na* = Relative deviation (RD) for duplicates cannot be evaluated as the value determined is lower than reporting limit.

Approved Signatory : Y.T.Wong Date : 29 Nov. 2005

Remarks :

QC REPORT

Project Name	:	Lamma Power Station Unit 4&5 Light Oil Tank Demolition Soil Contamination Investigation Works
Client Name	:	The Hong Kong Electric Company Limited
Contract No.	:	05/8239
Lab. Sample Ref. No.	:	16296,16313

2. High Molecular Weight Polyaromatic Hydrocarbons, HMW PAHs

2.1 Sample Duplicate

Client Reference	Sample					Batch	CHR	BaA	BbF	BkF	BaP	DBA	FLT	IPY	PYR	BPE
Drillhole No.	Depth, m			Type	Specimen											
	No.	From	To		Depth m		%	%	%	%	%	%	%	%	%	%
15286/2	N/A	N/A	N/A		N/A	1	na*	na*	na*	na*	na*	na*	na*	na*	na*	na*
Control Limits							+/- 30 % of the mean									

2.2 Sample Spike (Spike Level = 5 ug)

Client Reference	Sample					Batch	CHR	BaA	BbF	BkF	BaP	DBA	FLT	IPY	PYR	BPE
Drillhole No.	Depth, m			Type	Specimen											
	No.	From	To		Depth m		%	%	%	%	%	%	%	%	%	%
15286/2	N/A	N/A	N/A		N/A	1	102	100	97	96	104	90	102	99	96	91
Control Limits							70 - 130 %									

Notes :

1. na* = Relative deviation (RD) for duplicates cannot be evaluated as the value determined is lower than reporting limit.

Remark(s) :

QC REPORT

Project Name	:	Lamma Power Station Unit 4&5 Light Oil Tank Demolition Soil Contamination Investigation Works
Client Name	:	The Hong Kong Electric Company Limited
Contract No.	:	05/8239
Lab Sample Ref. No.	:	16296,16313

1. Low Molecular Weight Polyaromatic Hydrocarbons, LMW PAHs

1.3 QC Sample (Spike Level = 5 ug)

Client Reference	Sample					Batch	NAP	ANY	ANA	FLU	PHE	ANT
Drillhole No.	Depth, m			Type	Specimen							
	No.	From	To		Depth m		%	%	%	%	%	%
MB Spike	N/A	N/A	N/A		N/A	1	91	90	83	96	86	81
Control Limits							70 - 130 %					

1.4 Method Blank

Client Reference	Sample					Batch	NAP	ANY	ANA	FLU	PHE	ANT
Drillhole No.	Depth, m			Type	Specimen							
	No.	From	To		Depth m		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
N/A	N/A	N/A	N/A		N/A	1	<1	<1	<1	<1	<1	<1
Control Limits							Less than reporting limit					

Remarks :

QC REPORT

Project Name	:	Lamma Power Station Unit 4&5 Light Oil Tank Demolition Soil Contamination Investigation Works
Client Name	:	The Hong Kong Electric Company Limited
Contract No.	:	05/8239
Lab. Sample Ref. No.	:	16296,16313

2. High Molecular Weight Polyaromatic Hydrocarbons, HMW PAHs

2.3 QC Sample (Spike Level = 5 ug)

Client Reference	Sample					Batch	CHR	BaA	BbF	BkF	BaP	DBA	FLT	IPY	PYR	BPE
Drillhole No.	Depth, m			Type	Specimen											
	No.	From	To		Depth m		%	%	%	%	%	%	%	%	%	%
MB Spike	N/A	N/A	N/A		N/A	1	94	89	101	98	82	83	96	85	101	86
Control Limits							+/- 30 % of the mean									

2.4 Method Blank

Client Reference	Sample					Batch	CHR	BaA	BbF	BkF	BaP	DBA	FLT	IPY	PYR	BPE
Drillhole No.	Depth, m			Type	Specimen											
	No.	From	To		Depth m		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
N/A	N/A	N/A	N/A		N/A	1	<1	<1	<1	<1	<0.2	<1	<1	<1	<1	<1
Control Limits							Less than reporting limit									

Remark(s) :

Annex C

Summary of Worst-case Cumulative SO_2 and NO_2 Concentrations at ASRs

Table C.1 Worst-case SO_2 Concentrations before and after the Retrofit

ASR	Source B Before Retrofit[(a)] µg m^{-3}	Source B After Retrofit[(b)] µg m^{-3}	Other Sources[(c)] µg m^{-3}	Back-ground[(a)]	Total Before Retrofit[(a)] µg m^{-3}	Total After Retrofit[(d)] µg m^{-3}	Retrofit Impact µg m^{-3}	Retrofit Impact %
1	0	0	113	23	136	136	0	0
2	1	0	91	23	115	114	-1	-1
3	0	0	45	23	68	68	0	0
4	9	1	164	23	196	188	-8	-4
5	0	0	133	23	156	156	0	0
6	9	1	146	23	178	170	-8	-4
7	65	10	249	23	337	282	-55	-16
8	5	1	133	23	161	157	-4	-3
9	22	3	149	23	194	175	-19	-10
10	93	14	266	23	382	303	-79	-21
11	8	1	65	23	96	89	-7	-7
12	4	1	80	23	107	104	-3	-3
13	1	0	27	23	51	50	-1	-2
14	0	0	40	23	63	63	0	0
15	27	4	55	23	105	82	-23	-22
16	16	2	70	23	109	95	-14	-13
17	34	5	94	23	151	122	-29	-19
18	39	6	76	23	138	105	-33	-24
19	4	1	40	23	67	64	-3	-5
20	1	0	66	23	90	89	-1	-1
21	16	2	121	23	160	146	-14	-9
22	103	15	35	23	161	73	-88	-55
23	165	24	69	23	257	116	-141	-55
24	308	45	157	23	488	225	-263	-54
25	176	26	83	23	282	132	-150	-53
26	128	19	182	23	333	224	-109	-33
27	14	2	195	23	232	220	-12	-5
28	116	17	261	23	400	301	-99	-25
29	262	39	412	23	697	474	-223	-32
30	178	26	193	23	394	242	-152	-39
31	83	12	79	33	195	124	-71	-36
32	92	14	79	33	204	126	-78	-38
33	20	3	75	23	118	101	-17	-14
34	34	5	100	23	157	128	-29	-18
35	110	16	183	23	316	222	-94	-30
36	135	20	217	23	375	260	-115	-31
37	46	7	117	23	186	147	-39	-21
38	66	10	154	23	243	187	-56	-23
39	68	10	109	23	200	142	-58	-29
40	124	18	153	33	310	204	-106	-34
41	47	7	79	33	159	119	-40	-25
42	119	17	211	23	353	251	-102	-29
43	87	13	153	23	263	189	-74	-28
44	45	7	93	23	161	123	-38	-24
45	98	14	168	23	289	205	-84	-29
46	124	18	203	23	350	244	-106	-30
47	69	10	115	33	217	158	-59	-27
48	58	9	101	33	192	143	-49	-26
49	25	4	89	23	137	116	-21	-16
50	67	10	145	23	235	178	-57	-24
51	110	16	172	23	305	211	-94	-31
52	44	6	120	23	187	149	-38	-20
53	69	10	160	23	252	193	-59	-23

ASR	Source B Before Retrofit[a] µg m^{-3}	Source B After Retrofit[b] µg m^{-3}	Other Sources[c] µg m^{-3}	Back-ground[a]	Total Before Retrofit[a] µg m^{-3}	Total After Retrofit[d] µg m^{-3}	Retrofit Impact µg m^{-3}	Retrofit Impact %
54	245	36	349	23	617	408	-209	-34
55	67	10	101	33	201	144	-57	-28
56	86	13	130	33	249	176	-73	-29
57	73	11	151	23	247	185	-62	-25
58	89	13	157	23	269	193	-76	-28
59	99	15	166	23	288	204	-84	-29
60	73	11	190	23	286	224	-62	-22
61	130	19	225	23	378	267	-111	-29
62	85	12	175	23	283	210	-73	-26
63	59	9	150	23	232	182	-50	-22
64	127	19	260	23	410	302	-108	-26
65	107	16	237	23	367	276	-91	-25
66	149	22	245	23	417	290	-127	-30
67	118	17	203	23	344	243	-101	-29
68	40	6	128	23	191	157	-34	-18
69	178	26	282	23	483	331	-152	-31

Notes:

(a) From Table 5-1c of *Project Profile for Lamma Power Station Conversion of Two Existing Gas Turbines into a Combined Cycle Unit, 2000*

(b) Equal to Source B contribution before the retrofit reduced by a factor of 0.147

(c) Derived from Table 5-1c of *Project Profile for Lamma Power Station Conversion of Two Existing Gas Turbines into a Combined Cycle Unit, 2000*

(d) Sum of Source B after the retrofit, other sources and the background

Table C.2 Worst-case Cumulative NO_2 Concentrations after the Retrofit

ASR	Source B[(a)] µg m^{-3}	Other Sources[(b)] µg m^{-3}	Distance Correction[(c)]	Background[(a)] µg m^{-3}	Total[(d)] µg m^{-3}
1	0	29	0.52	49	64
2	0	23	0.81	49	68
3	0	13	0.38	49	54
4	1	43	0.71	49	80
5	0	35	0.96	49	83
6	1	37	0.93	49	84
7	10	49	0.96	49	106
8	1	35	0.72	49	75
9	3	36	0.76	49	79
10	14	57	0.72	49	100
11	1	20	0.42	49	58
12	1	22	0.69	49	65
13	0	5	0.40	49	51
14	0	8	0.71	49	55
15	4	12	1.00	49	65
16	3	14	0.93	49	65
17	5	20	0.91	49	72
18	9	12	1.44	49	79
19	1	9	0.50	49	54
20	0	16	0.82	49	62
21	2	20	1.00	49	71
22	16	10	0.69	49	67
23	26	23	0.92	49	94
24	48	34	1.23	49	150
25	27	14	0.83	49	83
26	20	29	1.09	49	102
27	2	47	0.61	49	79
28	16	58	1.25	49	141
29	41	72	1.90	49	264
30	28	35	1.68	49	154
31	13	16	1.92	80	135
32	14	15	1.93	80	136
33	3	20	1.69	49	88
34	5	24	1.76	49	100
35	17	34	1.54	49	128
36	21	40	1.52	49	142
37	7	27	1.77	49	109
38	10	33	1.64	49	119
39	12	17	1.61	49	95
40	19	22	1.88	80	158
41	7	17	1.84	80	125
42	18	39	1.47	49	133
43	13	28	1.49	49	110
44	7	27	1.55	49	102
45	15	28	1.55	49	116
46	19	36	1.75	49	146
47	11	21	1.93	80	142
48	9	19	1.92	80	134
49	4	24	1.47	49	90
50	10	28	1.50	49	106
51	17	30	1.84	49	135
52	7	26	1.46	49	97
53	11	34	1.41	49	113
54	38	60	1.81	49	226
55	10	19	2.00	80	137

ASR	Source B[(a)] µg m^{-3}	Other Sources[(b)] µg m^{-3}	Distance Correction[(c)]	Background[(a)] µg m^{-3}	Total[(d)] µg m^{-3}
56	13	22	2.00	80	150
57	11	34	1.40	49	112
58	14	32	1.36	49	111
59	15	33	1.70	49	130
60	11	42	1.39	49	123
61	20	43	1.37	49	135
62	13	36	1.60	49	127
63	9	33	1.53	49	114
64	20	48	1.52	49	153
65	17	46	1.52	49	144
66	23	42	1.79	49	165
67	18	35	1.80	49	145
68	6	30	1.68	49	109
69	28	48	1.85	49	189

Notes:

(a) From Table 5-1d of *Project Profile for Lamma Power Station Conversion of Two Existing Gas Turbines into a Combined Cycle Unit, 2000*

(b) Derived from Table 5-1d of *Project Profile for Lamma Power Station Conversion of Two Existing Gas Turbines into a Combined Cycle Unit, 2000*

(c) A correction factor based on the Janssen formula[1] that links the NO to NO_2 conversion rate to the prevailing meteorological conditions, distance to the receptor and the background ozone concentrations

(d) Sum of Source B and other sources multiplied by the distance correction and the background

(1) [1] Janssen L.H.J.M. et al. *A Classification of NO Oxidation Rates in Power Plant Plumes Based on Atmospheric Conditions*. Atmospheric Environment, 22, 43-53, 1988