EIA REPORT



Green Island Cement Company Limited Decommissioning of the Co-Combustion Pilot Plant at Tap Shek Kok

Environmental Impact Assessment Report

March 2009

Environmental Resources Management

21/F Lincoln House Taikoo Place 979 King's Road Island East Hong Kong Telephone 2271 3000 Facsimile 2723 5660



www.erm.com

EIA REPORT

Green Island Cement Company Ltd

Decommissioning of the Co-Combustion Pilot Plant at Tap Shek Kok: Environmental Impact Assessment Report

March 2009

Reference 0071019

For and on behalf of				
ERM-Hong Kong, Limited				
Approved by: Frank Wan				
Signed:	Ward-47			
Position:	Partner			
Date:	16 March 2009			

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

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

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

CONTENTS

1	INTRODUCTION	1-1
1.1	BACKGROUND	1-1
1.2	Objectives of the EIA Study	1-1
1.3	STRUCTURE OF THE REPORT	1-2
2	PROJECT DESCRIPTION	2-1
2.1	OPERATION OF THE CCPP	2-1
2.2	DEMOLITION OF CCPP	2-2
2.3	Demolition Methodology	2-9
2.4	CLEANING OF THE CO-COMBUSTION UNIT	2-12
2.5	Decommissioning Programme	2-14
3	AIR QUALITY ASSESSMENT	3-1
3.1	INTRODUCTION	3-1
3.2	LEGISLATION REQUIREMENTS AND EVALUATION CRITERIA	3-1
3.3	BASELINE CONDITIONS AND BACKGROUND AIR QUALITY	3-2
3.4	IDENTIFICATION OF AIR SENSITIVE RECEIVERS	3-2
3.5	EVALUATION OF IMPACTS	3-3
3.6	MITIGATION MEASURES	3-5
3.7	Environmental Monitoring and Audit	3-6
3.8	Conclusion	3-6
4	LAND CONTAMINATION ASSESSMENT	4-1
4.1	INTRODUCTION	4-1
4.2	LEGISLATIVE REQUIREMENTS AND EVALUATION CRITERIA	4-1
4.3	SITE CONDITIONS	4-2
4.4	POTENTIAL SOURCES OF LAND CONTAMINATION AT THE SITE	4-5
4.5	LAND CONTAMINATION SITE INVESTIGATION PROGRAMME	4-7
4.6	LAND CONTAMINATION IMPACT ASSESSMENT	4-11
4.7	LAND CONTAMINATION MITIGATION MEASURES	4-12
4.8	Residual Environmental Impacts	4-12
4.9	ENVIRONMENTAL MONITORING AND AUDIT	4-12
4.10	Conclusions	4-12
5	WASTE MANAGEMENT IMPLICATIONS	5-1
5.1	INTRODUCTION	5-1
5.2	LEGISLATION REQUIREMENTS AND EVALUATION CRITERIA	5-1
5.3	Expected Waste Sources	5-5
5.4	Assessment Methodology	5-6
5.5	WASTE MANAGEMENT ASSESSMENT	5-6
5.6	MITIGATION MEASURES	5-20
5.7	EVALUATION OF RESIDUAL IMPACTS	5-22
5.8	ENVIRONMENTAL MONITORING AND AUDIT	5-22
5.9	CONCLUSION	5-22

6	WATER QUALITY ASSESSMENT	6-1
6.1	INTRODUCTION	6-1
6.2	LEGISLATION AND STANDARDS	6-1
6.3	WATER QUALITY SENSITIVE RECEIVERS AND BASELINE CONDITIONS	6-6
6.4	POTENTIAL SOURCES OF WATER QUALITY IMPACTS	6-7
6.5	WATER QUALITY IMPACTS ASSESSMENT	6-7
6.6	WATER QUALITY MITIGATION MEASURES	6-9
6.7	Residual Environmental Impacts	6-10
6.8	ENVIRONMENTAL MONITORING AND AUDIT	6-11
6.9	CONCLUSION	6-11
7	ENVIRONMENTAL MONITORING AND AUDIT REQUIREMENTS	7-1
7.1	INTRODUCTION	7-1
7.2	SITE AUDITS	7-1
7.3	AIR QUALITY	7-1
7.4	LAND CONTAMINATION	7-1
7.5	WASTE MANAGEMENT	7-2
7.6	WATER QUALITY	7-2
7.7	IMPLEMENTATION SCHEDULE	7-2
8	SUMMARY OF ENVIRONMENTAL OUTCOMES AND CONCLUSION	8-1
8.1	INTRODUCTION	8-1
8.2	Air Quality Impacts	8-1
8.3	LAND CONTAMINATION	8-1
8.4	WASTE MANAGEMENT IMPLICATIONS	8-2
8.5	WATER QUALITY IMPACTS	8-3
8.6	ENVIRONMENTAL MONITORING AND AUDIT REQUIREMENTS	8-4
8.7	Environmental Outcomes	8-4
8.8	Environmental Benefits	8-4

ANNEXES

Annex A	Land Contamination Assessment / Analysis
Annex A1	Contamination Assessment Plan (CAP)
Annex A2	Contamination Assessment Report (CAR)
Annex A3	Laboratory analysis for Polychlorinated Biphenyl (PCBs) & Polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs)
Annex B	Residual Analysis Results
Annex C	Implementation Schedule

FIGURES

- Figure 2.1a Layout Plan of GICP and Location of CCPP
- Figure 2.1b General Layout of CCPP
- Figure 2.2a Structure to be Demolished (1)
- *Figure 2.2b* Structure to be Demolished (2) (Workshop and Reception Hall)
- *Figure 2.2c* Structure to be Demolished (3) (Fire Services Water Tank and Pump Room)
- Figure 3.4a Location of Air Sensitive Receivers
- Figure 5.5a Ashes Sampling
- Figure 5.5b Sampling Locations fro Refractory Bricks and Castable Linings
- Figure 6.3a Location of Water Quality Sensitive Receivers and EPD Marine Water Quality Monitoring Stations

1.1 BACKGROUND

In response to the Hong Kong SAR Government's initiative to develop bulk waste reduction facilities to tackle Hong Kong's waste disposal crisis, Green Island Cement Company Limited (hereafter referred to as "the Client" or GIC) established a pilot demonstration waste-to-energy facility (consisting of a Materials Recovery/Recycling Facility (MRRF) and a Co-Combustion Plant) within the Green Island Cement Plant (GICP) site at Tap Shek Kok, Tuen Mun. The aims of the Co-Combustion Pilot Plant (CCPP) were to determine the technical and economic issues associated with the operation of a MRRF as part of an integrated waste management system; to demonstrate that the CCPP will meet the requirements of the Guidance Note on the Best Practical Means for Incinerators (Municipal Waste Incineration) (BPM 12/1 (08)) issued by the Environmental Protection Department (EPD); and to obtain engineering data to refine the design of the Co-Combustion Plant.

The construction and installation of the CCPP was completed in February 2005 and commissioning tests were carried out in April and July/August 2005 in order to demonstrate its performance. Continuous operation of the CCPP was started in early October 2005. During the operation period, the cumulative operating time of the facility was 11 weeks and no more than 24 tonnes per day of Municipal Solid Waste (MSW) were treated. After completion of the tests and achieving the research objectives, the operation of pilot plant was stopped on 17 December 2005.

As the design throughput of the CCPP is less than 50 tonnes per day, it is not classified as a Designated Project (DP) under Category G.3 of Part I Schedule 2 of the *Environmental Impact Assessment Ordinance* (*EIAO*) and therefore the construction and operation of the plant did not require an Environmental Permit (EP). However, the decommissioning of such municipal waste incinerator is classified as a DP under Item 3 of Part II Schedule 2 of the *EIAO* and hence it requires an EP prior to the decommissioning works.

A Project Profile (PP-315/2007) for the decommissioning of the CCPP was submitted to EPD for application of an EIA Study Brief under the *EIAO* and Study Brief (ESB-164/2007) was issued on 7 June 2007 which sets out the scope of the work for this EIA Study.

1.2 OBJECTIVES OF THE EIA STUDY

The decommissioning of the CCPP involves demolition of the existing structures and removal of used equipment and waste materials as well as to clean up the CCPP site (hereafter referred to as the Project).

This EIA Study is conducted in accordance with the requirements of the EIA Study Brief (No. ESB-164/2007) and the Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM). The objectives of the EIA Study, as stated in the EIA Study Brief, are:

- to describe the Project and associated works together with the requirements for carrying out the Project;
- to identify and describe elements of community and environment likely to be affected by the Project, including natural and man-made environment and the associated environmental constraints;
- to provide information on the consideration of alternative decommissioning methods; to provide reasons for selecting the preferred method(s) and to describe the part environmental factors played in the selection of preferred method(s);
- to propose the provision of mitigation measures so as to minimize pollution, environmental disturbance and nuisance during the decommissioning activities;
- to investigate the feasibility, practicability, effectiveness and implications of the proposed mitigation measures;
- to identify, assess and specify methods, measures and standards, to be included in the proposed decommissioning works which are necessary to mitigate these environmental impacts and cumulative effects and reduce them to acceptable levels; and
- to design and specify environmental monitoring and audit requirements to ensure the effective implementation of the recommended environmental protection and pollution control measures.

1.3 STRUCTURE OF THE REPORT

The remainder of this *EIA Report* is organised as follows:

- *Section 2* describes the Project and the associated works together with the requirements for carrying out the Project; provides information on the consideration of alternative demolition methodologies and the reasons for selecting the preferred method(s) and describes the part environmental factors played in the selection of preferred method(s);
- *Section 3* presents the air quality assessment;
- *Section 4* presents the land contamination assessment;
- *Section 5* presents the an assessment of the waste management implications of the Project;
- *Section 6* presents the water quality assessment;

- *Section 7* describes the environmental monitoring and audit requirements during the decommissioning and demolition of the CCPP; and
- *Section 8* summarises the environmental outcomes associated with the decommissioning and demolition of the CCPP.

This page is deliberately left blank

2 PROJECT DESCRIPTION

2.1 **OPERATION OF THE CCPP**

The pilot plant, combining thermal treatment of municipal solid waste (MSW) with cement production, was developed by GIC in collaboration with the Chemical Engineering Department of the Hong Kong University of Science and Technology (HKUST). The pilot demonstration was funded by the Innovation and Technology Fund under the University-Industry Collaboration Programme. The CCPP consists of a MRRF at the front-end followed by a patented thermal process for integrated treatment of the MSW.

Before the plant was built, the GIC submitted its Specified Process (SP) licence application to the EPD under the *Section 14* of the *Air Pollution Control Ordinance*. The first licence was granted on 25 November 2003 and was renewed in 2005. According to the licence's conditions, the CCPP could only be in operation for a cumulative duration of 16 weeks (maximum) over the licensing period.

The CCPP was installed within the GICP at Tap Shek Kok by February 2005 and commissioning trials were undertaken in April and July/August 2005 in order to demonstrate its performance to EPD according to the licensing conditions. Continuous operation of the plant was started in early October 2005 and completed in December 2005 (for a cumulative period of 11 weeks). No more than 24 tonnes of MSW were treated per day during the pilot demonstration of the CCPP. *Figure 2.1a* shows the layout of the GICP and the location of CCPP. *Figure 2.1b* shows the detailed layout of the CCPP.

During the operation of pilot plant, the GIC and HKUST obtained satisfactory results and sufficient design and operational data on the Co-Combustion technology. All MSW delivered to the site was treated and no MSW is currently stored on-site. All the Co-Combustion residues (including bottom ash and fly ash) were securely packed in labelled sealed bags and stored in the covered waste reception hall of the MRRF building.

An air quality monitoring programme was commenced in December 2004 and continued throughout the pilot demonstration of the CCPP until one month after the completion of the trials. The Hong Kong Productivity Council was employed as the independent consultant for monitoring of flue gas emissions and ambient air quality at the site.

Monitoring equipment was installed in the stack of the CCPP for the continuous monitoring of Total Organic Carbon (TOC), Hydrogen Chloride (HCl), Hydrogen Fluoride (HF), Sulphur Dioxide (SO₂), Nitrogen Oxides (NO_x), Carbon Monoxide (CO) and opacity in the flue gas emissions during the operation of the CCPP.





Two off-site air quality monitoring stations were established in Butterfly Estate and Lung Kwu Tan Village to monitor the potential air quality impacts to these Air Sensitive Receivers (ASRs). Ambient air quality was monitored at these stations before (to establish the baseline conditions) and during the operation (impact monitoring) of the CCPP. The parameters monitored included Total Suspended Particulates (TSP), Respirable Suspended Particulates (RSP), Nitrogen Dioxide (NO₂), Sulphur Dioxide (SO₂), dioxins and heavy metals.

Monitoring results show that the operation of the CCPP did not cause adverse air quality impact to the identified ASRs. The results (including the flue gas emission and ambient air quality measured at the off-site monitoring stations) can be found on the GIC's web page at http://www.gii.com.hk/eng/coco_main.htm.

2.2 DEMOLITION OF CCPP

2.2.1 The Need of the Project

The CCPP was designed as a pilot demonstration process and had the following objectives:

- to demonstrate that the Co-Combustion plant could meet EPD's Best Practical Means for Incinerators (Municipal Waste Incineration) (BPM 12/1 (08)); and
- to obtain engineering data to refine the design of the Co-Combustion Process.

The pilot demonstration has fulfilled its objectives and the CCPP was closed down on 17 December 2005. It is necessary to demolish the whole pilot plant so that the Project Site could be released for the operation and future development of the GICP. The residues attached to the wall of the process equipment and units will be removed prior to reuse/disposal. It facilitates better materials recovery and recycling as the equipment and steel structure can be reused overseas or recycled locally.

Without this Project, the equipment, plant and buildings will be left on site and have to be regularly maintained by GIC to ensure their structural integrity. The residues of the CCPP will continue be stored on site. In the long-term, there is a potential of release of the residues due to degradation of the storage bags/containers. Most of the plant and equipment for the materials recovery facilities are still in good serviceable conditions and can be reused for other waste management facilities. If the CCPP is not demolished, the conditions of the equipment will be deteriorated and hence reduce the reuse opportunity of the equipment. This Project will not only enable the reuse of the materials recovery equipment, and minimise the long-term environmental risk of storage of residues on site but also will release the Project Site for operation and future development of the GICP.

2.2.2 Structures to be Demolished

The CCPP will be demolished and all structures, plant and equipment, foundations and footing will be dismantled and removed from the site. The site area will be restored into an open area for operations and development.

The structures to be demolished including their sizes and heights are shown in *Figures 2.2a* to 2.2*c*.

2.2.3 Consideration of Alternative Demolition & Cleaning Methods

All equipments and buildings of the CCPP are asbestos-free. Reusable equipments, such as materials sorting equipments, will be sold to second hand equipment vendors for reuse in other similar plants. The decommissioning works will begin by dismantling the process equipment into segments and disconnecting/removal of main process components. All equipment segments and pipes will then be cleaned ⁽¹⁾ in a designated area within the MRRF building prior to removal from the site for recycle or disposal.

Various dismantling/demolition methods have been considered and were compared in terms of engineering feasibility, potential environmental impacts and cost implication with reference to the Buildings Department's *Code of Practice for Demolition of Buildings* (2004) and other overseas projects ^{(2) (3)}. The assessment of alternative demolition methods are presented in *Table 2.2a*.

After the process equipments and structures been dismantled and demolished, a cleaning process will be carried out to allow recycling of the scrap metals and to minimise the potential environmental impacts associated with the disposal of the non-recyclable waste at landfills. Various cleaning methods ⁽¹⁾ have been considered and are summarised in *Table 2.2b*.

⁽¹⁾ The chemical analyses of the residues (including the fly ash, bottom ash and a small quantity of residues remaining in the plant and equipment of the thermal treatment unit) show that the residues contain very low level of heavy metals and extremely low concentrations of dioxins and furans (in term of part per trillion, see *Section 5*). The physical and chemical compositions of the residues are similar to those of the typical clinker raw materials. The residues will be reused on-site for the production of cement. The ground investigation shows that the soils to be distributed during the demolition works (ie for demolition of the shallow foundation of the CCPP) are not contaminated with reference to the RBRG standards (see *Section 4*). The term cleaning method is therefore used in the description.

⁽²⁾ Decontamination and Decommissioning Assessment for the Waste Incineration Facilities (Building 232-Z), United States Department of Energy, February 1994.

⁽³⁾ Development of Decommissioning Technology for Nuclear Power Plants in NUPEC. http://www.nupec.or.jp/database/paper/paper_12/p12_plant/R12-05-02.htm

Plan View of CCPP





Structure to be Demolished (1)

FILE: 0071019k1 DATE: 19/02/2009

Elevation Plan of CCPP

	Dimension
	Dia 2.2 x21.6m long
r	Dia 2.6 x16.8m long
	Dia 2.2x11m long
	Dia1.3x10m long
	cyclone body Dia 2.4x 7.9m height
	cyclone body Dia 1.7x 5.6m height
	2m x7.6m x4.8m height
	3.4m x 7.6m x10m height
	40m x16m x 6.8m
	7m x7m x 3.7m height
	5.3m x3.2m x2.6m height

Environmental Resources Management





Structure to be Demolished (2) (Workshop and Reception Hall)

FILE: 0071019k2 DATE: 04/03/2009

Environmental Resources Management







Structure to be Demolished (3) (Fire Services Water Tank and Pump Room)

FILE: 0071019k3 DATE: 04/03/2009

Environmental Resources Management



Method No.	Description	Principles/ Procedures	Engineering Feasibility	Potential Environmental Impacts	Cost Implication
1	Loosing the flanges, cutting & lifting	Dismantling the steel structures by loosing the nuts and bolts and flanges, or cutting the structure using mechanical, thermal or laser saw and then lift from top to the ground	It is the most common method for dismantling steel structures. Simple equipment will be required (eg electrical or hydraulically powered hand held tools). The structures can be dismantled with care and hence minimise the potential release of the Co-Combustion residues to the environment. Both ends of the structures will be sealed immediately after dismantling to contain the residues inside the structure.	Electrical or hydraulically powered hand held tools will be used and the potential for air and noise impacts will be minimal. As the structures can be dismantled with care and hence minimise the potential release of the Co-Combustion residues to the environment.	Low
2	Top down methods	Breaking away the structure by jack hammer, percussive or pneumatic hammer	This method is mostly used for concrete structures.	Potential release of Co-Combustion residues that remain in the process lines of the CCPP to the environment, which may cause adverse environmental impacts.	Low
3	Hydraulic crusher with long boom	Breaking the structure using a machine mounted hydraulic crusher with long arm extension	The hydraulic crusher can be operated from the ground outside the building or adjacent to the structures.	Potential release of Co-Combustion residues that remain in the process lines of the CCPP to the environment, which may cause adverse environmental impacts.	Medium
4	Wrecking ball	Destruction by impact of steel ball suspended from a crane	Suitable for dilapidated buildings, silos and other industrial facilities; requires substantial clear space and demands high level skill operators and well-maintained equipment. As the dismantled plant and equipment will be deformed, it will be difficult to decontaminate the equipment. It is therefore considered that this method is not appropriate.	Potential release of Co-Combustion residues that remain in the process lines of the CCPP to the environment, which may cause adverse environmental impacts.	Medium
5	Implosion	Use of explosives	Applicable for concrete structure but not suitable for incinerator/process equipments.	Potential of dispersion of building debris into adjoining land during	High

Table 2.2a Comparison of Potential Dismantling/ Demolition Methods for the CCPP

Method No.	Description	Principles/ Procedures	Engineering Feasibility	Potential Environmental Impacts	Cost Implication
				blasting and could cause significant dust, noise and vibration problems. Potential release of Co-Combustion residues that remain in the process lines of the CCPP to the environment, which may cause adverse environmental impacts.	
6	Drilling	Coring, drilling and cutting by stitch drilling	This is suitable for concrete structures but not for thermal treatment facilities or process equipment. With respect to the nature of the structures (ie steel structures and processing equipment) of the CCPP, this method is not suitable.	Potential release of Co-Combustion residues that remain in the process lines of the CCPP to the environment, which may cause adverse environmental impacts.	Medium
7	Non explosive demolition agent (NEDA)	Use of static demolition agent to generate an expansive pressure to crack and break concrete and stone	Not applicable to slabs and walls.	Low vibration, noise and dust impacts.	High
8	Thermal lance	Use of intense heat by fusion of metal	Involves very high temperature up to 2,000 to 4,000°C and therefore requires special precautionary measures and care.	Low vibration, noise and dust impacts.	High
9	Water jet	Jetting of water at high pressure	Requires protection of person and properties from high pressure water. With respect to the nature of the structures (ie steel structures and processing equipment) of the CCPP, this method is not suitable.	Large amount of wastewater with slurry of concrete debris and aggregate will be generated.	Medium

Method No.	Description	Principles/ Procedures	Advantage	Disadvantage
A	Manual wet wiping and scrubbing	Manual wiping and scrubbing by workers	 Suitable for small scale decontaminations Suitable for low-hazard potential buildings and equipments Low cost 	 Labour intensive Requires protection of person and properties from potential contaminated environment
В	Vacuum cleaning	Make use of vacuum cleaner	Require simple skills and equipments	• Not suitable for fastened materials
С	Abrasive blasting	High speed impingement of particles on an object with the purpose of abrading away surface materials	• High decontamination capability	• Containment of abrasive media and debris generated
D	Vibratory Decontamination Unit	A vibrating tub of metal beads that act to abrade particle, rust, debris etc. from the surfaces; a liquid flushing system is used to wash debris off of the decontaminated item prior to exit chute. Materials has to be cut into small pieces (< 30cm in diameter)	 Sectioned materials will occupy less volume Sectional materials will has higher packaging efficiency 	 Materials have to be cut into small pieces Equipment may not be available locally and it required large area for the decontamination activities Resulted in a liquid waste for disposal High cost and not common locally
Е	Chemical flushing	Dissolve away surface contamination from materials	• A variety of chemicals are available for decontamination	• Resulted in large volume of liquid waste requiring disposal
F	Electro-polishing	Similar to chemical flushing except that an electrical charge is applied to the items being decontaminated to create an accelerated corrosion reaction.	• Removal of surface materials from metallic items along with the contaminants on their surface	 Required corrosive liquid as the electro- polishing medium Resulted in large volume of liquid waste for disposal Only applicable for metallic items

Table 2.2b Comparison of Potential Cleaning Methods for Process Equipments and Structures

• Expensive

Method No.	Description	Principles/ Procedures	Advantage	Disadvantage
G	Ultrasonic	Transmitting high-frequency impulses though a liquid medium on the surface of a contaminated	Safe operation	• Materials have to be cut to fit into an ultrasonic cleaning tank.
		object.		• Resulted in liquid waste requiring disposal
Н	High pressure water lance	High-pressure water spray	Require simple equipments	• Resulted in large volume of contaminated wastewater requiring treatment prior to disposal
Ι	High-temperature water spray system	Provide cleaning spray and a vacuum collection system	• Suitable for removing loose contamination on concrete and brick surfaces	• Not applicable for hard or smooth surface

2.2.4 Selection of Preferred Demolition and Cleaning Methods

The selection of preferred demolition/dismantling methods has made reference to the common demolition methods in Hong Kong and the characteristics of the Project such as size of the CCPP, building materials, degree of potential contamination, demolition/dismantling duration, etc to avoid prolonged adverse environmental impacts.

The main system and MRRF building of the CCPP are mainly made of steel while the fire service water tank and pump house are made of concrete. In view of small size of the CCPP, the best option for dismantling the steel structures (e.g. the MRRF Building) and process equipment (e.g. the Co-Combustion unit) will be the loosing the flanges /cutting and lifting method (ie Method 1 in *Table 2.2a*). Mechanical cutting and thermal cutting are most common and will not cause significant environmental impacts. Other cutting methods (e.g. laser cutting/saw) which have a better cutting ability, are not considered with respect to the plate thickness of the CCPP and MRRF building. The sequence of the demolition works will be from the top to the bottom of the structures.

For the small concrete structures of the fire service water tank and pump house, breaking away the structure by jack hammer, pneumatic or hydraulic breaker (i.e. Method 2 – top down method in *Table 2.2a*) will be used.

Noise and dust impacts could easily be controlled by practical mitigation measures, such as low noise equipment, temporary noise barriers and water spraying at the work area, which are commonly used in Hong Kong.

The process equipments and structures of the Co-Combustion unit will then be cleaned before recycling or disposal. With respect to the small scale of the Project, wet wiping (i.e. Method A in *Table 2.2b*) and vacuum cleaning (Method B in *Table 2.2b*) are considered to be best suited and most cost effective for the Project. The cleaning will be conducted using a combination of scraping and vacuum cleaning, followed by wet wiping. *Table 2.2c* summarises the procedures.

	Scraping/ Vacuum Cleaning	Wet Wiping
Procedures	Residues attached to the wall of the equipments will be removed by scraping and then collected by vacuum cleaner.	Damping down the dust inside the ducts and equipment and then cleaned dust with wet cloths or other appropriate absorbents (eg paper towels).
Applicable areas / instruments	Lining inside the rotary kiln, secondary combustion chambers, gas cooler, bag filter chambers and internal lining of pipes and ducts.	Lining inside the rotary kiln, secondary combustion chambers, gas cooler, bag filter chambers and internal lining of pipes and ducts.
Secondary pollution	Residual dust will be collected by the vacuum cleaner with HEPA filter so that no dust will be escape to the atmosphere. Solid wastes will be stored in sealed bags/containers for reuse/disposal.	Additional waste will be generated from the clothes or paper used for the cleaning which will be disposed at a designated landfill.
Final Disposal / Treatment	The solid residues are intended to be reused as the raw materials for cement production.	The solid residues will be reused as the raw materials for cement production. The cleaning materials will be disposed of at a designated landfill.
Health and Safety of workers	Full body protection PPE will be provided to the workers. Potential of disturbing the dust during the vacuum cleaning process as the dust may escape to the atmosphere if not properly contained. The effectiveness of the HEPA filter needs to be checked regularly to ensure no damage.	Full body protection PPE will be provided to the workers. Dust generation is minimised by wetting the surface before wiping.

Table 2.2cSelected Cleaning Methods

To prevent the unintentional spread of the residues and dust throughout the process area, the cleaning process will be conducted inside the enclosed cleaning workshop (i.e. the MRRF building after removal of all equipments, see *Section 2.4* for further details) where forced ventilation will be provided and a slight negative pressured be maintained. All dust and residues collected will be packed into labelled polyethylene (PE) bags and will be reused as the raw materials for cement production.

2.3 DEMOLITION METHODOLOGY

The CCPP has been closed down awaiting decommissioning after the completion of the pilot demonstration. All structures and the associated foundation, and plant and equipment will be dismantled, cleaned (where necessary) and removed from the Project Site for reuse, recycling or disposal. The concrete slab of the Project Site will be demolished and the site will be backfilled with a layer of imported clean soil. The Project Site area will be levelled and landscaped.

Before the commencement of the demolition works, the Project Site area will be cordoned off and the access to the works area will be controlled ^{(1) (2)}. The south-east side of the CCPP will be separated from the existing cement plant by hoarding. Hoarding on the other sides are not considered necessary as the site is separated from the cement plant by existing road and drainage channel. Safety is a prime consideration of the Project. All required preparation works and general safety measures (including safety training, awareness programmes and provision of personnel protective equipments) will be in place before the commencement of the demolition works. Only authorised persons who have attended the appropriate safety training would be allowed to work at the site. Appropriate fire fighting equipment (eg fire extinguishers) will be provided at designated locations.

The overall sequence of demolition works is as follow:

- Cordon off the site and erection of hoarding;
- Disconnect the utilities (except for the power and water supplies to the fire services pump room and water tank);
- Dismantling and removal of all plant and equipment inside the MRRF building;
- Dismantling and removal of the Co-Combustion unit;
- Cleaning of the Co-Combustion unit within the enclosed cleaning workshop inside the MRRF building;
- Demolition of the steel structure of the MRRF building;
- Demolition of the fires services pump room and water tank;
- Demolition of the concrete slab and shallow footing foundation;
- Backfilling the site with clean soil;
- Provision of surface water drains at the site;
- Landscaping the Project site area.

The whole demolition process will be conducted in a safe manner for the protection of the workers and to minimise occupational health and safety hazards. Detailed description of the demolition procedures and safety precautions are discussed in the following sections.

⁽¹⁾ It should be noted that the Project Site is located with the GICP site. The access to the GICP (hence the Project Site) is controlled by the security guards on 24 hours basis. No unauthorised access is allowed. In addition, the Project Site will be cordoned off or segregated from the other parts of the GICP by hoarding and access to the Project Site will be controlled.

⁽²⁾ The Project Site boundary is not adjoining a public road, street, service land or other area accessible to the general public. It is therefore considered that a site hoarding will not be required. However, hoarding will be erected along the eastern boundary of the Project Site to separate the demolition works with the cement plant operation.

2.3.1 Site Preparation and Access Control

Before the demolition works, the Project Site will be cordoned off by hoarding or fencing. Portable barricades will be used to separate different work zones within the Project Site where demolition works are in progress. Suitable metal scaffolding working platform will be erected.

The access to the Project Site will be controlled by security guards and no unauthorised persons will be allowed to enter the site. Appropriate warning signboards will be posted around the perimeter of the Project Site.

2.3.2 Demolition of the Fire Services Water Tank and Pump House

The pumps and control panels will be dismantled and sold to scrap metal recyclers. All water in the water tank will be drained out. The concrete wall of the water tank and the pump house will be demolished and removed by a pneumatic drill mounted backhoe. The concrete structures will be damped down before and during the demolition works to control dust. The steel reinforcement will be recovered as far as practicable for recycling. The broken concrete will be disposed of at the public fill reception facilities. The load will be properly covered with tarpaulin to minimise dust during transportation.

2.3.3 Demolition/ Dismantling of the Co-Combustion Unit

The duct works of the Co-Combustion unit and the gas cooler will be dismantled by removal of the bolts or cutting at the joints. The openings (both ends of ducts) will be immediately sealed with 2 layers of fire retardant polyethylene sheets to prevent escape of any dust within the duct. The sheets will be secured with duct tapes. The capped equipment sections/pieces will be lowered to ground level by crane. Where necessary, the sections will be cut into smaller size to facilitate cleaning and transportation.

The internal wall of the ducts will be properly cleaned with wet cloths or other suitable absorbents to remove the loose dust deposits. The cleaning materials will be collected and placed in sealed bags and disposed of at a designated landfill.

The refractory bricks of the rotary kiln will be removed before lifting the whole equipment down to the ground. The refractory bricks will be placed in sealed bags and disposed of at a designated landfill. The internal wall of the secondary combustion chambers will be damped down prior to dismantling. The steel frame of the equipment will then be cut into manageable sections and sold to scrap metal recyclers.

All filter bags from the dust collector will be removed and placed in sealed bags for disposal at a designated landfill. The residual ash will be placed inside a sealed bag. The metal casing of the dust collector will be properly cleaning using the same procedures for the duct works. The cleaned dust collector will then be sold as scrap metal.

2.3.4 Dismantling of the MRRF Equipments

The main power supply to the Project Site will be cut off and all electrical cable and electrical equipment will be disconnected before the demolition works.

The materials recovery/recycling equipment (including shredder, conveyor belts, picking station, magnetic separator, eddy current separator, etc) in the MRRF building will be disassembled using powered mechanical hand tools and removed. Most of the plant and equipment are still in good serviceable conditions and will be sold to other MRRF operators or second hand equipment vendors.

2.3.5 Demolition of Steel Structure of MRRF Building

After having dismantled and removed all machinery and equipments, and cleaning of the Co-Combustion unit, the steel frame structure of the MRRF building will be demolished in accordance with the *Code of Practice for Demolition of Buildings* and generally in the reverse order to that of their construction. This building was used for reception sorting of MSW to recover recyclables. There is no potential of concern of land contamination. The structures will be demolished progressively from top to bottom. The external non-loading bearing cladding or any non-structural elements will be removed first. Crane and lifting gear will be used where possible to support the structural beams and columns whist they are being cut and lowered to the ground. Air-powered wrenches, cutting torches, cranes and similar industrial equipment will be used.

The steel beams and column will be cut to manageable size to facilitate transportation. This together with the metal claddings and scrap metals from the MRRF equipment will be sold to the scrap metal recyclers.

2.3.6 Demolition of the Foundation and Concrete Pavement

The foundation (including the reinforced concrete footing, plinths, with a maximum depth of 1.5m below ground) of the MRRF building, water tank and Co-Combustion unit will be demolished by hydraulic breakers and removed. The concrete slab of the Project Site will then be demolished. The demolition debris will be further broken down into manageable sizes (<250mm) and loaded on to dump trucks for transportation to public fill reception facilities. Steel bars will be separated from concrete for recycling.

The Project Site will then be backfilled using clean imported soil and landscaped.

2.4 CLEANING OF THE CO-COMBUSTION UNIT

After all the machinery and equipment were removed, half of the MRRF building will be converted into a cleaning workshop for cleaning works. At the entrance to the cleaning area, warning signs in both Chinese and English

will be posted in a prominent location outside the cleaning workshop throughout the entire period of the decommissioning works.

The cleaning workshop will be provided with forced ventilation and a slight negative pressure would be maintained within the cleaning workshop during the cleaning works. The exhaust air from the cleaning workshop will be cleaned using a High Efficiency Particulate Air (HEPA) filter prior to discharge to the atmosphere.

The characteristics of the residues were analysed. The results show that the physical and chemical compositions of the both residues are similar to those of the typical clinker raw materials (including pulverised fly ash and bottom ash from coal fired power station, iron/copper slag). The ingredients of both residues show the normal chemical substances associated with cement clinker raw feed materials (calcium carbonate/calcium oxide/calcium salts, alumina, and iron/copper slag). The residues contain very low levels of heavy metals and extremely low levels of (in the order of part per trillion) dioxins (see *Table 5.5c*). To minimise the exposure of residues, the workers will wear appropriate PPE (including face mask, protective gloves, overcoat, and safety boots).

It is expected that a small quantity of residues (e.g. fly ash, bottom ash) will remain inside the Co-Combustion unit since the operation of the CCPP was completed. The materials that may still be present in the gas cooler and dust collector etc. are estimated to be less than 5 m³ in total. The decommissioning process will start with removal of all residues remaining in the CCPP system by a vacuum cleaner with a HEPA filter. Any residues attached within the equipments will be removed by a combined method of scraping and cleaning. The internal surfaces of the equipments will be cleaned by wet wiping.

The scraped lining material will be placed in sealed bags and disposed of at a designated landfill. The filtered materials, and cloths used for wet wiping will be packed in sealed bags and disposal of at a designated landfill. With proper precautionary measures and handling procedures in place, contamination of steel structure of the MRRF is not anticipated.

During the entire decommissioning process, strict industrial hygiene and safety control will be exercised to protect workers from contact with the residues. The safety procedures to be used will include the use of personal protective gear such as chemical resistant clothing, gloves, boots and/or shoe covers, hard hats, full-face positive pressure respirators equipped with a cartridge that filter particulate, and other standard safety equipment.

After completion of the cleaning process of the Co-Combustion equipment and removal of the equipment, the cleaning workshop will be vacuum cleaned and wet wiping. The cleaning materials will be disposed of at designated landfill.

2.5 DECOMMISSIONING PROGRAMME

All operation of the CCPP ceased on 17 December 2005 after it achieved the Project objectives as stated in *Section 2.3.1*. Since that date the facility has been mothballed pending approval to decommission. The tentative programme for the demolition, cleaning and disposal works is shown in *Table 2.5a*.

Table 2.5aTentative Programme for the Demolition, Cleaning and Disposal Works of
CCPP

Tasks	Tentative Date
Issue of Environmental Permit by EPD	Iune 2009
Issue of Buildings Department Permit	July 2009
Demolition Works Tendering	June 2009
Site Preparation for Demolition Works	July 2009
Demolition and Cleaning	August to December 2009
Disposal of Scrap Materials	September to December 2009
Backfilling & Re-surfacing	December 2009
Completion of Demolition and Decommissioning	December 2009

3.1 INTRODUCTION

This *Section* presents the assessment of potential air quality impact associated with the demolition of the CCPP at the GICP. Dust generating from the construction activities would be the major air polluting concern during the demolition of the CCPP.

In view of the nature of the structures (mainly steel structure and equipment) and small scale (pilot demonstration) of the CCPP and large separation distance from the identified Air Sensitive Receivers (ASRs) (see *Figure 3.4a*), it is anticipated that with the implementation of the control measures described in the *Air Pollution Control (Construction Dust) Regulation* the potential dust impacts to the ASRs due to the demolition works will be minimal and controlled within the relevant standards as stipulated in Section 1 of Annex 4 of the *Technical Memorandum on Environmental Impact Assessment Process* (*EIAO-TM*). Hence, a quantitative air quality impact assessment will not be required.

A site audit programme (see *Section 3.7*) will be implemented during the demolition works to ensure that the control measures are properly implemented.

3.2 LEGISLATION REQUIREMENTS AND EVALUATION CRITERIA

The principal legislation for 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* (HKAQOs) stipulate the statutory Limits for air pollutants and the maximum allowable numbers of exceedances over specified periods.

Table 3.2aHong Kong Air Quality Objectives (µg 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

Air Pollutant		Averaging Time		
	or smaller			
(f)	f) Photochemical oxidants are determined by measurement of ozone only			

For construction dust impact assessment, the *EIAO-TM* also stipulates an hourly TSP criterion of 500 μ g m⁻³.

The dust control measures set out in the *Air Pollution Control (Construction Dust) Regulation* will be implemented to reduce dust impacts associated with the demolition works.

3.3 BASELINE CONDITIONS AND BACKGROUND AIR QUALITY

The CCPP is located within the GICP which is surrounded by the CLP Castle Peak Power Station and Shui Wing Steel Company. The CCPP is accessed via the Lung Mun Road.

The existing air quality in the vicinity of the CCPP is mainly contributed by the emissions from the adjacent industrial premises (including the Castle Peak Power Station, the operations of the GICP and Shui Wing Steel Company) and background air quality in the Pearl River Delta.

There is currently no Air Quality Monitoring Station (AQMS) operated by the EPD in the immediate vicinity. The nearest EPD AQMS is located in Tung Chung (TC), which is to the north of Sunset Peak and Lantau Peak. The annual average of TSP recorded at the AQMS at Tung Chung in 2006 is 75 μ g m⁻³ which is below the respective AQO.

3.4 IDENTIFICATION OF AIR SENSITIVE RECEIVERS

The Study Area is generally defined by an area within 500m from the boundary of CCPP. ASRs within 500m from the CCPP boundary were identified in line with the definition defined in the Annex 12 of the *EIAO-TM*. Their descriptions are presented in *Table 3.4a* and the locations are illustrated in *Figure 3.4a*. No residential dwellings (both existing and planned) were identified within the Study Area.

ASR	Description	Type of Uses	Approximate Distance from CCPP Site Boundary (m)	Approximate Maximum Height of Building above Ground (m)
A1-1	Castle Peak Power Station – Guard House	Office	210	3
A1-2	Castle Peak Power Station – Office	Office	300	20
A2-1	Shui Wing Steel Company – Office	Office	180	10
A2-2	Shui Wing Steel Company – Workshops	Workshop	145	6

Table 3.4aIdentified Air Sensitive Receivers

ASR	Description	Type of Uses	Approximate Distance from CCPP Site Boundary (m)	Approximate Maximum Height of Building above Ground (m)
A3	Permanent Aviation Fuel Facility – Central Operation Building	Office	410	6
A4	EcoPark	Office	560	6
A5-1	GICP - Site Office	Office	90	20
A5-2	GICP - Guard House	Office	160	6

3.5 EVALUATION OF IMPACTS

The number of construction plant and equipment (1 to 2 mobile cranes, and 1 to 2 backhoe (with pneumatic drill mounted on the backhoe) used for the demolition works will be limited. Only a few dump trucks/lorries will be working on site at any one time to remove the demolished concrete and scrap metals. The air emissions from the operation of these plant and equipment will be minimal. Besides, the additional road traffic generated during the decommissioning of the CCPP will also be small (ie a maximum of 10 truck trips per day associated with the disposal of C&D materials). It is therefore anticipated that the operation of construction plant and equipment on-site and additional road traffic generated during the decommissioning work will not cause adverse air quality impact to the identified ASRs.

The demolition method is described in *Section 2.3.* GIC will implement good site practices and dust control measures stipulated in the *Air Pollution Control (Construction Dust) Regulation* (as listed in *Section 3.6*) throughout the demolition works. According to the *Hong Kong Planning Standards and Guidelines* (HKPSG), fugitive dust will be localised to an area within 100m from the site boundary. With respect to the nature of the demolition works (dismantling of the plant and equipment using powered mechanical hand tools and mobile cranes) and the small scale of the concrete structures (a small fire services water tank and foundation block (to about 1.5m below ground)), the demolition works will not cause adverse dust impact to the identified ASRs which are located more than 90m from the CCPP site.

The chemical analysis of the Co-Combustion residues contains very low concentration of heavy metals and extremely low concentration (in part per trillion levels) of dioxins and furans (please refer to *Tables 5.5b, 5.5c, 5.5g* and *5.5h* for the chemical analysis results). As discussed in *Section 2.3*, the proposed demolition method has carefully designed to minimise potential release of residues during the dismantling and cleaning of the plant and equipment. Together with the implementation of effective control measures recommended in *Section 3.6*, the emissions of the residues will be effectively controlled and hence the emissions of dioxins and heavy metals during the demolition and cleaning process will be minimal and will not cause air quality impact to the vicinity.



The evaluation of the potential air quality impacts during decommissioning works, particularly how to control the emission of dust within the Co-Combustion unit are further discussed in the following sections.

3.5.1 Dismantling and Demolition of Equipments and Steel Structures

The materials recovery/recycling equipment (including shredder, conveyor belts, picking station, magnetic separator, eddy current separator, etc) in the MRRF building will be disassembled using powered mechanical hand tools. No significant dust and air emissions will be generated from this activity.

After removal of the materials recovery equipment from the MRRF building, the MRRF will be used as the cleaning workshop for the Co-Combustion unit. The cleaning workshop will be provided with forced ventilation and maintained with a slight negative pressure during the cleaning works. The exhaust air will be cleaned with a High Efficiency Particulate Air (HEPA) filter prior to discharge to the atmosphere. Further details of the cleaning procedures are provided in *Section 2.4*.

The duct works of the secondary combustion unit and the gas cooler will be dismantled by removal of the bolts or cutting at the joints. The openings (both ends of ducts) will be immediately sealed with 2 layers of fire retardant polyethylene sheets to prevent escape of any dust from the duct. The sheets will be secured with duct tapes. The capped equipment sections/pieces will be lowered to ground level. Where necessary, the sections may be cut into smaller size to facilitate cleaning and transportation. The segments of the equipment will be transported to the cleaning area within the MRRF building. The internal wall of the ducts will be damped with water spray and properly cleaned with wet cloths. The cleaning materials will be collected and placed in sealed containers lined with plastic sheeting and disposed of at a designated landfill.

The refractory bricks of the rotary kiln will be removed before lifting the whole equipment down to the ground. The refractory bricks will be placed in sealed bags and then in drum for disposal at a designated landfill. The internal lining of the secondary combustion chamber will be damped down and properly cleaned with wet cloths. The lining material will be removed and placed together with the cleaning materials in sealed containers lined with polyethylene sheeting and disposed of at a designated landfill. The cleaned steel frame of the equipment will then be cut into manageable sections and sold to scrap metal recyclers.

The filter bags from the dust collector will be removed in accordance with manufacturer's instructions and placed in sealed bags or containers for disposal. The metal casing of the dust collector will be properly cleaning using the same procedures for the duct works. The cleaned dust collector will then be sold as scrap metal.

After the completion of the cleaning of the Co-Combustion unit, the cleaning workshop will be removed. The steel frame structure of the MRRF building

will then demolished in accordance with the *Code of Practice for Demolition of Buildings* and generally in the reverse order to that of their construction. The structures will be demolished progressively from top to bottom. The external non-loading bearing cladding or any non-structural elements will be removed first. Crane and lifting gear will be used where possible to support the structural beams and columns whist they are being cut and lowered to the ground. Air-powered wrenches, cutting torches, cranes and similar industrial equipment will be used. The steel beams and column will be cut to manageable size to facilitate transportation. No significant dust and air emissions will be generated from this activity.

With the implementation of the proposed control measures, it is not anticipated that the dismantling and demolition of equipments and steel structures will cause adverse dust impacts to the identified ASRs. The release of dust from the Co-Combustion unit will be minimal.

3.5.2 Dismantling of Concrete Structures

The concrete structures (fire services water tank and pump house, concrete slab and foundation) will be sprayed with water immediate prior to and regularly during the demolition works to control potential of dust and air emissions. The broken concrete and scrap metals will be placed in separate skips and removed off-site as soon as practicable.

With the implementation of the proposed dust and air control measures, it is not anticipated that the demolition of the concrete structures will cause adverse dust impacts to the identified ASRs.

3.5.3 Backfilling of the CCPP Site with Soil

The CCPP Site will be backfilled with imported clean soil and restored into an open area. Due to the relative small area of the CCPP site (about 4,000 m²) and the volume of soil to be handled on site at any one time will be small, it is not anticipated that the minor earthworks will cause adverse dust impact to the identified ASRs with the implementation of the dust control measures described in the *Air Pollution (Construction Dust) Regulation*.

3.6 MITIGATION MEASURES

It is not anticipated that the demolition of the CCPP will cause adverse air quality and dust impacts to the identified ASRs. However, GIC will implement the following good site practices and dust control measures stipulated in the *Air Pollution Control (Construction Dust) Regulation*. Special care will be taken when dismantling the Co-Combustion unit of the CCPP and removal of any residual dust attached to the internal lining or surface of the equipment so that potential dust releases to the atmosphere will be minimal.

• The engine of idling construction plant will be switched off;

- Construction plant will be regularly checked and maintenance to avoid emission of black smoke;
- Wheel washing facilities will be provided at the exit of the CCPP Site;
- Both ends of the individual section of the duct works of the Co-Combustion unit will be sealed with two layers of polyethylene sheet immediately after dismantle and prior to lower down to the ground level;
- Internal lining or surface of the Co-Combustion unit (including duct works, and chambers of the rotary kiln, secondary combustion unit, gas cooler, and dust collector) will be damped down followed by wet wiping to remove any residual dust. Cleaning materials will be placed in sealed containers and disposed of at a designated landfill by the EPD;
- Filter bags of dust collector will be removed in accordance with the manufacturer's procedures and placed in sealed bags/containers and disposed of with the cleaning materials at a designated landfill;
- The concrete structures and slab will be damped down prior to and during the demolition works to minimal dust generation;
- Broken concrete and scrap metals will be placed in separate skips. The skips storing broken concrete will be covered with impervious sheet at the end of each working day and where necessary during windy days; and
- The dropping height of the imported soil during material handling or will be minimised as much as practicable to minimise dust generation.

3.7 Environmental Monitoring and Audit

Due to the small scale of the demolition works, it is not anticipated that the works will cause adverse air quality and dust impacts to the identified ASRs. No dust monitoring will be required.

The cleaning of the Co-Combustion units will be carried out in the enclosed cleaning workshop within the MRRF building. The proposed cleaning method will effectively control dust emission. The cleaning workshop will be provided with forced ventilation and maintained a slight negative pressure, and the exhaust air will be cleaned with a HEPA filter. As the cleaning activities will not cause adverse dust impacts to the ASRs, no dust monitoring will be required.

Regular environmental site audit will also be conducted to ensure that recommended dust control measures are implemented accordingly.

3.8 CONCLUSION

No residential dwellings (both existing and planned) were identified within the Study area (ie 500m from the CCPP Site boundary). The nearest Air

Sensitive Receiver (ASR) is located at about 90m from the CCPP Site boundary.

The number of construction plant and equipment to be used for the demolition works will be limited. Only a few dump trucks/lorries will be working on site at any one time to remove the demolished concrete and scrap metals. Air emissions from the operation of these plant and equipment will be minimal and it is therefore not anticipated that it will cause adverse air quality impact to the identified ASRs.

GIC will implement good site practices and dust control measures stipulated in the *Air Pollution Control (Construction Dust) Regulation* (as listed in *Section 3.6*) throughout the demolition works. Special care will be taken when dismantling the Co-Combustion unit of the CCPP and removal of any residual dust attached to the internal lining or surface of the equipment so that the potential dust releases to the atmosphere will be minimal.

With the implementation of the recommended control measures described in the EIA and those stipulated in the *Air Pollution Control (Construction Dust) Regulation,* the potential air quality impacts to the identified ASRs will be controlled within the relevant standards as stipulated in *Section 1* of *Annex 4* of the *EIAO-TM*. No adverse air quality impact is anticipated.
This page is deliberately left blank

4.1 INTRODUCTION

4

This *Section* presents the assessment of potential land contamination impact associated with the demolition of the CCPP at the GICP. The assessment identifies the potential source of land contamination, summarises the intrusive site assessment findings and recommends mitigation measures, monitoring and audit programme to minimise potential environmental implications from demolition of the CCPP, and assesses potential residue impacts after the implementation of the mitigation measures.

A site appraisal of CCPP was carried out to identify potential sources of land contamination within the Project area and a Contamination Assessment Plan (CAP) was prepared outlining a programme for the intrusive site investigation at the CCPP to determine presence and extent (if any) of contamination at the Project area. References are made to potential land contamination that may be present due to the historical and current land uses of the Project area and the surroundings during the proposed demolition works and the proposed future uses of the Project area. The CAP was approved by the EPD in January 2008.

Land contamination site investigation was carried out in accordance with the CAP in February, 2008. Upon completion of the site investigation, a Contamination Assessment Report (CAR) was prepared detailing the investigation programme, on-site observations and the results of the soil sampling and testing. The CAR was endorsed by the EPD in May 2008.

This land contamination assessment has been undertaken in accordance with the requirements of Section 3.4.2 of the *EIA Study Brief* and makes reference to the CAP, dated 7 January 2008 (a copy of which is included in *Annex A1*) and the CAR, dated 11 April 2008 (a copy of which is included in *Annex A2*).

4.2 LEGISLATIVE REQUIREMENTS AND EVALUATION CRITERIA

As described in *Section 1*, the decommissioning of the CCPP is classified as a designated project under Item 3 of Part II Schedule 2 of the *Environmental Impact Assessment Ordinance (EIAO)* and hence it requires an EP prior to the decommissioning works.

Section 3.2.1 (ii) of the *EIA Study Brief* requires the EIA study to address likely issues associated with the land contamination due to past uses at the site. The brief requires the contamination impact to be evaluated and assessed as stipulated in Section 3 of Annex 19 of the *Technical Memorandum on the Environmental Impact Process* (EIAO-TM), issued under Section 16 of the *EIAO. Annex* 19 of the *EIAO-TM*: *Guidelines for Assessment of Impact on Sites of Cultural*

Heritage and Other Impacts provides guidance on contamination assessment of potential contaminated land.

The assessment of land contamination sources and the potential impacts to particular development projects are guided by the EPD's *Guidance Manual for Use of Risk-based Remediation Goals (RBRGs) for Contaminated Land Management* (the RBRG Guidance Manual), the associated *Guidance Note for Contaminated Land Assessment and Remediation*, and the EPD's *Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol Filling Stations, Boatyards, and Car Repair/Dismantling Workshop.* The RBRGs were developed for four different post-restoration land-use scenarios. The Project Site is classified as an Industrial Site under the RBRGs.

Of particular relevance to the land contamination assessment for this Project is the concept of preparing a conceptual site model (CSM) for the site, which is referred to in *The Guidance Manual for Use of Risk-based Remediation Goals for Contaminated Land Management.* The guidance manual requires that a CSM is used to illustrate the potential sources of contamination, possible receptors and likely pathways linking the two.

In addition, reference has been made to the following documents published by the EPD.

- Waste Disposal Ordinance (Cap 354);
- Waste Disposal (Chemical Waste) (General) Regulation (Cap 354C);
- *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes,* EPD (1992); and
- Waste Disposal (Charges for Disposal of Construction Waste) Regulation (Cap 354N)

4.3 SITE CONDITIONS

The following sections describe the Project Site, its environmental setting and the CSM.

The following information is contained in the CAP in *Annex A1* and referenced as deemed necessary.

4.3.1 Site Environmental Setting

The Project Site is surrounded by the following land uses.

- *North*: a lawn beyond which is situated a LPG store (to the northwest), and a container office (to the northeast);
- *South*: an internal road, beyond which is the Pulverised Fly Ash (PFA) Grinding and Classification system;

- *East*: the operating cement kiln; and
- *West*: an internal road, beyond which is situated a Pack House and cement silos (to the northwest) and to the southwest, underground fuel storage tanks.

The overall setting of the Green Island Cement Plant (GICP) within which the CCPP is situated is as follows.

- *North:* the Lung Mun Road;
- *South:* the sea;
- *East:* the Shiu Wing Steel works;
- *West:* the Castle Peak Power Station.

The GICP site is constructed on land reclaimed from the sea and as such the underlying groundwater is not considered to be a resource. *Figures D1* and *D2* of the CAP (see *Annex A1*) illustrate the fill materials underlying the GICP site, which appear to be natural hillside stone.

The whole CCPP site area was paved with concrete or asphalt during its operation. *Figure B1* of the CAP shows the layout plan of the CCPP.

4.3.2 Description of Existing Conditions

Present Land Use and Activities of the CCPP

The operation of the CCPP commenced in October 2005 and was stopped in December 2005. No chemicals or hazardous substances were handled at the CCPP. Municipal Solid Waste (MSW) (eg paper, plastics, metals and putrescible materials) was delivered to the Materials Recovery/Recycling Facility (MRRF) by refuse collection vehicles. The waste was unloaded onto an impermeable concrete ground surface and then loaded to the MRRF to recover recyclable materials in the waste. The residual waste was shredded and fed to the co-combustion unit to recover energy from the waste. The flue gas from the combustion process was cleaned prior to discharge to the atmosphere.

The CCPP comprised the following key components:

- The MRRF which consisted of a waste reception hall, trommel screen, separators, shredder, belt conveyors and an underground wastewater storage tank. The wastewater was fed to the on-site wastewater treatment plant of the GICP for treatment and disposal;
- The Main Thermal Treatment System, which consisted of feed and combustion chambers, rotary kiln, pre-calciner, cyclones with tipping valves, bag house filter/dust collector, ash storage tank and heat exchanger among other items; and

• The Lime Cooling System, which consisted of a lime storage bin, feed bin, lime ejector, air blower and cyclone with tipping values.

The layout of the CCPP and location of potential sources of land contamination within the Study Area are shown in *Figure B2* of the CAP. The possible land contamination sources are also shown in *Figure B2* as the rotary kiln, secondary combustion chamber, bag house filter/dust collector and heat exchanger. These are all above ground structures where residues from the various activities may have collected. The wastewater storage tank could also contain residues of wastewater from the MRRF.

As mentioned above, all activities associated with the CCPP have ceased at the Project Site. During the short operation period (11 weeks) of the CCPP no accidents, leakages, spillages or other problems likely to cause land contamination were reported.

Historical Land Use and Activities

The Project Site is situated on an area of reclamation and was developed using fill materials from the nearby hillsides, see *Figures D1* and *D2* of the CAP.

Following start up of the cement plant in 1982, the Project Site was used for stockpiling of cement clinker until 1985. The Project Site was also used as an emergency open stockpile of natural limestone between 1990 and 1994. A propane storage area was reportedly built in the late 1980's, but was never commissioned, and was removed in 1992.

Table 4.3a summarises the historical development of the GICP and CCPP. Further details of the historical land uses are provided in the *Section 2.4* of the CAP.

Time	GICP	CCPP Site
Late 1970s	Site reclamation	-
Before 1982	Construction of the cement plant	-
1982	Operation of the GICP cement kiln began	Reserved for propane storage and used as emergency stockpile of cement clinker until 1985
1984-1990	Operation of the cement kiln suspended	Reserved for propane storage and left vacant
1990-1994	Operation of the cement kiln restarted	Reserved for propane storage and used as emergency storage of limestone imported from Japan

Table 4.3aSite Historical of the GICP and CCPP Site

Time	GICP	CCPP Site
1992	Continuous operation of the GICP	Propane storage was built but never commissioned. It was removed in March 1992
After 1994	Continuous operation of the GICP	Rehabilitated as a kiln lawn until the construction of CCPP
Dec 2001	Clinker production was suspended	Rehabilitated as a kiln lawn until the construction of CCPP
Jun 2004	Clinker production was suspended	Construction of the CCPP foundation
Apr 2005	Clinker production was suspended	First load commissioning test of the CCPP
Jul 2005	Clinker production was suspended	Second load commissioning test of the CCPP
Oct 2005	Clinker production was suspended	Continuous operation of the CCPP
Dec 2005	Clinker production was suspended	Operation ceased after all operation data has been collected
Jan 2006	Clinker production resumed	-

4.4 POTENTIAL SOURCES OF LAND CONTAMINATION AT THE SITE

Based on the historical uses of the Project Site and the environmental setting described above, the following potential existing on and off-site sources of contamination that could affect the Project Site have been identified. They are described in the following sections.

4.4.1 *Off-Site Sources*

- The storage and transfer of fuel (diesel oil) at the fuel underground storage tanks (UST) and dispensing station located approximately 20m to the southwest of the Project Site. The USTs were reportedly constructed of single-shell steel encased in concrete with a minimum thickness of 150mm. In order to minimise risk of accidental oil leakages, tank piping pressure tests/hydraulic tests are conducted once every 5 years. The fuel dispensing station was used for filling of around 20 vehicles per day. The area was paved. The fuel UST and dispensing station will not be included in the proposed decommissioning of CCPP.
- Potential leakage of fuel from overhead fuel pipelines connecting the fuel oil storage tank (located approximately 100m to the southwest of the Project Site) with the CCPP and the main cement kiln. No evidence of leakage was observed during the site visit.

4.4.2 On-Site Sources

- The storage and handling of MSW used in the pilot tests. It is noted that prior to being fed into the rotary kiln, all the wastes were received, stored and sorted in the MRRF, which was an enclosed building with concrete floor. All leachate and wastewater generated in the building was collected in an enclosed drainage system leading to an UST and then transferred to the wastewater treatment plant of the GICP for treatment. The likelihood of the MSW or leachate / wastewater causing contamination below the impermeable concrete floor is considered to be negligible.
- Leakage and/or spillage from the UST for leachate generated from the MRRF. The UST is a steel tank and its integrity has been checked to ensure no leakage prior to use. The tank was used for a short period of time (11 weeks) during the operations of the CCPP and no evidence of leakage/damage was observed. Therefore the likelihood of the leachate / wastewater contaminating the soil around the tank and groundwater is considered to be very low. Moreover, the waste handled at the MRRF was MSW and the leachate generated from the operation of the MRRF would be expected to have been organic in nature and not expected to contain potential contaminants of concern such as heavy metals or persistent organic compounds.
- Leakage/spillage of contaminants from the ash generated from the rotary kiln system during the MSW incineration process. It is noted that all ash generated from the CCPP was collected from the kiln directly into bags and transferred for storage in the reception hall of the MRRF building. After the completion of the pilot test, the remaining ashes were vacuumed from the units and also collected in bags. Therefore it is unlikely that anything more than very limited fugitive ash was spilled on the paved floor of the reception hall. The likelihood of this ash then contaminating the soil or groundwater beneath the paved floor is considered to be negligible.
- Leakage/spillage of contaminants from bottom ash quenching tank located at the bottom of the rotary kiln. It is noted that the bottom ash was quenched, collected in bags and transferred for storage in the reception hall thus limiting the potential for the contamination of the underlying soils and groundwater to negligible levels.

Locations and photos of these potential sources are presented in the CAP (*Annex A1*).

The whole Project Site area was paved with concrete and asphalt. The wastewater from the MRRF was connected to a collection sump and was then transferred for treatment at GICP. The stormwater run-off from the outdoor plant area was collected within the GICP drainage system.

It was observed that the fuel oil transfer pipelines used overhead pipes. No oil, ash and wastewater spillage/leakage had reportedly occurred at the

Project Site during its short period of operation and none were observed during the site visit.

Potential existing off-site sources of soil and groundwater contamination are associated with the current operation of the cement plant surrounding the Project Site. Further off-site, the potential sources may include the power station and a steel manufacturing plant which are also industrial use.

4.4.3 Potential Future Source

The Project Site's future use remains industrial (manufacture of cement and cement related products) and is surrounded by remaining areas of the GICP. After decommissioning, the concrete and asphalt slab and concrete foundations and sub structures will be excavated, to a maximum depth of 1.5m. The whole Project Site will then be levelled using clean imported materials. The Project Site will remain as an open area for the operation and future development of the GICP. It is currently proposed that the surface of the clean imported materials will be rehabilitated into a grass lawn.

All traces of MSW and the associated CCPP will have been removed and there will not be a potential source of contamination present at the Project Site.

4.5 LAND CONTAMINATION SITE INVESTIGATION PROGRAMME

An intrusive contamination investigation was conducted at the Project Site, details of which are presented in the CAR (see *Annex A2*). The site investigation (SI) included:

- Excavation of six trial pits down to a maximum of 1.5m below ground level (m bgl), with two trial pits (S1/S2 and S3/S4) located adjacent to the wastewater UST and four trial pits (S5/S6, S7/S8, S9/S10 and S11/S12) located around the CCPP area to determine any soil contamination;
- Sampling of two (2) soil samples were taken from each sampling location at just below the concrete pavement and at between 1.0 to 1.5m bgl for laboratory analysis of potential contaminants plus QA/QC samples;
- Laboratory analysis of soil samples for heavy metals (including Antimony (Sb), Arsenic (As), Barium (Ba), Cadmium (Cd), Chromium III and VI (Cr III and Cr VI), Cobalt (Co), Nickel (Ni), Copper (Cu), Lead (Pb), Manganese (Mn), Mercury (Hg), Molybdenum (Mo), Nickel (Ni), Tin (Sn), and Zinc (Zn)); total petroleum hydrocarbons (TPH); and benzene, toluene, ethyl benzene, and xylene (BTEX); and
- Laboratory analysis of three soil samples for Polychlorinated biphenyls (PCBs) and Polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs) (see *Annex A3*).

4.5.1 Soil Analytical Results

The results of the laboratory analysis of the soil samples are presented in *Tables 4.5a*.

Levels of TPH analysed for all three carbon ranges were below the reported detection limits for all samples. Concentrations of BTEX were also below the reported detection limits at all locations. Levels of all metals analysed in all samples were well below the RBRG values. Levels of PCBs, dioxins and furans analysed in all samples were well below the RBRG values for soil in industrial area. Therefore, no concern of dioxins/ PCBs contamination in the soil is expected.

The detailed results of the laboratory analysis of the samples with the QA/QC information are presented in the CAR (*Annex A2*) and *Annex A3* of this report.

Parameters	LOR ^(a)	S1	S2	S 3	S4	S5	S6	S7	S 8	S9	S10	S11	S12	S13 ^(b)	RBRG Industrial	C_{sat} (d)
% Moisture Content	0.1	15.3	8.1	10.6	9.8	10.3	9.8	9.4	10.6	7.4	7.5	9.5	10.6	7.6	-	-
TPH																
C6-C8 Fraction	5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	1.00E+04	1.00E+03
C9-C16 Fraction	200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	1.00E+04	3.00E+03
C17-C35 Fraction	500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	1.00E+04	5.00E+03
Benzene	0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	9.12E+00	3.36E+02
Toluene	0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	1.00E+04	2.35E+02
Ethyl-benzene	0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	8.24E+03	1.38E+02
m,p-Xylene	0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	1.23E+03(c)	1.50E+02(c)
o-Xylene	0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	1.23E+03(c)	1.50E+02(c)
Priority Metal																
Antimony (Sb)	1	7	<1	5	<1	2	<1	1	<1	<1	<1	2	1	<1	2.61E+02	-
Arsenic (As)	1	25	<1	25	<1	2	<1	1	<1	<1	<1	4	1	2	1.96E+02	-
• Barium (Ba)	0.5	110	30.4	109	23.1	53.4	23.1	41.5	29.4	22.8	21.1	60.4	35.8	24.5	1.00E+04	-
Cadmium (Cd)	0.2	2.2	0.2	0.7	< 0.2	0.6	< 0.2	0.5	< 0.2	< 0.2	< 0.2	0.6	0.7	< 0.2	6.53E+02	-
• Chromium III (Cr III)	0.5	35.3	8.8	28.2	2.3	14.2	3	12.1	4.2	8.5	3.2	15.7	21.5	24.5	1.00E+04	-
• Chromium VI (Cr VI)	0.5	< 0.5	< 0.5	0.8	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	1.2	1.96E+03	-
Cobalt (Co)	0.5	11.5	3.2	14.6	2.7	3.9	3.4	5.2	2.6	2.3	1.4	4.3	3.7	3.5	1.00E+04	-
Copper (Cu)	1	226	22	103	2	35	2	20	3	17	2	57	32	30	1.00E+04	-
• Lead (Pb)	1	85	42	35	61	54	59	46	42	51	42	49	42	47	2.29E+03	-
• Manganese (Mn)	0.5	152	452	447	296	279	265	339	254	364	316	298	221	344	1.00E+04	-
• Mercury (Hg)	0.05	0.24	< 0.05	0.08	< 0.05	< 0.05	< 0.05	0.05	< 0.05	< 0.05	< 0.05	0.05	< 0.05	< 0.05	3.84E+01	-
Molybdenum (Mo)	1	77	3	33	5	19	2	7	2	2	2	21	12	4	3.26E+03	-
Nickel (Ni)	1	21	3	22	1	<1	<1	3	<1	2	<1	2	<1	13	1.00E+04	-
• Tin (Sn)	0.5	45.7	5.4	8.2	4.2	7.4	4.3	5.5	4	4.2	2.6	7.6	5.8	6.9	1.00E+04	-
• Zinc (Zn)	1	523	72	387	31	116	31	114	34	92	32	142	162	228	1.00E+04	-

Table 4.5aSoil Analytical Results (all results in mg/kg dry weight)

ENVIRONMENTAL RESOURCES MANAGEMENT

Parameters	LOR ^(a)	S1	S2	S3	<i>S</i> 4	S5	S6	S7	S 8	S9	S10	S11	S12	S13 ^(b)	RBRG Industrial	C_{sat} (d)
Dioxins and Furans (e)																
• PCDD/F	Note (f)	1.2E-04	-	-	-	6.3E-06	-	8.9E-06	-	-	-	-	-	-	5.00E-03	-
• PCBs	Note (f)	9.8E-06	-	-	-	6.1E-07	-	6.4E-07	-	-	-	-	-	-	7.48E-01	-
Notes:																

(a) LOR = Limit of reporting

(b) The duplicate sample taken from S7

(c) The RBRG Industrial values for Total Xylenes

(d) The C_{sat} value/limit is the contaminant concentration in soil at which the absorptive limits of the soil particles, the solubility limits of the soil pore water and saturation of soil pore air have been reached

(e) Based on the locations and their potential of PCDD/Fs and PCBs contamination, laboratory analysis for PCBs and PCDD/Fs were conducted for three soil samples (S1, S5 & S7).

(f) The limits of detection for different PCDD/Fs and PCBs compounds can be referred to the Annex A3.

4.6 LAND CONTAMINATION IMPACT ASSESSMENT

4.6.1 Conceptual Site Model at the CCPP Site

Based on the above sources identified and the results of the investigation a conceptual site model has been constructed for the Project Site as presented in *Table 4.6a* (see also *Section 3* of the CAR).

Source	Pathway	Receptor	Risk
Historical storage of cement and limestone/ foundation construction	Ingestion, inhalation and skin contact	Site workers involved in the decommissioning and demolition work	None – The concentrations in the soil samples were well below the RBRGs. The demolition work will be limited to the top 1.5 m and hence will not touch these materials.
	Soil pore migration	Ground and surface waters	None – The concentrations in the soil samples were well below the RBRGs. The storage occurred over 10 years ago.
MSW feedstock	Ingestion, inhalation and skin contact	Humans (eg Site workers during decommissioning and demolition works)	None – The concentrations in the soil samples were well below the RBRGs. No MSW remains on site at the time of the site visit.
Ash residue from the thermal treatment trial	Ingestion, inhalation and skin contact	Humans (eg Site workers during decommissioning and demolition works)	None – The concentrations in the soil samples were well below the RBRGs. No ash residues were left on the ground at the time of the site visit. The residues currently properly stored within the MRRF building and will be properly utilised or disposed of.
Liquid runoff from MSW/ash	Ingestion, inhalation and skin contacts	Humans (eg Site workers during decommissioning and demolition works)	None – The concentrations in the soil samples were well below the RBRGs.
Liquid runoff from MSW/ash	Soil pore water	Groundwater/ surface water	None – The concentrations in the soil samples were well below the RBRGs. Impermeable hardstanding and enclosed drainage system. No leakage of the wastewater collection UST reported.
Off-site contamination sources	Migration on to the CCPP site via soil pore water or air borne dust	Humans - Site workers during decommissioning Groundwater under the Site	None – The concentrations in the soil samples were well below the RBRGs. There was no evidence to suggest any spillages or leaks have occurred off-site to such an extent as to impact the soils or groundwater underlying the Project Site.

Table 4.6aConceptual Model at the CCPP Site

4.6.2 Potential Impacts

It is considered that the only potential receptors at risk might be site workers involved in decommissioning and demolition works, which was discussed in the *CAP* (see *Annex A1*).

As the contaminants analysed were either not detected or with concentrations well below the RBRGs, it is not considered that the activities of the CCPP pose risks to any receptor.

No potential land contamination impact is anticipated during the CCPP demolition or thereafter.

4.7 LAND CONTAMINATION MITIGATION MEASURES

Based on the above investigation results, no mitigation measures are required during the demolition works.

4.8 RESIDUAL ENVIRONMENTAL IMPACTS

After completion of demolition works, the Project Site will be backfilled with clean soil and landscaped. The area will be left as an open grassed area whilst awaiting a future industrial use as part of the GICP operation.

There will not be any residual impacts at the Project Site after completion of the demolition works.

4.9 ENVIRONMENTAL MONITORING AND AUDIT

Based on the above investigation results, no further investigation is warranted.

As no potential risks to receptors anticipated, no monitoring is deemed necessary.

4.10 CONCLUSIONS

The assessment of land contamination sources and the potential impacts to potential receptors were investigated in accordance with the *RBRG Guidance*. Site appraisal comprising a site visit, and a review of background information and land history in relation to possible land contamination was conducted. Potential sources of contamination and associated impacts, risks or hazards are identified in the *CAP* (see *Annex A1*). Land contamination assessment was carried out and results presented in the *CAR* (see *Annex A2*).

The results of the site investigation works determined that:

• TPH/BTEX were below the reported detection limits in any of the soil samples collected;

- Concentrations of priority pollutant metals detected were well below the RBRG standards; and
- Levels of PCBs, dioxins and furans analysed in all samples were well below the RBRG values.

Excavation works proposed for the decommissioning and demolition works will be limited to the concrete sub-structures and UST. No soil excavation or groundwater extraction will be required for the Project and hence no off-site disposal of soil and groundwater will be required.

The substructure areas of the Project Site will be filled using clean imported fill materials and rehabilitated as green lawn and open area. The potential for human contact with any underlying contamination in the future is considered low.

As the result of the above, no potential impact from the contaminated soil is anticipated.

This page is deliberately left blank

5 WASTE MANAGEMENT IMPLICATIONS

5.1 INTRODUCTION

This *Section* identifies the potential wastes arising from the demolition of the CCPP and potential environmental impacts associated with the handling and disposal of the waste. The assessment was undertaken in accordance with the criteria presented in *Annexes* 7 and 15 of the *EIAO-TM*, which are summarised as follows:

- Evaluate opportunities to reduce, reuse and recycle waste;
- Estimate the types and quantities of the wastes to be generated; and
- Assess the secondary environmental impacts due to the management of waste with respect to potential hazards, air and odour emissions, noise, wastewater discharges and traffic.

5.2 LEGISLATION REQUIREMENTS AND EVALUATION CRITERIA

The following legislation covers, or has some bearing upon, the handling, treatment and disposal of wastes in Hong Kong, and has been 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;
- Waste Disposal (Charges for Disposal of Construction Waste) Regulation (Cap 354N)

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 de-sludging, de-silting or dredging works.

The Construction Waste Disposal Charging Scheme came into operation on 1 December 2005. Processing of account applications by the EPD started on the same day. A contractor who undertakes construction work with value of HK\$1 million or above is required to open a billing account solely for the contract. Charging for the disposal of construction waste started on 20 January 2006.

Depending on the percentage of inert materials in the material, construction waste can be disposed of at public fill reception facilities, landfills and outlying islands transfer facilities, where differing disposal costs would be applied. The scheme encourages waste reduction so that the contractor or Project Proponent can minimise their costs. *Table 5.2a* summarises the Government's construction waste disposal facilities, the types of waste accepted and disposal the associated costs.

Table 5.2aGovernment 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.

Chemical waste producers shall register 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 construction waste ⁽¹⁾ (also called public fill) may be taken to public fill reception facilities. Public fill reception facilities are operated by the Civil Engineering and Development Department (CEDD). The *Land (Miscellaneous Provisions) Ordinance* requires that individuals or companies who deliver public fill to the public fill reception facilities 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 fill reception facilities will only accept inert earth, soil, sand, rock, boulder, rubble, brick, tile, concrete, asphalt, masonry or used bentonite. In addition, in accordance with paragraph 11 of ETWB-TC (Works) No. 31/2004, Public Fill Committee will advise on the acceptance criteria (eg no mixing of construction waste, nominal size of the materials less than 250mm, etc. 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 fill reception facility.

5.2.4 Public Cleansing and Prevention of Nuisances Regulation

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

5.2.5 Landfill Disposal Criteria for Contaminated Soil

No contaminated soil will be generated due to the demolition of the CCPP (see *Section 4*). If the residues generated from the cleaning of the Co-Combustion unit have to be disposed of at the designated landfill, the residues have to meet the landfill disposal criteria. The criteria are set primarily in terms of Toxicity Characteristic Leaching Procedure (TCLP) limits and are summarised in *Table 5.2b*.

^{(1) &}quot;Construction waste" 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 fill reception facilities. The rock and concrete can be crushed and processed to produce aggregates for various civil and building engineering applications. The remaining construction waste (comprising timber, paper, plastics, and general refuse) are to be disposed of at landfills.

Parameter	TCLP Limit (ppm or mg L ⁻¹)
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	1,000
Note:	

(a) Soil samples should be stored at 0 - 4°C. The allowable storage time for mercury in soil samples is 8 days while the storage time for the rest of the parameters 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.

5.2.6 Other Relevant Guidelines

Other 'guideline' documents, which detail how the project proponent or contractor should comply with the local regulations, are as follows:

- *Waste Disposal Plan for Hong Kong* (December 1989), Planning, Environment and Lands Branch Government Secretariat, Hong Kong Government;
- *Environmental Guidelines for Planning In Hong Kong* (1990), 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 Bureau, Hong Kong 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 Subcommittee Papers; Works Bureau, Hong Kong SAR Government;
- *WBTC No. 12/2000, Fill Management;* Works Bureau, Hong Kong SAR Government;
- ETWB TCW No. 33/2002, Management of Construction and Demolition Material Including Rock; Environment, Transport and Works Bureau, Hong Kong SAR Government;
- ETWB TCW No. 31/2004, Trip Ticket System for Disposal of Construction & Demolition Materials, Environment, Transport and Works Bureau, Hong Kong SAR Government; and
- ETWB TCW No. 19/2005, Environmental Management on Construction Sites, Environment, Transport and Works Bureau, Hong Kong SAR Government.

5.3 EXPECTED WASTE SOURCES

All equipments and building/structures of the CCPP are made from asbestosfree materials and therefore no asbestos containing materials are expected to be arisen from the decommissioning and demolition works. During the pilot demonstration, all MSW delivered to the site was treated and no MSW is currently stored on-site. However, the following wastes will be generated from the demolition and cleaning of the CCPP or need to be handled during the decommissioning of the Project:

- Bottom ash and fly ash collected during the operation of the CCPP;
- Lining of the Co-Combustion unit, such as refractory bricks of the rotary kiln;
- Scrap metals from dismantling of the MRRF building and Co-combustion unit;
- Reinforced concrete from demolition of the concrete structures (fire services water tank and pump house), and foundation;
- Asphaltic concrete from site pavement;
- Chemical waste;
- Sewage; and
- General waste.

The potential environmental impacts associated with handling, storage, transport and disposal of these wastes are assessed in the following section.

5.4 ASSESSMENT METHODOLOGY

The potential environmental impacts associated with the handling and disposal of waste arising from the demolition of the CCPP were assessed in accordance with the criteria presented in *Annexes* 7 and 15 of the *EIAO-TM* and summarised as follows:

- Estimation of the types, quantities and timing of the wastes to be generated based on sequence and duration of the decommissioning and demolition activities;
- Evaluation of different opportunities for reducing waste generation and reuse/recycling on-site or off-site;
- Estimation of types and quantities of waste required to be disposed of and description of the disposal options; and
- Assessment of the secondary environmental impacts due to the management of the waste with respect to potential hazards, air and odour emissions, noise, wastewater discharges and traffic.

5.5 WASTE MANAGEMENT ASSESSMENT

5.5.1 Co-Combustion Residues

Bottom ash (residues from the rotary kiln) and fly ash (residues from dust collector) were generated during the commissioning and operation of the CCPP. After decommissioning of the CCPP, the residues were collected and placed in sealed bags with labels. The bags are currently stored at the reception hall of the MRRF building. *Table 5.5a* summarises the quantities of bottom ash and fly ash stored on-site.

Phases	Bottom	Ash	Fly Ash ^(a)							
	Weight (tonnes)	No. of bags	Weight (tonnes)	No. of bags						
Load Commissioning 1	3.06	5	12.43	(b)						
Load Commissioning 2	6.27	9	33.53	12						
Operation	60.65	89	83.43	123						
Total	70.0	103	129.4	135						
Notes:										
(a) Fly ash mixed with the residues collected from the gas cooler.										

Table 5.5aInventory of Bottom Ash and Fly Ash

(b) Less than 1 bag of fly ash was collected during load commissioning 1.

Laboratory Analysis Results

The quality of the residues is analysed in order to assess the opportunity for on-site use as a raw material for the cement production and to determine if further treatment will be required if the residues are to be disposed of at landfill. Bottom and fly ash samples were taken for laboratory analysis by ALS Technichem (HK) Pty Limited (a laboratory accredited under the Hong Kong Laboratory Accreditation Scheme (HKOLAS)) (see *Figure 5.5a*). Twenty-five (25) bags of residues were selected randomly from each ash category and about 500 grams of ash were taken from each bag. Five samples were combined to form one composite sample so that 5 composite samples of bottom ash and 5 composite samples of fly ash were collected for laboratory analysis. Toxicity Characteristic Leaching Procedure (TCLP) tests were carried out for the composite samples in order to determine whether the samples comply with the landfill disposal criteria. Heavy metals, dioxins/furans (polychlorinated dibenzodioxins (PCDD)/ dibenzofurans (PCDF)) and polychlorinated biphenyls (PCBs) contents of the ashes were also analysed. *Table 5.5b* and *5.5c* summarise the analysis results of the samples.

The results indicate that the residues contain a trace amount of dioxins (in part per trillion (ppt) level or 1x 10⁻¹²) and very low heavy metal concentrations. The TCLP results for both fly ash and bottom ash show that the heavy metal concentrations are well below the respective limits of the landfill disposal criteria (the concentrations of most of the parameters are below the detection limits). No treatment (e.g. stabilisation or fixation) will be required if the residues are to be disposed of at landfill. An advance agreement should be obtained from the Landfill Authority (EPD) for disposal of the residues at landfill.



Ashes were placed in sealed bags with labels within the MRRF building





Ashes sampling

Samples were labelled and stored for delivery to laboratory testing (Bottom Ash)



Samples were labelled and stored for delivery to laboratory testing (Fly Ash)

Environmental Resources Management



Figure 5.5a

FILE: 0071019j DATE: 21/07/2008

Ashes sampling

Parameter	Analytical Method	Assessment Criteria	Limit of Reporting			Fly Ash			Bottom Ash					
		(a) (mg L-1)	(mg L-1)		Composi	ite Sampl	e (mg L-1)			Composite Sample (mg L-1)				
				1-5	6-10	11-15	16-20	21-25	1-5	6-10	11-15	16-20	21-25	
TCLP Test														
Antimony		150	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	
Arsenic		50	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	
• Barium		1,000	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	
Beryllium		10	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	
Cadmium		10	0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	
Chromium		50	1	1	< 1	< 1	< 1	1	< 1	< 1	< 1	< 1	< 1	
Copper		250	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	
• Lead	USEPA Method 1311,	50	1	< 1	1	< 1	< 1	< 1	< 1	1	< 1	< 1	< 1	
• Mercury	3050B or 6010C	1	0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	
Nickel		250	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	
Selenium		1	0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	
• Silver		50	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	
Thallium		50	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	
• Tin		250	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	
• Vanadium		250	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	
• Zinc		250	1	< 1	< 1	<1	< 1	< 1	< 1	< 1	<1	<1	< 1	

Table 5.5b TCLP Test Results of Co-Combustion Residues

Notes:

(a) Assessment criteria are based on Landfill Disposal Criteria for Contaminated Soil (TCLP limits).

(b) Soil samples should be stored at 0 – 4 °C. The allowable storage time for mercury in soil samples is 8 days while the storage time for the rest of the parameters 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.

Parameter	Analytical Method	Limit of Reporting			Fly Ash					Bottom Asl	ı	
		(mg kg ⁻¹)		Composi	ite Sample	(mg kg	-1)		Compos	ite Sample	(mg kg ⁻¹)
			1-5	6-10	11-15	16-20	21-25	1-5	6-10	11-15	16-20	21-25
Dioxins Concentration												
PCDD/F (I-TEQ)	USEPA Method 8290 or equivalent	See Note (a) (b)	5 x 10-6	-	5.1x10-6	-	3.6x10 ⁻⁶	5.3x10-6	-	4.9x 10 ⁻⁶	-	5.6 x 10 ⁻⁶
Dioxin-like PCBs	USEPA Method 1668	See Note (a) (b)	1.2x10-6	-	1.3x10-6	-	1.1x10-6	1.0x10-6	-	1.3x 10-6	-	1.1 x 10-6
Heavy Metal Analysis												
Antimony		1	9	7	11	4	11	34	41	42	65	42
Arsenic		1	< 1	<1	1	2	2	2	4	5	6	4
• Barium		0.5	176	94.1	166	43.4	203	1180	1480	1280	1250	942
Cadmium		0.2	8.6	5.5	8.7	2.8	6.4	2.8	0.9	2.0	2.2	0.8
Trivalent Chromium		1	22	23	21	10	20	91	136	148	1110	195
Hexavalent Chromium		1	37	32	35	10	46	< 1	3	3	6	5
• Cobalt	USEPA Method 6020A/7000	0.5	2.2	1.7	2.6	1.6	2.2	8.9	12.6	9.4	16.4	7.4
Copper	ICPMS	1	71	56	79	24	76	1620	1380	2400	1470	1720
• Lead		1	303	309	176	155	258	352	158	1970	1310	113
Manganese		0.5	134	217	210	256	110	668	970	752	1050	842
Mercury		0.05	0.36	0.31	0.23	0.14	0.51	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Molybdenum		1	4	2	4	3	4	11	15	8	35	9
Nickel		1	7	8	11	4	9	104	70	113	672	69
• Tin		0.5	55.7	27.3	56.9	13.0	32.6	268	202	2300	330	280
Zinc		1	236	164	306	95	201	3970	2310	3490	3040	3360
Thallium		1	< 1	<1	< 1	< 1	< 1	< 1	< 1	< 1	<1	< 1
Vanadium		1	3	4	3	2	4	14	19	6	8	7

Table 5.5c Dioxins and Heavy Metal Concentrations in Co-Combustion Residues

Notes:

(a) The testing of PCDD/F and dioxin-PCBs consist of a range of testing for elements in the groups and their isomers with different limits of detection and quantification. Details of limits of detection and limit of quantification can be found in the testing report attached in *Annex B*.

(b) Three fly ash samples and three bottom ash samples were taken for PCDD/F and PCBs testing. The results presented in the table are the highest concentrations.

Reuse of the Residues for Cement Production

GIC has commissioned the Hong Kong University of Science and Technology (HKUST) to assess the feasibility of using fly ash and bottom ash as the raw material for production of cement clinker of the GICP. The physical properties and chemical composition of the residues were analysed. The results show that the characteristics ⁽¹⁾ of the both residues are similar to those of the typical clinker raw materials (including pulverised fly ash and bottom ash from coal fired power station, iron/copper slag). The ingredients of both residues show the normal chemical substances associated with cement clinker raw feed materials (ie calcium carbonate/calcium oxide/calcium salts, alumina, and iron/copper slag). The residues contain very low levels of heavy metals and extremely low levels of (in the order of part per trillion) dioxins (see *Table 5.5c*). The heavy metals will be encapsulated in the cement clinker at high temperature and the trace dioxins will be destroyed in the precalciner at about 1,040°C and in the cement kiln at about 1,400°C. The reuse of the residues for the cement clinker production will not cause adverse impacts on the gaseous emissions of the cement plant and the cement quality. It is therefore considered that the residues could be used as an alternative feedstock for the clinker production.

Table 5.5d presents the key parameters related to the assessment of the suitability of the residues to be used for cement clinker production.

GIC Cement Raw Materials	Bottom Ash	Fly Ash		
Powderly	Powderly	Powderly		
Al, Ca and Fe are the major components of cement. The raw materials for production of Portland cement clinker should have a levels of Al (>25,000 mg/kg) , Ca (>300,000 mg/kg) and Fe	Contain high levels of Al (> 25,000 mg/kg), Ca (> 300,000 mg/kg), and Fe which are comparable with those of the cement raw materials	Contain high levels of Al (> 25,000 mg/kg), Ca and Fe which are comparable with those of the cement raw materials		
Calcium oxide is the essential component of the raw materials for cement manufacturing. It represents about 80% (w/w) of the raw materials feed to the kiln	Calcium oxide is presented as the highest metal component, representing 80% w/w of the raw material feed to a Portland cement clinker kiln. Laboratory trial and test results showed that the quality of cement produced with bottom ash as part of the raw materials is identical to that of GIC cement.	Calcium oxide is presented as the highest metal component, representing 80% w/w of the raw material feed to a Portland cement clinker kiln. In addition, it has a high calcium carbonate/ calcium oxide content		

Table 5.5dComparison of the Characteristics of GIC Cement Raw Materials and the Co-
Combustion Residues

 Physical composition include: metals, glass, ceramics, alkali, silicates, and oxide residues. Chemical composition include: heavy metals, metals, elemental-C, H, N, O, S, Cl, loss on ignition, dioxins and dioxin-like PCBs.

GIC Cement Raw Materials	Bottom Ash	Fly Ash
	Bottom ash contains very	Fly ash contains very
	low levels of heavy metals	low levels of heavy metals
	and extremely low levels	and extremely low levels
	(pg/kg) of dioxins, which has	(pg/kg) of dioxins, which has
	no adverse impacts on the air	no adverse impacts on the air
	emissions of the cement plant	emissions of the cement plant

In order to maintain the same quality of cement clinker, a feed loading rate of 0.5% w/w of Co-Combustion residues to other raw materials will be used. Based on the current production rate of the cement plant, the residues will be added to the raw materials ⁽¹⁾ at a rate of 1.25 tonnes per hour prior to milling. Under this loading rate, it will take about 56 hours and 104 hours to reuse all the bottom ash and fly ash, respectively.

With respect to the short duration (7 days) that the residues will be processed at the cement plant, it is anticipated that the potential air quality impact will be minimal and is transient.

It is recommended that the Co-Combustion residues to be reused as a raw material for the cement production at the GICP as it will avoid the need to dispose the residues at landfill. Disposal of the residues at landfill should be considered as a last resort. As the TCLP tests indicate that the residues comply with the landfill disposal criteria, no further treatment will be required for landfill disposal. However, an advance agreement should be obtained from the Landfill Authority (EPD) for the disposal of residues at landfill.

5.5.2 Inner Lining Materials from the Thermal Treatment Facilities

The refractory bricks of the rotary kiln and the castable lining of the secondary combustion chamber and duct works will be removed. The materials will be placed in sealed bags and disposed of at a designated landfill. The internal wall of the kiln, secondary combustion chamber and duct works will be properly cleaned with wet cloths. The cleaning materials will be collected and placed in sealed plastic bags and disposed of at a designated landfill. All these materials are asbestos free. *Table 5.5e* presents the estimated quantities of the refractory bricks and lining materials to be removed.

Table 5.5eRefractory Bricks and Castable Lining to be Removed during Cleaning
Process

Items	Description	Weight (tonnes)
Refractory bricks / castable lining	Refractory bricks and castable lining of the C-Combustion unit	345
Dust collector and duct works	Residual dust inside the Co-Combustion unit	5.5
Others	Materials used for cleaning process (eg wiping cloths)	0.5
Total		351

(1) The raw materials are being processed at a rate of 250 tonnes per hour.

Samples have been taken from the refractory bricks and castable lining of the Co-Combustion unit and analysed by a HKOLAS Laboratory for TCLP and dioxins. The sampling locations of refractory bricks and castable lining are listed in *Table 5.5f* and shown in *Figure 5.5b*.

Location Number	Description
1	Rotary Kiln
2	Rotary Kiln
3	Rotary Kiln
4	Secondary Combustion Chamber
5	Gas Chamber 1
6	Gas Chamber 2
7	Cyclone 1
8	Cyclone 2
9	Ash outlet from cyclones
10	Duct to gas cooler
Dioxin Sample A	Mixture of sample 1, 2 and 3
Dioxin Sample B	Sample 4
Dioxin Sample C	Mixture of sample 7 and 8

 Table 5.5f
 Refractory Bricks and Castable Lining Sampling Locations

The residues inside the Co-Combustion equipment will be used as part of the raw materials for the cement production. Disposal of the residues at landfill will be the last resort. The laboratory analysis results are presented in *Table 5.5g* and *Table 5.5h*. The TCLP tests show that the concentrations of various metals in the leachate of the refractory kiln bricks and castable lining samples are well below the landfill disposal criteria for contaminated soil (the concentration of most of the heavy metals in the leachate is below the detection limits). It is therefore considered that the materials could be disposed of at a designated landfill without further treatment (eg stabilisation or fixation). An agreement should be obtained from the Landfill Authority (EPD) for the disposal of the residues at landfill.



Parameter Analytical Method		Assessment	Limit of Reporting	Sampling location (Refer to Figure 5.5b)									
	Criteria ^(a)	Criteria ^(a) (mg L ⁻¹)	1	2	3	4	5	6	7	8	9	10	
							Con	centratior	(mg L-1)				
TCLP Test													
Antimony		150	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
• Arsenic		50	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
• Barium		1000	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
• Beryllium		10	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Cadmium		10	0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Chromium		50	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	4	< 1
Copper		250	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
• Lead	USEPA Method 1311,	50	1	< 1	< 1	< 1	< 1	< 1	< 1	1	< 1	< 1	< 1
• Mercury	3050B or 6010C	1	0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Nickel		250	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Selenium		1	0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
• Silver		50	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Thallium		50	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
• Tin		250	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
• Vanadium		250	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
• Zinc		250	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1

Table 5.5g TCLP Test Results of the Castable Lining/ Refractory Brick Samples

Notes:

(a) Assessment criteria are based on Landfill Disposal Criteria for Contaminated Soil (TCLP limits).

(b) Soil samples should be stored at 0 – 4 °C. The allowable storage time for mercury in soil samples is 8 days while the storage time for the rest of the parameters 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.

Parameter	Analytical Method	Limit of Reporting (mg kg ⁻¹)	Sampling location (Refer to <i>Figure 5.5b</i>)									
			1	2	3	4	5	6	7	8	9	10
			Concentration (mg kg ⁻¹)									
Dioxins Concentration												
Dioxins (I-TEQ)	USEPA Method 1613	See Note ^(a)	1.6x10-6 (b)			1.7x10-6 (b)			1.3x10-6 (b)			
Heavy Metal Analysis												
Antimony		1	1	< 1	3	< 1	2	< 1	< 1	< 1	3	< 1
• Arsenic		1	5	4	4	< 1	12	3	2	2	6	3
• Barium		0.5	38	18	141	33	43	37	36	67	137	29
Cadmium		0.2	0.3	0.3	1.6	< 0.2	0.7	0.3	0.3	< 0.2	4.1	< 0.2
Trivalent Chromium		1	8	3	14	2	12	21	26	35	315	39
Hexavalent Chromium		1	< 1	< 1	< 1	< 1	< 1	1	14	4	128	6
• Cobalt	USEPA Method 6020A/7000	0.5	< 1	2	3	< 1	< 1	2	< 1	2	10	1
• Copper	ICPMS	1	25	4	18	5	5	15	6	19	41	18
• Lead		1	13	9	67	72	63	22	34	94	200	13
• Manganese		0.5	47	26	72	33	53	49	37	83	600	66
Mercury		0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Molybdenum		1	< 1	< 1	< 1	< 1	3	1	< 1	1	13	2
Nickel		1	11	3	7	< 1	< 1	7	4	15	310	6
• Tin		0.5	10	< 1	14	< 1	6	3	2	2	11	3
• Zinc		1	77	3	72	37	24	236	9	18	77	14
• Thallium		1	< 1	< 1	<1	<1	<1	<1	<1	<1	<1	< 1
Vanadium		1	32	28	48	82	57	79	80	77	23	62

Table 5.5h Heavy Metal and Dioxins Concentrations in the Castable Lining/ Refractory Bricks Samples

(a) The testing of PCDD/F consists of a range of testing for elements in the groups and their isomers with different limits of detection and quantification. Details of limits of detection and limit of quantification can be found in the testing report attached in *Annex B*.

(b) Dioxins Sample A is a composite sample of samples 1, 2 & 3; dioxins sample B is from sample 4; dioxins sample C is a composite sample of samples 7 & 8. The results presented in the table are the maximum concentrations of the samples.

Notes:

5.5.3 Reuse and Recycling of the MRRF Equipment and Scrap Metals

Most of the plant and equipment of the MRRF (including magnetic separator, eddy current separator, etc) are still in good serviceable conditions and will be sold to other MRRF operators or second hand equipment vendors. The other components will be dismantled and sold as scrap metals.

The steel frame structure of the MRRF building will be demolished. The steel beams and column will be cut to manageable size to facilitate transportation. This together with the metal claddings and scrap metals from the MRRF equipment will be sold to scrap metal recyclers.

After cleaning, the metals recovered from dismantling of the Co-Combustion unit (including the rotary kiln, secondary combustion chamber, duct works, gas cooler and dust collector) will be sold to recyclers (about 369 tonnes).

Table 5.5i summarises the equipment of the MRRF to be reused and quantities of scrap metal to be recycled.

System	Description	Estimated Weight (tonnes)				
		Equipment to be	Scrap metals to be			
		reused	recycled			
MRRF	Trommel	2				
	Ballistic separator	14				
	Magnetic separator	5				
	Aluminium separator	2				
	Belt conveyor	31				
	Steel structure		70			
Co-Combustion	Rotary kiln		88			
Unit	Feed chamber for rotary kiln		12			
	Secondary combustion chamber		100			
	Precalciner		141			
	Cyclone		71			
	Flue gas ducting		41			
	Discharge ducting		18			
	Tipping valve		6			
	Gas cooler		12			
	Dust collectors		19			
	Fans with motor	8				
	Ash storage tank		5			
	Bucket elevator		4			
	Urea water tank		4			
	Bottom ash drag chain conveyor		3			
	Steel structure		120			
Total		62	369 (a)			

Table 5.5iEquipments to be Reused and Quantities of Scrap Metal to be Recycled

5.5.4 Construction and Demolition Materials

The public fill (consisting of concrete and asphaltic concrete) will be generated from the demolition of the site pavement, fire services water storage tank and pump house, and foundation and sub-structures of the MRRF building and Co-Combustion unit. *Table 5.5j* presents the quantities of public fill to be generated from the demolition works and need to be disposed of at the public fill reception facilities (eg Tuen Mun Area 38).

C&D Materials	Sources	In Situ Volume (m³)	Bulk Volume to be disposed of (m ³)
Reinforced Concrete	Foundation of MRRF building and the Co-Combustion unit	950	1,330
	Fire water pump house	18	25.2
	Fire water tank	46	64.4
Asphaltic concrete	Surface layout of pavement	276	386.4
	Total	1,290	1,806

Table 5.5jQuantities of Public Fill to be Generated from the Demolition Works

No soil will be removed from the Project Site due to the demolition works.

The handling and temporary storage of such a small volume of public fill onsite will not cause adverse environmental impact. It is estimated that about 269 truck trips (assuming a payload of 6.7 m³ per truck) will be required to transport all public fill to the Tuen Mun Area 38 Fill Bank and a maximum of 10 truck trips per day will be generated. This small traffic flow will not cause adverse traffic impact to the local road network, and noise and air quality impacts. The disposal of a small quantity of public fill to the Tuen Mun Area 38 Fill Bank will not cause adverse operation impact to the fill bank. An advance agreement should be obtained from the Public Fill Committee (PFC) for the disposal of the anticipated amount of public fill at the designated public filling facilities.

5.5.5 *Chemical Waste*

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.

The remainder of unused reagents for the operation of the CCPP will be removed before demolition works. The unused reagents will be recycled by the suppliers or reused on-site as far as possible. As the last resort, the leftover reagents will be disposed of at chemical waste to the Chemical Waste Treatment Centre (CWTC) at Tsing Yi. *Table 5.5k* summarises the unused reagents to be recycled or reused on-site.

Table 5.5kManagement of Unused Reagents for the CCPP

Chemicals	Per packing unit	Quantity	Total	Disposal (D)/ Recycled by suppliers (R)/Reuse (RU)
Unused raw chemicals				
 Activated carbon 	25 kg	23	575 kg	R
• Urea	50 kg	56	2,800 kg	R
• Ecolo ^(a)	25 L	10	250 L	R
Chemical leftover in bins/	tanks			
• Activated carbon ^(b)	-	-	30 kg	RU
ML-C.				

Note:

(a) Ecolo is a deodourising solution used for the MRRF Building

(b) The activated carbon does not mix with any other chemicals. Due to it small quantity, it will be reused on-site by mixing with the coal and used as fuel for combustion in the cement plant.

In addition, a small amount of chemical waste (in the order of one hundred litres, mainly consist of used lubricant oil for plant and vehicles) will be generated from maintenance of demolition plant and equipment. These may include, but need not be limited to the following:

- Used batteries or spent acid/alkali from their maintenance;
- Used engine oils, hydraulic fluids and waste fuel;
- Spent mineral oils/cleaning fluids from mechanical machinery; and
- Spent solvents, 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.

GIC has been registered with the EPD as chemical waste producer. The chemical waste will be collected in appropriate containers and be removed by a licensed chemical waste collector periodically for disposal at the CWTC.

With the implementation of the control measures stipulated in the EPD's *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes,* the handling, collection and disposal of the chemical waste generated from the demolition of the CCPP will not cause adverse environmental impacts.

5.5.6 Sewage

Sewage will arise from the demolition staff and should be managed properly to avoid any adverse water quality impact, odour and potential health risks to the workforce by attracting pests and other disease vectors.

It is estimated that about 14 construction workers will be working on site at the peak of the construction programme. With a sewage generation rate of 0.15 m³ per worker per day, about 2.1 m³ of sewage will be generated per day.

The workers will use the existing sanitary facilities at the GICP. GIC confirmed that the existing wastewater treatment will have sufficient capacity to handle the anticipated flow generated from the demolition staff. No adverse water quality and odour impact are anticipated due to handling and disposal of the sewage generated from the demolition staff.

5.5.7 *General Waste*

The demolition staff would generate general refuse comprising food waste, paper, empty containers, etc. It is estimated that the quantity of general refuse to be generated from the demolition staff (up to 14 workers at any one time) will be minimal (about 9.1 kg per day assuming a waste generation of 0.65 kg per worker). This waste will be stored in covered waste container and be disposed of together with the general refuse arising from the operation of the GICP. The recyclables (eg paper and aluminium cans) will be separately collected and recycled as far as practicable. It is not anticipated that the handling and disposal of the anticipated quantity of general refuse to be generated from the demolition staff will cause adverse environmental impacts and operation impact to the landfill.

5.5.8 Summary of Waste Arising from the Demolition Works

Table 5.51 summarises the waste arising from the Project. Majority of the materials/waste arising from the demolition works will be reused or recycled (including the equipment of the MRRF, unused reagents, etc). Public fill will be disposed of at the Tuen Mun Area 38 Fill Bank, chemical waste will be disposed of at the CWTC and the general refuse will be disposed of at the WENT Landfill. It is intended that the Co-Combustion residues (including fly ash and bottom ash) will be reused on-site for the production of cement. Alternatively, the residues will be disposed of at a landfill designated by the EPD. The refractory lining and materials (cloths) arising from cleaning of the Co-Combustion unit will also be disposed of at a landfill designated by the EPD.

Туре	Estimated Quantity	Disposal/ Treatment Method
Co-Combustion residues (fly ash and bottom ash)	200 tonnes	Reuse on-site for cement production or disposal of at a designated landfill should be considered as the last resort
Kiln refractory bricks / castable lining of the Co-Combustion unit	345 tonnes	Disposal of at a designated landfill should be considered as the last resort
Residue inside the equipments	5.5 tonnes	Reuse on-site for cement production or disposal of at a designated landfill should be considered as the last resort
Waste (cloths) arising from cleaning of the Co-Combustion unit	0.5 tonne	Dispose of at a designated landfill
Equipments of the MRRF	124 tonnes	Sell to MRRF operators or second hand equipment vendors
Scrap metals	369 tonnes	Sell to recyclers
Unused reagents		
 Activated carbon 	575 kg	To be returned to the suppliers for
Urea solution	2,800 kg	reuse
Deodourising solution	250 litres	
Leftover reagent		
Activated carbon	30 kg	Re-use on site by mixing with coal and used it as fuel for combustion in the cement plant
Public fill (including reinforced Concrete and asphalt)	1,806 m ³	Dispose to Tuen Mun Area 38 Fill Bank
Chemical waste (mainly the lubricant oil from vehicle maintenance)	About 100 litres	Dispose of at the CWTC
Sewage	2.1 m ³ d ⁻¹	On-site wastewater treatment plant
General Waste	9.1 kg d ⁻¹	Dispose together with other general refuse arising from the GICP to landfill
5.6 MITIGATION MEASURES

This section recommends the mitigation measures and good site practices to avoid or reduce potential adverse environmental impacts associated with handling, collection and disposal of waste arising from the demolition of the CCPP.

The Contractor must ensure that all the necessary permits or licences required under the *Waste Disposal Ordinance* are obtained for the demolition works.

5.6.1 Waste Management Hierarchy

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

- Avoidance and reduction;
- Reuse of materials;
- Recovery and recycling; and
- Treatment and disposal.

The above hierarchy has been used to evaluate and select waste management options. The aim has been to reduce waste generation and reduce waste handling and disposal costs.

GIC will ensure that their contractors will implement the good site practices and mitigation measures recommended in this EIA Study and those given below. A Waste Management Plan (WMP) should be prepared by the main contractor taking account of the recommendations of this EIA Report and with reference to the requirements of ETWB TCW No. 19/2005. The Plan should be submitted to GIC for approval prior to the commencement of the demolition works.

Nomination of approved personnel to be responsible for good site practices, arrangements for collection and effective disposal to an appropriate facility of all wastes generated at the site;

- Training of site personnel in proper waste management and chemical handling procedures;
- Provision of sufficient waste disposal bags and containers and regular collection for disposal;
- Appropriate measures to reduce windblown litter and dust transportation of waste by either covering load with tarpaulin sheet or by transporting wastes in enclosed containers;

- Separation of chemical wastes for special handling and appropriate treatment at the CWTC;
- Regular cleaning and maintenance programme for drainage systems, sumps and oil interceptors (if used); and
- A recording system for the amount of wastes generated, reused on site, recycled and disposed.

5.6.2 Waste Reduction Measures

Good management and control can prevent generation of significant amount of waste. Waste reduction is best achieved at the planning and design stage, as well as by ensuring the implementation of good site practices. Recommendations to achieve waste reduction include:

- Segregation and storage of different types of waste in different containers, skips or stockpiles to enhance reuse or recycling of material and their proper disposal;
- Encourage collection and recycling of aluminium cans and waste paper during demolition works with separate labelled bins provided to segregate these recyclables from other general refuse generated by the workforce; and
- Unused reagents will be recycled as far as possible.
- The Co-Combustion residues should be reused on-site for cement production in order to avoid the disposal of these wastes at the landfill.

5.6.3 Handling and Disposal of Chemical Waste

GIC is a registered chemical waste producer and will liaise with EPD to determine the need to update the list of chemical wastes to be handled during the demolition works.

Chemical waste will be handled in accordance with the *Code of Practice on the Packaging, Handling and Storage of Chemical Wastes*. The containers to be used for storage of chemical wastes will:

- 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 will:

• 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.

Chemical waste will be disposed of:

- Via a licensed waste collector; and
- To a facility licensed to receive chemical waste, such as the CWTC which also offers a chemical waste collection service and can supply the necessary storage containers.

5.6.4 General Waste

General refuse will be stored in enclosed bins separately from construction and chemical wastes. Recycling bins will be provided at strategic locations to facilitate recovery of aluminium can and waste paper from the site. Materials recovered will be sold for recycling

5.7 EVALUATION OF RESIDUAL IMPACTS

With the implementation of the recommended mitigation measures, no adverse residual impacts are anticipated from the demolition of the CCPP.

5.8 Environmental Monitoring and Audit

It is recommended that monthly site audits of the waste management practices be carried out during the Project to determine if wastes are being managed in accordance with the good site practices described in this EIA Report. The audits should examine all aspects of waste management including waste storage, recycling, transport and disposal.

5.9 CONCLUSION

The decommissioning and demolition of the CCPP will generate a variety of wastes (including Co-Combustion residues, public fill, chemical waste, general refuse, sewage) and recyclables (MRRF Equipment, scrap metals, unused reagents, etc). The waste management implications and environmental impacts associated with the handling, storage and disposal of these wastes have been assessed. The physical properties and chemical

analysis results show that the characteristics of the Co-Combustion residues are similar to those of the typical clinker raw materials (including pulverised fly ash and bottom ash from coal fired power station, iron/copper slag). The residues contain very low levels of heavy metals and extremely low levels of (in the order of part per trillion) dioxins, which will not have adverse impacts on the gaseous emissions and the cement quality. The residues should be used as an alternative feedstock for the cement clinker production.

With the proposed loading rate of 0.5% w/w of the Co-Combustion residue to other raw materials for cement clinker production, it will not adversely affect the environmental performance of the cement plant. It will take about 7 days for the cement plant to consume all the residues. There is no concern of long-term environmental impacts associated with the proposed residue reuse option. This will avoid the disposal of residues at landfill.

As a last resort, the residues will be disposed of at a landfill designated by the EPD. The TCLP tests indicate that the concentrations of heavy metals in the leachate arising from the residues are well below the respective limits for landfill disposal. The residues can therefore be disposed of at the designated landfill without further treatment. An advance agreement should be obtained from the Landfill Authority (EPD) for the disposal of the residues at landfill.

The refractory bricks and lining of the Co-Combustion unit and waste generated from cleaning of the Co-Combustion unit will be placed in sealed PE bags and disposed of at a landfill designated by the EPD.

The MRRF equipment is still in good serviceable condition and will be sold to other MRRF operators or second hand equipment vendors. Scrap metals will be recycled.

Due the small scale of the CCPP, the quantities of public fill, chemical waste, general refuse, sewage to be generated will be small. With the implementation of the recommended mitigation measures in this EIA Report, the handling and disposal of these wastes will not cause adverse environmental and traffic impacts.

This page is deliberately left blank

6 WATER QUALITY ASSESSMENT

6.1 INTRODUCTION

The demolition of the CCPP has the potential to cause adverse water quality impacts if not properly managed. This section examines the potential impacts on the nearby water resources due to discharge of wastewater and surface runoff during decommissioning of the CCPP. The impacts are evaluated through a review of the surface water management systems during demolition processes.

6.2 LEGISLATION AND STANDARDS

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

- Water Pollution Control Ordinance (WPCO) (Cap. 358);
- Waste Disposal Ordinance (Cap. 354);
- Waste Disposal (Chemical Waste) (General) Regulation (Cap. 354C);
- Environmental Impact Assessment Ordinance (Cap. 499. S.16), Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM), Annexes 6 and 14;
- Technical Memorandum Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Inshore Waters (TM);
- *Practice Note for Professional Persons on Construction Site Drainage (Prop PECC PN 1/94); and*
- Hong Kong Planning Standards and Guidelines (HKPSG).

6.2.1 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. Corresponding statements of WQO are stipulated for different water regimes, i.e. marine waters, inland waters, bathing beaches subzones, secondary contact recreation subzones and fish culture subzones, in the WCZ based on their beneficial uses.

In accordance with the *WPCO*, the Study Area is located inside the North Western WCZ. The WQOs for the North Western WCZ, which are presented

in *Tables 6.2a*, are applicable as evaluation criteria for assessing compliance of any effects from the discharges of the Project.

Table 6.2aWater Quality Objectives for North Western Water Control Zone

Water Quality Objectives		North Western WCZ
А.	AESTHETIC 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 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 Whole Zone contain substances which settle to form objectionable deposits.	Whole Zone
В.	BACTERIA	
(a)	The level of Escherichia coli should not exceed 610 per 100 ml, calculated as the geometric mean of all samples collected in one calendar year.	Secondary Contact Recreation Subzones and Fish Culture Subzones (L.N. 451 of 1991)
(b)	The level of Escherichia coli should be less than 1 per 100 ml, calculated as the running median of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Tuen Mun (A) and Tuen Mun (B) Subzones and Water Gathering Ground Subzones
(c)	The level of Escherichia coli should not exceed 1000 per 100 ml, calculated as the running median of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Tuen Mun (C) Subzone and other inland waters
(d)	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. Samples should be taken at least 3 times in one calendar month at intervals of between 3 and 14 days.	Bathing Beach Subzones
C.	COLOUR	
(a)	Waste discharges shall not cause the colour of water to exceed 30 Hazen units.	Tuen Mun (A) and Tuen Mun (B) Subzones and Water Gathering Ground Subzones
(b)	Waste discharges shall not cause the colour of water to exceed 50 Hazen units.	Tuen Mun (C) Subzone and other inland waters
D.	DISSOLVED OXYGEN	
(a)	Waste discharges shall not cause the level of dissolved oxygen to fall below 4 mg per litre for 90% of the sampling occasions during the whole year; values should be calculated as water column average (arithmetic mean of at least 3 measurements at 1 m below surface, mid-	Marine waters

Wat	er Quality Objectives	North Western WCZ
	depth and 1 m above seabed). In addition, the concentration of dissolved oxygen should not be less than 2 mg per litre within 2 m of the seabed for 90% of the sampling occasions during the whole year.	
(b)	Waste discharges shall not cause the level of dissolved oxygen to be less than 4 mg per litre.	Tuen Mun (A), Tuen Mun (B) and Tuen Mun (C) Subzones, Water Gathering Ground Subzones and other inland waters
E.	pН	
(a)	The pH of the water should be within the range of 6.5-8.5 units. In addition, waste discharges shall not cause the natural pH range to be extended by more than 0.2 unit.	Marine waters excepting Bathing Beach Subzones
(b)	Waste discharges shall not cause the pH of the water to exceed the range of 6.5-8.5 units	Tuen Mun (A), Tuen Mun (B) and Tuen Mun (C) Subzones and Water Gathering Ground Subzones
(c)	The pH of the water should be within the range of 6.0-9.0 units.	Other inland waters
(d)	The pH of the water should be within the range of 6.0-9.0 units for 95% of samples collected during the whole year. In addition, waste discharges shall not cause the natural pH range to be extended by more than 0.5 unit.	Bathing Beach Subzones
F.	TEMPERATURE	
	Waste discharges shall not cause the natural daily temperature range to change by more than 2.0°C.	Whole Zone
G.	SALINITY	
	Waste discharges shall not cause the natural ambient salinity level to change by more than 10%.	Whole Zone
H.	SUSPENDED SOLIDS	
(a)	Waste discharges shall neither cause the natural ambient level to be raised by 30% nor give rise to accumulation of suspended solids which may adversely affect aquatic communities.	Marine waters
(b)	Waste discharges shall not cause the annual median of suspended solids to exceed 20 mg L ⁻¹ .	Tuen Mun (A), Tuen Mun (B) and Tuen Mun (C) Subzones and Water Gathering Ground Subzones
(b)	Waste discharges shall not cause the annual median of suspended solids to exceed 25 mg L ⁻¹ .	Other inland waters
I.	AMMONIA	
	The ammonia nitrogen level should not be more than 0.021 mg L ⁻¹ , calculated as the annual average (arithmetic mean), as unionized form.	Whole Zone
J.	NUTRIENTS	
(a)	Nutrients shall not be present in quantities sufficient to cause excessive or nuisance growth of algae or other	Marine waters

eak Bay Subzone
vaters excepting eak Bay Subzone
וח (A), Tuen Mun (B) א Mun (C) Subzones er Gathering Ground s
and waters
ın (A), Tuen Mun (B) n Mun (C) Subzones er Gathering Ground s
and waters
one
one
Beach Subzones
Beach Subzones

Technical Memorandum for Effluent Discharges into Drainage and Sewerag Systems, Inland and Inshore Waters (TM)

All discharges from the Project are required to comply with the *Technical Memorandum for Effluents Discharged into Drainage and Sewerage Systems, Inland and Inshore Waters* (TM) issued under Section 21 of the WPCO. The TM

6.2.2

defines discharge limits for different types of receiving waters. Under the *TM*, effluents discharged into the drainage and sewerage systems, inshore and inshore waters of the WCZs are subject to pollutant concentration standards for particular discharge volumes. Any 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. Any sewage from the proposed construction and operational activities should comply with the standards for effluent discharged into the foul sewers or inshore waters of the North Western WCZs, shown in Tables 1 and 10a of the *TM*, respectively.

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

Annexes 6 and 14 of the Environmental Impact Assessment Ordinance (Cap. 499. S.16), Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM) provide general guidelines and criteria to be used in assessing water quality issues.

6.2.4 Practice Note for Professional Persons on Construction Site Drainage (ProPECC PN 1/94)

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

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.

6.2.5 Hong Kong Planning Standards and Guidelines (HKPSG)

Chapter 9 of the *Hong Kong Planning Standards and Guidelines (HKPSG)* provides guidance for including environmental considerations in the planning of both public and private developments. It applies both to the planning of permanent or temporary uses which will have potential to cause significant changes to the biophysical environment or which are sensitive to environmental impacts. *Section 5* in *Chapter 9* of the *HKPSG* provides additional information on regulatory guidelines against water pollution for sensitive uses such as aquaculture and fisheries zones, bathing waters and other contact recreational waters.

6.2.6 WPCO Discharge Licence of GICP

The *WPCO* discharge licence was issued to GICP in order to restrict the quality and quantity of the effluent of the on-site Wastewater Treatment Plant (WWTP) discharged into the public sewer or North Western WCZ. Any discharge from the GICP to public foul sewer or North Western WCZ should comply with the discharge licence criteria.

6.3 WATER QUALITY SENSITIVE RECEIVERS AND BASELINE CONDITIONS

6.3.1 **Existing Conditions**

The GICP has its own on-site WWTP. The existing treatment works adopted the aerobic digestion treatment process for the treatment of all wastewater generated from the site including wastewater from the cement production. The design capacity of the WWTP is 76 m³ d⁻¹. The current flow to the WWTP is about 50 m³ d⁻¹.

The GICP is located at the seafront of Tap Shek Kok near the Urmston Road. The 2007 EPD marine water monitoring data show that the water quality in the North Western WCZ has attained 73% compliance with the WQOs. The marine water monitoring data of the nearest EPD monitoring stations are summarised in *Table 6.3a* and the locations are shown in *Figure 6.3a*.

Table 6.3a Summary of Water Quality Statistics for North Western WCZ (2007)

Parameter	EPD Monitoring Stations ^(a)	
	Pillar Point (NM3)	Urmston Road (NM5)
Temperature (°C)	23.2 (17.3-28.2)	23.4 (17.3-28.3)
Salinity (ppt)	30.1 (24.9-33.1)	28.6 (23.0-33.0)
Dissolved Oxygen (Surface to 2m above Bottom) (mg L-1)	5.8 (3.2-9.6)	5.7 (3.0-9.3)
Dissolved Oxygen (Bottom) (mg L-1)	5.5 (2.5-9.7)	5.4 (2.1-9.2)
Suspended Solids (mg L-1)	7.4 (3.9-11.7)	11.1 (4.3-18.7)
5-Day Biochemical Oxygen Demand (mg L-1)	1.1 (0.5-1.5)	1.1 (0.5-2.7)
Unionised Ammonia (mg L-1)	0.006 (0.001- 0.012)	0.008 (0.001- 0.014)
Total Inorganic Nitrogen (mg L-1)	0.47 (0.13-0.87)	0.64 (0.22-1.06)
Total Phosphorus (mg L-1)	0.05 (0.04-0.08)	0.06 (0.04-0.08)
Chlorophyll a (µg L-1)	5.9 (1.0-22.0)	5.5 (1.3-23.0)
E. coli (cfu 100mL ⁻¹)	430 (45-2,400)	590 (64-2,200)
Note:		
(a) Figures in bracket represent the range of monitoring r	oculto	

(a) Figures in bracket represent the range of monitoring results.

6.3.2 Water Sensitive Receivers

The Sha Chau & Lung Kwu Chau Marine Park is located at about 3.2km from the Project Site. To the north of the Project Site there are two non-gazetted beaches (the Lung Kwu Tan Beach and Lung Kwu Sheung Tan Beach). The gazetted Butterfly Beach is located at about 3.5km from the Project Site and other gazetted beaches (the Castle Peak, Kadoorie, Cafeteria New & Old, Golden and Angler's) are located at more than 6km from the Project Site.

There are several seawater intakes located in the vicinity of the Project Site which may be affected by the effluent discharges associated with the Project. The details of the identified Water Sensitive Receivers (WSRs) are summarized in *Table 6.3b* and their locations are shown in *Figure 6.3a*.



Table 6.3bWater Sensitive Receivers

No.	WSR	Approximate Distance from the Project Site
WSR 1	Sha Chau & Lung Kwu Chau Marine Park	3.2 km
WSR 2	Non-gazetted Lung Kwu Tan Beach	1.8 km
WSR 3	Non-gazetted Lung Kwu Sheung Tan Beach	3.8 km
WSR 4	Black Point Power Station Intake	4.6 km
WSR 5	Gazetted Butterfly Beach	3.8 km
WSR 6	Gazetted beaches in Tuen Mun	> 6 km
WSR 7	Castle Peak Power Station water intake	500 m
WSR 8	Shiu Wing Steel Mill water intake	Adjacent to the Project Site
WSR 9	Area 38 and proposed EcoPark water intake	150 m
WSR 10	Tuen Mun WSD water intake	5 km

6.4 POTENTIAL SOURCES OF WATER QUALITY IMPACTS

Potential sources of water quality impact associated with the proposed demolition activities at the works areas have been identified and include:

- wastewater from the cleaning process;
- site runoff from the Project Site; and
- sewage effluent produced by on-site workforce.

6.5 WATER QUALITY IMPACTS ASSESSMENT

6.5.1 Wastewater from Cleaning Processes

The cleaning works will be carried out inside the cleaning workshop of the MRRF building. During the cleaning process, wet wiping and vacuum cleaning will be used to clean the internal lining of the ducting/equipment and remove the loose dust particles deposited on the surface of the ducts and equipment. Water flushing will not be used to clean the plant and equipment of the Co-Combustion unit and hence the wastewater generated from the cleaning works will be minimal.

If necessary, water will be sprayed at the concrete breaking area to control dust. Negligible runoff will be generated from this process.

Disposable protective clothing will be used for the personnel who works inside the cleaning workshop and the used clothing will be disposed of at the end of each working day.

All the demolition and cleaning process will be conducted within the Project Site area which is about 240m from the waterfront of the GICP site. Prior to the commencement of the demolition and cleaning works, temporary drainage channels, earth bunds or sand bag barriers will be constructed or placed to delineate clean area and potential contaminated area within the Project Site and to divert the wastewater or contaminated runoff generated from the Project Site area to the existing underground wastewater storage tank of the MRRF and clean surface runoff to the existing surface water drainage system of the GICP.

With respect to the nature of the works, the wastewater generated from the demolition works will mainly be inorganic (eg suspended solids). The wastewater will then be pumped to the on-site WWTP for treatment. Currently the on-site WWTP has a free capacity of about 26 m³ d⁻¹. As the anticipated additional flow of wastewater generated from the demolition works will be limited (less than 2 m³ d⁻¹) and GIC's process engineers have confirmed that the treatment of this small additional load will not have adverse impact on the performance of the WWTP and the effluent quality. No wastewater will be discharged directly into the adjacent marine water or any other water bodies in the vicinity of the Project Site. It is therefore expected that the demolition of the CCPP will not cause adverse water quality impact.

6.5.2 Demolition Site Runoff and Drainage

During demolition activities, site run-off may cause pollution if they enter the marine waters. Pollutant such as residual ashes and chemicals may enter the receiving waters if site runoff is not properly managed.

As discussed above the clean surface runoff from the Project Site will be diverted to the existing drainage system of the GICP which will lead to the onsite stormwater detention pond. Suspended solids will be settled out in the pond before discharging into the stormwater drainage. With respect to the small scale of the demolition works, small site area, and the site is paved for most periods of the demolition works, it is anticipated that the surface runoff will not have a high level of suspended solids. It will not cause adverse impacts to the performance of the existing site stormwater detention pond. It should be noted that the total volume of surface water runoff from the GICP has not been changed due to the CCPP.

As all surface water runoff generated from the works area will be properly collected, treated and disposed during the demolition processes, no unacceptable impact to water sensitive receivers is anticipated.

6.5.3 Sewage Generated from Workforce

Sewage will arise from the demolition workforce. It is estimated that a maximum of 14 workers will be working at the site at any one time. The amount of sewage to be generated will be about 2.1 m³ per day. The existing toilet facility of the GICP will be available to the construction workforce. The sewage will be discharged to the on-site WWTP. No adverse impact water quality is anticipated due to the treatment and disposal of sewage generated from the workforce.

As the sewage generated from the workforce will be properly treated and the treated effluent will be discharged through the existing arrangement which is acceptable to the EPD, no unacceptable water quality impacts to sensitive receivers are predicted.

6.6 WATER QUALITY MITIGATION MEASURES

The impact assessment has indicated that the demolition works, if properly controlled, will not cause adverse impacts to the surrounding waters and the sensitive receivers. Hence, no addition mitigation measures are required.

Appropriate on-site measures are defined to reduce potential impacts, which will be sufficient to prevent adverse impacts to water quality from demolition activities. These measures are appropriate for general land based demolition activities. All effluent discharge from the demolition works will be subject to control under the *WPCO*.

Site Run-off

Prior to the demolition works, perimeter cut-off drains to direct off-site water around the site will be constructed and internal drainage works and erosion and sedimentation control facilities implemented. Channels, earth bunds or sand bag barriers will be provided on site to direct potential contaminated wastewater to existing underground wastewater storage tank of the MRRF building. The wastewater will then be pumped to the on-site WWTP for treatment. The design of any silt removal facilities will be based on the guidelines in Appendix A1 of *ProPECC PN 1/94*.

- All drainage facilities and erosion and sediment control structures will be regularly inspected and maintained to ensure proper and efficient operation at all times and particularly following rainstorms. Deposited silt and grit will be removed regularly and disposed of.
- Measures will be taken to reduce the ingress of site drainage into excavations. If the excavation of concrete foundation is to be carried out in wet season, they will be dug and backfilled in short sections wherever practicable. Water pumped out from trenches or foundation excavations will be discharged into storm drains via silt removal facilities.
- Open stockpiles of excavated and demolition materials will be covered with tarpaulin or similar fabric during rainstorms. Measures will be taken to prevent the washing away of residues, chemicals or debris into any drainage system.
- Manholes (including newly constructed ones) will always be adequately covered and temporarily sealed so as to prevent silt, construction materials or debris being washed into the drainage system.
- Precautions will be taken when a rainstorm is imminent or forecasted, and actions to be taken during or after rainstorms are summarised in

Appendix A2 of *ProPECC PN 1/94*. Particular attention will be paid to the control of silty surface runoff during storm events.

• All temporary and permanent drainage pipes and culverts provided to facilitate runoff discharge will be adequately designed for the controlled release of storm flows. All sediment traps will be regularly cleaned and maintained. The temporary diverted drainage will be reinstated to the original condition when the construction work has finished or the temporary diversion is no longer required.

Wastewater from Site Facilities

- Vehicle and plant servicing areas, vehicle washing bays and lubrication bays will, as far as possible, be located within roofed areas. The drainage in these covered areas will be connected to foul sewers via a petrol interceptor.
- Oil leakage or spillage will be contained and cleaned up immediately. Waste oil will be collected and stored for recycling or disposal, in accordance with the *Waste Disposal Ordinance*.

Storage and Handling of Oil, Other Petroleum Products and Chemicals

- Waste streams classifiable as chemical wastes will be properly stored, collected and treated for compliance with *Waste Disposal Ordinance* or *Waste Disposal (Chemical Waste) (General) Regulation* requirements.
- All fuel tanks and chemical storage areas will be provided with locks and be sited on paved areas.
- The storage areas will be surrounded by bunds with a capacity equal to 110% of the storage capacity of the largest tank to prevent spilled oil, fuel and chemicals from reaching the receiving waters.
- The Contractors will prepare guidelines and procedures for immediate clean-up actions following any spillages of oil, fuel or chemicals.
- Surface run-off from bunded areas will pass through oil/grease traps prior to discharge to the stormwater system.

Sewage from Workforce

• The existing toilet facility of the GICP will be available to the construction workforce. The sewage will be discharged to existing WWTP of the GICP. The effluent discharge from the site will be monitored as part of the routine monitoring under the *WPCO* licence.

6.7 RESIDUAL ENVIRONMENTAL IMPACTS

With the implementation of the recommended mitigation measures, no residual impacts are anticipated from the demolition of the CCPP.

6.8 Environmental Monitoring and Audit

With the implementation of the good site practice and the proposed demolition and cleaning procedures, no adverse water quality impact is anticipated due to the demolition of the CCPP. All wastewater and site runoff from the Project Site will be treated using the existing WWTP and stormwater detention pond of the GICP and the effluent discharge from the site will be monitored as part of the routine monitoring under the *WPCO* licence. No additional environmental monitoring and audit programme is therefore required.

Monthly site audits of the works areas will be carried out to monitor the environmental performance of the Project and to enable prompt actions to rectify any malpractice which may give rise to water pollution problem.

6.9 CONCLUSION

The anticipated quantities of wastewater to be generated during the Project will be small and all wastewater will be treated in the existing on-site WWTP. With the implementation of general good site practices, the demolition of CCPP will not cause adverse water quality impact. This page is deliberately left blank

7.1 INTRODUCTION

7

This *Section* describes the requirements for environmental monitoring and audit requirements during the demolition of the CCPP. With respect to the identified potential impacts and the nature (including general site audits during demolition works) and frequency (monthly) of the site audit to be undertaken, it is considered that real-time reporting of the monitoring data is not applicable. With respect to the nature of the environmental monitoring and audit (EM&A) required for the Project, it is considered that a separate EM&A Manual will not be required.

The Implementation Schedule, containing the recommended mitigation measures, monitoring and audit requirements, and implementation agent of the mitigation measures for the Project, is presented in *Annex C*.

7.2 SITE AUDITS

Monthly site audits will be undertaken jointly by the site representative of GIC and the contractor during the demolition works to ensure that dust control, construction waste and site runoff and are managed in accordance with the good site practices described in *Sections 3, 5* and *6* respectively.

7.3 AIR QUALITY

With the implementation of the recommended control measures described in the EIA and those stipulated in the *Air Pollution Control (Construction Dust) Regulation,* no adverse air quality impact is anticipated. The potential dust impact will be minimal. No dust monitoring will be considered necessary.

The Co-Combustion residues (including bottom ash, fly ash and the residual dust collected during the cleaning process) will be used as part of the raw materials for the cement production. As the properties of the residues are similar to the raw materials used for the cement production and they contain negligible concentration of dioxins (in terms of part per trillion) and very low concentrations of heavy metals, the reuse of the residues for the cement production at the proposed rates will not affect the air emissions of the cement plant. No air quality monitoring will be required.

7.4 LAND CONTAMINATION

The site investigation indicates that the contaminants analysed for all soil samples were either not detected or with concentrations well below the *RBRG guideline* values, the potential risk to the workers due to demolition activities will be minimal.

After the demolition works, the Project Site will be levelled using clean imported soil. The Project Site will remain as an open area for the operation and future development of the GICP. It is currently proposed that the Project Site will be rehabilitated into and restored to a grass lawn. The potential for human contact with any underlying contamination (if any) in the future is considered low. It is therefore concluded that the risk of future exposure to any contamination is deemed negligible. There will be no residual impacts due to the Project after the decommissioning and demolition works have been completed.

It is therefore considered that no environmental and audit requirement with respect to land contamination is required.

7.5 Waste Management

It is recommended that monthly site audits of the waste management practices be carried out during the Project to determine if wastes are being managed in accordance with the good site practices described in this EIA Report. The audits should examine all aspects of waste management including waste storage, recycling, transport and disposal.

7.6 WATER QUALITY

The anticipated quantities of wastewater to be generated during the Project will be small and all wastewater will be treated in the on-site wastewater treatment plant. With the implementation of general good site practices, the demolition of CCPP will not cause adverse water quality impact. The effluent discharge from the existing wastewater treatment plant will be monitoring in accordance with the existing monitoring programme as required under the *WPCO* Licence. No additional water quality monitoring is considered necessary.

7.7 IMPLEMENTATION SCHEDULE

Mitigation measures discussed in the preceding sections are summarised in the Implementation Schedule in *Annex C*.

8.1 INTRODUCTION

This *Section* summarises the environmental outcomes associated with the demolition of the CCPP.

8.2 AIR QUALITY IMPACTS

With respect to the small scale of the demolition works, the number of demolition plant and equipment to be used for the works will be limited. Air emissions from the operation of these plant and equipment will be minimal and it is therefore not anticipated that it will cause adverse air quality impact to the identified ASRs.

GIC will implement good construction site practices and dust control measures stipulated in the *Air Pollution Control (Construction Dust) Regulation* (as listed in *Section 3.6*) throughout the demolition works. Special care will be taken when dismantling the Co-Combustion unit of the CCPP and removal of any residual dust attached to the internal lining or surface of the equipment so that the potential dust releases to the atmosphere will be minimal.

The removal of the residual dust within the Co-Combustion unit will be carried out in an enclosed cleaning workshop within MRRF building. The cleaning workshop will be provided with ventilation which will maintain a slight negative pressure at all times with the cleaning process is being carried out and the exhaust air will be cleaned by passing through the HEPA filters.

With the implementation of the recommended control measures described in this EIA Report and those stipulated in the *Air Pollution Control (Construction Dust) Regulation,* the potential air quality and dust impacts to the identified ASRs will be controlled within the relevant standards as stipulated in *Section 1* of *Annex 4* of the *EIAO-TM*. No adverse air quality impact is anticipated. Therefore no dust monitoring will be required during the decommissioning and demolition works.

8.3 LAND CONTAMINATION

The assessment of land contamination sources and the potential impacts to potential receptors were investigated in accordance with the *RBRG Guidance*. Site appraisal comprising a site visit, and a review of background information and land history in relation to possible land contamination was conducted. Potential sources of contamination and associated impacts, risks or hazards are identified in the *Contaminated Assessment Plan (CAP)* (see *Annex A1*).

Site investigation was conducted at the Project Site in accordance with the recommendations of the CAP to determine if the soil within the Project Site at

the depth of excavation (ie up to 1.5m below ground) is contaminated. Soil samples were taken and tested for heavy metals, total petroleum hydrocarbons (TPH); BTEX (including benzene, toluene, ethyl benzene, and xylene), dioxins and furans, and Polychlorinated biphenyls (PCBs). Levels of TPH analysed for all three carbon ranges were below the reported detection limits for all samples. Concentrations of BTEX were also below the reported detection limits at all locations. Levels of all metals analysed in all samples were well below the RBRG values. Levels of PCBs, dioxins and furans analysed in all samples were well below the RBRG values. Therefore, there is no concern of heavy metals, TPH, BTEX and dioxins/PCBs contamination in the soil within the depth that the excavation works will be undertaken.

The asphaltic concrete surface of the Project Site will be removed. Excavation works to be carried out will be limited to the removal of the concrete substructures and the underground storage tank (previously used for the storage of wastewater from the MRRF building). No soil excavation or groundwater extraction will be required for the demolition works and hence no potentially contaminated materials requiring off-site disposal will be generated from the Site.

The assessment of land contamination sources and the potential impacts to future use of the Project Site have been assessed in accordance with the *RBRG Guidance* and the results are presented in the *Contaminated Assessment Report* (*CAR*) (see *Annex A2*). The Project Site's future use remains industrial (manufacture of cement and cement related products) and is surrounded by remaining areas of the GICP. It is considered that the only potential receptors at risk might be site workers involved in decommissioning and demolition works. As the contaminants analysed were either not detected or with concentrations well below the RBRG guideline values, the potential risk to the workers due to demolition activities will be minimal.

After the demolition works, the Project Site will be levelled using clean imported soil. The Project Site will remain as an open area for the operation and future development of the GICP. It is currently proposed that the Project Site will be rehabilitated into and restored to a grass lawn. The potential for human contact with any underlying contamination (if any) in the future is considered low. It is therefore concluded that the risk of future exposure to any contamination is deemed negligible. There will be no residual impacts due to the Project after the decommissioning and demolition works have been completed.

It is therefore considered that no environmental and audit requirement with respect to land contamination is required.

8.4 WASTE MANAGEMENT IMPLICATIONS

The demolition works will generate a variety of wastes (including public fill (about 1,806 m³), scrap metals (about 369 tonnes), Co-Combustion residues

(about 200 tonnes), refractory bricks and lining (about 345 tonnes), general refuse (about 9.1 kg d⁻¹) and sewage (about 2.1 m³ d⁻¹)). The public fill will be disposed of at the Tuen Mun Area 38 Fill Bank. It is proposed that the Co-Combustion residues will be reused on-site as a raw material for the cement production. Alternatively, Co-Combustion residues could be disposed of at a designated landfill. The refractory brick and lining will be disposed of at the designated landfill. The TCLP tests for the Co-Combustion residues and refractory bricks and lining show that the concentrations of metals in the leachate were well below with the respective landfill disposal criteria (the concentrations of most of the parameters are below the detection limits). The disposal of these wastes at landfill will not cause adverse environmental impacts.

The scrap metals will be recycled. The chemical waste and general refuse to be generated from the maintenance of the construction plant/equipment and construction workforce will be disposed of with other chemical waste and general refuse arising from the GICP, respectively.

With respect to the small quantities of the wastes to be generated from the demolition works, the handling and disposal of these wastes will not cause adverse environmental impacts with the implementation of general good site practices.

8.5 WATER QUALITY IMPACTS

Potential sources of water quality impact associated with the proposed demolition activities at the works areas include wastewater from the cleaning processes, surface runoff from the Project Site and sewage from demolition workforce. Wet wiping and vacuum cleaning will be used to clean the internal lining of the ducting/equipment and remove the loose dust particles deposited on the surface of the ducts and equipment. Water flushing will not be used to clean the plant and equipment of the Co-Combustion unit and hence the wastewater generated from the cleaning works will be minimal. The anticipated quantity of wastewater to be generated from the demolition works will be small and it will be treated at the existing wastewater treatment With respect to the small volume of wastewater to be plant of the GICP. generated from the demolition activities, it will have negligible impact to the flow and load of the wastewater to be generated from the cement production and hence the treatment capacity of the existing wastewater treatment plant. GICP has confirmed that the existing wastewater treatment plant will be able to handle the additional flow and load of the wastewater arising from the demolition activities.

The surface runoff from the demolition area will handle via the existing stormwater retention pond of the GICP prior to discharge off-site. Therefore no adverse water impact will be anticipated.

With the implementation of general good site practices, the demolition works will not cause adverse water quality impact to the identified water sensitive receivers.

8.6 Environmental Monitoring and Audit Requirements

Monthly site audits will be undertaken jointly by the site representative of GIC and the contractor during the demolition works to ensure that dust control, construction waste, wastewater and site runoff are properly managed in accordance with the good site practices described in this *EIA Report*.

The Co-Combustion residues (including both bottom ash, fly ash and the residual dust collected during the cleaning process) will be used as part of the raw materials for the cement production. As the properties of the residues are similar to the raw materials used for the cement production and residues contain negligible concentration of dioxins (in terms of part per trillion) and very low concentrations of heavy metals, the reuse of the residues for the cement production at the proposed rates will not affect the air emissions of the cement plant. Therefore no air quality monitoring will be required.

8.7 Environmental Outcomes

An environmental impact assessment (covering air quality, land contamination, waste management and water quality) has been undertaken for the proposed decommissioning and demolition works of the CCPP. The potential environmental impacts are considered transient and minimal. No adverse environmental impacts are envisaged due to the works in accordance with relevant assessment criteria stipulated in the *EIAO-TM*. Therefore no adverse residual environmental impact is anticipated.

8.8 ENVIRONMENTAL BENEFITS

The operation of the CCPP has provided very useful technical and economic information on the operation of a materials recovery/ recycling facility (MRRF) together with a thermal treatment facility as part of an integrated waste management system in Hong Kong. It demonstrated that the co-combustion plant can meet emission standards stipulated in the Best Practical Means for Thermal Treatment of Municipal Solid Waste (MSW) (BPM 12/1) issued by the EPD. In addition, engineering data regarding the operation of the plant have been obtained to refine the design of Co-Combustion plant which will benefit the application of such technology in Hong Kong as part of the waste management strategy.

After completion of the tests and achieving the research objectives, the operation of pilot plant was stopped on 17 December 2005. The pilot plant will be demolished so that the Project Site could be released for the operation and future development of the GICP. The Co-Combustion residues will be reused as a raw material for the cement production. This will not only avoid

the disposal of the residues at landfill but also reduce the import of raw materials for the cement production. The process equipments and Co-Combustion units will also be properly cleaned and recycled as much as possible to minimise the amount of waste to be disposed of at landfills. This page is deliberately left blank

Annex A

Land Contamination Assessment / Laboratory Analysis Results Annex A1

Contamination Assessment Plan (CAP)



Contamination Assessment Plan for Decommissioning of the Co-Combustion Pilot Plant at Tap Shek Kok

Green Island Cement Company Limited

7 January 2008

Submitted by Environmental Resources Management 21/F Lincoln House Taikoo Place, 979 King's Road Island East, Hong Kong Telephone 2271 3000 Facsimile 2723 5660

www.erm.com



CONTAMINATION ASSESSMENT PLAN

Green Island Cement Company Limited

Decommissioning of the Co-Combustion Pilot Plant at Tap Shek Kok

January 2008

Environmental Resources Management 21/F Lincoln House 979 King's Road Taikoo Place Island East, Hong Kong Telephone: (852) 2271 3000

Facsimile: (852) 2723 5660 E-mail: post.hk@erm.com http://www.erm.com

CONTAMINATION ASSESSMENT PLAN

Green Island Cement Company Limited

Decommissioning of the Co-Combustion Pilot Plant at Tap Shek Kok

January 2008

For and on behalf of	
ERM-Hong Kong, Limited	
Approved by: <u>Alastair McNair Scott</u>	
h 1 ∞ 1	
Signed:	
Desition. Desta en	
Position: <u>Partner</u>	
Date: 7 th January 2008	

. .

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

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

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

1	INTRODUCTION	1
1.1	BACKGROUND TO THE STUDY	1
1.2	OBJECTIVE OF THE CAP	1
1.3	Environmental Legislation and Non-statutory Guidelines	2
2	SITE APPRAISAL	3
2.1	SITE SETTING	3
2.2	SITE DESCRIPTION	3
2.3	PROPOSED DECOMMISSIONING OF CCPP	4
2.4	SITE HISTORY	5
3	POTENTIAL SOURCES OF SOIL AND GROUNDWATER CONTAMINATION	8
3.1	POTENTIAL HISTORICAL SOURCES	8
3.2	POTENTIAL CURRENT SOURCES	8
3.3	POTENTIAL FUTURE SOURCE	10
3.4	CONCEPTUAL MODEL OF POTENTIAL POLLUTANT LINKAGE	10
4	POTENTIAL HUMAN HEALTH AND ENVIRONMENTAL IMPACTS	12
4.1	EVALUATION OF IMPACTS	12
4.2	POTENTIAL IMPACTS	12
5	SITE INVESTIGATION PLAN	15
5.1	INTRODUCTION	15
5.2	PROPOSED SITE INVESTIGATION	15
6	CONCLUSIONS AND RECOMMENDATIONS	19
6.1	Conclusions	19
6.2	RECOMMENDATIONS	19
	ANNEXES	
ANNEX A	THE GUIDANCE MANUAL FOR USE OF RISK-BASED REMEDIATION GOALS FOR Contaminated Land Management and the Guidance Note for Contaminated Land Assessment and Remediation	
ANNEX B	SITE LAYOUT PLAN AND SITE PHOTOGRAPHS	
ANNEX C	SITE ARIAL PHOTOGRAPH	
ANNEX D	HISTORICAL PHOTOGRAPHS	
ANNEX E	PROPOSED SAMPLING LOCATIONS	
ANNEX F	Response To Comments	

1.1 BACKGROUND TO THE STUDY

As part of the research programme, in collaboration with the Hong Kong University of Science and Technology (HKUST), to develop a new thermal treatment process for municipal solid waste (MSW), the Co-Combustion Pilot Plant (CCPP) was constructed in a designated area inside the Green Island Cement Plant site (GICP). For the purposes of this report, the designated area in which the CCPP was constructed will be referred to as the Site. The GICP is located at Tap Shek Kok, Tuen Mun. The CCPP was constructed in 2004 and has been permanently shutdown since the completion of the pilot plant study in December 2005. Green Island Cement Company Limited (the Client) has now initiated a project to demolish the existing CCPP, to remove the disused equipment and disposal of waste materials generated thereof (the Project).

The Project is a designated project under Schedule 3, Item of Part II, Schedule 2 of the Environmental Impact Assessment Ordinance (EIAO): "Decommissioning Projects: A municipal, chemical or clinical waste incinerator". An environmental impact assessment (EIA) study brief was issued for the Project by Environmental Protection Department (EPD) in June 2007 (EIA Study Brief No. ESB-164/2007).

In compliance with one of the EIA requirements, a contamination impact assessment should be conducted to evaluate the land contamination impact due to the past land uses at the Site. In accordance with the EIA Study Brief, a Contamination Assessment Plan (CAP) should be prepared and submitted to the Director of Environmental Protection (the Director) for endorsement prior to conducting the contamination impact assessment,

ERM-Hong Kong, Ltd (ERM) was commissioned by the Client to conduct a contamination impact assessment of the Site in accordance with the EIA study Brief requirements and this report describes the Contamination Assessment Plan (CAP) for the contamination impact assessment. A site appraisal was carried out by ERM auditors on 16 August 2007.

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 works for demolition of the CCPP. This CAP aims to provide systematic procedures for identifying any potential sources of land contamination, identify contaminants of concern, evaluate the potential receptors, exposure pathways (if any) and the potential impacts from such contamination to the receptors. The CAP will determine and detail the requirements, if any, for a programme for the intrusive site investigation of the Site, to identify the nature and extent of the on site contamination. The specific tasks of the CAP include:

- Review of background information on, and land history of, the Site in relation to possible land contamination;
- Identification of potential contamination and associated impacts, risks or hazards; and
- Submission of a contamination assessment plan for agreement with the EPD prior to its implementation.

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) *Guidance Manual for Use of Risk-based Remediation Goals for Contaminated Land Management* (the RBRG Guidance Manual), the associated *Guidance Note for Contaminated Land Assessment and Remediation*, and the EPD's *Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol Filling Stations, Boatyards, and Car Repair/Dismantling Workshop*.

The *RBRG Guidance Manual* and the *Guidance Note for Contaminated Land Assessment and Remediation* were issued by EPD on 15 August 2007 and were effective immediately (although with a transitional period of 3 months enabling use of either the Dutch B levels or the RBRGs). The RBRGs were developed for four different post-restoration land-use scenarios. The Site is classified as an Industrial Site under the RBRGs.

RBRGs for Soil and Soil Saturation Limits, and for Groundwater and Solubility Limits present the remediation goals for soil and groundwater respectively. Detected concentrations of Chemicals of Concern (COCs) in soil and/or groundwater shall be compared to their respective RBRGs for the industrial category and Non Aqueous Phase Liquid (NAPL) Trigger Levels (soil saturation limit values and solubility limit values). The *Guidance Manual for Use of Risk-based Remediation Goals for Contaminated Land Management* is attached in *Annex A*.

Under the *Technical Memorandum on Environmental Impact Assessment Process* (*EIAO-TM*), *Annex 19: Guidelines for Assessment of Impacts of Sites of Cultural Heritage and 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.

2

The site appraisal comprised of the review of the background information and land history in relation to possible land contamination and a site visit to identify potential sources and evidence of contamination at the Site and surrounding areas.

2.1 SITE SETTING

The Site is surrounded by the remaining areas of the GICP. The immediate uses of the area surrounding the CCPP included:

- *North*: a lawn beyond which was an LPG storage to the northwest and a container office to the northeast;
- *South*: an internal road, beyond which is the PFA Grinding & Classification System;
- *East*: the operating cement kiln of GICP; and
- *West*: an internal road, beyond which was a Pack House and cement silos to the northwest and fuel underground storage tanks and dispensing station to the southwest.

The neighbours of the GICP are the Castle Peak Power Station of CLP Power Limited to the west, the Shiu Wing Steel Company steel manufacturing plant to the east, Lung Mun Road to the north and the sea shore to the south. The site layout plan is attached in *Annex B1* and an aerial photograph showing the current site conditions is presented in *Annex C*.

2.2 SITE DESCRIPTION

The Site occupies an area of about 4,000 m². It consists of a waste sorting facility or materials recovery and recycling facility (MRRF) at the front-end followed by a thermal treatment system for an integrated treatment of MSW utilizing the Co-combustion Process patented by the Client. The Co-combustion Process is a novel cement manufacturing process in which the waste provides the energy source for the calcination step, and the calcined materials are reused in the cement production kiln. During operation, the pilot plant handled no more than 24 tonnes of MSW per day on average and the cumulative duration of Pilot Plant operation was 11 weeks.

The waste used in the CCPP consisted of typical Hong Kong municipal solid waste (MSW), of which the main components were paper, plastics and putrescibles. The incoming MSW was unloaded at the reception hall (complete with impermeable paved floor) before feeding into the sorting plant. The wastewater generated from the MRRF was collected and treated at the wastewater treatment plant at GICP.

The CCPP comprised three parts, the MRRF, the main thermal treatment system,

and lime cooling system:

MRRF:

- reception Hall
- trommel screen;
- separators;
- shredder;
- belt conveyors; and
- underground storage tank (UST) for leachate wastewater;

The Main Thermal Treatment System:

- feed chamber;
- rotary kiln;
- secondary combustion chamber;
- pre-calciner;
- cyclones with tipping valves;
- gas cooler ;
- tipping valves;
- bag house filter / dust collector;
- flue gas ducting;
- induction draft fan
- discharge ducting;
- ash storage tank;
- bucket elevator; and
- urea water tank;

Lime Cooling System:

- lime storage bin;
- feed bin;
- lime ejector;
- air blower; and
- cyclone with tipping valves.

During the site visit, no activities were being carried out at the CCPP. All aboveground systems were installed over concrete paved and asphalt paved ground. The fly ash and bottom ash collected from the past CCPP operations were being stored in sealed bags in the reception hall which was concrete paved.

2.3 PROPOSED DECOMMISSIONING OF CCPP

The proposed decommissioning of the CCPP will involve the demolition of the existing structures and concrete slab and asphalt hard surface, removal of used equipment, the removal of the concrete foundations supporting the equipment and the disposal of waste materials generated by the demolition. It is understood that the Site will then be left as an area of open space for possible future industrial use associated with the surrounding cement plant operations.
2.4 SITE HISTORY

The whole of the GICP Site was formed through reclamation in the late 70's. The fill materials used were mainly from the nearby hillsides. Some sand materials were also reportedly imported to the area. The construction of the GICP commenced in 1978 and the operations of the GICP commenced in 1982.

The GICP site was approved for the purpose of manufacture of cement and cement-related products. The Site of the pilot plant is an open area reserved for a second cement kiln. Following start up of the GICP in 1982, the Site was used as an emergency stockpile for cement clinker until 1985. The Site was also used as emergency open stock pile of natural limestone imported from Japan between 1990 and 1994. The stockpile area was not paved initially. A propane storage was reportedly built in the late 1980s but was never commissioned, and was removed in March 1992.

The CCPP was constructed in June 2004 after receiving approval from the Lands Department, EPD and the Buildings Department. The continuous pilot operation commenced in October 2005 and finished in December 2005. Of note is that the combined total operating time of the pilot plant from the commissioning to the end of the operation was only 11 weeks.

*Table 2.1*to *2.3* ⁽¹⁾, respectively, present the historical, current and anticipated future land uses of the CCPP Site. *Table 2.4* shows the historical development of the CCPP and the GICP. Historical photographs showing the site development are presented in *Annex D*.

Type of	On Site	Date Began	Description	Owner or	Approx	Off Site
Facility	Property Land	_		Occupier	Site Area	Property
	Use					Affected
None	Reclaimed land	Late 1970	Site reclamation	GIC	4,000 m ²	No
Industrial	Storage area of cement clinker	1982	Reserved for storage of propane but used for cement clinker stockpiling	GIC	As above	No
Industrial	Reserved storage area	1984-1990	Not used	GIC	As above	No
Industrial	Storage area	1990-1994	Storage of limestone	GIC	As above	No
Industrial	Grassed area	1994-June 2004	Used as kiln lawn	GIC	As above	No

Table 2.1Summary of Historical On Site Land Use

ENVIRONMENTAL RESOURCES MANAGEMENT

⁽¹⁾ The tables are prepared in accordance with *Standard form 3.1 from the RBRG guidance*

Type of Facility	On Site Property Land Use	Date Began	Description	Owner or Occupier	Approx Site Area	Off Site Property Affected
Industrial	Construction site	June 2004	Construction of foundations	GIC	4,000 m ²	No
Industrial	CCPP	Oct 2005 – Dec 2005	11 week trial operation	GIC	As above	No

Note. Table based on Standard Form 3.1 from the RBRG guidance

Table 2.2Summary of Current On Site Land Use

Type of Facility	On Site Property Land Use	Date Began	Description	Owner or Occupier	Approx Site Area	Off Site Property Affected
Industrial	Disused trial co- combustion pilot plant	Oct 2005 to Dec 2005	Trial CCPP	Green island cement (GIC)	4,000 m ²	No

Note Based on Standard Form 3.1 from the RBRG guidance

Table 2.3Summary of Anticipated Future On Site Land Use

Type of Facility	On Site Property Land Use	Date Began	Description	Owner or Occupier	Approx Site Area	Off Site Property Affected
Industrial	Open space	2008?	Site to be left as open grassed area in the immediate term.	GIC	4,000 m ²	No

Table 2.4Site Historical information for the GICP and CCPP Site

Time	GICP	CCPP Site
late 1970s	Site reclamation	-
Before 1982	Construction of the cement plant	-
1982	Operation of the GICP cement kiln began	Reserved for propane storage and used as emergency stock pile of cement clinker until 1985
1984-1990	Operation of the cement kiln suspended	Reserved for propane storage and left vacant
1990-1994	Operation of the cement kiln restarted	Reserved for propane storage and used as emergency storage of limestone imported from Japan
1992	Continuous operation of the GICP	Propane storage was built but never commissioned. It was removed in March 1992.
After 1994	Continuous operation of the GICP	Rehabilitated as a kiln lawn until the construction of CCPP
Dec 2001	Clinker production was suspended	Rehabilitated as a kiln lawn until the construction of CCPP
Jun 2004	Clinker production was suspended	Construction of the CCPP foundation

Time	GICP	CCPP Site
Apr 2005	Clinker production was suspended	First load commissioning test of the CCPP
Jul 2005	Clinker production was suspended	Second load commissioning test of the CCPP
Oct 2005	Clinker production was suspended	Continuous operation of the CCPP
Dec 2005	Clinker production was suspended	Operation ceased after all operation data has been collected
Jan 2006	Clinker production resumed	-

This Page Intentionally Left Blank

POTENTIAL SOURCES OF LAND CONTAMINATION

Based upon the Site appraisal and observations from the Site visit, this section identifies potential sources of soil and groundwater contamination and the associated impacts, risks or hazards.

3.1 POTENTIAL HISTORICAL SOURCES

3

Potential historical on site sources of soil and groundwater contamination are those that may be associated with the emergency stockpiling of cement clinker during 1980s and limestone during early 1990s and the operation of the GICP.

The construction of the foundation of CCPP started in June 2004. Most of the top soil was reportedly excavated for the foundation construction during that time. After the foundation work, it was reported that the Site was backfilled with the original top soil and then paved with concrete and asphalt.

There are potential historical off site sources of soil and groundwater contamination associated with the continuous operation of the cement plant surrounding the Site for more than 20 years.

3.2 POTENTIAL CURRENT SOURCES

The potential current on and off site sources of contamination that could affect the Site include:

OFF SITE SOURCES

- The storage and transfer of fuel (diesel oil) at the fuel underground storage tanks (UST) and dispensing station located approximately 20 m to the southwest of the Site. The USTs were reportedly constructed of single-shell steel encased in concrete with a minimum thickness of 150mm. In order to minimize risk of accidental oil leakages, the tank piping pressure tests/hydraulic tests are conducted every 5 years. The fuel dispensing station was used for filling of around 20 vehicles per day. The area was paved. The fuel UST and dispensing station will not be included in the proposed decommissioning of CCPP.
- Potential leakage of fuel from overhead fuel pipelines connecting the fuel oil storage tank (located approximately 100 m to the southwest of the Site) with the CCPP and the main cement kiln. No evidence of leakage was observed during the site visit.

ON SITE SOURCES

• The storage and handling of MSW used in the pilot tests. It is noted that prior to being fed into the rotary kiln, all the wastes were received, stored and sorted in the MRRF, which was an enclosed building with concrete

floor. All leachate and wastewater generated in the building was collected in an enclosed drainage system leading to an underground storage tank (UST) and then transferred for treatment at GICP. The likelihood of the MSW or leachate / wastewater causing contamination below the impermeable concrete floor is considered to be negligible.

- Leakage and/or spillage from the UST for leachate generated from the MRRF. The UST is a steel tank and its integrity has been checked to ensure no leakage prior to use. The tank was used for a short period of time (11 weeks) during the operations of the CCPP only and no evidence of leakage/damage was observed. Therefore the likelihood of the leachate / wastewater contaminating the soil around the tank and groundwater is considered to be very low. Moreover, the waste handled at the MRRF was municipal solid waste and the leachate generated from the operation of the MRRF would be expected to have been organic in nature and not expected to contain potential contaminants of concern such as heavy metals or persistent organic compounds.
- Leakage/spillage of contaminants from the ash generated from the rotary kiln system during the CCPP operation process. It is noted that all ash generated from the CCPP was collected from the kiln directly into bags and transferred for storage in the reception hall. After the completion of the pilot test, the remaining ashes were vacuumed from the units and also collected in bags. Therefore it is unlikely that anything more than very limited fugitive ash was spilled on the paved floor. The likelihood of this ash then contaminating the soil or groundwater beneath the paved floor is considered to be negligible.
- Leakage/spillage of contaminants from bottom ash quenching tank located at the bottom of the rotary kiln. It is noted that the bottom ash was quenched, collected in bags and transferred for storage in the reception hall thus limiting the potential for the contamination of the underlying soils and groundwater to negligible levels.

Locations and photos of these potential sources are presented in *Annex B2*.

The whole CCPP Site area was paved with concrete and asphalt. The wastewater from the MRRF was connected to a collection sump and was then transferred for treatment at GICP. The stormwater run-off from the outdoor plant area was collected within the GICP drainage system.

It was observed that the fuel oil transfer pipelines used overhead pipes. No oil, ash and wastewater spillage/leakage had reportedly occurred at the Site during its short period of operation and none were observed during the Site visit.

Potential current off site sources of soil and groundwater contamination are associated with the current operation of the cement plant surrounding the Site. Further off site are a power station and a steel manufacturing plant which are also industrial use.

3.3 POTENTIAL FUTURE SOURCE

The Site's future use remains industrial (manufacture of cement and cement related products) and is surrounded by remaining areas of the GICP. After decommissioning, the concrete slab and concrete foundations and sub structures will be excavated, to a maximum depth of 1.5 m. The whole Site will then be levelled using clean imported materials. The Site will remain as an open area awaiting a decision to be made in the future for industrial use. It is currently proposed that the surface of the clean imported materials will be rehabilitated into a grass lawn.

All traces of MSW and the associated CCPP will have been removed and there will not be a potential source of contamination present at the Site.

3.4 CONCEPTUAL MODEL OF POTENTIAL POLLUTANT LINKAGE

The potential pollutant linkages that could be present at the Site due to the on site activities of the CCPP are summarised in the following *Table 3.4*. As presented in the *Table 3.4* it is not considered that the activities of the CCPP have resulted in any significant pollutant linkage between an identifiable source of contamination caused by the activities of the CCPP and any receptor.

It is considered that the only potential receptors at risk might be site workers involved in decommissioning and demolition works, which is discussed in the *Section 4*.

Source	Pathway	Receptor	Risk
Historical storage of cement and limestone/ foundation construction	Ingestion, inhalation and skin contact.	Site workers involved in the decommissioning and demolition work	Negligible to low - The materials were stored over 10 years ago and were likely to be inert or were natural materials.
	Soil pore migration.	Ground and surface waters	None - The storage occurred over 10 years ago.
Municipal waste feedstock (MSW)	Ingestion, inhalation and skin contact.	Humans (eg Site workers during decommissioning and demolition works)	None – No MSW remains on site at the time of the site visit. MSW was stored and handled within the material recovery building which was enclosed with impermeable ground surface.
Ash residue from the thermal treatment trial	Ingestion, inhalation and skin contact.	Humans (eg Site workers during decommissioning and demolition works)	None– All ash has been collected directly from the equipment and sealed in bags.

Table 3.4Conceptual Model of Potential Pollutant Linkage at the CCPP site

Source	Pathway	Receptor	Risk
Liquid runoff from MSW/ash	Ingestion, inhalation and skin contacts	Humans (eg Site workers during decommissioning and demolition works)	Negligible to low - All wastewater/leachate was collected in an enclosed drainage system leading to a steel tank. Dismantling of this system may pose a health and safety risk, see <i>Section 4.2.1</i> .
Liquid runoff from MSW/ash	Soil pore water	Groundwater/ surface water	As above – Impermeable hardstanding and enclosed drainage system. No leakage of the wastewater collection UST reported.
Off site contamination sources	Migration on to the CCPP site via soil pore water or air borne dust	Humans - Site workers during decommissioning Groundwater under the Site	Low – There was no evidence to suggest any spillages or leaks have occurred off site to such an extent as to impact the soils or groundwater underlying the Site.

4.1 EVALUATION OF IMPACTS

Based on the conceptual model it is considered that the only potential receptor present at the Site, is possibly any workers involved in the excavation works. There is considered a negligible to low potential risk that any as yet unidentified contaminants may have adverse impacts to the site workers involved in the demolition and excavation of the foundations of the CCPP.

A description of general hazardous properties of typical contaminants associated with fuel storage, machinery operations and municipal waste incineration is presented for information purposes, in *Table 4.1*. It is noted that currently, based on the findings of Section 3 and 4, it is not considered likely that that any of these contaminants are present at the site.

Typical Contaminants	General Hazardous Properties
Traces of heavy metals from combustion process and lead from fuel	 Can be toxic by ingestion and contact; and Specific precautions may be required in relation to monitoring dust control during the demolition works.
Petroleum hydrocarbon products from adjacent fuel storage, dispensing facilities and overhead pipelines	Can be toxic by contact; andConcentrations may be flammable.
Simple aromatic (including benzene, toluene, xylenes, and ethylbenzene) from equipment maintenance	Can be toxic by inhalation, ingestion and contact; andMay be flammable at high concentrations.

4.2 POTENTIAL IMPACTS

The potential impacts which may arise from any contaminated soil at the Site are considered to be the following:

- Health risks to site workers involved in the decommissioning, excavation and demolition works on site;
- Disposal of contaminated materials;
- Possible potential risks to future users of the CCPP Site.

4.2.1 Health Risk to Site Workers

The demolition works will include the dismantling of equipment, the breaking and removal of; the concrete slab, the reinforced concrete footing plinths and the blinding layer (limited to the areas where the foundations have to be demolished) and removal of all waste materials. Although considered unlikely, site construction workers may become exposed to contaminated soil materials during the demolition and removal of substructures. The main exposure routes for site construction workers are skin contact with potentially toxic or harmful contaminants in the surrounding soils or accidental ingestion of contaminated material through poor hygiene, eating and smoking on site.

Based on the results of the intrusive investigation, and as required, appropriate mitigation measures will be used in breaking any potential linkage between contaminated materials and site workers. This may include but not limited to identification and use of Personal Protection Equipment (PPE), using mechanical equipment for sub structure and UST removal and transport to limit human contact to underlying soil and groundwater. The H&S mitigation measures will be described in the Project's Health & Safety Plan. The appointed Contractor(s) for the decommissioning and demolition works should prepare a Health and Safety (H&S) plan, prior to the commencement of the demolition works. The Contractor(s) should also ensure that all site workers are aware of the requirements outlined in the H&S plan, as well as capable of reacting to any identified contamination concerns.

4.2.2 Disposal of Contaminated Materials

The excavation to be carried out as part of the demolition will be limited to the concrete sub-structures only and no soil will be excavated from the Site. The work will not involve the handling or disposal of potentially contaminated soil that may be underneath the concrete/steel installations due to be demolished/excavated.

In addition, there is currently no further development planned for the Site and no buildings or associate piling or construction activities will be carried out at the Site.

The excavation depth will be limited to the bottom of the current foundation and UST, which are both located approximately 1.5 m bgl. The groundwater in the surrounding area is reported at approximately 2.5 to 4 m bgl⁽¹⁾. The proposed excavation for the demolition works will therefore be above the groundwater level and no groundwater extraction from the excavated areas will be required and no contact with groundwater is expected.

Should any ingress water (such as from precipitation) need to be removed from the excavation area, the water will be disposed of in *the existing on-site waste water treatment system*.

4.2.3 Potential Health Risks to Future Users

After completion of decommissioning and demolition works, the whole Site will be levelled using clean imported fill materials which will effectively cover

⁽¹⁾ Based on information from ERM's previous projects in nearby areas.

or cap the whole area. The Site will be left as an open space awaiting any future industrial use decision and is to be grassed for aesthetic purposes.

The potential for human contact with the underlying materials after the completion of the levelling and capping work (approximate thickness of one metre) is not considered likely. As such no pollutant linkage to human is anticipated at the Site after the completion of decommissioning and demolition works.

It is noted that capping of a site so as to isolate metal contamination from users could be considered as a remediation action (*Ref. Appendix III of the EPD Guidance Note for Contaminated Land Assessment and Remediation*). This scenario may be applicable for the Site and thus could be considered an appropriate remedial option should metal contamination be detected.

This Page Intentionally Left Blank

5.1 INTRODUCTION

As mentioned in the earlier sections, no soil excavation or groundwater extraction will be required for the Project and no potentially contaminated materials requiring disposal will be generated from the Site. Human exposure to potentially contaminated material will be limited to possible site worker contact during the excavation of the foundations and substructures.

The following site investigation programme is proposed to provide additional information for the site area to offer a level of confidence on the presence and (if found) the concentrations of contaminants in the underlying soil materials and help in the formulation of a site specific health and safety plan.

The objectives of contamination sampling are in general to:

- identify if the soil below ground surface within the Project site is contaminated; and
- if contaminants are present, determine their concentrations.

The following investigation programme has been developed based on the *Guidance Manual for Use of Risk-based Remediation Goals for Contaminated Land Management* (RBRG Guidance Manual) and the associated Guidance Notes, and the EPD's *Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol Filling Stations, Boatyards, and Car Repair/Dismantling Workshop.*

5.2 **PROPOSED SITE INVESTIGATION**

5.2.1 Soil Sampling

Underground Storage Tank (UST) for Wastewater

It is proposed that soil sampling be undertaken at two locations (S1/S2 and S3/S4) adjacent to the UST to identify whether soil surrounding the UST is contaminated.

Two (2) soil samples are proposed to be taken at each sampling location using trial pits at below the concrete slab and asphalt hard surface and at the bottom of the UST (ie at 1.5 m below ground level, m bgl) ⁽¹⁾. It is proposed that a mechanical excavator will be used to break the concrete slab and asphalt hard surface and then to excavate trial pits to 1.5 m bgl to facilitate soil sampling. Soil samples will be sampled manually using a hand auger or alternative manual means, such as a trowel. *Figure E1, Annex E* shows the proposed sampling locations at the UST.

⁽¹⁾ The UST dimension is (1 m (wide) x 4 m (Length) x 1.5 m (depth).

Remaining Areas of the CCPP

Four (4) subsurface soil sampling locations are proposed to be located around the CCPP area to provide information on the level of contaminants in the subsurface soil around the CCPP.

Based on the review of the site history and historical pictures of the site, in particular during the site formation (see *Annex D*), the shallow geology underlying the site is anticipated to comprise homogeneous fill materials (consisting of decomposed granites, rocks, boulders from nearby hills mixed with imported sand materials). The proposed sampling locations are therefore located along the CCPP structure focussing where foundations are located and at similar intervals to provide coverage of the proposed area where underground subsurface disturbance will occur during the demolition. The proposed sampling locations are shown in *Figure E2, Annex E*.

To determine the presence and extent of contamination from the surface soil ⁽¹⁾ and in the fill materials ⁽²⁾, two (2) soil samples will be taken from each sampling location at just below the concrete pavement and at 1.5 m bgl. A mechanical excavator will be used to break the concrete pavement and then to excavate trial pits to 1.0 to 1.5 m to facilitate soil sampling (depths depend on the depth of the foundation in each area). Soil samples will be sampled manually using a hand auger or similar manual means.

5.2.2 Analytical Parameters & Procedures

All samples will be analysed by a HOKLAS accredited laboratory for the parameterslisted in *Table 5.2* below.

Table 5.2Methods of Analysis for Soil Samples

Parameter	Referenced Analytical Method
Total Petroleum Hydrocarbons (TPH) fractions including C6-C8, C9-C16 and C17-C35	USEPA Method 8015
Simple Aromatics (e.g. benzene, toluene, ethyl benzene, and xylenes) (BTEX)	USEPA Method 8260
Heavy metals:	
Antimony (Sb), Arsenic (As), Barium (Ba), Cadmium (Cd), Chromium III and VI (Cr III and Cr VI), Cobalt (CO), Nickel (Ni), Copper (Cu), Lead (Pb), Manganese (Mn), Mercury (Hg), Molybdenum (Mo), Nickel (Ni), Tin (Sn), and Zinc (Zn)	USEPA Method 6020A/7000 ICPMS

Note: The TPH fractions and list of heavy metals are based on the RBRGs list.

Table 5.3 summarises the proposed sampling programme.

⁽¹⁾ It is anticipated that any contamination from the CCPP operations will have entered the underlying soils from the surface as no subsurface pipelines or channels were located within the CCPP.

⁽²⁾ It was reported that the original fill material was excavated from the site for the foundation construction during the construction of the CCPP which was then backfilled on site. The site was used for storage of materials prior to the CCPP construction.

Sample	Sampling Location	Depth of Sampling	Sampling Parameters	No of Samples to be taken
S1/S2	Located to the north of the UST.	Underneath concrete pavement and at 1.5 m	Heavy metals, TPH, BTEX	2
S3/S4	Located to the south of the UST.	Underneath concrete pavement and at 1.5 m	Heavy metals, TPH, BTEX	2
S5/S6	Located to the east of the rotary kiln.	Underneath concrete pavement and at 1.5 m	Heavy metals, TPH, BTEX	2
S7/S8	Located to the west of the cyclones.	Underneath concrete pavement and at 1.5 m	Heavy metals, TPH, BTEX	2
59/S10	Located to the south of the CCPP and north of the overhead fuel pipelines connecting the fuel oil storage tank (located approximately 100 m to the southwest of the CCPP).	Underneath concrete pavement and at 1.5 m	Heavy metals, TPH, BTEX	2
S11/S12	Located to the northwest of the reception hall and to the southeast of the fuel underground storage tanks and dispensing station.	Underneath concrete pavement and at 1.0 m	Heavy metals, TPH, BTEX	2
QC	To be collected on a random basis	Underneath concrete pavement or at 1.5 m	Heavy metals, TPH, BTEX	1
			Total no. of samples	13

Table 5.3Sampling Locations and Parameters for Site Investigation

5.2.3 Sample Duplication

One field duplicate soil sample will be taken every 20 soil samples collected during the land contamination investigation. The duplicate samples will be collected on a random basis and submitted to the HOKLAS accredited laboratory for the purpose of quality control (QC)/quality assurance (QA).

5.2.4 Sampling Programme

The sampling programme will be undertaken with strict adherence to appropriate protocols so as to minimise the potential for cross-contamination between sampling locations. The sampling methodologies are based on methods developed by the US EPA, adapted to Asian standards of operation and practice, as appropriate. These methods include decontamination procedures, sample collection, preparation and preservation, and chain of custody documentation, as outlined below. The volume of soil and groundwater samples to be collected should be confirmed with the analytical laboratory taking into account the sample analysis requirements (ie soil samples are normally required to be 2 kg in weight) and sample preservation procedures.

5.2.5 Sample Collection

Stainless steel hand augers will be used for soil sampling. The equipment used for sample collection will be decontaminated (as described in *Section* 5.2.6) prior to each sampling. Clean latex gloves will be worn and changed before each new sample is collected.

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

All samples will be transported under appropriate chain-of-custody documentation, as described below, in clean coolers with ice packs at a temperature of approximately +4°C. Samples will be delivered to the laboratory as soon as possible after collection, noting the recommended maximum holding times.

5.2.6 Decontamination Procedures

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

During sampling and decontamination activities, disposable latex/nitrile gloves will be worn to prevent transfer of contaminants from other sources. Any disposable equipment will be disposed as general waste after each use.

5.2.7 Analytical Laboratory

Analysis of samples will be carried out by an appropriate, HOKLAS certified analytical laboratory located in Hong Kong or another qualified overseas laboratory. The laboratory shall maintain high standards of analytical and technical services for the detection of trace organic contaminants. All analysis should be conducted according to standard procedures set by the US EPA, APHA, ASTM along with internal QA/QC procedures.

6.1 CONCLUSIONS

The assessment of land contamination sources and the potential impacts to particular development projects were investigated in accordance with the *RBRG Guidance*. Site appraisal comprising a site visit and the review of background information and land history in relation to possible land contamination was conducted. Potential sources of contamination and associated impacts, risks or hazards are identified in this CAP.

Excavation works proposed for the decommissioning and demolition works will be limited to the concrete sub-structures and UST. No soil excavation or groundwater extraction will be required for the Project and hence no potentially contaminated materials requiring off-site disposal will be generated from the Site.

The substructure areas of the CCPP Site will be filled using clean imported fill materials and rehabilitated as green lawn and open area. The potential for human contact with any underlying contamination in the future is considered low.

It is concluded that the risk of future exposure to any contamination is deemed negligible.

6.2 **RECOMMENDATIONS**

Although no soil excavation or groundwater abstraction will be required during the demolition of the CCPP and that no soil or groundwater material will be required to be disposed of off site, as a precautionary measure and after discussions with the EPD, a limited site investigation programme comprising subsurface soil sampling and analysis is proposed in this CAP. A total of six soil sampling locations (with a total of 13 soil samples including one soil duplicate sample) are proposed.

Following approval of this CAP, a site investigation will be carried out. A Contamination Assessment Report (CAR) will be prepared presenting the findings of the land contamination assessment programme.

The laboratory analytical results will be compared against the *RBRGs for Industrial Land Use* in the *Guidance Manual for Use of Risk-based Remediation Goals for Contaminated Land Management* and a conceptual model will be presented for the site.

Aside of health and safety mitigation, remediation action is not currently expected. However, if necessary, a Remedial Action Plan (RAP) will be prepared for submission to EPD for approval. The proposed remedial options will examine the relevant issues of remedial treatment versus

disposal, these options will be based on the proposed future land uses as an open grassed space, and associated potential risks based upon the site data and the EPD guidance. The RAP will also detail any further site investigation that maybe required during the Contactor's execution of the remediation work.

It is also recommended that the appointed Contractor(s) for the demolition removal prepare a Health and Safety (H&S) plan, based upon the soil results, prior to the commencement of the decommissioning and demolition works.

Annex A

The Guidance Manual for Use of Risk-based Remediation Goals for Contaminated Land Management and the Guidance Note for Contaminated Land Assessment and Remediation Guidance Manual for Use of Risk-based Remediation Goals for Contaminated Land Management

> Hong Kong SAR Government Environmental Protection Department July 2007

Guidance Manual for Use of Risk-based Remediation Goals for Contaminated Land Management

Contents

Section 1	Introduction	
1.1	The Problem of Contaminated Land1-	1
1.2	Replacement of Dutch B Levels with Risk-Based Remediation Goals (RBRGs)1-	1
1.3	Risk-based Approach for Contaminated Land Management1-	2
1.4	Scope and Structure of this Guidance Manual1-	2
Section 2	Development of RBRGs	
2.1	Risk-based Approach2-	1
2.2	Development Process2-	1
	2.2.1 Chemicals of Concern	2
	2.2.2 Land Use Scenarios	3
	2.2.3 Identification of Exposure Pathways2-	4
	2.2.4 Cancer and Non-Cancer Toxicity2-	4
	2.2.5 Non-Aqueous Phase Liquid (NAPL)2-	5
2.3	Risk-based Remediation Goal Tables2-	6
2.4	Limitation on the Use of RBRGs2-7	
Section 3	Application of RBRGs in Land Contamination Assessment	
3.1	Steps for Applying RBRGs in Contaminated Land Assessment	
Section 4	Record Keeping and Reporting	
Section 5	General Reference	

i

List of TablesTable 2.1Risk-BTable 2.2Risk-B	ased Remediation Goals (RBRGs) for Soil and Soil Saturation Limit ased Remediation Goals (RBRGs) for Groundwater and Solubility	Exposure pathway	The course a toxic chemical takes from the source area to a receptor. Each exposure pathway includes a source or release from a source, a point of exposure, and an exposure route. If the exposure point is not at the source, a transport medium is also involved.
Limit List of Figures		Exposure route	The mechanism by which a receptor inhales, consumes, absorbs, or otherwise takes in a toxic chemical at an exposure point.
Figure 1.1 Boatya	rds	Groundwater	Means any water beneath the earth's surface in the zone of saturation.
Figure 1.2 Petrol I Figure 1.3 Car Re	pair/Dismantling Workshops	Hazard quotient	Ratio of the intake to the reference dose.
Figure 3.1 Land C Figure 3.2 Land C Figure 3.3 NAPL	Contamination Assessment and Preparation of CAP, CAR and RAP Contamination Assessment Process: Input and Reporting Requirements Assessment Flowchart	Intake	A measure of exposure expressed as the mass of a substance in contact with the exchange boundary per unit body weight per unit time (e.g. mg/kg-day). Also termed the normalized exposure rate; equivalent to administered dose.
3.1. Summa 3.2. Soil Da	rd Forms rry of On-Site Land Use tta Summary and Comparison to RBRGs and C _{sat}	Integrated Risk Information System (IRIS)	An US EPA database containing verified reference doses (RfDs) and cancer slope factors (CSFs) and up-to-date health risk and US EPA regulatory information for numerous chemicals.
 3.3. Groundwater Data Summary and Comparison to RBRGs and Solubility Limits 3.4. Soil Sample Concentrations and Exceedances of RBRGs and C_{sat} 3.5. Groundwater Sample Concentrations and Exceedances of RBRGs and 		Non-aqueous Phase Liquid (NAPL)	Chemicals that are insoluble or only slightly soluble in water that exist as a separate liquid phase.
Solubil	ity Limits	Pathway	The route a toxic chemical takes to go from a source to a receptor.
Glossary	A plausible upper-bound estimate of the probability of a cancer	Quality assurance/ Quality control documentation	Results of test run by the laboratory to verify the precision and accuracy of analytical tests and equipment.
(CSF)	response per unit intake of a chemical over a lifetime. The slope factor is used to estimate an upper-bound probability of an individual developing cancer as a result of exposure to a	Receptor	Any person that is or may be affected by a release of toxic chemicals.
	particular level of a potential carcinogen. The cancer slope factor is given in units of the reciprocal of milligrams of chemical per kilogram of body weight per day $(mg/kg-day)^{-1}$.	Reference Dose (RfD)	An estimate of a daily exposure level for the human population including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime, or portion of a lifetime. The RfD is given in units of milligrams
Method Reporting Limit (MRL)	The lowest amount that can be distinguished from the normal "noise" of an analytical instrument or method.		of chemical per kilogram of body weight per day.
Exposure	Contact of a receptor with a chemical or physical agent. Exposure is quantified as the amount of the agent at the exchange boundaries of the receptor (e.g. skin, lungs, gut) and available for absorption.	Release	Means any spilling, leaking, pouring, emitting, emptying, discharging, injecting, pumping, escaping, leaching, dumping, or disposing of a toxic chemical into the environment (including the abandonment or discarding of barrels, containers, and other closed receptacles containing hazardous wastes or hazardous constituents).

Remediation	An action, including removal, chemical, physical, or biological treatment of soil, groundwater, or other environmental media, intended to restore or improve the land condition impacted by chemical contamination.
Risk assessment	An analysis of the potential for adverse effects caused by a toxic chemical at a site and to determine the need for remedial action or to develop cleanup levels where remedial action is required.
Site	Defined by the likely physical distribution of the toxic chemicals from a source area. A site could be an entire property or facility, a defined area or portion of a facility or property, or multiple facilities or properties.
Soil	Means any unconsolidated mineral and organic matter overlying bedrock that has been subjected to and influenced by geologic and other environmental factors, excluding sediment.
Soil saturation limit	The contaminant concentration in soil at which the absorptive limits of the soil particles, the solubility limits of the soil pore water and saturation of soil pore air have been reached.
Solubility Limit	The maximum amount of solute that can be dissolved in a given quantity of solvent (e.g. water) at a given temperature.
Source	Presence of a toxic chemical at or below the ground surface at a hazardous concentration.
Toxicity value	A numerical expression of a substance's dose-response relationship that is used in risk assessments. The most common toxicity values used are reference doses (RfD) for noncarcinogenic effects and cancer slope factors (CSFs) for carcinogenic effects.
Water table	Means the upper elevation of the surface of the saturated zone.
Zone of saturation	Means any part of the earth's crust in which all voids are filled with water.

Abbreviations

ASTM	American Society for Testing and Materials
CAP	Contamination Assessment Plan
CAR	Contamination Assessment Report
COC	Chemical of Concern
CSF	Cancer Slope Factor
CSM	Conceptual Site Model
DQO	Data Quality Objective
DNAPL	Dense Non-aqueous Phase Liquid
EPD	Environmental Protection Department of the Hong Kong SAR
HEAST	Health Effects Assessment Summary Table
HOKLAS	Hong Kong Laboratory Accreditation Scheme
IRIS	Integrated Risk Information System
LNAPL	Light Non-aqueous Phase Liquid
MRL	Method Reporting Limit
NAPL	Non-aqueous Phase Liquid
PCB	Polychlorinated Biphenyl
QA/QC	Quality Assurance/ Quality Control
RAP	Remediation Action Plan
RBRG soil	Risk-Based Remediation Goal for soil
RBRG gw	Risk-Based Remediation Goal for groundwater
RfD	Reference Dose
RR	Remediation Report
SI	Site Investigation
SVOC	Semi-volatile Organic Chemical
ТРН	Total Petroleum Hydrocarbons
US EPA	United States Environmental Protection Agency
VOC	Volatile Organic Chemical
WHO	World Health Organisation

v

Section 1 Introduction

Section 1 INTRODUCTION

1.1 Purpose of this Guidance Manual

This Guidance Manual for Use of Risk-Based Remediation Goals (RBRGs) for Contaminated Land Management (Guidance Manual) introduces the background of RBRGs and presents instructions for comparison of soil and groundwater data to the RBRGs. Included in this guidance are RBRGs for soil and groundwater protective of human health for 54 chemicals of concern.

The RBRGs have been designed to protect the health of people who could potentially be exposed to land impacted by chemicals, under four broad post-restoration land-use categories. They are intended to be used as site assessment criteria that will be appropriate on a stand-alone basis for the majority of sites in Hong Kong, where human health is the only significant receptor that needs to be protected. On sites where this is not the case e.g. where groundwater quality needs to be protected as it is abstracted on site or nearby for industrial use, irrigation or drinking, where surface water quality may be impacted or where significant ecological receptors are potentially impacted, then the RBRGs will not be appropriate and other criteria will be required. These other criteria could include drinking water standards or ecological protection criteria.

The philosophy of the RBRGs is that, in being risk-based, they tailor the extent of remediation required to the level of risk under certain land-uses. For example as residential land-use is more sensitive than industrial land-use the land would need to be remediated to a greater extent.

The Guidance Manual is organized as follows:

Section 1 – Introduction Section 2 – Development of RBRGs Section 3 – Application of RBRGs in Land Contamination Assessment Section 4 – Record Keeping and Reporting Section 5 – General Reference

Detailed information (e.g. exposure parameters, site assumptions, toxicity information, chemical properties) on the derivation of the RBRGs is provided in the *Background Document on Development of Risk-Based Remediation Goals for Contaminated Land Management* (Background Document).

The Guidance Manual should be used in conjunction with the new Guidance Note for Contaminated Land Assessment and Remediation (which replaces the ProPECC Note PN3/94), and the Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol Filling Stations, Boatyards and Car Repair/Dismantling Workshops. Copies of these may be downloaded from: http://www.epd.gov.hk/epd/english/envir_standards/non_statutory/esg_non_stat.html

1.2 The Problem of Contaminated Land

Contaminated land is caused by spillage, leakage or disposal of toxic chemicals to the ground. Soil at or below the ground surface and sometimes groundwater may be contaminated depending on the subsurface conditions. Contaminated land is a health concern if the public is exposed to toxic chemicals through the impacted soil or groundwater. In Hong Kong, examples of industrial or commercial activities that may potentially cause land contamination include boatyards, petrol filling stations, vehicle repair/maintenance or dismantling workshops, metal or mechanical workshops or oil installations etc. (Figures 1.1, 1.2 and 1.3). The potentially polluting activities generally involve (i) underground oil or chemical storage in tanks that may leak due to corrosion, or (ii) operations that may cause spillage of chemicals. Ground surface condition is also a factor affecting the severity of contamination. Spillage over bare soil results in more serious contamination than that over a capped surface.

Before a contaminated site is re-developed or handed back from a tenant/purchaser/allocatee to the Government, it is necessary to assess the level of contamination by collecting soil and groundwater samples for laboratory analyses. If contamination is above an acceptable level, defined by a set of standards or remediation goals, remediation is required to render the site safe for future use.

1.3 Replacement of Dutch B Levels with Risk-Based Remediation Goals (RBRGs)

Historically, Hong Kong has no locally-derived contaminated land standards. The Dutch B levels of the Netherlands referenced in the Practice Note for Professional Persons for Contaminated Land Assessment and Remediation, ProPECC PN3/94 issued by EPD in 1994, have been used up to the present.

Contaminated land standards specifically derived for Hong Kong are necessary to replace the Dutch B levels for three reasons. Firstly, the Dutch government has already developed a new set of risk-based standards to replace the Dutch B levels. Secondly, the Dutch B levels were developed to protect the people and environment in the Netherlands only which means that they are not entirely suitable for Hong Kong. Thirdly, the world-wide practice is for each country to develop country specific standards based on a risk assessment approach to suit their local environmental conditions and community needs. This risk approach means that decisions on defining a site as contaminated, and hence the level of remediation required, are made based on the potential risks to receptors and the intended land-use.

To bring Hong Kong in line with the international practice and to replace the Dutch B levels, a set of locally-derived contaminated land standards, the RBRGs, has been developed for four types of land-use in Hong Kong to protect the local human receptors. This Guidance Manual explains the risk-based approach and guides users in applying the RBRGs to their contaminated sites.

1.4 Risk-Based Approach for Contaminated Land Management

The RBRGs were developed using a risk-based approach which means that decisions on contaminated soil and groundwater remediation will be based on the nature and extent of the potential risks that are posed to human receptors as a result of exposure to chemicals in the soil and/or groundwater. This approach acknowledges that there are some low levels of exposure to the contaminants that will pose minimal risks to the receptors. RBRGs have been developed as threshold contaminant concentrations, below which hazards or risks to human health arising from exposure to soil and/or groundwater are considered minimal. These target hazard and risk levels will be quantified in subsequent chapters of this document. Remediation of contaminated soil or groundwater that poses such minimal risks would not be necessary for the protection of public health. When concentrations of soil or groundwater are detected above the RBRGs, cleanup will be required. The risk-based approach also facilitates the use of Hong Kong data in respect of typical working

Section 1 Introduction

schedules, soil conditions, meteorological conditions, typical building designs, etc. to suit local conditions. This approach provides a specifically relevant and technically defensible framework for the assessment of contaminated sites as well as promotes cost-effective remediation in Hong Kong.





Figure 1.1 – Boatyards



Figure 1.2 – Petrol Filling Stations



Figure 1.3 – Car Repair / Dismantling Workshops

Section 2 DEVELOPMENT OF RBRGs

2.1 Risk-based Approach

Managing contaminated land using the risk-based approach involves taking the source-pathway-receptor into consideration before making decisions on the assessment and remediation of contaminated land. This involves construction of a conceptual site model (CSM), which is the qualitative description of the ways in which receptors can be exposed to site contamination, and is developed to provide an overall understanding of the site. For exposure to be considered possible, some mechanism ('pathway') must exist by which contamination from a given source can reach a given receptor. Such complete 'source-pathway-receptor' exposure mechanisms are commonly termed 'pollutant linkages'.

The term exposure pathway is used to describe a potentially complete source-pathway-receptor linkage, i.e. where a chemical in the environment has a means by which it can reach a human receptor. There are different exposure pathways for different types of land-use which represent different physical settings. Also, the ways in which people come into contact with contaminated soil and/or groundwater, including the intensity and frequency of contact, are largely dependent on the type of land-use. It was therefore necessary to identify the relevant land-use scenarios in Hong Kong and develop a set of RBRGs for each land-use.

2.2 Development Process

The RBRGs were developed based on the principles in risk assessment calculation which can be expressed as:

Exposure Concentrations x Exposure Factors x Toxicity = Risk

Where:

X	times or multiply by
Exposure Concentrations	Chemical concentrations that people are exposed to, i.e. RBRGs
Exposure Factors	Describe how people are exposed to the chemicals
Toxicity	Level of toxicity of the chemicals
Risk	Level of health risk acceptable to the public

As shown, RBRGs can be determined based on the risk assessment technique provided that the risk level, toxicity level and exposure factors are known.

RBRGs are concentrations in soil and groundwater protective of human health. The RBRG development process consisted of the following key steps:

- Identify the chemicals of concern (COCs) for Hong Kong.
- Define the different types of land-use where these chemicals may be found.
- Identify the human receptors who could come into contact with these chemicals at contaminated sites.

- Identify the exposure pathways through which the receptors could come in contact with these chemicals at contaminated sites.
- Identify the equations, models, and toxicity information that could be used to develop RBRGs to protect the receptors exposed to COCs.
- Collect information specific to Hong Kong on land-use, building design, site conditions, and people's behavior, to develop RBRGs protective of human health.

Relevant overseas methodologies such as ASTM (1995), ASTM (2000) and CCME (1996) were used in establishing the RBRGs with input of local data as far as possible, resulting in standards more suited to the Hong Kong conditions. The RBRGs were locally derived using established methods and the risk-based approach and are more objective, consistent, and scientifically defensible while at the same time able to ensure a satisfactory level of protection to the public.

For certain chemicals, the calculated RBRGs are higher than the concentrations where a separate, non-aqueous phase may be present in soil or groundwater. Chemicals that exist in this form, referred to as non-aqueous phase liquid (NAPL), can be difficult to locate, contain, or treat and require special consideration USEPA (1992). Screening criteria were developed for NAPL in soil and groundwater that must be considered along with RBRGs to determine whether a site requires further action. The development of NAPL screening criteria is also discussed in the following sections.

2.2.1 Chemicals of Concern

RBRGs have been developed for 54 COCs which were selected on the basis that either they are known to occur in the Hong Kong environment, or are in use locally.

The COCs are grouped into the following chemical classes:

- Volatile organic chemicals (VOCs) 13 chemicals
- Semi-volatile organic chemicals (SVOCs) 19 chemicals
- Metals 15 chemicals
- Dioxins and Polychlorinated Biphenyls (PCBs) 2 chemicals
- Petroleum carbon ranges 3 groups
- Other inorganic compounds 1 chemical
- Organometallics 1 chemical

Soil and groundwater collected at sites contaminated with petroleum should be analyzed using a method that can fractionate the material into categories based on carbon numbers. Whilst toxicity values are generally not provided for Total Petroleum Hydrocarbons (TPH) as a whole, toxicity information is available for individual petroleum carbon fractions. Therefore, RBRGs have been developed for three separate hydrocarbon ranges as follows:

- C6-C8 (Carbon numbers from 6 to 8)
- C9-C16 (Carbon numbers from 9 to 16)
- C17-C35 (Carbon numbers from 17 to 35)

Note that the list of 54 COCs was compiled to the best of EPD's knowledge on what may reasonably be found in contaminated sites in Hong Kong.

In practice, the number and types of chemicals to be analyzed should not be dictated by the 54 COCs, but by the past and present chemical usage/storage activities on-site. Users of this Guidance Manual are advised to select only those COCs from the RBRG list that are relevant to their sites for laboratory testing. On the other hand, if a study of the past and present uses of a site reveals that there may be COCs specific to the site that are not in the list of 54, those specific COCs should be included in the test programme even though they do not appear in the RBRG list.

For any COC outside the list of 54, the user should propose, with justifications, the appropriate standard/remediation goal to be set for agreement with EPD.

2.2.2 Land-use Scenarios

RBRGs were developed for four different post-restoration land-use scenarios reflecting the typical physical settings in Hong Kong under which people could be exposed to contaminated soil and groundwater. Sets of RBRGs have been developed to protect workers at industrial sites, the public visiting public parks, and residents in urban and rural areas. Separate sets of RBRGs have been developed according to different land-uses, because it has been shown that the ways in which people come into contact with contaminated soil and/or groundwater, including the intensity and frequency of their contact, are largely dependent on the type of land-use. A description of each land-use scenario is as follows:

- 1. Urban residential Sites located in an urban area where main activities involve habitation by individuals. The typical physical setting is a high rise residential building situated in a housing estate that has amenity facilities such as landscaped yards and children playground. The receptors are residents who stay indoors most of the time except for a short period each day, during which they are outdoors and have the chance of being in direct contact with soil at landscaping or play areas within the estate.
- 2. **Rural residential** Sites located in a rural area where main activities involve habitation by individuals. These sites typically have village-type houses or low rise residential blocks surrounded by open space. The receptors are rural residents who stay at home and spend some time each day outdoor on activities such as gardening or light sports. Degree of contact with soil under the rural setting is more than that of the urban setting both in terms of the intensity and frequency of contact.
- 3. **Industrial** Any site where activities involve manufacturing, chemical or petrochemical processing, storage of raw materials, transport operations, energy production or transmission etc. Receptors include those at sites where part of the operation is carried out directly on land and the workers are more likely to be exposed to soil than those working in multi-storey factory buildings.
- 4. **Public parks** Receptors include individuals and families who frequent parks and play areas where there is contact with soil present in lawns, walkways, gardens and play areas. Parks are considered to be predominantly hard covered with limited areas of predominantly landscaped soil. Furthermore, public parks are not considered to have buildings present on them.

2.2.3 Identification of Exposure Pathways

For each land-use, consideration was given to ways in which contact with chemicals could occur. The term exposure pathway is used to describe the course a chemical takes from its source area to reach an individual. Each exposure pathway has the following components:

- A source
- A release and transport mechanism (if exposure occurs away from the source)
- A point or location of exposure
- An exposure route by which the chemical enters the human body (the skin, inhalation, ingestion)

For the four land-use categories, it was assumed that exposure could occur in two ways:

- by direct contact with soil (see explanation below) and/or
- by inhalation of vapors if volatile chemicals migrate from soil or groundwater into the air of a building constructed on top of residual contamination.

Thus, there are two combinations of exposure pathways:

- **Soil** includes direct contact through dermal contact and incidental ingestion of soil, as well as inhalation of particulates and volatile emissions in the ambient air from surface soil and inhalation of subsurface soil contamination in residential or industrial buildings.
- **Groundwater** includes inhalation of volatiles from subsurface groundwater in residential or industrial buildings.

RBRGs were developed to be protective of each of these two exposure pathways, however, not all exposure pathways are relevant to all land-use categories. For example, public parks are open space areas with good ventilation. They do not generally have occupied buildings in which indoor air could be impacted by the underlying soil. The exposure pathway of indoor air impact therefore would not be applicable to public parks.

The following four different types of RBRGs, have been developed for the land-use categories that are marked with \checkmark :

	Type of RBRG	Soil					Groundwater
	Pathway	Ingestion of	Dermal	Volatiles	Particulates	Subsurface	Volatiles
	-	surface soil	contact with	from	from	volatiles	indoor from
			surface soil	surface soil	surface soil	indoor	groundwater
s o	Urban Residential	✓	✓	✓	~	✓	√
d-u ari	Rural Residential	✓	✓	✓	~	✓	√
and cen	Industrial	✓	✓	✓	~	✓	✓
ч v	Public Parks	✓	✓	✓	✓		

Compared to other developed countries, the only significant land-use/pathway combination not recommended for Hong Kong is ingestion of contaminated groundwater as drinking water. The elimination is based on the fact that groundwater is generally not used for potable purposes in Hong Kong and this situation is unlikely to change in the future.

2.2.4 Cancer and Non-Cancer Toxicity

Chemicals are classified as to whether they exhibit cancer and/or non-cancer health effects.

Section 2 Development of RBRGs

Chemicals are also classified as to whether they are associated with health effects via one or more routes of exposure, e.g., ingestion, dermal and/or inhalation exposures. Toxicity indices, including cancer slope factors (CSFs) and reference doses (RfDs) (protective of non-cancer effects) are necessary to develop RBRGs.

In general, RfD is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of adverse effects during a lifetime. The CSF is a measure of the cancer potency of a chemical. Conservatism and safety factors are built into both RfDs and CSFs to account for the fact that many of these values are based on animal, rather than human studies.

Toxicity indices for RBRG development were derived from a number of sources including the US Environmental Protection Agency's (EPA) Integrated Risk Information System (IRIS) and Health Effects Assessment Summary Tables (HEASTs), US Department of Energy's Risk Assessment Information System (RAIS), the World Health Organisation (WHO) publications, the UK and the Netherlands contaminated land guidance documents. Values published on the RAIS were assessed for reliability before being used for RBRG development.

RBRGs protective of cancer health effects and non-cancer health effects are calculated separately. In the event that a chemical was associated with both cancer and non-cancer health effects, both a cancer-based RBRG and a noncancer-based RBRG were developed. The lower of these two RBRGs was selected as the final RBRG.

RBRGs protective of the cancer endpoint were based on an excess life time cancer risk of one in a million (10^{-6}) . RBRGs protective of noncancer endpoints were based on a hazard quotient of 1.0. A hazard quotient of 1.0 signifies that the derived RBRG, which is the environmental concentration, is equal to the reference dose (RfD) concentration. This concentration is the level at which no adverse effects are expected. In most cases, the RfD incorporates a safety factor so that with a hazard quotient of 1.0, a margin of safety would exist.

2.2.5 Non-Aqueous Phase Liquid (NAPL)

NAPL is a general term that refers to any organic liquid present in the environment as a separate distinct phase. The liquid may consist of a single pure chemical (e.g., benzene) or a complex mixture of chemicals (e.g., gasoline).

Two categories of NAPL are recognized: (1) dense non-aqueous phase liquids (DNAPLs) which are heavier than water; and (2) light non-aqueous phase liquids (LNAPLs) which are lighter than water. Examples of DNAPLs include PCBs, trichloroethylene and tetrachloroethylene. Examples of LNAPLs include gasoline, jet fuel, and toluene. LNAPLs released into soil in sufficient quantities may migrate vertically through the soil and eventually encounter the groundwater zone where the NAPL displaces water. DNAPLs released into the soil in sufficient quantities may penetrate deep into the soil with movement below the groundwater table.

Chemicals in this state can be difficult to locate, contain, or treat, and require special consideration for the following reasons:

Released LNAPLs and DNAPLs can migrate vertically through the subsurface due to gravity, or laterally due to capillary suction. Given a large enough release, LNAPL will encounter the groundwater zone where it spreads laterally and begins to dissolve into groundwater. Once the surface LNAPL release ceases, subsurface spreading of LNAPL

slows as the forces driving migration dissipate. However the dissolved phase may begin to migrate down gradient. Any such movement in the LNAPL plume can result in a significant expansion of the contaminated area and could result in imminent hazards or chronic risks to underground structures (e.g., sewers, basements) or to nearby surface waters and associated aquatic resources. DNAPLs can proceed below the groundwater table, and their flow may be enhanced by the presence of fractures in the soil or bedrock.

- When such NAPLs accumulate, they become pockets of essentially neat (i.e., undiluted) chemicals and could present a significant health threat (imminent hazard as well as chronic risk) to exposed receptors. Direct exposure to pockets of NAPLs could involve significantly greater exposures/uptakes than would be associated with similar organic chemicals that are present as sorbates on soil or solutes in groundwater.
- Pockets of NAPLs can act as long-term sources of contamination to the nearby environment via volatilization and dissolution. Vapors from volatilization may migrate to ambient air or to underground structures. Solutes from dissolution will migrate to groundwater. Such pockets of NAPL are not commonly depleted rapidly by such volatilization/dissolution, nor by degradation, so that the material acts as a source of pollution for many years or decades.

For these reasons, screening criteria (soil saturation limits, C_{sat}) were developed for NAPLs in soil and solubility limits for NAPL in groundwater for the more mobile organic chemicals. These criteria must be considered in addition to RBRGs to determine whether a site requires further action.

2.3 Risk-Based Remediation Goal Tables

RBRGs for Soil and Soil Saturation Limits (Table 2.1) and RBRGs for Groundwater and Solubility Limits (Table 2.2) present the remediation goals for soil and groundwater respectively. Each table presents a list of the COCs and RBRGs for the relevant land-use categories. Detected concentrations of COCs in soil and/or groundwater are to be compared to their respective RBRGs for the appropriate land-use category. COCs for which no groundwater RBRGs are provided were lacking either the appropriate toxicity values or physical/chemical property values necessary to calculate the RBRGs, or they were not considered to be volatile (i.e. volatile chemicals are those with Henry's Law Constant $>10^{-5}$).

Table 2.1 presents the soil saturation limits (C_{sat}) for the more mobile organic chemicals (with molecular weight less than 200 g/mol). C_{sat} is the concentration at which a chemical can, in theory, be present in the environment as NAPL. Table 2.2 presents the Solubility Limits for organic chemicals in groundwater. Solubility Limits were only calculated for those COCs with Henry's Law Constant >10⁻⁵. For these chemicals, detected concentrations must be compared to both the RBRG and C_{sat} /Solubility Limits to determine whether further action is required at the site. The C_{sat} and Solubility Limits serve as trigger levels indicating the potential for NAPL to be present. The issue of NAPL is of less concern for chemicals with molecular weights greater than 200 g/mol as chemicals with higher molecular weights are considered to be less mobile.

A non risk-based 'ceiling limit' is given as 10^4 mg/kg for soil and 10^4 mg/L for groundwater for the relatively less toxic inorganic, volatile and semi-volatile contaminants.

Instruction for comparing site data to RBRGs and C_{sat}/Solubility Limits is presented in Section 3.

Section 2 Development of RBRGs

2.4 Limitation on the Use of RBRGs

The RBRGs have been developed in consideration of environmental conditions, activities and building designs typical in Hong Kong. Conservative yet realistic assumptions have also been made on the degree of exposures that can occur to residents, workers and the public but only the common, important and complete exposure pathways have been included in the derivation of the RBRGs. Users of this Manual must familiarize themselves with the assumptions behind the derivation of these RBRGs before adopting them for their sites of concern. In particular, they must satisfy themselves that all exposure pathways important to their sites of concern have been considered in the derivation of the RBRGs in this manual.

Groundwater Utilization

An example of unusual activity which may lead to an exposure pathway not considered in the derivation of the RBRGs in this manual is the extraction of groundwater from within the site or locations close to the site for beneficial use, such as for drinking or irrigation. Where such exposure pathways exist, the user needs to conduct a separate assessment of the risks posed through such pathways. There are standards for drinking water in Hong Kong and these must be adhered to.

Ecological Receptors

The users should note that ecological receptors are not specifically covered by the RBRGs. The reason for this is that the brownfield sites in Hong Kong are primarily former industrial or in some cases commercial premises. Today these sites will be re-developed for residential, commercial or government/institutional use. It is highly unlikely that a contaminated site in Hong Kong will be re-developed for agricultural uses or into a nature conservation area. In the rare event that protection of ecological resources becomes necessary at a particular site, a focused ecological risk assessment (ERA) should be carried out to assess the ecological risks, in addition to applying the RBRGs. An ecological risk assessment is effectively a detailed consideration of the mechanisms and probability of exposure of ecological receptors to contamination and a characterization of the potential adverse effects which may arise from this exposure. There is considerable guidance available on ERA including: CCME (1996) and USEPA (1998).

Landscaping Plants

There is a chance that a contaminated site may be re-developed into a public park. RBRGs were derived for this land-use to protect the park users (see Section 2.2.2). No remediation standards were set to protect landscaping plants which are the major ecological receptors in a public park. The reason for this is that uncontaminated off-site soil with suitable soil characteristics, instead of the original site soil, is normally used for planting. The imported soil is then mixed with soil conditioners and fertilizers to make it suitable for planting use. Project proponents also have the option of planting more hardy landscaping plants that are resistant to contamination.

Conceptual Site Model

It will be necessary for those investigating contaminated land to build a conceptual model that describes the sources of contamination, the potential receptors and the pathways by which one may reach the other. In rare circumstances where significant ecology receptors are potentially impacted or where groundwater abstraction, surface water quality or other receptors are potentially at risk then the RBRGs will not be protective of these receptors. Site investigators will need to undertake a more detailed risk assessment that selects different, more appropriate criteria such as drinking water guidelines to protect groundwater abstractions. It is envisaged that this circumstance will be rare in Hong Kong. When encountered, site investigators will be required to have their risk assessments reviewed and approved by the EPD.

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

	Risk-Based Remediation Goals for Soil					
Chemical	Urban Residential (mg/kg)	Rural Residential (mg/kg)	Industrial (mg/kg)	Public Parks (mg/kg)	Soil Saturation Limit (Csat) (mg/kg)	
VOCS	0.500.02	4.2CE+02	1.000 .04*	1.00E+0.4*	***	
Acetone	9.59E+03	4.26E+03	1.00E+04*	1.00E+04*	***	
Benzene	7.04E-01	2.79E-01	9.21E+00	4.22E+01	3.36E+02	
Bromodicnioromethane	3.1/E-01	1.29E-01	2.85E+00	1.34E+01	1.03E+03	
2-Bulanone	1.00E+04*	1.00E+04*	1.00E+04*	1.00E+04*	1.10E+02	
Ethylbanzona	1.32E-01 7.00E+02	3.29E-02	1.34E+00	2.33E+02	1.10E+03	
Mothyl tort Butyl Ethor	7.09E+02	2.98E+02	8.24E+05	5.05E+02	1.36E+02 2.28E+02	
Methylopo Chlorido	1.20E+00	5 20E 01	1.20E+01	1.29E+02	0.21E+02	
Styropo	3.22E+03	1.54E±03	1.00E±04*	1.28E+02 1.00E+04*	9.21E+02 4.97E±02	
Tetrachloroethene	1.01E.01	1.34E+03	7.77E.01	1.84E+00	4.97E+02	
Teluene	1.01E-01	4.44E-02	1.00E+04*	1.04E+00 1.00E+04*	9./1E+01 2.25E+02	
Trichloroothono	5 22E 01	2.11E.01	5.68E+00	6.04E+01	2.33E+02 4.99E+02	
Xylenes (Total)	9.50E±01	2.11E-01 3.68E±01	1.23E+03	1.00E±04*	4.08E+02	
SVOCs	9.50L+01	5.082+01	1.2512+05	1.001+04	1.502+02	
Acenaphthene	3 51F±03	3.28F±03	1.00F+04*	1.00F±04*	6.02E±01	
Acenaphthylene	2 34E+03	1 51E+03	1.00E+04*	1.00E+04*	1.98E+01	
Anthracene	1.00F+04*	1.00F+04*	1.00E+04*	1.00E+04*	2.56F+00	
Benzo(a)anthracene	1 20E+01	1.14E+01	9 18E+01	3.83E+01	2.301100	
Benzo(a)pyrene	1.20E+01	1 14F±00	9 18F±00	3.83E±00		
Benzo(b)fluoranthene	9.88E+00	1.01E+01	1.78E+01	2.04E+01		
Benzo(a h i)pervlene	1.80E+03	1.71E+03	1.00E+04*	5.74E+03		
Benzo(k)fluoranthene	1.00E+02	1.14E+02	9.18E+02	3.83E+02		
bis-(2-Ethylhexyl)phthalate	3.00E+01	2.80E+01	9.18E+01	9.42E+01		
Chrysene	8.71E+02	9.19E+02	1 14E+03	1.54E+03		
Dibenzo(a,h)anthracene	1.20E+00	1.14E+00	9.18E+00	3.83E+00		
Fluoranthene	2.40E+03	2.27E+03	1.00E+04*	7.62E+03		
Fluorene	2.38E+03	2.25E+03	1.00E+04*	7.45E+03	5.47E+01	
Hexachlorobenzene	2.43E-01	2.20E-01	5.82E-01	7.13E-01		
Indeno(1,2,3-cd)pyrene	1.20E+01	1.14E+01	9.18E+01	3.83E+01		
Naphthalene	1.82E+02	8.56E+01	4.53E+02	9.14E+02	1.25E+02	
Phenanthrene	1.00E+04*	1.00E+04*	1.00E+04*	1.00E+04*	2.80E+01	
Phenol	1.00E+04*	1.00E+04*	1.00E+04*	1.00E+04*	7.26E+03	
Pyrene	1.80E+03	1.71E+03	1.00E+04*	5.72E+03		
Metals						
Antimony	2.95E+01	2.91E+01	2.61E+02	9.79E+01		
Arsenic	2.21E+01	2.18E+01	1.96E+02	7.35E+01		
Barium	1.00E+04*	1.00E+04*	1.00E+04*	1.00E+04*		
Cadmium	7.38E+01	7.28E+01	6.53E+02	2.45E+02		
Chromium III	1.00E+04*	1.00E+04*	1.00E+04*	1.00E+04*		
Chromium VI	2.21E+02	2.18E+02	1.96E+03	7.35E+02		
Cobalt	1.48E+03	1.46E+03	1.00E+04*	4.90E+03		
Copper	2.95E+03	2.91E+03	1.00E+04*	9.79E+03		
Lead	2.58E+02	2.55E+02	2.29E+03	8.57E+02		
Manganese	1.00E+04*	1.00E+04*	1.00E+04*	1.00E+04*		
Mercury	1.10E+01	6.52E+00	3.84E+01	4.56E+01		
Molybdenum	3.69E+02	3.64E+02	3.26E+03	1.22E+03		
Nickel	1.48E+03	1.46E+03	1.00E+04*	4.90E+03		
l in	1.00E+04*	1.00E+04*	1.00E+04*	1.00E+04*		
	1.00E+04*	1.00E+04*	1.00E+04*	1.00E+04*		
Dioxins / PCBs	1.005.02	1.005.02	5 00E 02	1.005.02		
DIOXINS (I-TEQ)	1.00E-03	1.00E-03	5.00E-03	1.00E-03		
Pubs	2.36E-01	2.26E-01	/.48E-01	7.56E-01		
Concern Carbon Kanges	1.41E+02	5 455 .02	1.000 .04*	1.000.04*	1.00E+02	
	1.41E+03	5.45E+02	1.00E+04*	1.00E+04*	1.00E+03	
	2.24E+03	1.33E+03	1.00E+04*	1.00E+04*	5.00E+03	
Other Inorgania Compounds	1.00E+04*	1.00E+04*	1.00E+04*	1.00E+04*	5.00E+03	
Cuanido, froo	1.48E+02	1.46E+02	1.00E+04*	4.00E+02		
Organomotallics	1.46E+03	1.40E+03	1.00E+04*	4.90E+03		
TBTO	2 21E+01	2 18E+01	1.96E±02	7.35E±01		

Notes:

(1) For Dioxins, the cleanup levels in USEPA Office of Solid Waste and Emergency Response (OSWER) Directive of 1998 have been adopted. The OSWER Directive value of 1 ppb for residential use has been applied to the scenarios of "Urban Residential", "Rural Residential", and "Public Parks", while the low end of the range of values for industrial, 5 ppb, has been applied to the scenario of "Industrial".

(2) Soil saturation limits for petroleum carbon ranges taken from the Canada-Wide Standards for Petroleum Hydrocarbons in Soil, CCME 2000.
(3) * indicates a 'ceiling limit' concentration.

(4) *** indicates that the Csat value exceeds the 'ceiling limit' therefore the RBRG applies.

Table 2.2 Risk-Based Remediation Goals (RBRGs) for Groundwater and Solubility Limit				
Risk-Based Remediation Goals for Groundwater				
Chemical	Urban Residential (mg/L)	Rural Residential (mg/L)	Industrial (mg/L)	Solubility Limit (mg/L)
VOCs				
Acetone	1.00E+04*	1.00E+04*	1.00E+04*	***
Benzene	3.86E+00	1.49E+00	5.40E+01	1.75E+03
Bromodichloromethane	2.22E+00	8.71E-01	2.62E+01	6.74E+03
2-Butanone	1.00E+04*	1.00E+04*	1.00E+04*	***
Chloroform	9.56E-01	3.82E-01	1.13E+01	7.92E+03
Ethylbenzene	1.02E+03	3.91E+02	1.00E+04*	1.69E+02
Methylana Chlarida	1.53E+02	6.11E+01	1.81E+03	***
	1.90E+01	7.59E+00	2.24E+02	2 10E+02
Styrerie	3.02E+03	1.16E+03	1.00E+04*	3.10E+02
	2.30E-01 5.11E+02	9.90E-02	2.93E+00	2.00E+02
Trichloroothono	1.21E+00	1.9/E+03	1.00E+04*	3.20E+02
	1.21E+00 1.12E+02	4.01E-01 4.33E±01	1.42E+01 1.57E±03	1.10E+03
	1.12LT02	4.331401	1.376703	1.7515+02
Acenanhthene	1 00F±04*	7.09E±03	1 00F±04*	4 24E±00
Acenaphthylene	1.001704	5.42E+02	1.00E+04*	3.93E+00
Anthracene	1.00F+04*	1.00E±04*	1.005+04*	4 34F-02
Benzo(a)anthracene	1.001104	1.001104	1.001707	7.5412-02
Benzo(a)pyrene				
Benzo(b)fluoranthene	5 39E-01	2.03E-01	7 53E+00	1 50E-03
Benzo(g h i)pervlene	5.572 01	2.052 01	7.551100	1.502 05
Benzo(k)fluoranthene				
bis-(2-Ethylhexyl)phthalate				
Chrysene	5.81E+01	2.19E+01	8.12E+02	1.60E-03
Dibenzo(a h)anthracene	510112101	2.17,2101	0.122102	1.002 05
Eluoranthene	1 00E+04*	1 00E+04*	1 00E+04*	2.06E-01
Fluorene	1.00E+04*	1.00E+04*	1.00E+04*	1.98E+00
Hexachlorobenzene	5.89E-02	2 34E-02	6 95E-01	6.20E+00
Indeno(1.2.3-cd)pyrene				
Naphthalene	6.17E+01	2.37E+01	8.62E+02	3.10E+01
Phenanthrene	1.00E+04*	1.00E+04*	1.00E+04*	1.00E+00
Phenol				
Pyrene	1.00E+04*	1.00E+04*	1.00E+04*	1.35E-01
Metals				
Antimony				
Arsenic				
Barium				
Cadmium				
Chromium III				
Chromium VI				
Cobalt				
Copper				
Lead				
Manganese				
Mercury	4.86E-01	1.84E-01	6.79E+00	
Molybdenum				
Nickel				
Tin				
Zinc				
Dioxins / PCBs				
Dioxins (I-TEQ)				
PCBs	4.33E-01	1.71E-01	5.11E+00	3.10E-02
Petroleum Carbon Ranges				
C6 - C8	8.22E+01	3.17E+01	1.15E+03	5.23E+00
C9 - C16	7.14E+02	2.76E+02	9.98E+03	2.80E+00
C17 - C35	1.28E+01	4.93E+00	1.78E+02	2.80E+00
Other Inorganic Compoun	ds			
Cyanide, free				
Organometallics				
TBTO				

Notes:

(1) Blank indicates that RBRG could not be calculated because the toxicity or physical / chemical values were unavailable, or the condition of Henry's Law Constant>10⁻⁵ was not met for the inhalation pathway.

(2) Water solubilities for Petroleum Carbon Range aliphatic C9-C16 and greater than C16 generally are considered to be effectively zero and therefore the aromatic solubility for C9-C16 is used.

(3) * indicates a 'ceiling limit' concentration.

(4) *** indicates that the solubility limit exceeds the 'ceiling limit' therefore the RBRG applies.

Section 3 APPLICATION OF RBRGs IN LAND CONTAMINATION ASSESSMENT

The normal contamination assessment practice in Hong Kong is illustrated in Figure 3.1. RBRGs should be used in place of the Dutch B levels to determine the need for future action and remediation at a contaminated site, during the preparation of Contamination Assessment Plan (CAP), Contamination Assessment Report (CAR) and Remediation Action Plan (RAP). Implementation of the RBRGs and an assessment of the RBRGs to chemical concentrations detected on a site should be undertaken by a competent specialist consultant.

Figure 3.2 presents the steps in the application of RBRGs in contamination investigation. The primary information required includes: (1) knowledge of the past, current and future land-uses at a site; and (2) sufficient analytical data on the concentrations of COCs in the site's soil and groundwater.

3.1 Steps for Applying RBRGs in Contaminated Land Assessment

Figure 3.2 presents the following six steps in contamination assessment:

Step 1: Identify land-use and select COCs

Step 2: Assess laboratory data for COCs

Step 3: Compare maximum detected concentrations to RBRGs and NAPL trigger criteria

Step 4: Point-by-point comparison

Step 5: Establish whether NAPL is present

Step 6: Incorporate results into CAR

Once information has been compiled through the steps above, it can be summarized and reported on Standard Forms 3.1 through 3.5, which are introduced in the steps below and in Section 4 of this Guidance Manual.

User instruction is provided as follows.

Step 1: Identify Land-use and Select COCs

The first step is to identify the past, current and future land-uses of a property. This information is typically compiled as part of the initial site appraisal (see Figure 3.1). Past and current land-use information is important for developing a list of potential COCs and for assessing the potential presence of NAPL-related chemicals at the site. During initial site appraisal, it is important to identify past and present site activities that have potential to cause contamination and to make an inventory of the chemicals manufactured, stored, used and disposed of. COCs for a site should be selected on the basis of the information collected during the initial site appraisal and not necessarily bound by the 54 COCs in Tables 2.1 and 2.2.

Standard Form 3.1 can be used to summarize the past, current and anticipated future uses of a property.

3-1

Section 3

If past usage of a site was different from the current use, all past operations and site conditions, back to the time the affected property was pre-industrial, are to be provided. Maps of the layout of former operations, if available, should be attached to this standard form to illustrate the past site conditions. The type of business/facility/site, the names of the landowners, and a description of the primary products or process associated with each past use should also be specified. The number of years the business was in operation, or if the site was not in use, the number of years the property was in that condition should be indicated.

Current use information of the site, including maps showing the present layout of the site, the type of facility or business, a description of the business operations and primary products or processes, and the name of the landowner should be provided. If the site is presently vacant, this should be indicated on the standard form as well. If there is evidence that site-related contamination has migrated beyond property boundaries to downgradient properties, the types of land-use at the affected properties should be indicated.

It is always useful to examine the past and present aerial photographs of a site to help identify the historical and current conditions or activities that may have caused contamination.

The land-use classifications for any future use of the property, e.g., urban residential, rural residential, industrial or public parks should be clearly stated. Site contamination data should be compared to the RBRGs developed for the future land-use reported for the site as the applicability of each set of RBRGs is dependent on land-use. In the event that the future land-use is unknown, the most stringent set of RBRGs should be adopted as the cleanup standards so that the site will be suitable for all use after remediation. If a site is to be excavated after remediation and the excavated soil will be re-used off-site, the most stringent set of RBRGs should be adopted. As it is usually very difficult to control the exact location in which the soil will finally be re-used, adopting the most stringent RBRGs will ensure that the destination site of the soil, wherever that may be, will be suitable for all land-uses after being filled.

For any future land-use categories falling outside the four categories described in Section 2, the user of this manual needs to compare the exposure characteristics of his/her site with those described for the four categories and identify one category that most closely matches the exposure characteristics of his/her particular site in question. The RBRGs for the category that is most similar to the user's site are the applicable RBRGs for his/her site of concern. For example, if a school site has exposure characteristics most similar to that of the "urban residential" category, the RBRGs specified for the "urban residential" category should be adopted for the school site.

When applying the RBRGs to a commercial land-use scenario, a case-by-case judgment is appropriate because there are many different forms of commercial use. For example, a commercial use of a single storey building located in a rural area will likely resemble the rural residential setting, and thus the RBRGs for rural residential will apply. If a commercial use is within an urban residential building, then the RBRGs for urban residential will apply.

Examples of post-restoration land-uses and the appropriate RBRGs are as follows:

Land-use	Corresponding RBRGsLand-use	
Commercial/residential		
urban high rise	Urban Residential	
 low rise in rural area 	Rural Residential	
Commercial /Business & Offices	Urban Residential	
Schools	Rural Residential	

Public park with an indoor games hall	Lower of Public Park or Urban
	Residential
Warehouse & Storage	Industrial
Government, Institution & Community	Urban Residential
Facilities	
Roads including pedestrian walkway	Lower of Industrial or Public Park
Railways	Industrial
Open Space	Public Park
Public utilities	Industrial

Step 2: Assess Laboratory Data for COCs

Following site investigation (Part II of Figure 3.1), a check must be made that the data collected from the site present a reasonably reliable description of the soil and groundwater contamination. Standard quality control/quality assurance (QA/QC) field procedures must be adopted during sampling and storage/transport of the samples to the laboratory. Such QA/QC procedures will ensure sample integrity and reduce the potential for cross-contamination and sample errors (e.g. erroneous concentrations of phthalates which are commonly found in plastic sampling products).

Laboratory analytical data should be reviewed to check that basic quality assurance and quality control protocols were followed. Any unusual problems reported by the laboratory to have prevented attainment of a method reporting limit less than the RBRG should be reported. For example, it may be difficult for a laboratory to quantify the individual constituents present in a sample contaminated with high concentrations of petroleum products. In these cases, special measures, such as sample dilution, can be employed by laboratories to maintain the lowest possible method reporting limits. In general, analytical data with method reporting limits that exceed RBRGs are considered invalid for use in assessment.

All detected chemicals must be compared to their respective RBRGs. If a chemical is reported in a quality control sample analyzed by the laboratory, i.e., a "blank", or is suspected to be a laboratory contaminant, this information should be recorded in the CAR document.

All laboratory test methods must be accredited by the Hong Kong Laboratory Accreditation Scheme (HOKLAS) or one of its Mutual Recognition Arrangement partners.

Step 3: Compare Maximum Detected Concentrations to RBRGs and NAPL Trigger Criteria

The CAR document should include data summary tables for soil and/or groundwater. Standard Forms 3.2 and 3.3 can be used for this purpose. All detected chemicals are to be listed by chemical category, e.g., volatile organic chemicals, semi-volatile organic chemicals, etc. Additional statistics and information should include the following:

- Frequency of Detection the number of times a chemical was detected divided by total number of samples collected and analyzed for that parameter.
- Range of Detected Concentration the minimum and maximum detected concentrations for each chemical.
- Range of Method Reporting Limits the minimum and maximum method reporting limits reported by the laboratory for each chemical.
- Analytical Method reference for the method used to analyze each chemical.
- Land-use Category list the relevant land-use categories.

- RBRG list the lowest of the appropriate RBRG(s) from Table 2.1 for soil and Table 2.2 for groundwater for all the land-use categories applicable for the site. If there is no RBRG in Tables 2.1 or 2.2 for a COC found at a site, the user of this manual should propose for EPD's agreement a suitable remediation goal for the COC.
- C_{sat} or Solubility for the soil and groundwater data summary (Standard Form 3.2 and 3.3), list the soil saturation or solubility limit from Table 2.1 and Table 2.2.

Step 4: Point-by-Point Comparison

A point-by-point comparison must also be presented. A point-by-point comparison involves tabulation of all sample numbers, concentrations, locations, and depths of all samples. Checks are to be placed in the appropriate columns on Standard Forms 3.4 and 3.5 for samples that exceed the soil RBRG or C_{sat} (Standard Form 3.4) and the groundwater RBRG or Solubility Limit (Standard Form 3.5). A site figure is to be submitted indicating the distribution of contamination for samples that exceed an RBRG or NAPL trigger criterion.

Step 5: Establish whether NAPL is Present

If the maximum detected chemical concentrations in soil exceed the C_{sat} , or the maximum detected chemical concentrations in groundwater exceed the Solubility Limit, additional assessment is required to determine whether NAPL may be present.

 C_{sat} and Solubility Limits represent the initial NAPL screen for soil in unsaturated subsurface zones and groundwater, respectively. The decision on whether or not the soil or groundwater at a site contains NAPL or other non-natural free liquids will likely require professional judgement and a weight-of-evidence approach to balance out potentially conflicting information. The evidence may include information on the historic land-use activities at the site, soil boring logs (visual evidence and/or hydrocarbon vapor readings), as well as soil, groundwater and soil vapor concentrations of various chemicals. An industry "rule of thumb" for groundwater DNAPL contamination is that DNAPL may be present where groundwater concentrations have been observed in excess of 1 % of the effective solubility of the compound detected. This is an approximation and should be considered as an indicator of the likely presence of DNAPL, it should be used in conjunction with the site specific details listed above.

Field observations are considered in determining the potential occurrence of NAPL. Records should be kept to indicate whether any of the following three field conditions was observed during sample collection:

- 1. Stained, unnaturally colored, or wet soil above the water table. The presence of NAPL may be obvious based on visual evidence of liquids in the soil, especially if the appearance is of a colored (or opaque) liquid or of a viscous liquid.
- 2. Petroleum or solvent odours in soil or groundwater samples.
- 3. Presence of sheen on water samples or bailer, or oily residual on soil samples or split spoon sampler.

If any of the above field conditions was observed, NAPL is likely to be present and remediation is required. In this instance the rules below are likely to apply (see Figure 3.3), although situations may vary on a site by site basis:

1. Site concentration greater than RBRG

If the field assessment indicates no trace of NAPL then the remediation goal will be the RBRG. If the field assessment indicates NAPL as present, then NAPL removal will be necessary and the lower of the RBRG or $C_{\rm sat}$ or solubility limit will be the clean-up criterion.

2. Site concentration less than RBRG

If the field assessment indicates no trace of NAPL then remediation is not required. If the field assessment indicates NAPL as present, then NAPL removal will be necessary and the lower of the RBRG or C_{sat} or solubility limit will be the clean-up criterion.

Step 6: Incorporate Results into CAR

The contamination assessment results, presented in Standard Forms 3.1 through 3.5 (or other similar format), should be included in the CAR along with recommendations for further actions. The presence of the following conditions indicates that contamination exists and remedial action is required at the site:

- Any detected chemical concentration in soil or groundwater exceeds an RBRG;
- Any detected chemical concentration in soil exceeds a NAPL trigger criterion and/or a chemical concentration in groundwater exceeds the solubility limit, as well as other evidence suggests that NAPL is of concern.

Figure 3.1 – Land Contamination Assessment and Preparation of CAP, CAR and RAP

I. Contamination Assessment Plan (CAP)



Figure 3.2 – Land Contamination Assessment Process: Input and Reporting Requirements

Step	Necessary Information	Prepare Standard Form
1. Identify land use and select COCs	 Past land uses and activities Current use of site and activities Future use of site and expected activities Maps and aerial photos of historic, current and future (if available) site layout and operations COC selection based on past and current activities Previous Site Investigation reports, if available 	• Form 3.1 – Summary of On-Site Land Use
2. Assess laboratory data for COCs	 Soil and groundwater analytical data with method reporting limits less than RBRGs Soil and groundwater COC concentrations to be representative of vertical and horizontal extent of contamination Basic QA/QC evaluation of laboratory data noting spurious results or other reported problems 	
3. Compare maximum detected concentrations to RBRGs and NAPL trigger criteria	 Sample concentrations reported as mass/mass (soil) and mass/volume (water) Comparison of maximum concentrations in soil samples to RBRG and C_{sat} Comparison of maximum concentrations in groundwater samples to RBRG and solubility limits 	 Form 3.2 – Soil Data Summary and Comparison to RBRGs and C_{sat} Form 3.3 – Groundwater Data Summary and Comparison to RBRGs and Solubility Limits
4. Point-by-point comparison	 Point-by-point tabulation of all chemicals, sample numbers, locations, and depths and indicate any exceedance of the soil RBRG and C_{sat} Point-by-point tabulation of all chemicals, sample numbers, locations, and depths and indicate any exceedance of the groundwater RBRG and solubility limits 	 Form 3.4 –Soil Sample Concentrations and Exceedances of RBRG and C_{sat} Form 3.5 - Groundwater Sample Concentrations and Exceedances of RBRG and Solubility Limits
5. Establish whether NAPL is present	 Record of field observations including visual and odour evidence of NAPL plus field instrument readings. 	
6. Incorporate results into CAR	 Conclusions regarding need for remediation Discussion of information gaps and uncertainties, if applicable 	• CAR



1. If site concentration is less than both the RBRG and C_{sat} / solubility limit, only removal of NAPL is necessary.

Standard Form 3.1 - Summary of On-Site Land Use

Property Name

	Off-site property affected ? Yes No	
	Approximate size of on- site property	
	Owner or Occupier	
	Description of business process/primary products	
	Date began ¹	
	On-site property land use	
Current Use	Type of facility/business	

If Yes, complete this section. ٩ Yes _ Past Use Are past uses different from current uses? Complete this table with each different operation, use, or status of the on-site property. Include all operations back to pre-commercial or pre-industrial time if this information is necessary to characterize the site. Specify the status of the property at each stage, including times it may have been vacant. Start with the most recent use and list in chronological order backwards through time.

Off-site prop affected 3 Approximate size of on-site property (if different from current size) Owner or Occupier Description of business process/primary products Date ended³ Date began² On-site property land use Type of facility/business

Future Use

Iture uses different from	current uses? Yes No	If Yes, complete this secti	ion.	
of facility/business	On-site property land use ⁴	Description of business process/primary products	Owner or Occupier	Approximate size of on-site property

¹ Specify the approximate year in which the current use of the on-site property began.
² Specify the approximate year in which the past use of the on-site property began.
³ Specify the approximate year in which the past use of the on-site property ended.
⁴ Specify all applicable land use including urban residential, rural residential, industrial or public parks

Soil Data Summary and Comparison to RBRGs and $\mathsf{C}_{\mathsf{sat}}$

								Maximum Dete	cted
						Lowest		Concentration E	xceeds
	Frequency of Detection ⁽¹⁾	Range of Detected	Range of Method	Analytical	Relevant Land Use	RBRG(s)	c _{sat}	(check if applic	able)
Chemical	(x/y)	Concentration ⁽²⁾	Reporting Limit ⁽³⁾	Method	Categories	(mg/kg)	(mg/kg)	RBRG	C _{sat}
Volatile Organic Chemicals (List)									
Semi-Volatile Organic Chemicals (List)									
Metals (LISt)									
Dioxins/PCBs (LISt)									
Petroleum Carbon Ranges (List)									
Other Inorganic Compounds (List)									
Organometallics (List)									
]

x = number of samples in which chemical was found above the method reporting limit y = number of samples and remixed is the method reporting limit 2. Give minimum and maximum detected values 3. Give minimum and maximum method reporting limits

Standard Form 3.3 Groundwater Data Summary and Comparison to RBRGs and Solubility Limits

Chemical	Frequency of Detection ⁽¹⁾ (x/y)	Range of Detected Concentration ⁽²⁾	Range of Method Reporting Limit ⁽³⁾	Analytical Method	Relevant Land Use Categories	Lowest RBRG(s) (mg/L)	Solubility Limit (mg/L)	Maximum De Concentration RBRG (check if a RBRG S	tected Exceeds toplicable) olubility
Volatile Organic Chemicals (List)									
Semi-Volatile Organic Chemicals (List)									
Metals (List)									
Dioxins/PCBs (LIst)									
Petroleum Carbon Ranges (List)									
Other Inorganic Compounds (List)									
Organometallics (List)									

x= number of samples in which chemical was found above the method reporting limit y=number of samples analyzed for chemical
 Give minimum and maximum detected values
 Give minimum and maximum method reporting limits

Standard Form 3.4 Soil Sample Concentrations and Exceedances of RBRGs and $C_{\rm sat}$

	List \$	Samples					
Chemical	Sample Number	Sample Depth	Concentration	Check if RBRG Exceeded	Check if C _{sat} Exceeded	Approximate size of Affected Area	
Volatile Organic Chemicals (List)							
Semi-Volatile Organic Chemicals (List)							
Metals (List)							
Dioxins/PCBs (List)							
Petroleum Carbon Ranges (List)							
Other Inorganic Compounds (List)							
Organometallics (List)							

Standard Form 3.5 Groundwater Sample Concentrations and Exceedances of RBRGs and Solubility Limits

	•				•	
	ListS	amples				
Chemical	Sample Number	Sample Depth	Concentration	Check if RBRG Exceeded	Check if Solubility Limit Exceeded	Approximate size of Affected Area
Volatile Organic Chemicals (List)						
Semi-Volatile Organic Chemicals (List)						
Metals (List)						
Dioxins/PCBs (List)						
Petroleum Carbon Ranges (List)						
Other Inorganic Compounds (List)						
Organometallics (List)						

Section 4 RECORD KEEPING AND REPORTING

As a final step in the assessment process, the user should record in the CAR all the results mentioned in Section 3 for EPD's approval.

Standard Forms 3.1 through 3.5 are provided as templates for summarizing the information necessary to complete the contamination assessment. Reproduced copies of these forms, or similar forms containing the same information, are to be included in the CAR along with a narrative to describe their contents. The following Standard Forms have been included in this manual:

- Standard Form 3.1 Summary of On-Site Land-use
- Standard Form 3.2 Soil Data Summary and Comparison to RBRGs and C_{sat}
- Standard Form 3.3 Groundwater Data Summary and Comparison to RBRGs and Solubility
 Limits
- Standard Form 3.4 Soil Sample Concentrations and Exceedances of RBRG and Csat
- Standard Form 3.5 Groundwater Sample Concentrations and Exceedances of RBRG and Solubility Limits

Instructions for completing these forms are provided in Section 3. This information is to be submitted as part of the CAR, along with conclusions regarding the need for further action, or a determination of "no further action".

The following support documentation must be maintained by the project proponents and should be submitted to EPD when required:

- Field and Laboratory Data Package Copies of field records and laboratory analytical reports for all media samples.
- Chain-of-custody documentation.
- Quality assurance/quality control documentation.

Laboratory reports must include the following information: name and address of the laboratory, name and address of client, project name, sample results, method reporting limits, sample ID number, lab ID number, sample matrix, date and time of sample collection, date of receipt of sample, date of sample preparation and extraction, date of analysis, preparation and analytical method numbers, method quantitation limits, analytical results, signature of laboratory personnel and issue date.

Chain-of-custody documentation must include: affected property name, address, and regulatory identification number, name of person who collected the samples, date of sample collection, type of analyses requested, sample matrix, sample ID number and sampling location, sample preservation method(s), date(s) and time(s) of transfer to other person, date and time received by the laboratory, signatures of collectors, the laboratory, and any intermediary persons, laboratory-assigned job number and sample numbers, and any other pertinent log-in information.

Quality control documentation should include any other information necessary to convey the results

of the analyses and a brief summary to document that the data meet the project objectives. The project data quality objectives (DQOs) for media samples should be included in an appendix of the support documentation.

The DQO process defines the type, quantity and quality of data needed from site investigation or remediation. DQOs provide a systematic approach for defining the criteria that a data collection design should satisfy, including when, where and how to collect samples or measurements; determination of tolerable decision error rates; the number of samples or measurements that should be collected and the method reporting limits that should be achieved.

The US Environmental Protection Agency (USEPA) describes the DQO process as a stepped iterative planning approach used to prepare plans for environmental data collection. USEPA (2000) documents guidance for the DQO process and the DQO process for hazardous waste site investigations.
Section 5 General Reference

Section 5 GENERAL REFERENCE

ASTM, 1995. *Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites.* American Society for Testing and Materials (November, 1995).

ASTM, 2000. *Standard Guide for Risk-Based Corrective Action*. American Society for Testing and Materials (ASTM, November 2000).

CCME, 1996. A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines. Canadian Council of Ministers of the Environment (March 1996).

CCME, 2000. *Canada-Wide Standards for Petroleum Hydrocarbons (PHCs) in Soil: Scientific Rationale - Supporting Technical Document.* Canadian Council of Ministers of the Environment (CCME, December 2000).

US EPA, 1992. *Estimating Potential for Occurrence of DNAPL at Superfund Sites*. Office of Solid Waste and Emergency Response, US Environmental Protection Agency, R.S. Kerr Environmental Research Laboratory, Houston, Texas, USA (1992).

US EPA, 1998. Guidelines for Ecological Risk Assessment. United States Environmental Protection Agency, April 1998, EPA/630/R-95/002F. USEPA Risk Assessment Forum, Washington DC

USEPA 2000, Data Quality Objectives Process for Hazardous Waste Site Investigations, EPA QA/G-4HW Final, Washington DC

Annex B

Site Layout Plan and Site Photographs







Photo 1 – CCPP



Photo 3 – Material recovery building



Photo 5 – Ash bags in material recovery building



Photo 2 – CCPP



Photo 4 – Conveyor belt connecting the CCPP unit with the material recovery building



Photo 6 - Fuel USTs and dispensing station

Annex C

Site Aerial Photograph



Figure C1

FILE: 0071019b3 DATE: 07/09/2007 Annex D

Historical Photographs





GENERAL VIEW OF SITE LOOKING SOUTH. JANUARY 22, 1981.



CASTLE PEAK CEMENT PROJECT SITE. FEBRUARY 27, 1981



GENERAL VIEW OF SITE LOOKING SOUTH, MARCH 21, 1981.





Historical Photographs

Figure D1

FILE: 0071091b DATE: 07/09/2007





BURNING & COOLING AREA, LOOKING SOUTH. JUNE 20, 1981.



VIEW OF SITE FACING SOUTH C-4, JULY 24, 1982.

Environmental Resources Management



Figure D2

FILE: 0071019b1 DATE: 07/09/2007

Historical Photographs



Environmental Resources Management



Figure D3

Historical Photographs (year 1981)

FILE: 0071019b2 DATE: 07/09/2007



Year 1983



Year 1995



Year 1982

Figure D4

Historical Photographs

Environmental Resources Management



FILE: 0071019b4 DATE: 07/09/2007 Annex E

Proposed Sampling Locations





Annex F

Response to Comments

RESPONSE TO COMMENTS Contamination Assessment Plan for Decommissioning of the Co-Combustion Pilot Plant at Tap Shek Kok

H:\Team\EM\GMS Projects\0071019 EIA for Decommissioning of Co-Combustion Plant\Deliverables\annex E CAP\Submission to EPD 9 Nov 2007\Annex\0071019_CAP_RTC_26102007.doc

Ref.	Department	Reference	Comments	Consultant's Response
i.	Environmental Protection Department	() in Ax (1) to EP2/N4/PT2/80 dated 24 October 2007	1 st bullet of Off Site Sources, Section 3.2 – Please confirm whether the fuel underground storage tanks will be included in the proposed decommissioning of CCPP. If yes, a proper site investigation should be included in this CAP. If no, please state clearly in the report that it will not form part of the proposed decommissioning of CCPP.	The fuel underground fuel storage tank is not part of the decommissioning of the CCPP. Text has been elaborated to clarify this.
ii.			2 nd bullet of On Site Sources, Section 3.2 – Please state in the report what contingency measures will be provided if any evidence of past leakage and/or spillage is found during the demolition of underground storage tank for MRRF's leachate.	As discussed in Section 3.2, the UST was a steel tank. Its integrity has been checked to ensure no leakage prior to use. The tank was used for a short period of time (11 weeks) during the operations of the CCPP only and no evidence of leakage/damage was observed. Therefore the likelihood of the leachate /wastewater contaminating the soil around the tank and groundwater is considered to be very low. Moreover, the waste handled at the MRRF was municipal solid waste and the leachate generated from the operation of the MRRF was organic in nature and did not contain potential contaminants of concern such as heavy metals or persistent organic compounds. Text has been amended accordingly.

Ref.	Department	Reference	Comments	Consultant's Response
iii.			2 nd para., Section 1.3 – Please amend "The RBRG Guidance was published on" to read "The RBRG Guidance Manual and associated Guidance Notes was issued by EPD on"	Noted. Text has been amended accordingly.
iv.			5 th para., Section 2.2 – Please add "Proposed Decommissioning of CCPP" as a sub-heading for the paragraph.	Noted. Sub-heading has been added.
v.			Annex B – Please indicate clearly on Figure B2 the exact extent and parts of the CCPP to be included in the proposed decommissioning.	Noted. The exact extend and parts of the CCPP to be included in the proposed decommissioning works have been included in <i>Figure B2.</i>

Annex A2

Contamination Assessment Report (CAR)



Contamination Assessment Report for Decommissioning of the Co-Combustion Pilot Plant at Tap Shek Kok

Green Island Cement Company Limited

11 April 2008

Submitted by Environmental Resources Management 21/F Lincoln House Taikoo Place, 979 King's Road Island East, Hong Kong Telephone 2271 3000 Facsimile 2723 5660

www.erm.com



CONTAMINATION ASSESSMENT REPORT

Green Island Cement Company Limited

Decommissioning of the Co-Combustion Pilot Plant at Tap Shek Kok

April 2008

Reference 0071019

For and on behalf of		
ERM-Hong Kong, Limited		
Approved by: <u>Dr. Andrew Jackson</u> Signed:		
Position: <u>Managing Director</u>	٢	à,
Date:11th April 2008		

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

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

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

CONTENTS

1	INTRODUCTION	1
1.1	BACKGROUND TO THE STUDY	1
1.2	OBJECTIVES OF THE ASSESSMENT	1
1.3	SCOPE OF THE ASSESSMENT	2
1.4	STRUCTURE OF THE CAR	3
2	THE SITE	4
2.1	SITE DESCRIPTION	4
2.2	PROPOSED DECOMMISSIONING OF CCPP	4
2.3	Environmental Setting	4
2.4	SITE HISTORY	5
3	SITE INVESTIGATION PROGRAMME	7
3.1	SITE INVESTIGATION PROGRAMME	7
3.2	Analytical Results	9
3.3	CONCEPTUAL MODEL OF POTENTIAL POLLUTANT LINKAGE	12
3.4	EVALUATION OF IMPACTS	13
4	CONCLUSIONS AND RECOMMENDATIONS	14
4.1	Conclusions	14
4.2	Recommendations	14
	ANNEXES	
ANNEX A	ТНЕ САР	
ANNEX B	SITE INVESTIGATION REPORT BY THE CIVIL CONTRACTOR	
ANNEX C	LABORATORY ANALYTICAL REPORT	

- ANNEX D RBRG STANDARDS
- ANNEX E SELECTED PHOTOGRAPHS FROM THE SITE INVESTIGATION

ABBREVIATIONS

As	Arsenic
Ва	Barium
BTEX	Benzene, toluene, ethyl benzene, and xylene
CAP	Contamination Assessment Plan
CAR	Contamination Assessment Report
ССРР	Co-Combustion Pilot Plant
Cd	Cadmium
Со	Cobalt
Cr III and Cr VI	Chromium III and VI
Csat	Soil Saturation Limits
Cu	Copper
EIA	Environmental Impact Assessment
EIAO	Environmental Impact Assessment Ordinance
EPD	Environmental Protection Department
GICP	Green Island Cement Plant
Hg	Mercury
HKUST	Hong Kong University of Science and Technology
HOKLAS	Hong Kong Laboratory Accreditation Scheme
LOR	Limit of Reporting
Mn	Manganese
Мо	Molybdenum
MRRF	Materials Recovery and Recycling Facility
MSW	Municipal Solid Waste
Ni	Nickel
Pb	Lead
QA	Quality Assurance
QC	Quality Control
RBRG Guidance Manual	Guidance Manual for Use of Risk-based Remediation Goals for Contaminated Land Management
RBRGs	Risk-based Remediation Goals for Contaminated Land
Sb	Antimony
SI	Site Investigation
Sn	Tin
TPH	Total Petroleum Hydrocarbons

USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
Zn	Zinc

1.1 BACKGROUND TO THE STUDY

As part of the research programme, in collaboration with the Hong Kong University of Science and Technology (HKUST), to develop a new thermal treatment process for municipal solid waste (MSW), the Co-Combustion Pilot Plant (CCPP, the Site) was constructed in a designated area inside the Green Island Cement Plant site (GICP). For the purposes of this report, the designated area in which the CCPP was constructed will be referred to as the Site. The GICP is located at Tap Shek Kok, Tuen Mun. The CCPP was constructed in 2004 and has been permanently shutdown since the completion of the pilot plant study in December 2005. Green Island Cement Company Limited (the Client) has now initiated a project to demolish the existing CCPP, to remove the disused equipment and to dispose of any waste materials so generated (the Project).

The Project is a Designated Project under Schedule 3, Item of Part II, Schedule 2 of the *Environmental Impact Assessment Ordinance* (EIAO): "Decommissioning Projects: A municipal, chemical or clinical waste incinerator". An environmental impact assessment (EIA) Study Brief was issued for the Project by the Environmental Protection Department (EPD) in June 2007 (EIA Study Brief *No. ESB-164/2007*).

In compliance with one of the EIA requirements, a contamination impact assessment was required to be conducted to evaluate the land contamination impact due to the past land uses at the Site. In accordance with the EIA Study Brief, a Contamination Assessment Plan (CAP) prepared by ERM, and was submitted to and approved by the EPD in January 2008. A copy of the CAP is presented in *Annex A*.

The land contamination assessment site investigation (SI) was conducted in February 2008 in accordance with the approved CAP and based on the guidelines set out in the EPD's *Guidance Manual for Use of Risk-based Remediation Goals for Contaminated Land Management* (RBRG Guidance Manual) and the associated Guidance Notes, and the EPD's *Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol Filling Stations, Boatyards, and Car Repair/Dismantling Workshop.*

1.2 OBJECTIVES OF THE ASSESSMENT

This Contamination Assessment Report (CAR) presents the results obtained during the land contamination investigation at the Site. As mentioned in the CAP, no soil excavation or groundwater extraction will be required for the Project and no potentially contaminated materials requiring disposal will be generated from the Site. Human exposure to potentially contaminated material will be limited to possible worker contact during the excavation of the foundations and substructures.

The site investigation programme was proposed to provide additional information for the Site area to offer a level of confidence on the presence and (if found) the concentrations of contaminants in the underlying soil materials and to help in the formulation of a site-specific health and safety plan.

The objectives of contamination sampling are to:

- identify whether the soil below the ground surface within the Project site is contaminated; and
- if contaminants are present, to determine their concentrations.

This CAR provides a detailed description of the methodology used, the results of the soil sampling investigation, and field observations and findings noted during the investigation programme.

1.3 SCOPE OF THE ASSESSMENT

The scope of the study, as outlined in the CAP (*Annex A*), was to undertake an investigative assessment of the site and included the following elements:

- Provision of an account of the present use of the land and the relevant past land use history in relation to possible land contamination;
- Excavation of six trial pits down to a maximum of 1.5 m below ground level (m bgl), with two trial pits (S1/S2 and S3/S4) located adjacent to the wastewater underground storage tank (UST) and four trial pits (S5/S6, S7/S8, S9/S10 and S11/S12) located around the CCPP area to determine any soil contamination;
- To determine the presence and extent of contamination from the surface soil and in the fill materials, two (2) soil samples were taken from each sampling location at just below the concrete pavement and at between 1.0 to 1.5 m bgl for laboratory analysis;
- Laboratory analysis of soil and groundwater samples for heavy metals (Antimony (Sb), Arsenic (As), Barium (Ba), Cadmium (Cd), Chromium III and VI (Cr III and Cr VI), Cobalt (Co), Nickel (Ni), Copper (Cu), Lead (Pb), Manganese (Mn), Mercury (Hg), Molybdenum (Mo), Nickel (Ni), Tin (Sn), and Zinc (Zn)); total petroleum hydrocarbons (TPH); and benzene, toluene, ethyl benzene, and xylene (BTEX);
- Assess the extent and level of soil contamination by comparing against Hong Kong's *Risk-based Remediation Goals for Contaminated Land (RBRGs)*; and

• Provide recommendations for mitigation measures during the demolition of the CCPP as required and appropriate.

1.4 STRUCTURE OF THE CAR

The remainder of this report is structured as follows:

Section 2 summarises the site background conditions;

Section 3 summarises the site investigation programme and analytical results from soil sampling;

Section 4 outlines the conclusions and recommendations of the CAR.

The report is accompanied by the following set of annexes:

Annex A presents the CAP;

Annex B contains the laboratory analytical report

Annex C contains the RBRG standards;

- *Annex D* contains site investigation report by the civil contractor; and
- *Annex E* presents the selected photographs from the Site Investigation.

2.1 SITE DESCRIPTION

The CCPP was built within the GICP site at Tap Shek Kok, Tuen Mun. The Site is surrounded by the remaining areas of the GICP. The immediate uses of the area surrounding the CCPP included:

- *North*: a lawn beyond which was an LPG storage to the northwest and a container office to the northeast;
- *South*: an internal road, beyond which is the PFA Grinding & Classification System;
- *East*: the operating cement kiln of GICP; and
- *West*: an internal road, beyond which was a Pack House and cement silos to the northwest and fuel underground storage tanks and dispensing station to the southwest.

The neighbours of the GICP are the Castle Peak Power Station of CLP Power Limited to the west, the Shiu Wing Steel Company steel manufacturing plant to the east, Lung Mun Road to the north and the sea shore to the south. The site layout plan and an aerial photograph showing the current site conditions are attached in the CAP (see *Annex A*).

The Site occupies an area of about 4,000 m². It consists of a waste sorting facility or materials recovery and recycling facility (MRRF) at the front-end followed by a thermal treatment system for the integrated treatment of MSW utilizing the Co-combustion Process patented by the Client.

2.2 PROPOSED DECOMMISSIONING OF CCPP

The proposed decommissioning of the CCPP will involve the demolition of the existing structures and concrete slab and asphalt hard surface, removal of used equipment, the removal of the concrete foundations supporting the equipment and the disposal of waste materials generated by the demolition. It is understood that the Site will then be left as an area of open space for possible future industrial use associated with the surrounding cement plant operations.

2.3 Environmental Setting

The whole of the GICP Site was formed through reclamation in the late 70's. The fill materials used were mainly from the nearby hillsides. Some sand materials were also reportedly imported to the area. Based on the review of the site history and historical pictures of the site, in particular during the site formation (see *CAP*), the shallow geology underlying the site is anticipated to

comprise homogeneous fill materials (consisting of decomposed granites, rocks, boulders from nearby hills mixed with imported sand materials).

2.4 SITE HISTORY

The construction of the GICP commenced in 1978 and the operations of the GICP commenced in 1982. The GICP site was approved for the purpose of manufacture of cement and cement-related products. The Site of the pilot plant is an open area reserved for a second cement kiln. Following start up of the GICP in 1982, the Site was used as an emergency stockpile for cement clinker until 1985. The Site was also used as emergency open stock pile of natural limestone imported from Japan between 1990 and 1994. The stockpile area was not paved initially. A propane store was reportedly built in the late 1980s but was never commissioned, and was removed in March 1992.

The CCPP was constructed in June 2004 after receiving approval from the Lands Department, EPD and the Buildings Department. The continuous pilot operation commenced in October 2005 and finished in December 2005. Of note is that the combined total operating time of the pilot plant from the commissioning to the end of the operation was only 11 weeks.

Tables 2.4a to 2.4*c* ⁽¹⁾, respectively, present the historical, current and anticipated future land uses of the CCPP Site. *Table 2.4d* shows the historical development of the CCPP and the GICP. Historical photographs showing the site development are presented in the CAP (see *Annex A*).

Type of	On Site	Date Began	Description	Owner or	Approx	Off Site
Facility	Property Land			Occupier	Site Area	Property Affected
None	Reclaimed land	Late 1970	Site reclamation	GIC	4,000 m ²	No
Industrial	Storage area of cement clinker	1982	Reserved for storage of propane but used for cement clinker stockpiling	GIC	As above	No
Industrial	Reserved storage area	1984-1990	Not used	GIC	As above	No
Industrial	Storage area	1990-1994	Storage of limestone	GIC	As above	No
Industrial	Grassed area	1994-June 2004	Used as kiln lawn	GIC	As above	No
Industrial	Construction site	June 2004	Construction of foundations	GIC	4,000 m ²	No

Table 2.4aSummary of Historical On Site Land Use

(1) The tables are prepared in accordance with *Standard form 3.1 from the RBRG guidance*

Type of Facility	On Site Property Land Use	Date Began	Description	Owner or Occupier	Approx Site Area	Off Site Property Affected
Industrial	ССРР	Oct 2005 – Dec 2005	11 week trial operation	GIC	As above	No

Table 2.4bSummary of Current On Site Land Use

Type of Facility	On Site Property Land Use	Date Began	Description	Owner or Occupier	Approx Site Area	Off Site Property Affected
Industrial	Disused trial co- combustion pilot plant	From Jan 2006 to present	Trial CCPP	GIC	4,000 m ²	No

Table 2.4cSummary of Anticipated Future On Site Land Use

Type of Facility	On Site Property Land Use	Date Began	Description	Owner or Occupier	Approx Site Area	Off Site Property Affected
Industrial	Open space	2008	Site to be left as open grassed area in the immediate term	GIC	4,000 m ²	No

Table 2.4dSite Historical information for the GICP and CCPP Site

Time	GICP	CCPP Site
late 1970s	Site reclamation	-
Before 1982	Construction of the cement plant	-
1982	Operation of the GICP cement kiln began	Reserved for propane storage and used as emergency stock pile of cement clinker until 1985
1984-1990	Operation of the cement kiln suspended	Reserved for propane storage and left vacant
1990-1994	Operation of the cement kiln restarted	Reserved for propane storage and used as emergency storage of limestone imported from Japan
1992	Continuous operation of the GICP	Propane storage was built but never commissioned. It was removed in March 1992.
After 1994	Continuous operation of the GICP	Rehabilitated as a kiln lawn until the construction of CCPP
Dec 2001	Clinker production was suspended	Rehabilitated as a kiln lawn until the construction of CCPP
Jun 2004	Clinker production was suspended	Construction of the CCPP foundation
Apr 2005	Clinker production was suspended	First load commissioning test of the CCPP
Jul 2005	Clinker production was suspended	Second load commissioning test of the CCPP
Oct 2005	Clinker production was suspended	Continuous operation of the CCPP
Dec 2005	Clinker production was suspended	Operation ceased after all operation data has been collected
Jan 2006	Clinker production resumed	-

SITE INVESTIGATION PROGRAMME

This section presents the summary of the contamination assessment programme and includes the methodology used during the soil sampling work, details of field observations such as visual observations made during the investigation programme, results of field screening and analytical results from soil and ground water sample analyses.

3.1 SITE INVESTIGATION PROGRAMME

A limited intrusive contamination investigation was conducted at the site. The site investigation (SI) program included excavation of six trial-pits, sampling of soil materials at different depths, and laboratory analysis of soil samples for potential contaminants. The SI program was designed in accordance with the EPD's *Guidance Manual for Use of Risk-based Remediation Goals for Contaminated Land Management* (RBRG Guidance Manual) and the associated Guidance Notes, and the EPD's *Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol Filling Stations, Boatyards, and Car Repair/Dismantling Workshop.* The details of the SI program are presented in the following sections.

3.1.1 Soil Sampling

3

The SI was conducted during 21 to 22 February 2008. Six 1.0 m x 1.0 m trial pits were excavated down to maximum depth of 1.5 m bgl.

Soil samplings were undertaken at two locations (S1/S2 and S3/S4) adjacent to the UST to identify whether soil surrounding the UST is contaminated. Two (2) soil samples are taken at each sampling location using trial pits at below the concrete slab and asphalt hard surface and at the bottom of the UST (ie at 1.5 m below ground level, m bgl) ⁽¹⁾.

Four (4) subsurface soil sampling locations (S5/S6, S7/S8, S9/S10 and S11/S12) were located around the CCPP area to provide information on the level of contaminants in the subsurface soil around the CCPP. The sampling locations were located along the CCPP structure focussing where foundations are located and at similar intervals to provide coverage of the proposed area where underground subsurface disturbance will occur during the demolition. To determine the presence and extent of contamination from the surface soil ⁽²⁾ and in the fill materials ⁽³⁾, two (2) soil samples were taken from each sampling

⁽¹⁾ The UST dimension is (1 m (wide) x 4 m (Length) x 1.5 m (depth).

⁽²⁾ It is anticipated that any contamination from the CCPP operations will have entered the underlying soils from the surface as no subsurface pipelines or channels were located within the CCPP.

⁽³⁾ It was reported that the original fill material was excavated from the site for the foundation construction during the construction of the CCPP which was then backfilled on site. The Site was used for storage of materials prior to the CCPP construction.

location at just below the concrete pavement and asphalt hard surface and at 1.5 m bgl.

Soil samples were collected using a stainless steel scoop and were placed immediately into laboratory supplied bottles. The sample bottles were then labelled and placed directly into the cooler with ice packs for shipment to the laboratory for analysis.

The sampling methodologies applied were based on methods developed by the US Environmental Protection Agency (US EPA) and included sample preparation and preservation and chain-of-custody documentation. All of the sampling equipment were cleaned with water and phosphate-free detergent, and then rinsed with tap water. The cleaning procedure was repeated after each sample to avoid potential cross contamination.

The sampling locations are shown in *Figure 3.1a* and a summary of the above soil sampling programs is presented in *Table 3.1a*.

Sample	Sampling Location	Depth of Sampling	Sampling Parameters	No of Samples to be taken
S1/S2	Located to the north of the UST.	Underneath concrete pavement and at 1.5 m	Heavy metals, TPH, BTEX	2
S3/S4	Located to the south of the UST.	Underneath concrete pavement and at 1.5 m	Heavy metals, TPH, BTEX	2
S5/S6	Located to the east of the rotary kiln.	Underneath concrete pavement and at 1.5 m	Heavy metals, TPH, BTEX	2
S7/S8	Located to the west of the cyclones.	Underneath concrete pavement and at 1.5 m	Heavy metals, TPH, BTEX	2
59/S10	Located to the south of the CCPP and north of the overhead fuel pipelines connecting the fuel oil storage tank (located approximately 100 m to the southwest of the CCPP).	Underneath concrete pavement and at 1.5 m	Heavy metals, TPH, BTEX	2
S11/S12	Located to the northwest of the reception hall and to the southeast of the fuel underground storage tanks and dispensing station.	Underneath concrete pavement and at 1.0 m	Heavy metals, TPH, BTEX	2
QC	Collected from S7/S8	Underneath concrete pavement	Heavy metals, TPH, BTEX	1
		-	Total no. of samples	13

Table 3.1a Sampling Locations and Parameters for Site Investigation



3.1.2 Sample Duplication

One field duplicate soil sample was collected during the land contamination investigation. The duplicate sample was collected on a random basis and has been submitted to the HOKLAS accredited laboratory for the purpose of quality control (QC)/quality assurance (QA).

3.1.3 Laboratory Analytical Programme

The analysis of soil samples was carried out by the ALS Technichem (HK) Pty Ltd Laboratory, based in Hong Kong. ALS is a Hong Kong Laboratory Accreditation Scheme (HOKLAS) certified laboratory and performs analyses to US EPA protocols and Quality Assurance (QA) guidelines. Samples were collected by the ALS Laboratory courier in a sealed cooler with chain-ofcustody documentation. All soil samples were analysed for the following parameters:

- Total Petroleum Hydrocarbons (TPH) fractions including C6-C8, C9-C16 and C17-C35 by USEPA Method 8015;
- Simple Aromatics (eg benzene, toluene, ethyl benzene, and xylenes) (BTEX) by USEPA Method 8260; and
- Heavy metals including antimony (Sb), arsenic (As), barium (Ba), cadmium (Cd), chromium III and VI (Cr III and Cr VI), cobalt (Co), nickel (Ni), copper (Cu), lead (Pb), manganese (Mn), mercury (Hg), molybdenum (Mo), nickel (Ni), tin (Sn), and zinc (Zn) by USEPA Method 6020A/7000 ICPMS.

3.1.4 Field Observations

During the trial pit excavation and sampling activities, it was observed that the soil materials encountered during the trial pit excavations (to 1.5 m bgl) comprised mainly of fill materials.

No evidence of contamination, such as staining, discoloration or odour, was observed during excavation. No water was encountered in any of the trial pit.

3.2 ANALYTICAL RESULTS

3.2.1 Criteria for Assessment

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

The existing soil results have been compared against the RBRGs and the associated Soil Saturation Limits (C_{sat}). RBRGs were developed for four different post-restoration land use scenarios (ie Urban Residential, Rural Residential, Industrial and Public Parks). For the purposes of this CAP, the Site has been given a preliminary classification as an Industrial Site, as defined in the *RBRs Guidance Manual*. The RBRG values are present in the *RBRGs Guidance Manual* and are also attached in *Annex C*.

3.2.2 Soil Analytical results

The results of the laboratory analysis of the soil samples are presented in *Tables 3.2a*.

Levels of TPH analysed for all three carbon ranges were below the reported detection limits for all samples. Concentrations of BTEX were also below the reported detection limits at all locations. Levels of all metals analysed in all samples were well below the RBRG values.

The detailed results of the laboratory analysis of the samples with the QA/QC information are presented in *Annex B*.

Parameters	LOR ^(a)	S1	S2	S3	S4	<i>S</i> 5	S6	<i>S</i> 7	S 8	S9	S10	S11	S12	S13 ^(b)	RBRG	Csat
															Industrial	
% Moisture Content	0.1	15.3	8.1	10.6	9.8	10.3	9.8	9.4	10.6	7.4	7.5	9.5	10.6	7.6	-	-
TPH																
C6-C8 Fraction	5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	1.00E+04	1.00E+03
C9-C16 Fraction	200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	1.00E+04	3.00E+03
 C17-C35 Fraction 	500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	1.00E+04	5.00E+03
Benzene	0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	<0.2	9.12E+00	3.36E+02
Toluene	0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	<0.2	1.00E+04	2.35E+02
Ethyl-benzene	0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	8.24E+03	1.38E+02
m,p-Xylene	0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	1.23E+03(c)	1.50E+02(c)
o-Xylene	0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	1.23E+03(c)	1.50E+02(c)
Priority Metal																
Antimony (Sb)	1	7	<1	5	<1	2	<1	1	<1	<1	<1	2	1	<1	2.61E+02	-
• Arsenic (As)	1	25	<1	25	<1	2	<1	1	<1	<1	<1	4	1	2	1.96E+02	-
• Barium (Ba)	0.5	110	30.4	109	23.1	53.4	23.1	41.5	29.4	22.8	21.1	60.4	35.8	24.5	1.00E+04	-
Cadmium (Cd)	0.2	2.2	0.2	0.7	< 0.2	0.6	< 0.2	0.5	< 0.2	< 0.2	< 0.2	0.6	0.7	< 0.2	6.53E+02	-
Chromium III (Cr III)	0.5	35.3	8.8	28.2	2.3	14.2	3	12.1	4.2	8.5	3.2	15.7	21.5	24.5	1.00E+04	-
• Chromium VI (Cr VI)	0.5	< 0.5	< 0.5	0.8	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	1.2	1.96E+03	-
Cobalt (Co)	0.5	11.5	3.2	14.6	2.7	3.9	3.4	5.2	2.6	2.3	1.4	4.3	3.7	3.5	1.00E+04	-
Copper (Cu)	1	226	22	103	2	35	2	20	3	17	2	57	32	30	1.00E+04	-
• Lead (Pb)	1	85	42	35	61	54	59	46	42	51	42	49	42	47	2.29E+03	-
 Manganese (Mn) 	0.5	152	452	447	296	279	265	339	254	364	316	298	221	344	1.00E+04	-
• Mercury (Hg)	0.05	0.24	< 0.05	0.08	< 0.05	< 0.05	< 0.05	0.05	< 0.05	< 0.05	< 0.05	0.05	< 0.05	< 0.05	3.84E+01	-
 Molybdenum (Mo) 	1	77	3	33	5	19	2	7	2	2	2	21	12	4	3.26E+03	-
Nickel (Ni)	1	21	3	22	1	<1	<1	3	<1	2	<1	2	<1	13	1.00E+04	-
• Tin (Sn)	0.5	45.7	5.4	8.2	4.2	7.4	4.3	5.5	4	4.2	2.6	7.6	5.8	6.9	1.00E+04	-
• Zinc (Zn)	1	523	72	387	31	116	31	114	34	92	32	142	162	228	1.00E+04	-

Table 3.2aSoil Analytical Results (all results in mg/kg dry weight)

Notes:

(a) LOR = Limit of reporting

(b) The duplicate sample taken from S7.

(c) The RBRG Industrial values for Total Xylenes
3.3 CONCEPTUAL MODEL OF POTENTIAL POLLUTANT LINKAGE

The potential pollutant linkages that could be present at the Site due to the on site activities of the CCPP are summarised in the *Table 3.3a*. It is considered that the only potential receptors at risk might be site workers involved in decommissioning and demolition works, which was discussed in the *CAP* (see *Annex A*).

As the contaminants analysed were either not detected or with concentrations well below the RBRGs, it is not considered that the activities of the CCPP pose risks to any receptor.

Source	Pathway Receptor		Risk
Historical storage of cement and limestone/ foundation construction	Ingestion, inhalation and skin contact	Site workers involved in the decommissioning and demolition work	None – The concentrations in the soil samples were well below the RBRGs. The demolition work will be limited to the top 1.5 m and hence will not touch these materials.
	Soil pore migration	Ground and surface waters	None – The concentrations in the soil samples were well below the RBRGs. The storage occurred over 10 years ago.
Municipal waste feedstock (MSW)	Ingestion, inhalation and skin contact	Humans (eg Site workers during decommissioning and demolition works)	None – The concentrations in the soil samples were well below the RBRGs. No MSW remains on site at the time of the site visit.
Ash residue from the thermal treatment trial	Ingestion, inhalation and skin contact	Humans (eg Site workers during decommissioning and demolition works)	None – The concentrations in the soil samples were well below the RBRGs. No ash residues were left on the ground at the time of the site visit.
Liquid runoff from MSW/ash	Ingestion, inhalation and skin contacts	Humans (eg Site workers during decommissioning and demolition works)	None – The concentrations in the soil samples were well below the RBRGs.
Liquid runoff from MSW/ash	Soil pore water	Groundwater/ surface water	None – The concentrations in the soil samples were well below the RBRGs. Impermeable hardstanding and enclosed drainage system. No leakage of the wastewater collection UST reported.
Off site contamination	Migration on to	Humans - Site	None – The concentrations in the

Table 3.3aConceptual Model of Potential Pollutant Linkage at the CCPP site

ENVIRONMENTAL RESOURCES MANAGEMENT

Source	Pathway	Receptor	Risk
sources	the CCPP site via	workers during	soil samples were well below the
	soil pore water or air borne dust	decommissioning Groundwater under the Site	RBRGs. There was no evidence to suggest any spillages or leaks have occurred off site to such an extent as to impact the soils or groundwater underlying the Site.

3.4 EVALUATION OF IMPACTS

As all the detected concentrations of potential contaminants in the soil samples were well below the referenced RBRGs and soil saturation limits (Csat) no potential land contamination impact is anticipated during the CCPP demolition or thereafter.

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS

The assessment activities were performed in accordance with internationally recognized practices. The results of the site investigation works determined that:

- TPH/BTEX were not detected in any of the soil samples collected.
- Concentrations of priority pollutant metals were detected were well below the RBRG standards.

As the result of the above, no potential impact from the contaminated soil is anticipated.

4.2 **RECOMMENDATIONS**

Based on the above investigation results, no further investigation is warranted and no mitigation measures are required.

Annex A

The CAP

Please refer to Annex A1 of the EIA Report

Annex B

Site Investigation Report by the Civil Contractor

Site Investigation Works

for

Green Island Cement Plant, Tap Shek Kwok, Tuen Mun

GROUND INVESTIGATION REPORT

13 March 2008

CONSULTANT ENGINEER

Environmental Resources Management

CONTRACTOR

ŝ

CITY 城市土力工程有限公司

GEO City Geotechnical Engineering Ltd Unit 3016, New Tech Plaza, 34 Tai Yau Street, San Po Kong, Kowloon Telephone : (852) 2997 7288 Fax : (852) 2997 6766

Certificate of Compliance/Certificate of Supervision (for inclusion in ground investigation report)

 Project name & location
 :
 Green Island Cement Plant, Tap Shek Kwok, Tuen Mun.

 CGEL Contract No.
 :
 C577

 Consultant Engineer
 :
 Environmental Resources Management

<u>Part 1 : Certificate of Compliance</u> (to be completed by Authorized Signatory)

l, the person appointed to act for the registered specialist contractor (ground investigation field works category) <u>WOO Kwong Yeung (胡廣湯)</u>, certify that : -

- (i) we are responsible for the works stated in the report and that the works have been conducted according to GEOGUIDE 2 and 3;
- (ii) the works have been carried out under our supervision in accordance with the requirements stipulated and the Quality Supervision Plan for Ground Investigation Field Works submitted to the Buildings Department;
- (iii) the logging of samples and preparation of borehole logs in accordance with GEOGUIDE 3 have been carried out by a Competent Person; and
- (iv) the field density tests and other tests of samples have been conducted by a HOKLAS accredited laboratory. (*)

	Name of the RSC (GIFW)	:	City Geotechnical Engineering Ltd.
	Certificate of Registration No.	:	SC(GI) 5 /2001
· · · · · · · · · · · · · · · · · · ·	Date of expiry of registration	:	1 July 2010
	Signature of Authorized Signatory	:	aplow
	Date	:	13 March 2008

Part 2 : Certificate of Supervision (to be completed by Registered Geotechnical Engineer)

I, the Registered Geotechnical Engineer (name in full)	(Chinese),
--	------------

:

certify that I have provided supervision in accordance with the requirement stipulated and the Quality Supervision Plan for Ground Investigation Field Works submitted to the Buildings Department.

 Certificate of Registration No.
 :

 Date of expiry of registration
 :

Signature

Date

^{*} Delete where appropriate

Ĵ.

CITY GEOTECHNICAL ENGINEERING LTD

CONTRACT NO. C577

Site Investigation Works

for

Green Island Cement Plant, Tap Shek Kwok, Tuen Mun

CONTENTS

- 1. Site Investigation Works Layout Plan
- 2. Survey Record
- 3. Trial Pit Log
- 4. Photograph

Site Investigation Works Layout Plan



į,

. 1

Survey Record

CITY GEOTECHNICAL ENGINEERING LTD

Site Investigation Works

for

Green Island Cement Plant, Tap Shek Kwok, Tuen Mun

Survey Records

Trial Pit No.	Level		
	(m.P.D.)		
S1/S2	+6.95		
S3/S4	+6.92		
S5/S6	+7.10		
S7/S8	+6.90		
S9/S10	+7.05		
S11/S12	+6.94		

3

Trial Pit Log



Location [:]	Green Islan Ground Ir	d Cement Plant, Tap Shek	Kwok, Tuen Mun		Trial pit No.: S3/S4	Sheet 1 of 1		
Logged by Date:	: <u>LKM</u> Ch 22/2/	ecked by: <u>AW</u> Excav /08	vation method:	HAND	DUG	Excavated: $22/2/08$ Backfilled: $22/2/08$		
Samples & Test	Depth (m)	Face A: width: 1.90	Face B: m width: 1.80	m	Face C: width: 1.90 m	Face D: width: 1.80 m		
	0.00	Datum line +6.92 m $\land \land $						
•	- 0.50 							
	1.00 							
•	1.50 - - - -	*****			~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~			
		A						
				 	Section X -	- X (not to scale)		
	D		В		1.50 × A A A A S * S * S * S * S * S * S * S *			
		C Plan of pit						
Remarks		<u> </u>			<u> </u>			
Legend	Grey, CC	Description		Grade	Plan (not to scale)		
	Block, A Yellowisi	SPHALT. n brown, silty SAND with	n some fine to		Leachate UST	ST BECEPtion Hall		
	medium (FILL)	graveis.			Worksho	ο Small disturbed somple		
					 	 Lorge disturbed sample Water sample Seepage Black sample 		









Photograph

7

7

ŝ

Å

Law or shall

La cal

tan sa ang

la se se a

ند

























Annex C

Laboratory Analytical Report

ALS Technichem (HK) Pty Ltd

ALS Laboratory Group

ANALYICAL CHEMISTRY & TESTING SERVICES



CERTIFICATE OF ANALYSIS

Client Contact Address	2 GREEN ISLAND CEMENT LIMITED 2 MS LAURENCE GENEE 2	Laboratory Contact Address	 ALS Technichem (HK) Pty Ltd Alice Wong 11/F., Chung Shun Knitting Centre, 1 - 3 Wing Yip Street, Kwai Chung, N.T., Hong Kong 	Page Work Order	1 of 8 HK0802860
E-mail	∴ laurence.genee@erm.com	E-mail	Alice.Wong@alsenviro.com		
Telephone	:	Telephone	÷ +852 2610 1044		
Facsimile	:	Facsimile	: +852 2610 2021		
Project	: (ERM 0071019)	Quote number	:	Date received	22 Feb 2008
Order number	:			Date of issue	: 13 Mar 2008
C-O-C number	: H002505-H002506			No. of samples	- Received : 13
Site	: GIC				- Analysed : 13

Report Comments

This report for ALS Technichem (HK) Pty Ltd work order reference HK0802860 supersedes any previous reports with this reference. The completion date of analysis is 29 Feb 2008. Results apply to sample(s) as submitted. All pages of this report have been checked and approved for release. When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for process purposes. Abbreviations: CAS number = Chemical Abstract Services number. LOR = Limit of reporting.

Specific comments for Work Order HK0802860 :

Sample(s) were received in a chilled condition. Soil sample(s) analysed on an as received basis. Result(s) reported on a dry weight basis.

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

This report may not be reproduced except with prior written	This document has been electronically signed by those names that appear on this report and are the authorised				
approval from ALS Technichem (HK) Pty Ltd.	signatories. Electronic signing has been carried out in compliance with procedures specified in the 'Electronic				
	Transactions Ordinance' of Hong Kong. Chapter 553. Section 6.				
	Transactions Ordinance' of Hong Kong. Chapter 553. Section 6. Signatory Position Authorised results for:- Ant Nace Unumb Description				
	Anh Ngoc Huynh	Senior Chemist	Organics		
	Fung Lim Chee, Richard	General Manager	Inorganics		

ALS Laboratory Group Trading Name: ALS Technichem (HK) Pty Ltd 11/F., Chung Shun Knitting Centre, 1-3 Wing Yip Street, Kwai Chung, N.T., Hong Kong Tel: +852 2610 1044 Fax: +852 2610 2021 www.alsenviro.com

A Campbell Brothers Limited Company

Page Number : 2 of 8 : GREEN ISLAND CEMENT LIMITED Client Work Order HK0802860



Analytical Results		CI	ient Sample ID :	S1	\$2	S3	S4	S5
Analytical Results		Labora	tory Sample ID :	HK0802860-001	HK0802860-002	HK0802860-003	HK0802860-004	HK0802860-005
Submatrix: SOIL		0	I Data / Time i					
Γ		Sam	pie Date / Time :	22 Feb 2008	22 Feb 2008	22 Feb 2008	22 Feb 2008	22 Feb 2008
Method: Analysis Description	CAS number	LOR	Units	11.00	11:15	11:30	11.45	13:30
EA/ED: Physical and Aggregate Pro	perties				1	1		1
EA055: Moisture Content (dried @		0.1	%	15.3	8.1	10.6	9.8	10.3
103°C)								
EG: Metals and Major Cations						1		1
EG020: Antimony	7440-36-0	1	mg/kg	7	<1	5	<1	2
EG020: Arsenic	7440-38-2	1	mg/kg	25	<1	25	<1	2
EG020: Barium	7440-39-3	0.5	mg/kg	110	30.4	109	23.1	53.4
EG020: Cadmium	7440-43-9	0.2	mg/kg	2.2	0.2	0.7	<0.2	0.6
EG020: Cobalt	7440-48-4	0.5	mg/kg	11.5	3.2	14.6	2.7	3.9
EG020: Copper	7440-50-8	1	mg/kg	226	22	103	2	35
EG020: Lead	7439-92-1	1	mg/kg	85	42	35	61	54
EG020: Manganese	7439-96-5	0.5	mg/kg	152	452	447	296	279
EG020: Mercury	7439-97-6	0.05	mg/kg	0.24	<0.05	0.08	<0.05	<0.05
EG020: Molybdenum	7439-98-7	1	mg/kg	77	3	33	5	19
EG020: Nickel	7440-02-0	1	mg/kg	21	3	22	1	<1
EG020: Tin	7440-31-5	0.5	mg/kg	45.7	5.4	8.2	4.2	7.4
EG020: Zinc	7440-66-6	1	mg/kg	523	72	387	31	116
EG049: Trivalent Chromium	16065-83-1	0.5	mg/kg	35.3	8.8	28.2	2.3	14.2
EG050: Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	<0.5	0.8	<0.5	<0.5
EP-071/080: Total Petroleum Hydroc	arbons (TPH Volati	ile) / BTEX	(-	
C6 - C8 Fraction		5	mg/kg	<5	<5	<5	<5	<5
EP-071: Total Petroleum Hydrocarbo	ons (TPH)							•
C9 - C16 Fraction		200	mg/kg	<200	<200	<200	<200	<200
C17 - C35 Fraction		500	mg/kg	<500	<500	<500	<500	<500
EP-080: BTEX					•	•		•
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Chlorobenzene	108-90-7	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Ethylbenzene	100-41-4	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
meta- & para-Xylene	108-38-3	0.4	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
	106-42-3							
ortho-Xylene	95-47-6	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
EP-080S: TPH(Volatile)/BTEX Surrogate							Surrogate control lir	nits listed at end of this report.
Dibromofluoromethane 1868-53-7 0.1 %			89.5	87.4	85.8	88.0	86.6	
Toluene-D8	2037-26-5	0.1	%	97.5	96.8	98.2	96.8	97.4
4-Bromofluorobenzene	460-00-4	0.1	%	93.0	92.5	94.9	94.4	94.6
Page Number : 3 of 8 : GREEN ISLAND CEMENT LIMITED Client Work Order HK0802860



Analytical Results		CI	ient Sample ID :	S6	S7	S8	S9	S10
Analytical Results		Labora	tory Sample ID :	HK0802860-006	HK0802860-007	HK0802860-008	HK0802860-009	HK0802860-010
Submatrix: SOIL		Com	ala Data (Tima)			00 5-6 0000		
[Sam	pie Date / Time :	22 Feb 2008	22 Feb 2008	22 Feb 2008	22 Feb 2008	22 Feb 2008
Method: Analysis Description	CAS number	LOR	Units	13.45	14.15	14.50	10.15	10.30
EA/ED: Physical and Aggregate Prope	rties				I	1	1	1
EA055: Moisture Content (dried @		0.1	%	9.8	9.4	10.6	7.4	7.5
103°C)								
EG: Metals and Major Cations	7440.00.0	4		- 4				
EG020: Antimony	7440-36-0	1	mg/kg	<1	1	<1	<1	<1
EG020: Arsenic	7440-38-2	1	mg/kg	<1	1	<1	<1	<1
EG020: Barium	7440-39-3	0.5	mg/kg	23.1	41.5	29.4	22.8	21.1
EG020: Cadmium	7440-43-9	0.2	mg/kg	<0.2	0.5	<0.2	<0.2	<0.2
EG020: Cobalt	/440-48-4	0.5	mg/kg	3.4	5.2	2.6	2.3	1.4
EG020: Copper	7440-50-8	1	mg/kg	2	20	3	17	2
EG020: Lead	7439-92-1	1	mg/kg	59	46	42	51	42
EG020: Manganese	7439-96-5	0.5	mg/kg	265	339	254	364	316
EG020: Mercury	7439-97-6	0.05	mg/kg	<0.05	0.05	<0.05	<0.05	<0.05
EG020: Molybdenum	7439-98-7	1	mg/kg	2	7	2	2	2
EG020: Nickel	7440-02-0	1	mg/kg	<1	3	<1	2	<1
EG020: Tin	7440-31-5	0.5	mg/kg	4.3	5.5	4.0	4.2	2.6
EG020: Zinc	7440-66-6	1	mg/kg	31	114	34	92	32
EG049: Trivalent Chromium	16065-83-1	0.5	mg/kg	3.0	12.1	4.2	8.5	3.2
EG050: Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
EP-071/080: Total Petroleum Hydrocar	bons (TPH Volati	ile) / BTEX	I					
C6 - C8 Fraction		5	mg/kg	<5	<5	<5	<5	<5
EP-071: Total Petroleum Hydrocarbon	s (TPH)							
C9 - C16 Fraction		200	mg/kg	<200	<200	<200	<200	<200
C17 - C35 Fraction		500	mg/kg	<500	<500	<500	<500	<500
EP-080: BTEX						- -		- -
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Chlorobenzene	108-90-7	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Ethylbenzene	100-41-4	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
meta- & para-Xylene	108-38-3	0.4	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
	106-42-3							
ortho-Xylene	95-47-6	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
EP-080S: TPH(Volatile)/BTEX Surroga	te						Surrogate control lir	nits listed at end of this report.
Dibromofluoromethane	1868-53-7	0.1	%	86.0	85.8	85.4	84.0	80.4
Toluene-D8	2037-26-5	0.1	%	96.8	97.8	97.1	97.0	96.6
4-Bromofluorobenzene	460-00-4	0.1	%	94.2	95.2	92.5	92.6	94.4

Page Number: 4 of 8Client: GREEN ISLAND CEMENT LIMITEDWork OrderHK0802860



Analytical Results		Cli	ent Sample ID :	S11	S12	S13		
Analytical Acoulto		Labora	tory Sample ID :	HK0802860-011	HK0802860-012	HK0802860-013		
Submatrix: SOIL		•				[00 Eab 0000]		
		Samp	ble Date / Time :	22 Feb 2008	22 Feb 2008	[22 Feb 2008]		
Method: Analysis Description	CAS number	LOR	Units	10:30	10:45			
EA/ED: Physical and Aggregate Proper	ties				1	1		
EA055: Moisture Content (dried @		0.1	%	9.5	10.6	7.6		
103°C)								
EG: Metals and Major Cations								
EG020: Antimony	7440-36-0	1	mg/kg	2	1	<1		
EG020: Arsenic	7440-38-2	1	mg/kg	4	1	2		
EG020: Barium	7440-39-3	0.5	mg/kg	60.4	35.8	24.5		
EG020: Cadmium	7440-43-9	0.2	mg/kg	0.6	0.7	<0.2		
EG020: Cobalt	7440-48-4	0.5	mg/kg	4.3	3.7	3.5		
EG020: Copper	7440-50-8	1	mg/kg	57	32	30		
EG020: Lead	7439-92-1	1	mg/kg	49	42	47		
EG020: Manganese	7439-96-5	0.5	mg/kg	298	221	344		
EG020: Mercury	7439-97-6	0.05	mg/kg	0.05	<0.05	<0.05		
EG020: Molybdenum	7439-98-7	1	mg/kg	21	12	4		
EG020: Nickel	7440-02-0	1	mg/kg	2	<1	13		
EG020: Tin	7440-31-5	0.5	mg/kg	7.6	5.8	6.9		
EG020: Zinc	7440-66-6	1	mg/kg	142	162	228		
EG049: Trivalent Chromium	16065-83-1	0.5	mg/kg	15.7	21.5	24.5		
EG050: Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	<0.5	1.2		
EP-071/080: Total Petroleum Hydrocark	oons (TPH Volati	le) / BTEX				•		
C6 - C8 Fraction		5	mg/kg	<5	<5	<5		
EP-071: Total Petroleum Hydrocarbons	(TPH)							
C9 - C16 Fraction		200	mg/kg	<200	<200	<200		
C17 - C35 Fraction		500	mg/kg	<500	<500	<500		
EP-080: BTEX						•		
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2		
Toluene	108-88-3	0.2	mg/kg	<0.2	<0.2	<0.2		
Chlorobenzene	108-90-7	0.2	mg/kg	<0.2	<0.2	<0.2		
Ethylbenzene	100-41-4	0.2	mg/kg	<0.2	<0.2	<0.2		
meta- & para-Xylene	108-38-3	0.4	mg/kg	<0.4	<0.4	<0.4		
	106-42-3							
ortho-Xylene	95-47-6	0.2	mg/kg	<0.2	<0.2	<0.2		
EP-080S: TPH(Volatile)/BTEX Surrogate	•						Surrogate control lin	nits listed at end of this report.
Dibromofluoromethane	1868-53-7	0.1	%	87.5	82.9	93.6		
Toluene-D8	2037-26-5	0.1	%	97.6	96.8	97.4		
4-Bromofluorobenzene	460-00-4	0.1	%	92.8	93.6	92.4		



Quality Control - Laboratory Duplicate (DUP) Results

Matrix Type: SOIL					Duplicate (DUP)	Results		
Laboratory Sample ID	Client Sample ID	Method: Analysis Description	CAS number	LOR	Units	Original Result	Duplicate Result	RPD (%)
EA/ED: Physical and A	Aggregate Properties (QC Lo	ot: 604570)						
HK0802860-001	S1	EA055: Moisture Content (dried @ 103°C)		0.1	%	15.3	15.5	1.1
HK0802860-011	S11	EA055: Moisture Content (dried @ 103°C)		0.1	%	9.5	9.9	3.5
EG: Metals and Major	Cations (QC Lot: 607686)							
HK0802860-002	S2	EG020: Antimony	7440-36-0	1	mg/kg	<1	<1	0.0
		EG020: Lead	7439-92-1	1	mg/kg	42	50	18.2
		EG020: Manganese	7439-96-5	0.5	mg/kg	452	494	8.8
		EG020: Mercury	7439-97-6	0.05	mg/kg	<0.05	<0.05	0.0
		EG020: Molybdenum	7439-98-7	1	mg/kg	3	4	0.0
		EG020: Nickel	7440-02-0	1	mg/kg	3	4	0.0
		EG020: Tin	7440-31-5	0.5	mg/kg	5.4	6.1	12.7
		EG020: Arsenic	7440-38-2	1	mg/kg	<1	1	0.0
		EG020: Zinc	7440-66-6	1	mg/kg	72	80	11.6
		EG020: Barium	7440-39-3	0.5	mg/kg	30.4	29.4	3.6
		EG020: Cadmium	7440-43-9	0.2	mg/kg	0.2	0.2	0.0
		EG020: Cobalt	7440-48-4	0.5	mg/kg	3.2	2.7	20.0
		EG020: Copper	7440-50-8	1	mg/kg	22	19	13.3
HK0803455-007	Anonymous	EG020: Antimony	7440-36-0	1	mg/kg	1	1	0.0
		EG020: Lead	7439-92-1	0.5	mg/kg	12.0	12.8	5.8
		EG020: Manganese	7439-96-5	0.5	mg/kg	33.3	33.4	0.5
		EG020: Mercury	7439-97-6	0.5	mg/kg	0.7	0.6	0.0
		EG020: Molybdenum	7439-98-7	1	mg/kg	5	6	0.0
		EG020: Nickel	7440-02-0	0.5	mg/kg	11.8	12.5	5.6
		EG020: Tin	7440-31-5	0.5	mg/kg	16.3	15.6	4.6
		EG020: Arsenic	7440-38-2	0.5	mg/kg	2.6	2.8	7.2
		EG020: Zinc	7440-66-6	0.5	mg/kg	640	653	1.9
		EG020: Barium	7440-39-3	0.5	mg/kg	75.6	75.6	0.0
		EG020: Cadmium	7440-43-9	0.5	mg/kg	0.6	0.6	0.0
		EG020: Cobalt	7440-48-4	0.5	mg/kg	1.1	1.1	0.0
		EG020: Copper	7440-50-8	0.5	mg/kg	104	104	1.0
EG: Metals and Major	Cations (QC Lot: 609390)					•		
HK0802860-002	S2	EG050: Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	<0.5	0.0
HK0802860-011	S11	EG050: Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	<0.5	0.0
EP-071/080: Total Petr	roleum Hydrocarbons (TPH V	/olatile) / BT (QC Lot: 604500)						
HK0802860-001	S1	C6 - C8 Fraction		5	mg/kg	<5	<5	0.0
EP-071: Total Petroleu	um Hydrocarbons (TPH) (QC	Lot: 604502)				•		
HK0802860-001	S1	C9 - C16 Fraction		200	mg/kg	<200	<200	0.0
		C17 - C35 Fraction		500	mg/kg	<500	<500	0.0
						1		Comphell Brothers Limited Compo



Matrix Type: SOIL	Duplicate (DUP) Results							
Laboratory Sample ID	Client Sample ID	Method: Analysis Description	CAS number	LOR	Units	Original Result	Duplicate Result	RPD (%)
EP-080: BTEX (QC Lot: 6	04500)							
HK0802860-001	S1	Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.0
		Toluene	108-88-3	0.2	mg/kg	<0.2	<0.2	0.0
		Chlorobenzene	108-90-7	0.2	mg/kg	<0.2	<0.2	0.0
		Ethylbenzene	100-41-4	0.2	mg/kg	<0.2	<0.2	0.0
		meta- & para-Xylene	108-38-3	0.4	mg/kg	<0.4	<0.4	0.0
			106-42-3					
		ortho-Xylene	95-47-6	0.2	mg/kg	<0.2	<0.2	0.0

Quality Control - Method Blank (MB), Single Control Spike (SCS) and Duplicate Control Spike (DCS) Results

Matrix Type: SOIL			Method Blank (MB)) Results		Single Co	ntrol Spike (SCS) and Du	plicate Cont	rol Spike (DC	CS) Results	
					Spike	Spike Red	overy (%)	Recovery	Limits (%)	RPD	s (%)
Method: Analysis Description	CAS number	LOR	Units	Result	Concentration	SCS	DCS	Low	High	Value	Control Limit
EG: Metals and Major Cations (QCLot: 60	07686)										
EG020: Antimony	7440-36-0	1	mg/kg	<1	5 mg/kg	85.3		85	115		
EG020: Lead	7439-92-1	1	mg/kg	<1	5 mg/kg	87.1		85	115		
EG020: Manganese	7439-96-5	1	mg/kg	<0.5	5 mg/kg	99.5		85	115		
EG020: Mercury	7439-97-6	0.05	mg/kg	<0.05	0.1 mg/kg	93.6		85	115		
EG020: Molybdenum	7439-98-7	1	mg/kg	<1	5 mg/kg	99.4		85	115		
EG020: Nickel	7440-02-0	1	mg/kg	<1	5 mg/kg	92.3		85	115		
EG020: Tin	7440-31-5	1.0	mg/kg	<1.0	5 mg/kg	97.5		85	115		
EG020: Arsenic	7440-38-2	1	mg/kg	<1	5 mg/kg	97.2		85	115		
EG020: Zinc	7440-66-6	1	mg/kg	<1	5 mg/kg	100		85	115		
EG020: Barium	7440-39-3	1	mg/kg	<0.5	5 mg/kg	104		85	115		
EG020: Cadmium	7440-43-9	0.2	mg/kg	<0.2	5 mg/kg	94.8		85	115		
EG020: Cobalt	7440-48-4	1	mg/kg	<0.5	5 mg/kg	91.4		85	115		
EG020: Copper	7440-50-8	1	mg/kg	<1	5 mg/kg	94.3		85	115		
EG: Metals and Major Cations (QCLot: 60	09390)										
EG050: Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	2.5 mg/kg	99.0		85	115		
EP-071/080: Total Petroleum Hydrocarbo	ns (TPH Volatile) / B	T (QCLot: 6	604500)								
C6 - C8 Fraction		5	mg/kg	<5	3 mg/kg	81.1		45	106		
EP-071: Total Petroleum Hydrocarbons (1	[PH) (QCLot: 60450	2)									
C9 - C16 Fraction		200	mg/kg	<200	32 mg/kg	92.6		48	108		
C17 - C35 Fraction		500	mg/kg	<500	75 mg/kg	102		50	110		
EP-080: BTEX (QCLot: 604500)											
Benzene	71-43-2	0.2	mg/kg	<0.2	0.2 mg/kg	88.1		57	91		
Toluene	108-88-3	0.2	mg/kg	<0.2	0.2 mg/kg	81.2		60	107		
Chlorobenzene	108-90-7	0.2	mg/kg	<0.2	0.2 mg/kg	93.1		81	110		
Ethylbenzene	100-41-4	0.2	mg/kg	<0.2	0.2 mg/kg	86.2		76	105		

Page Number: 7 of 8Client: GREEN ISLAND CEMENT LIMITEDWork OrderHK0802860



Matrix Type: SOIL	Method Blank (MB) Results			Single Control Spike (SCS) and Duplicate Control Spike (DCS) Results							
				Spike	Spike Re	covery (%)	Recovery	Limits (%)	RPL	Ds (%)	
Method: Analysis Description	CAS number	LOR	Units	Result	Concentration	SCS	DCS	Low	High	Value	Control Limit
EP-080: BTEX (QCLot: 604500) - co	ontinued										
meta- & para-Xylene	108-38-3	0.4	mg/kg	<0.4	0.4 mg/kg	86.9		74	113		
	106-42-3										
ortho-Xvlene	95-47-6	0.2	mg/kg	<0.2	0.2 mg/kg	80.6		75	109		

Quality Control - Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Results

Matrix Type: SOIL				Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Results						
			Spike	Spike Reco	overy (%)	Recovery	Limits (%)	RPDs (%)	
Client Sample ID	Method: Analysis Description	CAS number	Concentration	MS	MSD	Low	High	Value	Control Limit	
ations (QCLot: 607686)										
S1	EG020: Antimony	7440-36-0	5 mg/kg	99.2		75	125			
	EG020: Lead	7439-92-1	5 mg/kg	Not Determined		75	125			
	EG020: Manganese	7439-96-5	5 mg/kg	Not Determined		75	125			
	EG020: Mercury	7439-97-6	0.1 mg/kg	Not Determined		75	125			
	EG020: Molybdenum	7439-98-7	5 mg/kg	Not Determined		75	125			
	EG020: Nickel	7440-02-0	50 mg/kg	87.9		75	125			
	EG020: Tin	7440-31-5	5 mg/kg	Not Determined		75	125			
	EG020: Arsenic	7440-38-2	5 mg/kg	Not Determined		75	125			
	EG020: Zinc	7440-66-6	5 mg/kg	Not Determined		75	125			
	EG020: Barium	7440-39-3	5 mg/kg	Not Determined		75	125			
	EG020: Cadmium	7440-43-9	5 mg/kg	89.6		75	125			
	EG020: Cobalt	7440-48-4	5 mg/kg	76.4		75	125			
	EG020: Copper	7440-50-8	5 mg/kg	Not Determined		75	125			
ations (QCLot: 609390)				·						
S1	EG050: Hexavalent Chromium	18540-29-9	2.5 mg/kg	101		75	125			
leum Hydrocarbons (TF	PH Volatile) / BT (QCLot: 604500)									
S2	C6 - C8 Fraction		3 mg/kg	57.3		50	130			
n Hydrocarbons (TPH)	(QCLot: 604502)			·		·				
S2	C9 - C16 Fraction		32 mg/kg	96.6		50	130			
	C17 - C35 Fraction		75 mg/kg	82.4		50	130			
604500)				·		·				
S2	Benzene	71-43-2	0.2 mg/kg	69.4		50	130			
	Toluene	108-88-3	0.2 mg/kg	70.6		50	130			
	Chlorobenzene	108-90-7	0.2 mg/kg	85.6		50	130			
	Ethylbenzene	100-41-4	0.2 mg/kg	76.2		50	130			
	meta- & para-Xylene	108-38-3	0.4 mg/kg	77.2		50	130			
		106-42-3								
	ortho-Xylene	95-47-6	0.2 mg/kg	74.4		50	130			
	Client Sample ID sations (QCLot: 607686) S1 Image: S2 Image: S2 </td <td>Client Sample ID Method: Analysis Description S1 S1 EG020: Antimony EG020: Lead EG020: Marganese EG020: Mercury EG020: Molybdenum EG020: Nickel EG020: Nickel EG020: Arsenic EG020: Arsenic EG020: Zinc EG020: Cadmium EG020: Cobalt EG020: Cobalt EG020: Cobalt EG020: Copper S1 EG020: Cobalt EG020: Cobalt EG020: Copper S1 EG050: Hexavalent Chromium S2 C6 - C8 Fraction S2 C9 - C16 Fraction C17 - C35 Fraction S2 S2 C9 - C16 Fraction C17 - C35 Fraction S2 S2 Chiorobenzene Ethylbenzene meta- & para-Xylene Meta- & para-Xylene</td> <td>Client Sample ID Method: Analysis Description CAS number stions (QCLot: 607686) 7440-36-0 \$1 EG020: Antimony 7440-36-0 \$2 EG020: Manganese 7439-92-1 \$2 EG020: Mercury 7439-97-6 \$2 EG020: Molybdenum 7439-98-7 \$2 EG020: Nickel 7440-31-5 \$2 EG020: Nickel 7440-31-5 \$2 EG020: Color 7440-31-5 \$2 EG020: Tin 7440-31-5 \$2 EG020: Calmium 7440-38-2 \$2 EG020: Calmium 7440-38-3 \$2 EG020: Calmium 7440-43-9 \$2 EG020: Cobalt 7440-43-9 \$2 EG020: Cobalt 7440-43-9 \$2 Co - C8 Fraction 7440-50-8 \$2 Co - C8 Fraction \$2 Co + C16 Fraction</td> <td>Litent Sample ID Method: Analysis Description CAS number Concentration cations QCLot: 607686) 5 S1 EG020: Antimony 7440-36-0 5 mg/kg a EG020: Lead 7439-92-1 5 mg/kg b EG020: Manganese 7439-96-5 5 mg/kg c EG020: Molybdenum 7439-96-7 5 mg/kg c EG020: Nickel 7440-02-0 50 mg/kg c EG020: Nickel 7440-31-5 5 mg/kg c EG020: Nickel 7440-33-3 5 mg/kg c EG020: Nickel 7440-33-3 5 mg/kg c EG020: Cation 7440-38-2 5 mg/kg c EG020: Cadmium 7440-38-3 5 mg/kg c EG020: Cobalt 7440-38-3 5 mg/kg c EG020: Cobalt 7440-50-8 5 mg/kg<</td> <td>Matrix 5 pike Spike Concentration MS S1 EG020: Antimony 7440-36-0 5 mg/kg Not Determined EG020: Manganese 7439-96-5 5 mg/kg Not Determined EG020: Molydenum 7439-97-6 0.1 mg/kg Not Determined EG020: Molydenum 7440-02-0 50 mg/kg 87.9 EG020: Chckel 7440-31-5 5 mg/kg Not Determined EG020: Chckel 7440-33-2 5 mg/kg Not Determined EG020: Cadmium 7440-38-3 5 mg/kg Not Determined EG020: Cobalt 7440-38-3 5 mg/kg Not Determined EG020: Cobalt 7440-48-4 5 mg/kg Not De</td> <td>Matrix Spike (MS) and Matrix Spike Recovery (%) Spike Recovery (%) Client Sample ID Method: Analysis Description CAS number Concentration MSD attors: GQLLot: 607686) 5 mg/kg 99.2 S1 EG020: Lead 7439-92-1 5 mg/kg Not Determined EG020: Manganese 7439-92-5 5 mg/kg Not Determined EG020: Moreury 7439-97-6 0.1 mg/kg Not Determined EG020: Moreury 7439-98-7 5 mg/kg Not Determined EG020: Nickel 7440-02-0 50 mg/kg 87.9 EG020: Nickel 7440-31-5 5 mg/kg Not Determined EG020: Nickel 7440-38-2 5 mg/kg Not Determined EG020: Zinc 7440-43-8 5 mg/kg Not Determined EG020: Cadmium 7440-38-3 5 mg/kg Not Determined EG020: Cobplt 7440-48-4 5 mg/kg 89.6 <</td> <td>$\begin terms in the term in$</td> <td>Matrix Spike RVS and Matrix Spike RV</td> <td>Intersective state in the state in</td>	Client Sample ID Method: Analysis Description S1 S1 EG020: Antimony EG020: Lead EG020: Marganese EG020: Mercury EG020: Molybdenum EG020: Nickel EG020: Nickel EG020: Arsenic EG020: Arsenic EG020: Zinc EG020: Cadmium EG020: Cobalt EG020: Cobalt EG020: Cobalt EG020: Copper S1 EG020: Cobalt EG020: Cobalt EG020: Copper S1 EG050: Hexavalent Chromium S2 C6 - C8 Fraction S2 C9 - C16 Fraction C17 - C35 Fraction S2 S2 C9 - C16 Fraction C17 - C35 Fraction S2 S2 Chiorobenzene Ethylbenzene meta- & para-Xylene Meta- & para-Xylene	Client Sample ID Method: Analysis Description CAS number stions (QCLot: 607686) 7440-36-0 \$1 EG020: Antimony 7440-36-0 \$2 EG020: Manganese 7439-92-1 \$2 EG020: Mercury 7439-97-6 \$2 EG020: Molybdenum 7439-98-7 \$2 EG020: Nickel 7440-31-5 \$2 EG020: Nickel 7440-31-5 \$2 EG020: Color 7440-31-5 \$2 EG020: Tin 7440-31-5 \$2 EG020: Calmium 7440-38-2 \$2 EG020: Calmium 7440-38-3 \$2 EG020: Calmium 7440-43-9 \$2 EG020: Cobalt 7440-43-9 \$2 EG020: Cobalt 7440-43-9 \$2 Co - C8 Fraction 7440-50-8 \$2 Co - C8 Fraction \$2 Co + C16 Fraction	Litent Sample ID Method: Analysis Description CAS number Concentration cations QCLot: 607686) 5 S1 EG020: Antimony 7440-36-0 5 mg/kg a EG020: Lead 7439-92-1 5 mg/kg b EG020: Manganese 7439-96-5 5 mg/kg c EG020: Molybdenum 7439-96-7 5 mg/kg c EG020: Nickel 7440-02-0 50 mg/kg c EG020: Nickel 7440-31-5 5 mg/kg c EG020: Nickel 7440-33-3 5 mg/kg c EG020: Nickel 7440-33-3 5 mg/kg c EG020: Cation 7440-38-2 5 mg/kg c EG020: Cadmium 7440-38-3 5 mg/kg c EG020: Cobalt 7440-38-3 5 mg/kg c EG020: Cobalt 7440-50-8 5 mg/kg<	Matrix 5 pike Spike Concentration MS S1 EG020: Antimony 7440-36-0 5 mg/kg Not Determined EG020: Manganese 7439-96-5 5 mg/kg Not Determined EG020: Molydenum 7439-97-6 0.1 mg/kg Not Determined EG020: Molydenum 7440-02-0 50 mg/kg 87.9 EG020: Chckel 7440-31-5 5 mg/kg Not Determined EG020: Chckel 7440-33-2 5 mg/kg Not Determined EG020: Cadmium 7440-38-3 5 mg/kg Not Determined EG020: Cobalt 7440-38-3 5 mg/kg Not Determined EG020: Cobalt 7440-48-4 5 mg/kg Not De	Matrix Spike (MS) and Matrix Spike Recovery (%) Spike Recovery (%) Client Sample ID Method: Analysis Description CAS number Concentration MSD attors: GQLLot: 607686) 5 mg/kg 99.2 S1 EG020: Lead 7439-92-1 5 mg/kg Not Determined EG020: Manganese 7439-92-5 5 mg/kg Not Determined EG020: Moreury 7439-97-6 0.1 mg/kg Not Determined EG020: Moreury 7439-98-7 5 mg/kg Not Determined EG020: Nickel 7440-02-0 50 mg/kg 87.9 EG020: Nickel 7440-31-5 5 mg/kg Not Determined EG020: Nickel 7440-38-2 5 mg/kg Not Determined EG020: Zinc 7440-43-8 5 mg/kg Not Determined EG020: Cadmium 7440-38-3 5 mg/kg Not Determined EG020: Cobplt 7440-48-4 5 mg/kg 89.6 <	$\begin terms in the term in $	Matrix Spike RVS and Matrix Spike RV	Intersective state in the state in	



Surrogate Control Limits

Submatrix Type: SOIL

Method: Analysis Description	Units	Lower Limit	Upper Limit
EP-080S: TPH(Volatile)/BTEX Surrogate			
Dibromofluoromethane	%	80	120
Toluene-D8	%	81	117
4-Bromofluorobenzene	%	74	121

Annex D

RBRG Standards

Risk-Dased R		Dick P	sol Remediation	Cools for Soil	
		KISK-Da	ased Remediation	Goals for Soli	
Chemical	Urban	Rural			
Chrometer	Residential	Residential	Industrial	Public Parks	Soil Saturation
	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	Limit (Csat) (mg/kg)
VOCs					
Acetone	9.59E+03	4.26E+03	1.00E+04*	1.00E+04*	***
Benzene	7.04E-01	2.79E-01	9.21E+00	4.22E+01	3.36E+02
Bromodichloromethane	3.17E-01	1.29E-01	2.85E+00	1.34E+01	1.03E+03
2-Butanone	1.00E+04*	1.00E+04*	1.00E+04*	1.00E+04*	***
Chloroform	1.32E-01	5.29E-02	1.54E+00	2.53E+02	1.10E+03
Ethylbenzene	7.09E+02	2.98E+02	8.24E+03	1.00E+04*	1.38E+02
Methylene Chloride	6.88E+00	2.80E+00	7.01E+01	5.05E+02	2.38E+03
Styropo	1.50E+00	1.54E+03	1.59E+01 1.00E+04*	1.26E+02	9.21E+02 4.97E+02
Tetrachloroethene	1.01E-01	4 44E-02	7.77E-01	1.84E±00	9.71E+01
Toluene	1.01E-01	7.05E+02	1.00E+04*	1.00E+04*	2.35E+02
Trichloroethene	5.23E-01	2.11E-01	5.68E+00	6.94E+01	4.88E+02
Xvlenes (Total)	9.50E+01	3.68E+01	1.23E+03	1.00E+04*	1.50E+02
SVOCs					
Acenaphthene	3.51E+03	3.28E+03	1.00E+04*	1.00E+04*	6.02E+01
Acenaphthylene	2.34E+03	1.51E+03	1.00E+04*	1.00E+04*	1.98E+01
Anthracene	1.00E+04*	1.00E+04*	1.00E+04*	1.00E+04*	2.56E+00
Benzo(a)anthracene	1.20E+01	1.14E+01	9.18E+01	3.83E+01	
Benzo(a)pyrene	1.20E+00	1.14E+00	9.18E+00	3.83E+00	
Benzo(b)fluoranthene	9.88E+00	1.01E+01	1.78E+01	2.04E+01	
Benzo(g,h,i)perylene	1.80E+03	1.71E+03	1.00E+04*	5.74E+03	
Benzo(k)fluoranthene	1.20E+02	1.14E+02	9.18E+02	3.83E+02	
Dis-(2-Ethylnexyl)phthalate	3.00E+01	2.80E+01	9.18E+01	9.42E+01	
Dibenzo(a b)anthracene	$\frac{6.71E+02}{1.20E+00}$	9.19E+02	0.18E±00	1.54E+05	
Fluoranthene	2 40F+03	2 27E+03	9.18E+00	7.62E+03	
Fluorene	2.38E+03	2.25E+03	1.00E+04*	7.45E+03	5.47E+01
Hexachlorobenzene	2.43E-01	2.20E-01	5.82E-01	7.13E-01	01112101
Indeno(1,2,3-cd)pyrene	1.20E+01	1.14E+01	9.18E+01	3.83E+01	
Naphthalene	1.82E+02	8.56E+01	4.53E+02	9.14E+02	1.25E+02
Phenanthrene	1.00E+04*	1.00E+04*	1.00E+04*	1.00E+04*	2.80E+01
Phenol	1.00E+04*	1.00E+04*	1.00E+04*	1.00E+04*	7.26E+03
Pyrene	1.80E+03	1.71E+03	1.00E+04*	5.72E+03	
Metals					
Antimony	2.95E+01	2.91E+01	2.61E+02	9.79E+01	
Arsenic	2.21E+01	2.18E+01	1.96E+02	7.35E+01	
Cadmium	7.38E+01	7.28E+01	6.53E+02	2.45E+02	
Chromium III	1.00E±04*	1.00E±04*	1.00E+04*	2.45E+02	
Chromium VI	2 21E+02	2 18E+02	1.00E+04	7 35E+02	
Cobalt	1.48E+03	1.46E+03	1.00E+04*	4.90E+03	
Copper	2.95E+03	2.91E+03	1.00E+04*	9.79E+03	
Lead	2.58E+02	2.55E+02	2.29E+03	8.57E+02	
Manganese	1.00E+04*	1.00E+04*	1.00E+04*	1.00E+04*	
Mercury	1.10E+01	6.52E+00	3.84E+01	4.56E+01	
Molybdenum	3.69E+02	3.64E+02	3.26E+03	1.22E+03	
Nickel	1.48E+03	1.46E+03	1.00E+04*	4.90E+03	
Tin	1.00E+04*	1.00E+04*	1.00E+04*	1.00E+04*	
	1.00E+04*	1.00E+04*	1.00E+04*	1.00E+04*	
	1.005.02	1.005.02	5 00E 02	1.005.02	
	1.00E-03	1.00E-03	5.00E-03	1.00E-03	
Petroleum Carbon Banges	2.30E-01	2.20E-01	/.48E-UI	7.30E-01	
C6 - C8	1 41F+03	5 45F+02	1 00F+04*	1 00F+04*	1 00F+03
C9 - C16	2.24E+03	1.33E+03	1.00E+04*	1.00E+04*	3.00E+03
C17 - C35	1.00E+04*	1.00E+04*	1.00E+04*	1.00E+04*	5.00E+03
Other Inorganic Compounds					
Cyanide, free	1.48E+03	1.46E+03	1.00E+04*	4.90E+03	
Organometallics					
ТВТО	2.21E+01	2.18E+01	1.96E+02	7.35E+01	

 Table 2.1

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

Notes:

(1) For Dioxins, the cleanup levels in USEPA Office of Solid Waste and Emergency Response (OSWER) Directive of 1998 have been adopted. The OSWER Directive value of 1 ppb for residential use has been applied to the scenarios of "Urban Residential", "Rural Residential", and "Public Parks", while the low end of the range of values for industrial, 5 ppb, has been applied to the scenario of "Industrial".

(2) Soil saturation limits for petroleum carbon ranges taken from the Canada-Wide Standards for Petroleum Hydrocarbons in Soil, CCME 2000.

(3) * indicates a 'ceiling limit' concentration.

(4) *** indicates that the Csat value exceeds the 'ceiling limit' therefore the RBRG applies.

 Table 2.2

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

	Risk-Based Remediation Goals for Groundwater						
Chemical	Urban Residential (mg/L)	Rural Residential (mg/L)	Industrial (mg/L)	Solubility Limit (mg/L)			
VOCs							
Acetone	1.00E+04*	1.00E+04*	1.00E+04*	***			
Benzene	3.86E+00	1.49E+00	5.40E+01	1.75E+03			
Bromodichloromethane	2.22E+00	8.71E-01	2.62E+01	6.74E+03			
2-Butanone	1.00E+04*	1.00E+04*	1.00E+04*	***			
Chloroform	9.56E-01	3.82E-01	1.13E+01	7.92E+03			
Ethylbenzene	1.02E+03	3.91E+02	1.00E+04*	1.69E+02			
Methyl tert-Butyl Ether	1.53E+02	6.11E+01	1.81E+03	***			
Methylene Chloride	1.90E+01	7.59E+00	2.24E+02	***			
Styrene	3.02E+03	1.16E+03	1.00E+04*	3.10E+02			
Tetrachloroethene	2.50E-01	9.96E-02	2.95E+00	2.00E+02			
Toluene	5.11E+03	1.97E+03	1.00E+04*	5.26E+02			
Trichloroethene	1.21E+00	4.81E-01	1.42E+01	1.10E+03			
Xylenes (Total)	1.12E+02	4.33E+01	1.57E+03	1.75E+02			
SVOCs		Z 00 Z 0 Z	1.0077.011				
Acenaphthene	1.00E+04*	7.09E+03	1.00E+04*	4.24E+00			
Acenaphthylene	1.41E+03	5.42E+02	1.00E+04*	3.93E+00			
Anthracene	1.00E+04*	1.00E+04*	1.00E+04*	4.34E-02			
Benzo(a)anthracene							
Benzo(a)pyrene	5.005.01	0.007.01	5 53 50	1.505.00			
Benzo(b)fluoranthene	5.39E-01	2.03E-01	7.53E+00	1.50E-03			
Benzo(g,h,i)perylene							
Benzo(k)fluoranthene							
bis-(2-Ethylnexyl)phthalate	5.010.01	2.105.01	0.105.00	1.000.02			
Chrysene	5.81E+01	2.19E+01	8.12E+02	1.60E-03			
	1.00E+04*	1.00E+04*	1.000.04*	2.06E.01			
	1.00E+04*	1.00E+04*	1.00E+04*	2.06E-01			
	1.00E+04*	1.00E+04*	1.00E+04*	1.98E+00			
Indono(1,2,3-cd)pyropo	3.89E-02	2.34E-02	0.93E-01	0.20E+00			
Naphthalono	6 17E+01	2 37E+01	8 62E+02	3 10E+01			
Phononthrono	1.00E±04*	$1.00E \pm 0.04*$	1.00E+02	1.00E+01			
Phenol	1.002+04	1.002+04	1.0012+04	1.002+00			
Pyrene	1 00E+04*	1 00F+04*	1 00F+04*	1 35E-01			
Metals	1.001101	1.001101	1.001104	1.552 01			
Antimony							
Arsenic							
Barium							
Cadmium							
Chromium III							
Chromium VI							
Cobalt							
Copper							
Lead							
Manganese							
Mercury	4.86E-01	1.84E-01	6.79E+00				
Molybdenum							
Nickel							
Tin							
Zinc							
Dioxins / PCBs							
Dioxins (I-TEQ)							
PCBs	4.33E-01	1.71E-01	5.11E+00	3.10E-02			
Petroleum Carbon Ranges							
C6 - C8	8.22E+01	3.17E+01	1.15E+03	5.23E+00			
C9 - C16	7.14E+02	2.76E+02	9.98E+03	2.80E+00			
C17 - C35	1.28E+01	4.93E+00	1.78E+02	2.80E+00			
Other Inorganic Compound	ls						
Cyanide, free				L			
Organometallics							
ІВТО							

Notes:

(1) Blank indicates that RBRG could not be calculated because the toxicity or physical / chemical values were unavailable, or the condition of Henry's Law Constant> 10^{-5} was not met for the inhalation pathway.

(2) Water solubilities for Petroleum Carbon Range aliphatic C9-C16 and greater than C16 generally are considered to be effectively zero and therefore the aromatic solubility for C9-C16 is used.

(3) * indicates a 'ceiling limit' concentration.

(4) *** indicates that the solubility limit exceeds the 'ceiling limit' therefore the RBRG applies.

Annex E

Selected Photographs from the Site Investigation



Photo 1 – CCPP



Photo 3 – Breaking of concrete surface at S1/S2



Photo 5 – Excavation Pit



Photo 7 – Breaking of concrete surface at S11/S12



Photo 2 – Conveyor belt connecting the CCPP unit with the material recovery building



Photo 4 – Excavation at S3/S4



Photo 6 – Identification of soil profile by contractor

Annex A3

Laboratory analysis of soil samples for Polychlorinated Biphenyl (PCBs) & Polychlorinated dibenzo-pdioxins and dibenzofurans (PCDD/Fs)

A3.1 PURPOSE AND APPROACH

A3.1.1 PURPOSE OF THE ANALYSIS

To reassure the soil underneath the concrete pavement is not contaminated with Polychlorinated Biphenyl (PCBs) and Polychlorinated dibenzo-p-dioxins & dibenzofurans (PCDD/Fs) due to the operation of the CCPP.

A3.1.2 SOIL SAMPLING & TESTING

The site investigation was conducted during 21 to 22 February 2008. Soil samples were obtained from 6 sampling locations within the CCPP site (plus one QC sample). Soil sampling locations can be referred to Contamination Assessment Plan (CAP) and Contamination Assessment Report (CAR). At each location, soil samples are collected underneath the concrete pavement and at 1.5m below ground.

For the PCBs and PCDD/Fs testing, soil samples obtained from areas next to the rotary kiln, cyclone and the MRF building (where the residues are temporary stored after the completion of the trial) are analysed as these areas have the highest potential of dioxins contamination (if any) due to operation of the CCPP or release of the residues. As the CCPP has only operated for a very short period, it is considered adequate to analyse the samples collected underneath the concrete pavement.

A total of 3 soil samples will be analysed for dioxins (ie Samples S1, S5 and S7, please refer to *Figure 3.1a* of the CAR). The samples were sent to accredited chemical analysis laboratory for PCBs and PCDD/Fs testing.

The Laboratory analysis reports are attached in this *Annex*. Levels of PCBs, dioxins and furans analysed in all samples were well below the RBRG values for soil in industrial area. Detailed discussion and land contamination assessment should be referred to the *Chapter 4* of the *EIA Report*.

Sample: HK0802860-1 S1

1. Measurement results PCDD/F:

Sample:	HK0802	860-1 S1			
			Final extract [µ1]:		75
Sample weight [g]:	5.2	240	Injection volume [µ1]:		2
Dry matter [%]:	91	.9	Acquisition date [d.m.	y h:m]:	12.6.08 20:59
2,3,7,8-PCDD/Fs	Content	Limit of	Limit of	¹ I-TEFs	I-TEQ
		Detection	Quantification		
	[ng/g dw]	[ng/g dw]	[ng/g dw]		[ng/g dw]
2,3,7,8-TCDD	0.0087	0.00030	0.00060	1	0.0087
1,2,3,7,8-PeCDD	0.026	0.00047	0.00094	0.5	0.013
1,2,3,4,7,8-HxCDD	0.015	0.00078	0.0016	0.1	0.0015
1,2,3,6,7,8-HxCDD	0.025	0.00078	0.0016	0.1	0.0025
1,2,3,7,8,9-HxCDD	0.021	0.00078	0.0016	0.1	0.0021
1,2,3,4,6,7,8-HpCDD	0.11	0.00088	0.0018	0.01	0.0011
OCDD	0.14	0.0015	0.0029	0.001	0.00014
2,3,7,8-TCDF	0.11	0.00033	0.00065	0.1	0.011
1,2,3,7,8-PeCDF	0.094	0.00047	0.00095	0.05	0.0047
2,3,4,7,8-PeCDF	0.11	0.00047	0.00095	0.5	0.053
1,2,3,4,7,8-HxCDF	0.08	0.00088	0.0018	0.1	0.0080
1,2,3,6,7,8-HxCDF	0.076	0.00088	0.0018	0.1	0.0076
1,2,3,7,8,9-HxCDF	0.0063	0.00088	0.0018	0.1	0.00063
2,3,4,6,7,8-HxCDF	0.044	0.00088	0.0018	0.1	0.0044
1,2,3,4,6,7,8-HpCDF	0.17	0.0010	0.0020	0.01	0.0017
1,2,3,4,7,8,9-HpCDF	0.015	0.0010	0.0020	0.01	0.00015
OCDF	0.023	0.0011	0.0021	0.001	0.000023
I-TEQ from quantifi	ied 2,3,7,8-PCD	D/Fs [ng 2,3,7	,8-TCDD/g dw]-"Low	erbound"	0.12
I-TEQ from quantified	d 2,3,7,8-PCDD	s [ng 2,3,7,8-T0	CDD/g dw]		0.029
I-TEQ from quantifie	d 2,3,7,8-PCDF	s [ng 2,3,7,8-TC	CDD/g dw]		0.092
I-TEQ from n.d. and n	non quantified 2	,3,7,8-PCDD/F	s [ng 2,3,7,8-TCDD/g d	w]	0
Maximum possible I	-TEQ [ng 2,3,7	,8-TCDD/g dw]-"Upperbound"		0.12
PCDDs	Content	[ng/g dw]	PCDFs	Content	[ng/g dw]
Tetra-CDDs	0.	62	Tetra-CDFs		4.4
Penta-CDDs	0.	68	Penta-CDFs		1.9
Hexa-CDDs	0.	57	Hexa-CDFs	0	0.80
Hepta-CDDs	0.	23	Hepta-CDFs	0	0.24
OCDD	0.	14	OCDF	0	.023
Total PCDDs	2	.2	Total PCDFs	7.4	

¹I-TEF according to NATO.

The limits of quantification are defined as the double of the detection limits.

The limit of detection is defined as the amount of analyte producing a signal with S/N \geq 3.

The value of the detection limit is mentioned as the actual value at the acquisition date.

Measurement uncertainty is expressed as a double (k=2) relative standard deviation (RSD%), and corresponds to 95% interval of reliability.

Estimation of uncertainty of each 2,3,7,8-PCDD/F congener is 30% and total I-TEQ is 20%.

These values were ensured by analyses of certified reference material under conditions of internal reproducibility. Results marked "<" are situated in the interval of the limit of detection and the limit of quantification and are not quantified.

Results marked "n.d." are lower than the limit of detection.

2. Measurement results PCB:

Sample:	HK0802	860-1 S1	Final extract [µ1]:		750		
Sample weight [g]:	5.2	240	Injection volume [ul]:	2		
Dry matter [%]:	9	1.9	Acquisition date [d	l.m.y h:m]:	12.6.08 22:01		
	Content	Limit of	Limit of	¹ TEFs	TEQ		
		Detection	Quantification				
mono- and di-orthoPCBs	[ng/g dw]	[ng/g dw]	[ng/g dw]		[ng/g dw]		
PCB #105	< 0.13	0.0023	0.13	0.0001	0		
PCB #114	< 0.017	0.0027	0.017	0.0005	0		
PCB #118	< 0.17	0.0024	0.17	0.0001	0		
PCB #123	< 0.0082	0.0027	0.0082	0.0001	0		
PCB #156	< 0.058	0.0033	0.058	0.0005	0		
PCB #157	< 0.014	0.0034	0.014	0.0005	0		
PCB #167	< 0.022	0.0033	0.022	0.00001	0		
PCB #170	< 0.020	0.0068	0.020	0.0001	0		
PCB #180	< 0.058	0.0051	0.058	0.00001	0		
PCB #189	n.d.	0.0051	0.010	0.0001	0		
Total TEQ from quantified	0						
TEQ from n.d. and non quantified mono- and di-ortho PCBs [ng 2,3,7,8-TCDD/g dw]							
Maximum possible TEQ fr	om mono-and di-	ortho PCBs [ng 2	2,3,7,8-TCDD/g dw]		0.000078		

Sample:	HK0802	860-1 S1	Final extract [µ1]:	750	
Sample weight [g]:	5.2	240	Injection volume [ul]:	2
Dry matter [%]:	9	1.9	Acquisition date [d	l.m.y h:m]:	12.6.08 22:01
	Content	Limit of	Limit of	¹ TEFs	TEQ
		Detection	Quantification		
non-orthoPCBs	[ng/g dw]	[ng/g dw]	[ng/g dw]		[ng/g dw]
PCB #77	0.31	0.0024	0.091	0.0005	0.00015
PCB #81	0.044	0.0024	0.0048	-	-
PCB #126	0.095	0.0023	0.0047	0.1	0.0095
PCB #169	0.011	0.0040	0.0079	0.01	0.00011
Total TEQ from quantified non-ortho PCBs [ng 2,3,7,8-TCDD/g dw]					0.0097
TEQ from n.d. and non quan	TEQ from n.d. and non quantified non-ortho PCBs [ng 2,3,7,8-TCDD/g dw]				
Maximum possible TEQ fr	om non-ortho PC	Bs [ng 2,3,7,8-TC	CDD/g dw]		0.0097

¹TEFs according to Ahlborg et al. 1994; Chemosphere, Vol. 28, No. 6, 1049-1067.

The limits of quantification are defined on the base of blank level or as double of the detection limits.

The limit of detection is defined as the amount of analyte producing a signal with S/N \geq 3.

The value of the detection limit is mentioned as the actual value at the acquisition date.

Measurement uncertainty is expressed as a double (k=2) relative standard deviation (RSD%), and corresponds to 95% interval of reliability.

Estimation of uncertainty of each PCB congener is 30% and total TEQ is 20%.

These values were ensured by analyses of certified reference material under conditions of internal reproducibility. Results marked "<" are situated in the interval of the limit of detection and the limit of quantification and are not quantified.

Results marked "n.d." are lower than the limit of detection.

Sample: HK0802860-5 S5

1. Measurement results PCDD/F:

Sample:	HK0802	860-5 S5			
			Final extract [µl]:	75	
Sample weight [g]:	4.7	'55	Injection volume [µ1]:	2	
Dry matter [%]:	92	2.3	Acquisition date [d.m.y	y h:m]:	12.6.08 23:13
2,3,7,8-PCDD/Fs	Content	Limit of	Limit of	¹ I-TEFs	I-TEQ
		Detection	Quantification		
	[ng/g dw]	[ng/g dw]	[ng/g dw]		[ng/g dw]
2,3,7,8-TCDD	n.d.	0.00035	0.00070	1	0
1,2,3,7,8-PeCDD	0.0015	0.00063	0.0013	0.5	0.00076
1,2,3,4,7,8-HxCDD	< 0.0019	0.00093	0.0019	0.1	0
1,2,3,6,7,8-HxCDD	0.0030	0.00093	0.0019	0.1	0.00030
1,2,3,7,8,9-HxCDD	0.0020	0.00093	0.0019	0.1	0.00020
1,2,3,4,6,7,8-HpCDD	0.018	0.0011	0.0022	0.01	0.00018
OCDD	0.23	0.0020	0.0039	0.001	0.00023
2,3,7,8-TCDF	0.0053	0.00042	0.00083	0.1	0.00053
1,2,3,7,8-PeCDF	0.0039	0.00059	0.0012	0.05	0.00020
2,3,4,7,8-PeCDF	0.0048	0.00059	0.0012	0.5	0.0024
1,2,3,4,7,8-HxCDF	0.0032	0.0010	0.0020	0.1	0.00032
1,2,3,6,7,8-HxCDF	0.0028	0.0010	0.0020	0.1	0.00028
1,2,3,7,8,9-HxCDF	n.d.	0.0010	0.0020	0.1	0
2,3,4,6,7,8-HxCDF	< 0.0020	0.0010	0.0020	0.1	0
1,2,3,4,6,7,8-HpCDF	0.0098	0.0012	0.0024	0.01	0.000098
1,2,3,4,7,8,9-HpCDF	n.d.	0.0012	0.0024	0.01	0
OCDF	0.0033	0.0014	0.0029	0.001	0.0000033
I-TEQ from quantifi	ed 2,3,7,8-PCD	D/Fs [ng 2,3,7	,8-TCDD/g dw]-"Lowe	erbound"	0.0055
I-TEQ from quantified	d 2,3,7,8-PCDD	s [ng 2,3,7,8-T	CDD/g dw]		0.0017
I-TEQ from quantified	d 2,3,7,8-PCDF	s [ng 2,3,7,8-TC	CDD/g dw]		0.0038
I-TEQ from n.d. and 1	non quantified 2	,3,7,8-PCDD/F	s [ng 2,3,7,8-TCDD/g d	w]	0.00085
Maximum possible I	-TEQ [ng 2,3,7	,8-TCDD/g dw]-"Upperbound"		0.0063
PCDDs	Content	[ng/g dw]	PCDFs	Content	[ng/g dw]
Tetra-CDDs	0.040		Tetra-CDFs	0	.21
Penta-CDDs	0.069		Penta-CDFs 0.		091
Hexa-CDDs	0.0	074	Hexa-CDFs	0.	035
Hepta-CDDs	0.0	038	Hepta-CDFs	0.	014
OCDD	0.1	23	OCDF	0.0	0033
Total PCDDs	0.45		fotal PCDFs0.35		.35

¹I-TEF according to NATO.

The limits of quantification are defined as the double of the detection limits.

The limit of detection is defined as the amount of analyte producing a signal with S/N \geq 3.

The value of the detection limit is mentioned as the actual value at the acquisition date.

Measurement uncertainty is expressed as a double (k=2) relative standard deviation (RSD%), and corresponds to 95% interval of reliability.

Estimation of uncertainty of each 2,3,7,8-PCDD/F congener is 30% and total I-TEQ is 20%.

These values were ensured by analyses of certified reference material under conditions of internal reproducibility. Results marked "<" are situated in the interval of the limit of detection and the limit of quantification and are not quantified.

Results marked "n.d." are lower than the limit of detection.

2. Measurement results PCB:

Sample:	HK0802	860-5 S5	Final extract [µ1]:	750	
Sample weight [g]:	4.7	755	Injection volume [ul]:	2
Dry matter [%]:	92	2.3	Acquisition date [d	.m.y h:m]:	13.6.08 0:15
	Content	Limit of	Limit of	¹ TEFs	TEQ
		Detection	Quantification		
mono- and di-orthoPCBs	[ng/g dw]	[ng/g dw]	[ng/g dw]		[ng/g dw]
PCB #105	< 0.034	0.0022	0.034	0.0001	0
PCB #114	n.d.	0.0025	0.0050	0.0005	0
PCB #118	< 0.089	0.0023	0.089	0.0001	0
PCB #123	n.d.	0.0025	0.0051	0.0001	0
PCB #156	< 0.012	0.0031	0.012	0.0005	0
PCB #157	n.d.	0.0033	0.0067	0.0005	0
PCB #167	< 0.0072	0.0031	0.0072	0.00001	0
PCB #170	< 0.030	0.0064	0.030	0.0001	0
PCB #180	< 0.068	0.0048	0.068	0.00001	0
PCB #189	n.d.	n.d. 0.0053		0.0001	0
Total TEQ from quantified mono- and di-ortho PCBs [ng 2,3,7,8-TCDD/g dw]					
TEQ from n.d. and non quan	tified mono- and d	li-ortho PCBs [ng	2,3,7,8-TCDD/g dw]	0.000026
Maximum possible TEQ fr	om mono-and di-	ortho PCBs [ng 2	2,3,7,8-TCDD/g dw]		0.000026

Sample:	HK0802	860-5 S5	Final extract [µ1]:		750
Sample weight [g]:	4.7	755	Injection volume [u1]:	2
Dry matter [%]:	92	2.3	Acquisition date [d	l.m.y h:m]:	13.6.08 0:15
	Content	Limit of	Limit of	¹ TEFs	TEQ
		Detection	Quantification		
non-orthoPCBs	[ng/g dw]	[ng/g dw]	[ng/g dw]		[ng/g dw]
PCB #77	< 0.040	0.0023	0.040	0.0005	0
PCB #81	n.d.	0.0022	0.0045	-	-
PCB #126	< 0.0051	0.0025	0.0051	0.1	0
PCB #169	n.d.	0.0052	0.010	0.01	0
Total TEQ from quantified non-ortho PCBs [ng 2,3,7,8-TCDD/g dw]					0
TEQ from n.d. and non quantified non-ortho PCBs [ng 2,3,7,8-TCDD/g dw]					0.00058
Maximum possible TEQ fr	om non-ortho PC	Bs [ng 2,3,7,8-TC	CDD/g dw]		0.00058

¹TEFs according to Ahlborg et al. 1994; Chemosphere, Vol. 28, No. 6, 1049-1067.

The limits of quantification are defined on the base of blank level or as double of the detection limits.

The limit of detection is defined as the amount of analyte producing a signal with S/N \geq 3.

The value of the detection limit is mentioned as the actual value at the acquisition date.

Measurement uncertainty is expressed as a double (k=2) relative standard deviation (RSD%), and corresponds to 95% interval of reliability.

Estimation of uncertainty of each PCB congener is 30% and total TEQ is 20%.

These values were ensured by analyses of certified reference material under conditions of internal reproducibility. Results marked "<" are situated in the interval of the limit of detection and the limit of quantification and are not quantified.

Results marked "n.d." are lower than the limit of detection.

Sample: HK0802860-71 S7

1. Measurement results PCDD/F:

Sample: HK0802860-7 S7						
			Final extract [µl]:	75		
Sample weight [g]:	4.9	51	Injection volume [µ1]:	2		
Dry matter [%]:	83	.6	Acquisition date [d.m.y	y h:m]:	13.6.08 1:27	
2,3,7,8-PCDD/Fs	Content	Limit of	Limit of	¹ I-TEFs	I-TEQ	
		Detection	Quantification			
	[ng/g dw]	[ng/g dw]	[ng/g dw]		[ng/g dw]	
2,3,7,8-TCDD	< 0.00081	0.00040	0.00081	1	0	
1,2,3,7,8-PeCDD	0.0019	0.00063	0.0013	0.5	0.00095	
1,2,3,4,7,8-HxCDD	< 0.0020	0.0010	0.0020	0.1	0	
1,2,3,6,7,8-HxCDD	0.0023	0.0010	0.0020	0.1	0.00023	
1,2,3,7,8,9-HxCDD	< 0.0020	0.0010	0.0020	0.1	0	
1,2,3,4,6,7,8-HpCDD	0.014	0.0013	0.0025	0.01	0.00014	
OCDD	0.20	0.0020	0.0040	0.001	0.00020	
2,3,7,8-TCDF	0.0087	0.00045	0.0009	0.1	0.00087	
1,2,3,7,8-PeCDF	0.0056	0.00062	0.0012	0.05	0.00028	
2,3,4,7,8-PeCDF	0.0065	0.00062	0.0012	0.5	0.0033	
1,2,3,4,7,8-HxCDF	0.0058	0.0012	0.0024	0.1	0.00058	
1,2,3,6,7,8-HxCDF	0.0053	0.0012	0.0024	0.1	0.00053	
1,2,3,7,8,9-HxCDF	n.d.	0.0012	0.0024	0.1	0	
2,3,4,6,7,8-HxCDF	0.0031	0.0012	0.0024	0.1	0.00031	
1,2,3,4,6,7,8-HpCDF	0.017	0.0014	0.0028	0.01	0.00017	
1,2,3,4,7,8,9-HpCDF	n.d.	0.0014	0.0028	0.01	0	
OCDF	0.0042	0.0015	0.0029	0.001	0.0000042	
I-TEQ from quantifi	ed 2,3,7,8-PCD	D/Fs [ng 2,3,7	,8-TCDD/g dw]-"Lowe	erbound"	0.0075	
I-TEQ from quantified	d 2,3,7,8-PCDD	s [ng 2,3,7,8-T	CDD/g dw]		0.0015	
I-TEQ from quantified	d 2,3,7,8-PCDF	s [ng 2,3,7,8-TC	CDD/g dw]		0.0060	
I-TEQ from n.d. and 1	non quantified 2	,3,7,8-PCDD/F	s [ng 2,3,7,8-TCDD/g d	w]	0.0013	
Maximum possible I	-TEQ [ng 2,3,7	,8-TCDD/g dw]-"Upperbound"		0.0089	
PCDDs	Content	[ng/g dw]	PCDFs	Content	[ng/g dw]	
Tetra-CDDs	0.0	39	Tetra-CDFs	0	.29	
Penta-CDDs	0.050		Penta-CDFs 0		.13	
Hexa-CDDs	0.0	48	Hexa-CDFs 0.		059	
Hepta-CDDs	0.0	32	Hepta-CDFs	0.	023	
OCDD	0.1	20	OCDF	0.0	0042	
Total PCDDs	0.	37	Total PCDFs 0		.51	

¹I-TEF according to NATO.

The limits of quantification are defined as the double of the detection limits.

The limit of detection is defined as the amount of analyte producing a signal with S/N \geq 3.

The value of the detection limit is mentioned as the actual value at the acquisition date.

Measurement uncertainty is expressed as a double (k=2) relative standard deviation (RSD%), and corresponds to 95% interval of reliability.

Estimation of uncertainty of each 2,3,7,8-PCDD/F congener is 30% and total I-TEQ is 20%.

These values were ensured by analyses of certified reference material under conditions of internal reproducibility. Results marked "<" are situated in the interval of the limit of detection and the limit of quantification and are not quantified.

Results marked "n.d." are lower than the limit of detection.

2. Measurement results PCB:

Sample:	HK0802	860-7 S7	Final extract [µ1]:	750	
Sample weight [g]:	4.9	951	Injection volume [ul]:	2
Dry matter [%]:	83	3.6	Acquisition date [d	.m.y h:m]:	13.6.08 2:29
	Content	Limit of	Limit of	¹ TEFs	TEQ
		Detection	Quantification		
mono- and di-orthoPCBs	[ng/g dw]	[ng/g dw]	[ng/g dw]		[ng/g dw]
PCB #105	< 0.041	0.0026	0.041	0.0001	0
PCB #114	n.d.	0.0030	0.0059	0.0005	0
PCB #118	< 0.096	0.0027	0.096	0.0001	0
PCB #123	n.d.	0.0030	0.0059	0.0001	0
PCB #156	< 0.017	0.0034	0.017	0.0005	0
PCB #157	n.d.	0.0036	0.0071	0.0005	0
PCB #167	< 0.0075	0.0034	0.0075	0.00001	0
PCB #170	< 0.024	0.0071	0.024	0.0001	0
PCB #180	< 0.071	0.0053	0.071	0.00001	0
PCB #189	n.d.	n.d. 0.0051		0.0001	0
Total TEQ from quantified mono- and di-ortho PCBs [ng 2,3,7,8-TCDD/g dw]					
TEQ from n.d. and non quan	tified mono- and d	li-ortho PCBs [ng	2,3,7,8-TCDD/g dw]	0.000029
Maximum possible TEQ fr	om mono-and di-	ortho PCBs [ng 2	,3,7,8-TCDD/g dw]		0.000029

Sample:	HK0802	860-7 S7	Final extract [µ1]:	750	
Sample weight [g]:	4.9	951	Injection volume [ul]:	2
Dry matter [%]:	83	3.6	Acquisition date [d	.m.y h:m]:	13.6.08 2:29
	Content	Limit of	Limit of	¹ TEFs	TEQ
		Detection	Quantification		
non-orthoPCBs	[ng/g dw]	[ng/g dw]	[ng/g dw]		[ng/g dw]
PCB #77	< 0.057	0.0026	0.057	0.0005	0
PCB #81	n.d.	0.0025	0.0050	-	-
PCB #126	< 0.0053	0.0026	0.0053	0.1	0
PCB #169	n.d.	0.0048	0.010	0.01	0
Total TEQ from quantified non-ortho PCBs [ng 2,3,7,8-TCDD/g dw]					0
TEQ from n.d. and non quan	TEQ from n.d. and non quantified non-ortho PCBs [ng 2,3,7,8-TCDD/g dw]				
Maximum possible TEQ fr	om non-ortho PC	Bs [ng 2,3,7,8-TC	CDD/g dw]		0.00061

¹TEFs according to Ahlborg et al. 1994; Chemosphere, Vol. 28, No. 6, 1049-1067.

The limits of quantification are defined on the base of blank level or as double of the detection limits.

The limit of detection is defined as the amount of analyte producing a signal with $S/N \ge 3$.

The value of the detection limit is mentioned as the actual value at the acquisition date.

Measurement uncertainty is expressed as a double (k=2) relative standard deviation (RSD%), and corresponds to 95% interval of reliability.

Estimation of uncertainty of each PCB congener is 30% and total TEQ is 20%.

These values were ensured by analyses of certified reference material under conditions of internal reproducibility. Results marked "<" are situated in the interval of the limit of detection and the limit of quantification and are not quantified.

Results marked "n.d." are lower than the limit of detection.



ANALYTICAL CHEMISTRY & TESTING SERVICES



ALS Czech Republic, s.r.o., Na Harfě 336/9, 190 00 Praha 9

 Telephone:
 +420 284 081 645, +420 284 081 646

 Fax:
 +420 284 081 750

 Internet:
 www.alsglobal.com, www.alsglobal.cz

 E-mail:
 info@alsglobal.com

ALS Technichem (HK) Pty Ltd 11/F, Chung Shun Knitting Centre Richard Fung 1-3 Wing Yip Street Kwai Chung Hong Kong

Test Report No. 12194 / 1 / 2008

Prague : 22.7.2008

Project:	Shipment No.: 941708519728
Date of sampling:	22.2.2008
Date of receipt:	9.6.2008
Sampling procedu	re: Sampling was performed by the client
Date of test perfor	mance: 9.6 16.6.2008
Place of test perfor	rmance: ALS Czech Republic, s.r.o., Laboratoř HRMS, V Ráji 906, 530 02 Pardubice
Test specification,	deviations, additions to or exclusions from the test specification and any other information:
D06_06_173	Determination of sum PCB and planar congeners PCB by HRMS by internal instruction. Analysed by
	HRGC/HRMS syst Agilent 6890N/Finnigan MAT 95XP resp. Trace GC Ultra/DFS. Resol. HRMS: 10000. GC
	column: RTX-500 60 m, 0,25 mm ID; film 0,1 µm
D06_06_175	Determination of polychlorinated dibenzo-p-dioxins and dibenzofurans according to US EPA 1613.
	Analysed by technique: HRGC/HRMS system - Agilent 6890N/Finnigan MAT 95XP resp. Trace GC
	Ultra/DFS. Resolution HRMS: 10000

Measurement results

sample name	HK0802860-1	HK0802860-5	HK0802860-7			
	S1	S5	S7			
matrix	soil	soil	soil			
parameter	result ми	result MU	result ми	unit	test specificatio	n
Dry matter at 105 °C	91,9 ±2	92,3 ±2	83,6 ±2	%	D06_06_175	Α
I-TEQ (PCDD/F)	0,12 ±20	0,0055 ±20	0,0075 ±20	ng/g dw	D06_06_175	Α
lowerbound						
I-TEQ (PCDD/F)	0,12	0,0063	0,0089	ng/g dw	D06_06_175	Α
upperbound						
I-TEQ (PCB) lowerbound	0,0097 ±20	0 ±20	0 ±20	ng/g dw	D06_06_173	Α
I-TEQ (PCB) upperbound	0,0098	0,00061	0,00064	ng/g dw	D06_06_173	Α

The report shall not be reproduced except in full without the written approval of the testing laboratory. The laboratory declares that the test results relate only to the items tested and do not substitute any other documents.



Ing. Emilie Pokorna Quality Manager

ALS Czech Republic, s.r.o., Na Harfě 9, 190 00 Praha 9 tel. +420 284 081 645, +420 284 081 646, fax +420 284 081 750 Measurement uncertainty (MU [%]) is expressed as expanded measurement uncertainty with coverage factor k = 2, representing of 95 % significance level.

Parameters indexed by 'A' in the last column of the table are accredited, parameters indexed by 'N' are not accredited.

Annex B

Residual Analysis Results

Annex B1

Residual Ashes Analysis Results

ALS Technichem (HK) Pty Ltd

ALS Laboratory Group

ANALYICAL CHEMISTRY & TESTING SERVICES



CERTIFICATE OF ANALYSIS

Client Contact Address	 GREEN ISLAND INTERNATIONAL (BVI) LTD MR AUNG KHINE NO.7, LUNG YIU STREET, 	Laboratory Contact Address	 ALS Technichem (HK) Pty Ltd Alice Wong 11/F., Chung Shun Knitting Centre, 	Page Work Order	² 1 of 5 HK0719132
E-mail	TAP SHEK KOK, TUEN MUN, N.T., HONG KONG ∴ akhine@gich.com.hk	E-mail	1 - 3 Wing Yip Street, Kwai Chung, N.T., Hong Kong ⊱ Alice.Wong@alsenviro.com	Amendment No.	: 1
Telephone	2440 5208	Telephone	: +852 2610 1044		
Facsimile	2404 3627	Facsimile	÷ +852 2610 2021		
Project	:	Quote number	<u>·</u>	Date received	: 13 Dec 2007
Order number	<u>;</u>			Date of issue	∴ 9 Jan 2008
C-O-C number	;			No. of samples	- Received : 10
Site	:				- Analysed : 10

Report Comments

This report for ALS Technichem (HK) Pty Ltd work order reference HK0719132 supersedes any previous reports with this reference. The completion date of analysis is 9 Jan 2008. Results apply to sample(s) as submitted. All pages of this report have been checked and approved for release. When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for process purposes. Abbreviations: CAS number = Chemical Abstract Services number. LOR = Limit of reporting.

 Specific comments for Work Order HK0719132 :
 Sample(s) were collected by ALS Technichem (HK) staff on 13 December, 2007.

 Sample(s) analysed and reported on an as received basis.
 Sample(s) analysed and reported on an as received basis.

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

This report may not be reproduced except with prior written	This document has been electronically signed by those names that appear on this report and are the authorised						
approval from ALS Technichem (HK) Pty Ltd.	signatories. Electronic signing has been carried out in compliance with procedures specified in the 'Electronic						
	Transactions Ordinance' of Hona Kona. Chapter 553. Section 6.						
	Signatory	Position	Authorised results for:-				
	Fung Lim Chee, Richard	General Manager	Inorganics				

ALS Laboratory Group Trading Name: ALS Technichem (HK) Pty Ltd 11/F., Chung Shun Knitting Centre, 1-3 Wing Yip Street, Kwai Chung, N.T., Hong Kong Tel: +852 2610 1044 Fax: +852 2610 2021 www.alsenviro.com

A Campbell Brothers Limited Company

Page Number : 2 of 5

Client : GREEN ISLAND INTERNATIONAL (BVI) LTD



Work Order HK0719132, Amendment 1

Analytical Results		Cli	ent Sample ID :	(BA) SAMPLE 1-5	(BA) SAMPLE 6-10	(BA) SAMPLE 11-15	(BA) SAMPLE 16-20	(BA) SAMPLE 21-25
		Laborat	tory Sample ID :	HK0719132-001	HK0719132-002	HK0719132-003	HK0719132-004	HK0719132-005
Submatrix: ASH		Samp	ble Date / Time :	13 Dec 2007	13 Dec 2007	13 Dec 2007	13 Dec 2007	13 Dec 2007
Method: Analysis Description	CAS number	LOR	Units	9:45	9:45	9:45	9:45	9:45
EG: Metals and Major Cations								
EG020: Antimony	7440-36-0	1	mg/kg	34	41	42	65	42
EG020: Arsenic	7440-38-2	1	mg/kg	2	4	5	6	4
EG020: Barium	7440-39-3	0.5	mg/kg	1180	1480	1280	1250	942
EG020: Cadmium	7440-43-9	0.2	mg/kg	2.8	0.9	2.0	2.2	0.8
EG020: Chromium	7440-47-3	1	mg/kg	91	139	151	1120	200
EG020: Cobalt	7440-48-4	0.5	mg/kg	8.9	12.6	9.4	16.4	7.4
EG020: Copper	7440-50-8	1	mg/kg	1620	1380	2400	1470	1720
EG020: Lead	7439-92-1	1	mg/kg	352	158	1970	1310	113
EG020: Manganese	7439-96-5	0.5	mg/kg	668	970	752	1050	842
EG020: Mercury	7439-97-6	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
EG020: Molybdenum	7439-98-7	1	mg/kg	11	15	8	35	9
EG020: Nickel	7440-02-0	1	mg/kg	104	70	113	672	69
EG020: Tin	7440-31-5	0.5	mg/kg	268	202	2300	330	280
EG020: Zinc	7440-66-6	1	mg/kg	3970	2310	3490	3040	3360
EG049: Trivalent Chromium	16065-83-1	1	mg/kg	91	136	148	1110	195
EG050: Hexavalent Chromium	18540-29-9	1	mg/kg	<1	3	3	6	5

Page Number : 3 of 5 : GREEN ISLAND INTERNATIONAL (BVI) LTD

Client

Work Order HK0719132, Amendment 1



Analytical Results		Cl	ient Sample ID :	(FA) SAMPLE 1-5	(FA) SAMPLE 6-10	(FA) SAMPLE 11-15	(FA) SAMPLE 16-20	(FA) SAMPLE 21-25
		Labora	tory Sample ID :	HK0719132-006	HK0719132-007	HK0719132-008	HK0719132-009	HK0719132-010
Submatrix: ASH		Sam	ole Date / Time :	13 Dec 2007	13 Dec 2007	13 Dec 2007	13 Dec 2007	13 Dec 2007
Method: Analysis Description	CAS number	LOR	Units	12:00	12:00	12:00	12:00	12:00
EG: Metals and Major Cations			-					
EG020: Antimony	7440-36-0	1	mg/kg	9	7	11	4	11
EG020: Arsenic	7440-38-2	1	mg/kg	<1	<1	1	2	2
EG020: Barium	7440-39-3	0.5	mg/kg	176	94.1	166	43.4	203
EG020: Cadmium	7440-43-9	0.2	mg/kg	8.6	5.5	8.7	2.8	6.4
EG020: Chromium	7440-47-3	1	mg/kg	59	55	56	20	66
EG020: Cobalt	7440-48-4	0.5	mg/kg	2.2	1.7	2.6	1.6	2.2
EG020: Copper	7440-50-8	1	mg/kg	71	56	79	24	76
EG020: Lead	7439-92-1	1	mg/kg	303	309	176	155	258
EG020: Manganese	7439-96-5	0.5	mg/kg	134	217	210	256	110
EG020: Mercury	7439-97-6	0.05	mg/kg	0.36	0.31	0.23	0.14	0.51
EG020: Molybdenum	7439-98-7	1	mg/kg	4	2	4	3	4
EG020: Nickel	7440-02-0	1	mg/kg	7	8	11	4	9
EG020: Tin	7440-31-5	0.5	mg/kg	55.7	27.3	56.9	13.0	32.6
EG020: Zinc	7440-66-6	1	mg/kg	236	164	306	95	201
EG049: Trivalent Chromium	16065-83-1	1	mg/kg	22	23	21	10	20
EG050: Hexavalent Chromium	18540-29-9	1	mg/kg	37	32	35	10	46



Quality Control - Laboratory Duplicate (DUP) Results

Matrix Type: SOIL						Duplicate (DUP)	Results	
Laboratory Sample ID	Client Sample ID	Method: Analysis Description	CAS number	LOR	Units	Original Result	Duplicate Result	RPD (%)
EG: Metals and Major	Cations (QC Lot: 565987)							
HK0719132-010	(FA) SAMPLE 21-25	EG020: Antimony	7440-36-0	1	mg/kg	11	11	0.0
		EG020: Lead	7439-92-1	1	mg/kg	258	260	1.1
		EG020: Manganese	7439-96-5	0.5	mg/kg	110	114	3.7
		EG020: Mercury	7439-97-6	0.05	mg/kg	0.51	0.42	19.4
		EG020: Molybdenum	7439-98-7	1	mg/kg	4	5	0.0
		EG020: Nickel	7440-02-0	1	mg/kg	9	8	15.4
		EG020: Tin	7440-31-5	0.5	mg/kg	32.6	34.7	6.2
		EG020: Arsenic	7440-38-2	1	mg/kg	2	1	0.0
		EG020: Zinc	7440-66-6	1	mg/kg	201	219	8.4
		EG020: Barium	7440-39-3	0.5	mg/kg	203	206	1.1
		EG020: Cadmium	7440-43-9	0.2	mg/kg	6.4	6.6	3.0
		EG020: Chromium	7440-47-3	1	mg/kg	66	64	0.0
		EG020: Cobalt	7440-48-4	0.5	mg/kg	2.2	2.2	0.0
		EG020: Copper	7440-50-8	1	mg/kg	76	87	13.7
EG: Metals and Major	Cations (QC Lot: 568275)	· · · · ·			· · · · · · · · · · · · · · · · · · ·		·	
HK0719132-004	(BA) SAMPLE 16-20	EG050: Hexavalent Chromium	18540-29-9	1	mg/kg	6	6	0.0

Quality Control - Method Blank (MB), Single Control Spike (SCS) and Duplicate Control Spike (DCS) Results

Matrix Type: SOIL			Method Blank (MB)	Results		Single Co	ontrol Spike (SCS) and	Duplicate Con	trol Spike (DC	S) Results	
					Spike	Spike Re	covery (%)	Recovery	Limits (%)	RP	Ds (%)
Method: Analysis Description	CAS number	LOR	Units	Result	Concentration	SCS	DCS	Low	High	Value	Control Limit
EG: Metals and Major Cations (QCL	ot: 565987)										
EG020: Antimony	7440-36-0	1	mg/kg	<1	5 mg/kg	86.4		85	115		
EG020: Lead	7439-92-1	1	mg/kg	<1	5 mg/kg	92.8		85	115		
EG020: Manganese	7439-96-5	1	mg/kg	<0.5	5 mg/kg	92.1		85	115		
EG020: Mercury	7439-97-6	0.05	mg/kg	<0.05	0.1 mg/kg	108		85	115		
EG020: Molybdenum	7439-98-7	1	mg/kg	<1	5 mg/kg	100		85	115		
EG020: Nickel	7440-02-0	1	mg/kg	<1	5 mg/kg	91.8		85	115		
EG020: Tin	7440-31-5	1	mg/kg	<0.5	5 mg/kg	94.0		85	115		
EG020: Arsenic	7440-38-2	1	mg/kg	<1	5 mg/kg	88.5		85	115		
EG020: Zinc	7440-66-6	1	mg/kg	<1	5 mg/kg	92.4		85	115		
EG020: Barium	7440-39-3	1	mg/kg	<0.5	5 mg/kg	95.4		85	115		
EG020: Cadmium	7440-43-9	0.2	mg/kg	<0.2	5 mg/kg	91.2		85	115		
EG020: Chromium	7440-47-3	1	mg/kg	<1	5 mg/kg	105		85	115		
EG020: Cobalt	7440-48-4	1	mg/kg	<0.5	5 mg/kg	89.8		85	115		
EG020: Copper	7440-50-8	1	mg/kg	<1	5 mg/kg	92.3		85	115		
EG: Metals and Maior Cations (QCL	ot: 568275)	•	·				•	· ·	· ·		<u>.</u>

 Page Number
 : 5 of 5

 Client
 : GREEN ISLAND INTERNATIONAL (BVI) LTD

 With the characteristic
 : With the characteristic





Matrix Type: SOIL			Method Blank (MB) Results		Single Co	ntrol Spike (SCS) and D	uplicate Cont	trol Spike (DC	CS) Results	
					Spike	Spike Re	covery (%)	Recovery	Limits (%)	RPL	Ds (%)
Method: Analysis Description	CAS number	LOR	Units	Result	Concentration	scs	DCS	Low	High	Value	Control Limit
EG: Metals and Major Cations (QCLot: 56	8275) - continued										
EG050: Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	2.5 mg/kg	108		85	115		

Quality Control - Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Results

Matrix Type: SOIL					Matrix S	pike (MS) and Matri	x Spike Duplica	ate (MSD) Re	sults	
				Spike	Spike Rec	overy (%)	Recovery	Limits (%)	RPDs (%)
Laboratory Sample ID	Client Sample ID	Method: Analysis Description	CAS number	Concentration	MS	MSD	Low	High	Value	Control Limit
EG: Metals and Major	Cations (QCLot: 565987)									
HK0719132-001	(BA) SAMPLE 1-5	EG020: Antimony	7440-36-0	5 mg/kg	Not Determined		75	125		
		EG020: Lead	7439-92-1	5 mg/kg	Not Determined		75	125		
		EG020: Manganese	7439-96-5	5 mg/kg	Not Determined		75	125		
		EG020: Mercury	7439-97-6	0.1 mg/kg	90.0		75	125		
		EG020: Molybdenum	7439-98-7	5 mg/kg	95.7		75	125		
		EG020: Nickel	7440-02-0	5 mg/kg	Not Determined		75	125		
		EG020: Tin	7440-31-5	5 mg/kg	Not Determined		75	125		
		EG020: Arsenic	7440-38-2	5 mg/kg	94.9		75	125		
		EG020: Zinc	7440-66-6	5 mg/kg	Not Determined		75	125		
		EG020: Barium	7440-39-3	5 mg/kg	Not Determined		75	125		
		EG020: Cadmium	7440-43-9	5 mg/kg	79.8		75	125		
		EG020: Chromium	7440-47-3	5 mg/kg	Not Determined		75	125		
		EG020: Cobalt	7440-48-4	5 mg/kg	76.0		75	125		
		EG020: Copper	7440-50-8	5 mg/kg	Not Determined		75	125		
EG: Metals and Major	Cations (QCLot: 568275)									
HK0719132-001	(BA) SAMPLE 1-5	EG050: Hexavalent Chromium	18540-29-9	2.5 mg/kg	106		75	125		

ALS Technichem (HK) Pty Ltd

ALS Laboratory Group

ANALYTICAL CHEMISTRY & TESTING SERVICES

CERTIFICATE OF ANALYSIS

Client Contact Address	∴ GREEN ISLAND INTERNATIONAL (BVI) LTD ∴ MR AUNG KHINE ∴ NO.7, LUNG YIU STREET,	Laboratory Contact Address	 ALS Technichem HK Pty Ltd Wong Wai Man, Alice 11/F., Chung Shun Knitting Centre, 	Page Work Order	∶ 1 of 3 ິ HK0801	754	
E-mail Telephone	TAP SHEK KOK, TUEN MUN, N.T., HONG KONG : akhine@gich.com.hk : +852 2440 5208	E-mail Telephone	1 - 3 Wing Yip Street, Kwai Chung, N.T., Hong Kong Alice.Wong@alsenviro.com +852 2610 1044	Amendment No.	: 1		
Facsimile	: +852 2404 3627	Facsimile	÷ +852 2610 2021				
Project	<u>;</u>	Quote number	<u>;</u>	Date received	: 13-DEC-200	7	
Order number	:			Date of issue	: 13-MAR-200	9	
C-O-C number	:			No. of samples	- Received	:	10
Site	:				- Analysed	:	10

Report Comments

This report for ALS Technichem (HK) Pty Ltd work order reference HK0801754_1.00 supersedes any previous reports with this reference. The completion date of analysis is 05-FEB-2008. Results apply to sample(s) as submitted. All pages of this report have been checked and approved for release. When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for process purposes. Abbreviations: CAS number = Chemical Abstract Services number. LOR = Limit of reporting.

 Specific comments for Work Order HK0801754 :
 Sample(s) were collected by ALS Technichem (HK) staff on 13 December, 2007.

 Sample(s) analysed and reported on an as received basis.
 Sample(s) analysed and reported on an as received basis.

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

This report may not be reproduced except with prior written	This document has been electronically signed by those names	s that appear on this report and are the a	uthorised signatories.
approval from ALS Technichem (HK) Pty Ltd.	Electronic signing has been carried out in compliance with pro	cedures specified in the 'Electronic Tran	sactions Ordinance'
	of Hong Kong, Chapter 553, Section 6.		
	Signatory	Position	Authorised results for:-
	Fung Lim Chee, Richard	General Manager	Inorganics

ALS Laboratory Group Trading Name: ALS Technichem (HK) Pty Ltd 11/F., Chung Shun Knitting Centre, 1-3 Wing Yip Street, Kwai Chung, N.T., Hong Kong

Tel: +852 2610 1044 Fax: +852 2610 2021 www.alsenviro.com

A Campbell Brothers Limited Company



Analytical Results

Sub-Matrix: ASH		Compound	EG020: Thallium	EG020: Vanadium		
		LOR Unit	1 mg/kg	1 mg/kg		
Client sample ID	Client sampling date /	Laboratory sample	EG: Metals and Major	EG: Metals and Major		
	time	ID	Cations	Cations		
(BA) SAMPLE 1-5	13-DEC-2007 09:45	HK0801754-001	<1	14		
(BA) SAMPLE 6-10	13-DEC-2007 09:45	HK0801754-002	<1	19		
(BA) SAMPLE 11-15	13-DEC-2007 09:45	HK0801754-003	<1	6		
(BA) SAMPLE 16-20	13-DEC-2007 09:45	HK0801754-004	<1	8		
(BA) SAMPLE 21-25	13-DEC-2007 09:45	HK0801754-005	<1	7		
(FA) SAMPLE 1-5	13-DEC-2007 12:00	HK0801754-006	<1	3		
(FA) SAMPLE 6-10	13-DEC-2007 12:00	HK0801754-007	<1	4		
(FA) SAMPLE 11-15	13-DEC-2007 12:00	HK0801754-008	<1	3		
(FA) SAMPLE 16-20	13-DEC-2007 12:00	HK0801754-009	<1	2		
(FA) SAMPLE 21-25	13-DEC-2007 12:00	HK0801754-010	<1	4		



Laboratory Duplicate (DUP) Report

Matrix: SOIL					Labo	ratory Duplicate (DUP) R	leport	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)
EG: Metals and Major	r Cations (QC Lot: 586293)							
HK0801754-010	(FA) SAMPLE 21-25	EG020: Thallium	7440-28-0	1	mg/kg	<1	<1	0.0
		EG020: Vanadium	7440-62-2	1	mg/kg	4	5	0.0

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

Matrix: SOIL			Method Blank (ME	3) Report		Laboratory Control S	pike (LCS) and Laborato	ry Control S	Spike Duplicat	e (DCS) Report	
					Spike	Spike Rec	overy (%)	Recovery	Limits (%)	RPDs	5 (%)
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	DCS	Low	High	Value	Control Limit
EG: Metals and Major Cations (QCLot: 586293)											
EG020: Thallium	7440-28-0	0.05	mg/kg	<1	5 mg/kg	89.0		85	115		
EG020: Vanadium	7440-62-2	0.5	mg/kg	<1	5 mg/kg	89.0		85	115		

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

Matrix: SOIL					Matrix Sp	ike (MS) and Matrix Spi	ke Duplicate	e (MSD) Repo	ort	
				Spike	Spike Rec	covery (%)	Recovery	Limits (%)	RPL)s (%)
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	MSD	Low	High	Value	Control Limit
EG: Metals and Major	Cations (QCLot: 586293)									
HK0801754-001	(BA) SAMPLE 1-5	EG020: Thallium	7440-28-0	5 mg/kg	86.0		75	125		
		EG020: Vanadium	7440-62-2	50 mg/kg	94.6		75	125		



ANALYTICAL CHEMISTRY & TESTING SERVICES



ALS Czech Republic, s.r.o., Na Harfě 9/336, 190 00 Praha 9

 Telephone:
 +420 284 081 645, +420 284 081 646

 Fax:
 +420 284 081 750

 Internet:
 www.alsglobal.com, www.alsglobal.cz

 E-mail:
 info@alsglobal.com

ALS Technichem (HK) Pty Ltd 11/F, Chung Shun Knitting Centre Richard Fung 1-3 Wing Yip Street Kwai Chung Hong Kong

|--|

Prague : 29.2.2008

Project:	not mentioned, shipment FedEx 9417 0851 3260						
Date of sampling:							
Date of receipt:	1.2.2008						
Sampling procedu	Ire: Sampling was performed by the client						
Date of test perfor	rmance: 1.2 29.2.2008						
Place of test perfo	rmance: ALS Czech Republic, s.r.o., Laboratoř HRMS, V Ráji 906, 530 02 Pardubice						
Test specification,	deviations, additions to or exclusions from the test specification and any other information:						
OM-SP5-0004	Determination of sum PCB and planar congeners PCB by HRMS by internal instruction. Analysed by						
	HRGC/HRMS syst Agilent 6890N/Finnigan MAT 95XP resp. Trace GC Ultra/DFS. Resol. HRMS: 10000. GC						
	column: RTX-500 60 m, 0,25 mm ID; film 0,1 μ m						
OM-SP5-0006	Determination of polychlorinated dibenzo-p-dioxins and dibenzofurans according to US EPA 1613.						
	Analysed by technique: HRGC/HRMS system - Agilent 6890N/Finnigan MAT 95XP resp. Trace GC						
	Jltra/DFS. Resolution HRMS: 10000						

Measurement results

sample name	HK-0801319-	HK-0801319-	HK-0801319-	HK-0801319-		
	1	2	3	4		
matrix	ash	ash	ash ash			
parameter	result MU	result MU	result MU	result MU	unit	test specification
I-TEQ (PCDD/F) lowerb	0,00039 ±20	0 ±20	0 ±20	0 ±20	ng/g dw	OM-SP5-0006 A
I-TEQ (PCDD/F) upperb	0,0050	0,0051	0,0036	0,0053	ng/g dw	OM-SP5-0006 A
I-TEQ (PCB) lowerboun	0 ±20	0 ±20	0 ±20	0 ±20	ng/g dw	OM-SP5-0004 A
I-TEQ (PCB) upperboun	0,0012	0,0013	0,0011	0,0010	ng/g dw	OM-SP5-0004 A

The report shall not be reproduced except in full without the written approval of the testing laboratory.

The laboratory declares that the test results relate only to the items tested and do not substitute any other documents.

ORYAC π (1)1163

Ing. Emilie Pokorna

Laboratory Manager Prague

ALS Czech Republic, s.r.o., Na Harfě 9, 190 00 Praha 9 tel. +420 284 081 645, +420 284 081 646, fax +420 284 081 750

sample name	HK-08013	319-	HK-08013	319-			
	5		6				
matrix	ash		ash				
parameter	result	MU	result	MU	unit	test specification	n
I-TEQ (PCDD/F) lowerb	0,00012	±20	0,0022	±20	ng/g dw	OM-SP5-0006	Α
I-TEQ (PCDD/F) upperb	0,0049		0,0056		ng/g dw	OM-SP5-0006	Α
I-TEQ (PCB) lowerboun	0	±20	0	±20	ng/g dw	OM-SP5-0004	A
I-TEQ (PCB) upperboun	0,0013		0,0011		ng/g dw	OM-SP5-0004	Α

Measurement uncertainty (MU [%]) is expressed as expanded measurement uncertainty with coverage factor k = 2, representing of 95 % significance level.

Parameters indexed by 'A' in the last column of the table are accredited, parameters indexed by 'N' are not accredited.

ALS Technichem (HK) Pty Ltd

ALS Laboratory Group

ANALYICAL CHEMISTRY & TESTING SERVICES



CERTIFICATE OF ANALYSIS

Client Contact Address	 GREEN ISLAND INTERNATIONAL (BVI) LTD MR AUNG KHINE NO.7, LUNG YIU STREET, TAP SHEK KOK, TUEN MUN, N.T., HONG KONG 	Laboratory Contact Address	 ALS Technichem (HK) Pty Ltd Alice Wong 11/F., Chung Shun Knitting Centre, 1 - 3 Wing Yip Street, Kwai Chung, N.T., Hong Kong 	Page Work Order	² 1 of 6 ² HK0718125
E-mail Telephone	∴ akhine@gich.com.hk ∴ 2440 5208	E-mail Telephone	 Alice.Wong@alsenviro.com +852 2610 1044 		
Facsimile	2404 3627	Facsimile	: +852 2610 2021		
Project	:	Quote number	:	Date received	: 13 Dec 2007
Order number	:			Date of issue	2 Jan 2008
C-O-C number	:			No. of samples	- Received : 10
Site	:				- Analysed : 10

Report Comments

This report for ALS Technichem (HK) Pty Ltd work order reference HK0718125 supersedes any previous reports with this reference. The completion date of analysis is 29 Dec 2007. Results apply to sample(s) as submitted. All pages of this report have been checked and approved for release. When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for process purposes. Abbreviations: CAS number = Chemical Abstract Services number. LOR = Limit of reporting.

Specific comments for Work Order HK0718125 :	Sample(s) were collected by ALS Technichem (HK) staff on 13 December, 2007.
	Sample(s) analysed and reported on an as received basis.
	The metal concentrations reported are those determined on the TCLP leachate. For samples HK0718125001 - HK0718125005, Extraction Fluid
	#1 pH 4.88 - 4.98 was used. For samples HK0718125006 - HK0718125010, Extraction Fluid #2 pH 2.83 - 2.93 was used.

This report may not be reproduced except with prior written	n This document has been electronically signed by those names that appear on this report and are the authorised					
approval from ALS Technichem (HK) Pty Ltd.	signatories. Electronic signing has been carried out in compliance with procedures specified in the 'Electronic					
	Transactions Ordinance' of Hong Kong. Chapter 553. Section 6.					
	Signatory Position Author					
	Fung Lim Chee, Richard	General Manager	Inorganics			

ALS Laboratory Group Trading Name: ALS Technichem (HK) Pty Ltd 11/F., Chung Shun Knitting Centre, 1-3 Wing Yip Street, Kwai Chung, N.T., Hong Kong Tel: +852 2610 1044 Fax: +852 2610 2021 www.alsenviro.com A Campbell Brothers Limited Company

Page Number : 2 of 6 GREEN ISLAND INTERNATIONAL (BVI) LTD Client Work Order HK0718125



Analvtical Results		Cli	ient Sample ID :	(BA) SAMPLE 1-5	(BA) SAMPLE 6-10	(BA) SAMPLE 11-15	(BA) SAMPLE 16-20	(BA) SAMPLE 21-25
		Labora	tory Sample ID :	HK0718125-001	HK0718125-002	HK0718125-003	HK0718125-004	HK0718125-005
Submatrix: TCLP LEACHATE		Samp	ole Date / Time :	13 Dec 2007	13 Dec 2007	13 Dec 2007	13 Dec 2007	13 Dec 2007
Method: Analysis Description	CAS number	LOR	Units	9:45	9:45	9:45	9:45	9:45
EG: Metals and Major Cations - Filtered								
EG020: Antimony	7440-36-0	1	mg/L	<1	<1	<1	<1	<1
EG020: Arsenic	7440-38-2	1	mg/L	<1	<1	<1	<1	<1
EG020: Barium	7440-39-3	1	mg/L	<1	<1	<1	<1	<1
EG020: Beryllium	7440-41-7	1	mg/L	<1	<1	<1	<1	<1
EG020: Cadmium	7440-43-9	0.2	mg/L	<0.2	<0.2	<0.2	<0.2	<0.2
EG020: Chromium	7440-47-3	1	mg/L	<1	<1	<1	<1	<1
EG020: Copper	7440-50-8	1	mg/L	<1	<1	<1	<1	<1
EG020: Lead	7439-92-1	1	mg/L	<1	<1	<1	<1	<1
EG020: Mercury	7439-97-6	0.2	mg/L	<0.2	<0.2	<0.2	<0.2	<0.2
EG020: Nickel	7440-02-0	1	mg/L	<1	<1	<1	<1	<1
EG020: Selenium	7782-49-2	0.2	mg/L	<0.2	<0.2	<0.2	<0.2	<0.2
EG020: Silver	7440-22-4	1	mg/L	<1	<1	<1	<1	<1
EG020: Thallium	7440-28-0	1	mg/L	<1	<1	<1	<1	<1
EG020: Tin	7440-31-5	1	mg/L	<1	<1	<1	<1	<1
EG020: Vanadium	7440-62-2	1	mg/L	<1	<1	<1	<1	<1
EG020: Zinc	7440-66-6	1	mg/L	<1	<1	<1	<1	<1
Sample Preparation Method								
E-TCLP: Extraction Fluid Number		1	-	1	1	1	1	1
Page Number : 3 of 6 : GREEN ISLAND INTERNATIONAL (BVI) LTD Client HK0718125



Analytical Results		CI	ient Sample ID :	(FA) SAMPLE 1-5	(FA) SAMPLE 6-10	(FA) SAMPLE 11-15	(FA) SAMPLE 16-20	(FA) SAMPLE 21-25
		Labora	tory Sample ID :	HK0718125-006	HK0718125-007	HK0718125-008	HK0718125-009	HK0718125-010
Submatrix: TCLP LEACHATE		Sam	ole Date / Time :	13 Dec 2007	13 Dec 2007	13 Dec 2007	13 Dec 2007	13 Dec 2007
Method: Analysis Description	CAS number	LOR	Units	12:00	12:00	12:00	12:00	12:00
EG: Metals and Major Cations - Filtered								
EG020: Antimony	7440-36-0	1	mg/L	<1	<1	<1	<1	<1
EG020: Arsenic	7440-38-2	1	mg/L	<1	<1	<1	<1	<1
EG020: Barium	7440-39-3	1	mg/L	<1	<1	<1	<1	<1
EG020: Beryllium	7440-41-7	1	mg/L	<1	<1	<1	<1	<1
EG020: Cadmium	7440-43-9	0.2	mg/L	<0.2	<0.2	<0.2	<0.2	<0.2
EG020: Chromium	7440-47-3	1	mg/L	1	<1	<1	<1	1
EG020: Copper	7440-50-8	1	mg/L	<1	<1	<1	<1	<1
EG020: Lead	7439-92-1	1	mg/L	<1	1	<1	<1	<1
EG020: Mercury	7439-97-6	0.2	mg/L	<0.2	<0.2	<0.2	<0.2	<0.2
EG020: Nickel	7440-02-0	1	mg/L	<1	<1	<1	<1	<1
EG020: Selenium	7782-49-2	0.2	mg/L	<0.2	<0.2	<0.2	<0.2	<0.2
EG020: Silver	7440-22-4	1	mg/L	<1	<1	<1	<1	<1
EG020: Thallium	7440-28-0	1	mg/L	<1	<1	<1	<1	<1
EG020: Tin	7440-31-5	1	mg/L	<1	<1	<1	<1	<1
EG020: Vanadium	7440-62-2	1	mg/L	<1	<1	<1	<1	<1
EG020: Zinc	7440-66-6	1	mg/L	<1	<1	<1	<1	<1
Sample Preparation Method								
E-TCLP: Extraction Fluid Number		1	-	2	2	2	2	2



Quality Control - Laboratory Duplicate (DUP) Results

Matrix Type: WATER			Duplicate (DUP) Results						
Laboratory Sample ID	Client Sample ID	Method: Analysis Description	CAS number	LOR	Units	Original Result	Duplicate Result	RPD (%)	
EG: Metals and Major	Cations - Filtered (QC Lot: 5641	16)							
HK0718125-002	(BA) SAMPLE 6-10	EG020: Antimony	7440-36-0	1	mg/L	<1	<1	0.0	
		EG020: Lead	7439-92-1	1	mg/L	<1	<1	0.0	
		EG020: Mercury	7439-97-6	0.2	mg/L	<0.2	<0.2	0.0	
		EG020: Nickel	7440-02-0	1	mg/L	<1	<1	0.0	
		EG020: Selenium	7782-49-2	0.2	mg/L	<0.2	<0.2	0.0	
		EG020: Silver	7440-22-4	1	mg/L	<1	<1	0.0	
		EG020: Thallium	7440-28-0	1	mg/L	<1	<1	0.0	
		EG020: Tin	7440-31-5	1	mg/L	<1	<1	0.0	
		EG020: Arsenic	7440-38-2	1	mg/L	<1	<1	0.0	
		EG020: Vanadium	7440-62-2	1	mg/L	<1	<1	0.0	
		EG020: Zinc	7440-66-6	1	mg/L	<1	<1	0.0	
		EG020: Barium	7440-39-3	1	mg/L	<1	<1	0.0	
		EG020: Beryllium	7440-41-7	1	mg/L	<1	<1	0.0	
		EG020: Cadmium	7440-43-9	0.2	mg/L	<0.2	<0.2	0.0	
		EG020: Chromium	7440-47-3	1	mg/L	<1	<1	0.0	
		EG020: Copper	7440-50-8	1	mg/L	<1	<1	0.0	
HK0718125-010	(FA) SAMPLE 21-25	EG020: Antimony	7440-36-0	1	mg/L	<1	<1	0.0	
		EG020: Lead	7439-92-1	1	mg/L	<1	<1	0.0	
		EG020: Mercury	7439-97-6	0.2	mg/L	<0.2	<0.2	0.0	
		EG020: Nickel	7440-02-0	1	mg/L	<1	<1	0.0	
		EG020: Selenium	7782-49-2	0.2	mg/L	<0.2	<0.2	0.0	
		EG020: Silver	7440-22-4	1	mg/L	<1	<1	0.0	
		EG020: Thallium	7440-28-0	1	mg/L	<1	<1	0.0	
		EG020: Tin	7440-31-5	1	mg/L	<1	<1	0.0	
		EG020: Arsenic	7440-38-2	1	mg/L	<1	<1	0.0	
		EG020: Vanadium	7440-62-2	1	mg/L	<1	<1	0.0	
		EG020: Zinc	7440-66-6	1	mg/L	<1	<1	0.0	
		EG020: Barium	7440-39-3	1	mg/L	<1	<1	0.0	
	EG020: Bervllium	EG020: Beryllium	7440-41-7	1	mg/L	<1	<1	0.0	
		EG020: Cadmium	7440-43-9	0.2	mg/L	<0.2	<0.2	0.0	
		EG020: Chromium	7440-47-3	1	mg/L	1	1	0.0	
		EG020: Copper	7440-50-8	1	mg/L	<1	<1	0.0	

Quality Control - Method Blank (MB), Single Control Spike (SCS) and Duplicate Control Spike (DCS) Results

Matrix Type: WATER	Method Blank (MB) Results			Single Control Spike (SCS) and Duplicate Control Spike (DCS) Results							
					Spike	Spike Recovery (%) Recovery Limits (%) RPDs (%)				9s (%)	
Method: Analysis Description	CAS number	LOR	Units	Result	Concentration	scs	DCS	Low	High	Value	Control Limit

Page Number : 5 of 6 Client : GREEN ISLAND INTERNATIONAL (BVI) LTD HK0718125



Work Order

Matrix Type: WATER			Method Blank (MB) Results		Single Co	ontrol Spike (SCS) and Du	uplicate Cont	trol Spike (DC	CS) Results	
					Spike	Spike Spike Recovery (%)		Recovery	Limits (%)	RPDs (%)	
Method: Analysis Description	CAS number	LOR	Units	Result	Concentration	SCS	DCS	Low	High	Value	Control Limit
EG: Metals and Major Cations - Filt	ered (QCLot: 564116)										
EG020: Antimony	7440-36-0	0.001	mg/L	<1	1 mg/L	85.5		85	115		
EG020: Lead	7439-92-1	0.001	mg/L	<1	1 mg/L	96.5		85	115		
EG020: Mercury	7439-97-6	0.0001	mg/L	<0.2	0.02 mg/L	103		85	115		
EG020: Nickel	7440-02-0	0.001	mg/L	<1	1 mg/L	97.1		85	115		
EG020: Selenium	7782-49-2	0.01	mg/L	<0.2	1 mg/L	92.1		85	115		
EG020: Silver	7440-22-4	0.001	mg/L	<1	1 mg/L	88.7		85	115		
EG020: Thallium	7440-28-0	0.001	mg/L	<1	1 mg/L	94.4		85	115		
EG020: Tin	7440-31-5	0.01	mg/L	<1	1 mg/L	88.8		85	115		
EG020: Arsenic	7440-38-2	0.01	mg/L	<10	1 mg/L	92.1		85	115		
EG020: Vanadium	7440-62-2	0.01	mg/L	<1	1 mg/L	100		85	115		
EG020: Zinc	7440-66-6	0.01	mg/L	<1	1 mg/L	96.0		85	115		
EG020: Barium	7440-39-3	0.001	mg/L	<1	1 mg/L	104		85	115		
EG020: Beryllium	7440-41-7	0.001	mg/L	<1	1 mg/L	89.0		85	115		
EG020: Cadmium	7440-43-9	0.0002	mg/L	<0.2	1 mg/L	97.2		85	115		
EG020: Chromium	7440-47-3	0.001	mg/L	<1	1 mg/L	101		85	115		
EG020: Copper	7440-50-8	0.001	mg/L	<1	1 mg/L	96.0		85	115		

Quality Control - Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Results

Matrix Type: WATER			Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Results							
				Spike	Spike Re	covery (%)	Recovery	Limits (%)	RPDs ('%)
Laboratory Sample ID	Client Sample ID	Method: Analysis Description	CAS number	Concentration	MS	MSD	Low	High	Value	Control Limit
EG: Metals and Major	Cations - Filtered (QCLot:	564116)								
HK0718125-001	(BA) SAMPLE 1-5	EG020: Antimony	7440-36-0	1 mg/L	92.1	88.9	75	125	3.5	
		EG020: Lead	7439-92-1	1 mg/L	95.8	96.3	75	125	0.5	
		EG020: Mercury	7439-97-6	0.02 mg/L	106	106	75	125	0.09	
		EG020: Nickel	7440-02-0	1 mg/L	96.1	97.0	75	125	1.0	
		EG020: Selenium	7782-49-2	1 mg/L	94.6	94.5	75	125	0.1	
		EG020: Silver	7440-22-4	1 mg/L	76.6	83.5	75	125	8.6	
		EG020: Thallium	7440-28-0	1 mg/L	91.8	95.8	75	125	4.2	
		EG020: Tin	7440-31-5	1 mg/L	89.1	88.8	75	125	0.3	
		EG020: Arsenic	7440-38-2	1 mg/L	94.8	92.8	75	125	2.1	
		EG020: Vanadium	7440-62-2	1 mg/L	102	102	75	125	0.2	
		EG020: Zinc	7440-66-6	1 mg/L	93.0	95.7	75	125	2.8	
		EG020: Barium	7440-39-3	1 mg/L	96.6	99.0	75	125	2.4	
		EG020: Beryllium	7440-41-7	1 mg/L	91.3	91.8	75	125	0.5	
		EG020: Cadmium	7440-43-9	1 mg/L	93.4	94.3	75	125	0.9	
		EG020: Chromium	7440-47-3	1 mg/L	98.4	102	75	125	4.0	

Page Number:6 of 6Client:GREEN ISLAND INTERNATIONAL (BVI) LTDWork OrderHK0718125



Matrix Type: WATER		Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Results									
		Spike	Spike Recovery (%)		Recovery Limits (%)		RPDs (%)				
Laboratory Sample ID	Client Sample ID	Method: Analysis Description	CAS number	Concentration MS MSD				High	Value	Control Limit	
EG: Metals and Major Cations - Filtered (QCLot: 564116) - continued											
HK0718125-001	(BA) SAMPLE 1-5	EG020: Copper	7440-50-8	1 mg/L	94.3	93.6	75	125	0.7		

Annex B2

Castable and Refractory Bricks Analysis Results

ALS Technichem (HK) Pty Ltd

PRELIMINARY RESULTS FOR REFERENCE ONLY

ALS Laboratory Group

ANALYICAL CHEMISTRY & TESTING SERVICES



CERTIFICATE OF ANALYSIS

Client Contact Address	 GREEN ISLAND CEMENT CO LIMITED MR SUNNY KWONG NO. 7 LUNG YIU STREET, TAP SHEK KOK, TUEN MUN, N.T., HONG KONG 	Laboratory Contact Address	:	ALS Technichem (HK) Pty Ltd Alice Wong 11/F., Chung Shun Knitting Centre, 1 - 3 Wing Yip Street, Kwai Chung, N.T., Hong Kong	Page Work Order	:	^{1 of 9} HK0806570
E-mail	∵ Sunnyk@gich.com.hk	E-mail	:	Alice.Wong@alsenviro.com			
Telephone	2440 5294	Telephone	:	+852 2610 1044			
Facsimile	2404 3627	Facsimile	:	+852 2610 2021			
Project	: (ERM 0071019)	Quote number	:		Date received	:	26 Apr 2008
Order number	:				Date of issue	:	
C-O-C number	: H002583-H002584				No. of samples	-	Received : 13
Site	; GIC					-	Analysed : 10

Report Comments

This report for ALS Technichem (HK) Pty Ltd work order reference HK0806570 supersedes any previous reports with this reference. The completion date of analysis is 30 Apr 2008. Results apply to sample(s) as submitted. All pages of this report have been checked and approved for release. When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for process purposes. Abbreviations: CAS number = Chemical Abstract Services number. LOR = Limit of reporting.

Specific comments for Work Order HK0806570 :	Sample(s) were picked up from client by ALS Technichem (HK) staff in an ambient condition. Soil sample(s) analysed on an as received basis. Result(s) reported on a dry weight basis. The metal concentrations reported are those determined on the TCLP leachate. Extraction Fluid #1 pH 4.88 - 4.98. Extraction Fluid #2 pH 2.83 -
	Soil sample(s) as received, digested by In-house method E-ASTM D3974-81 based on ASTM D3974-81, prior to the determination of metals.
This report may not be reproduced except with prior writte approval from ALS Technichem (HK) Pty Ltd.	This document has been electronically signed by those names that appear on this report and are the authorised signatories. Electronic signing has been carried out in compliance with procedures specified in the 'Electronic

Transactions Ordinance' of Hong Kong. Chapter 553. Section 6.

 Signatory
 Position
 Authorised results for:

 Fung Lim Chee, Richard
 General Manager
 Inorganics

ALS Laboratory Group Trading Name: ALS Technichem (HK) Pty Ltd 11/F., Chung Shun Knitting Centre, 1-3 Wing Yip Street, Kwai Chung, N.T., Hong Kong Tel: +852 2610 1044 Fax: +852 2610 2021 www.alsenviro.com

A Campbell Brothers Limited Company

Page Number : 2 of 9 : GREEN ISLAND CEMENT CO LIMITED Client HK0806570



Analytical Results		Cli	ent Sample ID :	S1	S2	S3	S41	S5
		Labora	tory Sample ID :	HK0806570-001	HK0806570-002	HK0806570-003	HK0806570-005	HK0806570-007
Submatrix: SOIL		Sam	ole Date / Time :	25 Apr 2008				
Method: Analysis Description	CAS number	LOR	Units	10:00	11:00	13:30	14:00	14:30
EA/ED: Physical and Aggregate Proper	ties							
EA055: Moisture Content (dried @		0.1	%	<0.1	<0.1	<0.1	<0.1	<0.1
103°C)								
EG: Metals and Major Cations								
EG020: Antimony	7440-36-0	1	mg/kg	1	<1	3	<1	2
EG020: Arsenic	7440-38-2	1	mg/kg	5	4	4	<1	12
EG020: Barium	7440-39-3	1	mg/kg	38	18	141	33	43
EG020: Cadmium	7440-43-9	0.2	mg/kg	0.3	0.3	1.6	<0.2	0.7
EG020: Cobalt	7440-48-4	1	mg/kg	<1	2	3	<1	<1
EG020: Copper	7440-50-8	1	mg/kg	25	4	18	5	5
EG020: Lead	7439-92-1	1	mg/kg	13	9	67	72	63
EG020: Manganese	7439-96-5	1	mg/kg	47	26	72	33	53
EG020: Mercury	7439-97-6	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
EG020: Molybdenum	7439-98-7	1	mg/kg	<1	<1	<1	<1	3
EG020: Nickel	7440-02-0	1	mg/kg	11	3	7	<1	<1
EG020: Thallium	7440-28-0	1	mg/kg	<1	<1	<1	<1	<1
EG020: Tin	7440-31-5	1	mg/kg	10	<1	14	<1	6
EG020: Vanadium	7440-62-2	1	mg/kg	32	28	48	82	57
EG020: Zinc	7440-66-6	1	mg/kg	77	3	72	37	24
EG049: Trivalent Chromium	16065-83-1	1	mg/kg	8	3	14	2	12
EG050: Hexavalent Chromium	18540-29-9	1	mg/kg	<1	<1	<1	<1	<1

Page Number : 3 of 9 : GREEN ISLAND CEMENT CO LIMITED Client HK0806570



Analytical Results		Cli	ient Sample ID :	S6	S7	S8	S9	S10
		Labora	tory Sample ID :	HK0806570-008	HK0806570-009	HK0806570-010	HK0806570-012	HK0806570-013
Submatrix: SOIL		Sam	ole Date / Time :	25 Apr 2008				
Method: Analysis Description	CAS number	LOR	Units	15:00	16:00	16:00	16:30	16:30
EA/ED: Physical and Aggregate Proper	ties							
EA055: Moisture Content (dried @		0.1	%	<0.1	0.2	3.2	13.9	0.2
103°C)								
EG: Metals and Major Cations								
EG020: Antimony	7440-36-0	1	mg/kg	<1	<1	<1	3	<1
EG020: Arsenic	7440-38-2	1	mg/kg	3	2	2	6	3
EG020: Barium	7440-39-3	1	mg/kg	37	36	67	137	29
EG020: Cadmium	7440-43-9	0.2	mg/kg	0.3	0.3	<0.2	4.1	<0.2
EG020: Cobalt	7440-48-4	1	mg/kg	2	<1	2	10	1
EG020: Copper	7440-50-8	1	mg/kg	15	6	19	41	18
EG020: Lead	7439-92-1	1	mg/kg	22	34	94	200	13
EG020: Manganese	7439-96-5	1	mg/kg	49	37	83	600	66
EG020: Mercury	7439-97-6	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
EG020: Molybdenum	7439-98-7	1	mg/kg	1	<1	1	13	2
EG020: Nickel	7440-02-0	1	mg/kg	7	4	15	310	6
EG020: Thallium	7440-28-0	1	mg/kg	<1	<1	<1	<1	<1
EG020: Tin	7440-31-5	1	mg/kg	3	2	2	11	3
EG020: Vanadium	7440-62-2	1	mg/kg	79	80	77	23	62
EG020: Zinc	7440-66-6	1	mg/kg	236	9	18	77	14
EG049: Trivalent Chromium	16065-83-1	1	mg/kg	21	26	35	315	39
EG050: Hexavalent Chromium	18540-29-9	1	mg/kg	1	14	4	128	6

Page Number : 4 of 9 : GREEN ISLAND CEMENT CO LIMITED Client HK0806570



Analytical Results		CI	ient Sample ID :	S1	S2	S3	S41	S5
		Labora	tory Sample ID :	HK0806570-001	HK0806570-002	HK0806570-003	HK0806570-005	HK0806570-007
Submatrix: TCLP LEACHATE		Sam	ole Date / Time :	25 Apr 2008				
Method: Analysis Description	CAS number	LOR	Units	12:00	12:00	12:00	12:00	12:00
EG: Metals and Major Cations - Filtered								
EG020: Antimony	7440-36-0	1	mg/L	<1	<1	<1	<1	<1
EG020: Arsenic	7440-38-2	1	mg/L	<1	<1	<1	<1	<1
EG020: Barium	7440-39-3	1	mg/L	<1	<1	<1	<1	<1
EG020: Beryllium	7440-41-7	1	mg/L	<1	<1	<1	<1	<1
EG020: Cadmium	7440-43-9	0.2	mg/L	<0.2	<0.2	<0.2	<0.2	<0.2
EG020: Chromium	7440-47-3	1	mg/L	<1	<1	<1	<1	<1
EG020: Copper	7440-50-8	1	mg/L	<1	<1	<1	<1	<1
EG020: Lead	7439-92-1	1	mg/L	<1	<1	<1	<1	<1
EG020: Mercury	7439-97-6	0.2	mg/L	<0.2	<0.2	<0.2	<0.2	<0.2
EG020: Nickel	7440-02-0	1	mg/L	<1	<1	<1	<1	<1
EG020: Selenium	7782-49-2	0.2	mg/L	<0.2	<0.2	<0.2	<0.2	<0.2
EG020: Silver	7440-22-4	1	mg/L	<1	<1	<1	<1	<1
EG020: Thallium	7440-28-0	1	mg/L	<1	<1	<1	<1	<1
EG020: Tin	7440-31-5	1	mg/L	<1	<1	<1	<1	<1
EG020: Vanadium	7440-62-2	1	mg/L	<1	<1	<1	<1	<1
EG020: Zinc	7440-66-6	1	mg/L	<1	<1	<1	<1	<1
Sample Preparation Method								
E-TCLP: Extraction Fluid Number		-		1	1	1	1	1

Page Number : 5 of 9 : GREEN ISLAND CEMENT CO LIMITED Client HK0806570



Analytical Results		CI	ient Sample ID :	S6	S7	S8	S9	S10
		Labora	tory Sample ID :	HK0806570-008	HK0806570-009	HK0806570-010	HK0806570-012	HK0806570-013
Submatrix: TCLP LEACHATE		Sam	ole Date / Time :	25 Apr 2008				
Method: Analysis Description	CAS number	LOR	Units	12:00	12:00	12:00	12:00	12:00
EG: Metals and Major Cations - Filtered								
EG020: Antimony	7440-36-0	1	mg/L	<1	<1	<1	<1	<1
EG020: Arsenic	7440-38-2	1	mg/L	<1	<1	<1	<1	<1
EG020: Barium	7440-39-3	1	mg/L	<1	<1	<1	<1	<1
EG020: Beryllium	7440-41-7	1	mg/L	<1	<1	<1	<1	<1
EG020: Cadmium	7440-43-9	0.2	mg/L	<0.2	<0.2	<0.2	<0.2	<0.2
EG020: Chromium	7440-47-3	1	mg/L	<1	<1	<1	4	<1
EG020: Copper	7440-50-8	1	mg/L	<1	<1	<1	<1	<1
EG020: Lead	7439-92-1	1	mg/L	<1	<1	<1	<1	<1
EG020: Mercury	7439-97-6	0.2	mg/L	<0.2	<0.2	<0.2	<0.2	<0.2
EG020: Nickel	7440-02-0	1	mg/L	<1	<1	<1	<1	<1
EG020: Selenium	7782-49-2	0.2	mg/L	<0.2	<0.2	<0.2	<0.2	<0.2
EG020: Silver	7440-22-4	1	mg/L	<1	<1	<1	<1	<1
EG020: Thallium	7440-28-0	1	mg/L	<1	<1	<1	<1	<1
EG020: Tin	7440-31-5	1	mg/L	<1	<1	<1	<1	<1
EG020: Vanadium	7440-62-2	1	mg/L	<1	<1	<1	<1	<1
EG020: Zinc	7440-66-6	1	mg/L	<1	<1	<1	<1	<1
Sample Preparation Method								
E-TCLP: Extraction Fluid Number		-		1	1	1	2	1

 Page Number
 :
 6 of 9

 Client
 :
 GREEN ISLAND CEMENT CO LIMITED

Work Order HK0806570



Quality Control - Laboratory Duplicate (DUP) Results

atrix Type: SOIL					Duplicate (DUP) Results					
Laboratory Sample ID	Client Sample ID	Method: Analysis Description	CAS number	LOR	Units	Original Result	Duplicate Result	RPD (%)		
EA/ED: Physical and A	Aggregate Properties (QC Lot	t: 646399)								
HK0806106-001	Anonymous	EA055: Moisture Content (dried @ 103°C)		0.1	%	52.7	52.5	0.3		
HK0806106-011	Anonymous	EA055: Moisture Content (dried @ 103°C)		0.1	%	49.2	48.2	2.2		
EA/ED: Physical and A	Aggregate Properties (QC Lot	t: 646400)				•	••			
HK0806570-013	S10	EA055: Moisture Content (dried @ 103°C)		0.1	%	0.2	0.3	0.0		
EG: Metals and Maior	Cations (QC Lot: 646406)									
HK0806570-002	S2	EG020: Antimony	7440-36-0	1	mg/kg	<1	<1	0.0		
		EG020: Lead	7439-92-1	1	mg/kg	9	7	15.7		
		EG020: Manganese	7439-96-5	1	mg/kg	26	24	4.2		
		EG020: Mercury	7439-97-6	0.05	mg/kg	<0.05	<0.05	0.0		
		EG020: Molybdenum	7439-98-7	1	mg/kg	<1	<1	0.0		
		EG020: Nickel	7440-02-0	1	mg/kg	3	2	0.0		
		EG020: Thallium	7440-28-0	1	mg/kg	<1	<1	0.0		
		EG020: Tin	7440-31-5	1	mg/kg	<1	<1	0.0		
		EG020: Arsenic	7440-38-2	1	mg/kg	4	4	0.0		
		EG020: Vanadium	7440-62-2	1	mg/kg	28	26	7.0		
		EG020: Zinc	7440-66-6	1	mg/kg	3	3	0.0		
		EG020: Barium	7440-39-3	1	mg/kg	18	17	0.0		
		EG020: Cadmium	7440-43-9	0.2	mg/kg	0.3	0.2	0.0		
		EG020: Cobalt	7440-48-4	1	mg/kg	2	1	0.0		
		EG020: Copper	7440-50-8	1	mg/kg	4	4	0.0		
EG: Metals and Major	Cations (QC Lot: 648311)									
HK0806499-002	Anonymous	EG050: Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	<0.5	0.0		
HK0806570-001	S1	EG050: Hexavalent Chromium	18540-29-9	1	mg/kg	<1	<1	0.0		
	· · · · ·					Duplicato (DUP)	Poquita			
Inaurix Type: WATER	Client Sample ID	Mothod: Analysis Description	CAS number	LOP	Units	Original Posult	Duplicato Posult			
EQ: Metale and Major		FOOSON	CAG humber	LON	onna	Original Kesan	Duplicate Result	N D (70)		
HK0806570-002	S2	EG020: Antimony	7440-36-0	1	ma/l	<1	<1	0.0		
		EG020: Lead	7439-92-1	1	mg/L	<1	<1	0.0		
		EG020: Mercury	7439-97-6	0.2	mg/L	<0.2	<0.2	0.0		
		EG020: Nickel	7440-02-0	1	ma/l	<1	<1	0.0		
		EG020: Nickel	7782-49-2	0.2	mg/l	<0.2	<0.2	0.0		
		EG020: Silver	7440-22-4	1	ma/L	<1	<1	0.0		
		EG020: Thallium	7440-28-0	1	ma/L	<1	<1	0.0		
		EG020: Tin	7440-31-5	1	ma/L	<1	<1	0.0		
		EG020: Arsenic	7440-38-2	1	ma/L	<1	<1	0.0		
		EG020: Vanadium	7440-62-2	1	ma/L	<1	<1	0.0		
	Į		1110 02 2	· · ·			· · ·	0.0		

Page Number: 7 of 9Client: GREEN ISLAND CEMENT CO LIMITEDWork OrderHK0806570



Matrix Type: WATER			Duplicate (DUP) Results							
Laboratory Sample ID	Client Sample ID	Method: Analysis Description	CAS number	LOR	Units	Original Result	Duplicate Result	RPD (%)		
EG: Metals and Major Cati	EG: Metals and Major Cations - Filtered (QC Lot: 650930) - continued									
HK0806570-002	S2	EG020: Zinc	7440-66-6	1	mg/L	<1	<1	0.0		
		EG020: Barium	7440-39-3	1	mg/L	<1	<1	0.0		
		EG020: Beryllium	7440-41-7	1	mg/L	<1	<1	0.0		
		EG020: Cadmium	7440-43-9	0.2	mg/L	<0.2	<0.2	0.0		
		EG020: Chromium	7440-47-3	1	mg/L	<1	<1	0.0		
		EG020: Copper	7440-50-8	1	mg/L	<1	<1	0.0		

Quality Control - Method Blank (MB), Single Control Spike (SCS) and Duplicate Control Spike (DCS) Results

Matrix Type: SOIL			Method Blank (MB) Results		Single Co	ntrol Spike (SCS) and D	plicate Con	trol Spike (DC	S) Results	
					Spike	Spike Red	overy (%)	Recovery	Limits (%)	RPD	s (%)
Method: Analysis Description	CAS number	LOR	Units	Result	Concentration	SCS	DCS	Low	High	Value	Control Limit
EG: Metals and Major Cations (QCLot: 64	16406)										
EG020: Antimony	7440-36-0	1	mg/kg	<1	5 mg/kg	90.7		85	115		
EG020: Lead	7439-92-1	1	mg/kg	<1	5 mg/kg	90.2		85	115		
EG020: Manganese	7439-96-5	1	mg/kg	<1	5 mg/kg	89.9		85	115		
EG020: Mercury	7439-97-6	0.05	mg/kg	<0.05	0.1 mg/kg	105		85	115		
EG020: Molybdenum	7439-98-7	1	mg/kg	<1	5 mg/kg	96.4		85	115		
EG020: Nickel	7440-02-0	1	mg/kg	<1	5 mg/kg	88.4		85	115		
EG020: Thallium	7440-28-0	1	mg/kg	<1	5 mg/kg	92.9		85	115		
EG020: Tin	7440-31-5	1	mg/kg	<1	5 mg/kg	95.2		85	115		
EG020: Arsenic	7440-38-2	1	mg/kg	<1	5 mg/kg	85.5		85	115		
EG020: Vanadium	7440-62-2	1	mg/kg	<1	5 mg/kg	86.6		85	115		
EG020: Zinc	7440-66-6	1	mg/kg	<1	5 mg/kg	85.4		85	115		
EG020: Barium	7440-39-3	1	mg/kg	<1	5 mg/kg	97.0		85	115		
EG020: Cadmium	7440-43-9	0.2	mg/kg	<0.2	5 mg/kg	95.4		85	115		
EG020: Cobalt	7440-48-4	1	mg/kg	<1	5 mg/kg	88.3		85	115		
EG020: Copper	7440-50-8	1	mg/kg	<1	5 mg/kg	93.2		85	115		
EG: Metals and Major Cations (QCLot: 64	48311)			•							
EG050: Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	2.5 mg/kg	114		85	115		
Matrix Type: WATER			Method Blank (MB) Results		Single Co	ntrol Spike (SCS) and Di	Iplicate Con	trol Spike (DC	S) Results	
					Spike	Spike Red	covery (%)	Recovery	Limits (%)	RPD)s (%)
Method: Analysis Description	CAS number	LOR	Units	Result	Concentration	scs	DCS	Low	High	Value	Control Limit
EG: Metals and Major Cations - Filtered (QCLot: 650930)										
EG020: Antimony	7440-36-0	0.001	mg/L	<1	1 mg/L	85.9		85	115		
EG020: Lead	7439-92-1	0.001	mg/L	<0.1	1 mg/L	92.9		85	115		
EG020: Mercury	7439-97-6	0.0001	mg/L	<0.2	0.02 mg/L	105		85	115		
EG020: Nickel	7440-02-0	0.001	mg/L	<1	1 mg/L	98.3		85	115		
EG020: Selenium	7782-49-2	0.01	mg/L	<0.2	1 mg/L	106		85	115		

Page Number : 8 of 9 Client : GREEN ISLAND CEMENT CO LIMITED



Work Order HK0806570

Matrix Type: WATER		Method Blank (MB) Results				Single Co	ntrol Spike (SCS) and D	uplicate Com	trol Spike (DC	S) Results	
					Spike	Spike Rec	covery (%)	Recovery	Limits (%)	RPD)s (%)
Method: Analysis Description	CAS number	LOR	Units	Result	Concentration	SCS	DCS	Low	High	Value	Control Limit
EG: Metals and Major Cations - Filtered (QCLot: 650930) - c	ontinued									
EG020: Silver	7440-22-4	0.001	mg/L	<1	1 mg/L	95.6		85	115		
EG020: Thallium	7440-28-0	0.001	mg/L	<1	1 mg/L	89.2		85	115		
EG020: Tin	7440-31-5	0.01	mg/L	<1	1 mg/L	89.6		85	115		
EG020: Arsenic	7440-38-2	0.01	mg/L	<1	1 mg/L	104		85	115		
EG020: Vanadium	7440-62-2	0.01	mg/L	<1	1 mg/L	108		85	115		
EG020: Zinc	7440-66-6	0.01	mg/L	<1	1 mg/L	103		85	115		
EG020: Barium	7440-39-3	0.001	mg/L	<1	1 mg/L	90.2		85	115		
EG020: Beryllium	7440-41-7	0.001	mg/L	<1	1 mg/L	97.2		85	115		
EG020: Cadmium	7440-43-9	0.0002	mg/L	<0.2	1 mg/L	95.8		85	115		
EG020: Chromium	7440-47-3	0.001	mg/L	<0.1	1 mg/L	107		85	115		
EG020: Copper	7440-50-8	0.001	mg/L	<0.1	1 mg/L	102		85	115		

Quality Control - Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Results

Matrix Type: SOIL					Matrix S	pike (MS) and Matrix	Spike Duplic	ate (MSD) Re	sults	
				Spike	Spike Reco	overy (%)	Recovery	Limits (%)	RPDs (%)
Laboratory Sample ID	Client Sample ID	Method: Analysis Description	CAS number	Concentration	MS	MSD	Low	High	Value	Control Limit
EG: Metals and Major	Cations (QCLot: 646406									
HK0806570-001	S1	EG020: Antimony	7440-36-0	5 mg/kg	79.6		75	125		
		EG020: Lead	7439-92-1	5 mg/kg	80.4		75	125		
		EG020: Manganese	7439-96-5	5 mg/kg	Not Determined		75	125		
		EG020: Mercury	7439-97-6	0.1 mg/kg	78.5		75	125		
		EG020: Molybdenum	7439-98-7	5 mg/kg	96.4		75	125		
		EG020: Nickel	7440-02-0	5 mg/kg	85.3		75	125		
		EG020: Thallium	7440-28-0	5 mg/kg	76.0		75	125		
		EG020: Tin	7440-31-5	5 mg/kg	86.6		75	125		
		EG020: Arsenic	7440-38-2	5 mg/kg	75.7		75	125		
		EG020: Vanadium	7440-62-2	5 mg/kg	Not Determined		75	125		
		EG020: Zinc	7440-66-6	5 mg/kg	Not Determined		75	125		
		EG020: Barium	7440-39-3	5 mg/kg	Not Determined		75	125		
		EG020: Cadmium	7440-43-9	5 mg/kg	95.2		75	125		
		EG020: Cobalt	7440-48-4	5 mg/kg	87.1		75	125		
		EG020: Copper	7440-50-8	5 mg/kg	Not Determined		75	125		
EG: Metals and Major	Cations (QCLot: 648311			·	·					
HK0806499-001	Anonymous	EG050: Hexavalent Chromium	18540-29-9	2.5 mg/kg	117		75	125		
Matrix Type: WATER					Matrix S	pike (MS) and Matrix	Spike Duplic	ate (MSD) Re	sults	
				Spike	Spike Reco	overy (%)	Recovery	Limits (%)	RPDs (%)
Laboratory Sample ID	Client Sample ID	Method: Analysis Description	CAS number	Concentration	MS	MSD	Low	High	Value	Control Limit

Page Number : 9 of 9 Client : GREEN ISLAND CEMENT CO LIMITED Work Order HK0806570



Motive Turney MATER

Matrix Type: WATER	ix Type: WATER				Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Results						
				Spike	Spike Re	ecovery (%)	Recovery	' Limits (%)	RPDs (S	%)	
Laboratory Sample ID	Client Sample ID	Method: Analysis Description	CAS number	Concentration	MS	MSD	Low	High	Value	Control Limit	
EG: Metals and Major	Cations - Filtered (QCLo	ot: 650930)									
HK0806570-001	S1	EG020: Antimony	7440-36-0	1 mg/L	86.5	86.5	75	125	0.0		
		EG020: Lead	7439-92-1	1 mg/L	91.7	96.5	75	125	5.1		
		EG020: Mercury	7439-97-6	0.02 mg/L	103	107	75	125	4.3		
		EG020: Nickel	7440-02-0	1 mg/L	99.0	95.1	75	125	4.0		
		EG020: Selenium	7782-49-2	1 mg/L	102	103	75	125	0.8		
		EG020: Silver	7440-22-4	1 mg/L	94.2	94.8	75	125	0.6		
		EG020: Thallium	7440-28-0	1 mg/L	90.4	91.6	75	125	1.2		
		EG020: Tin	7440-31-5	1 mg/L	91.4	91.1	75	125	0.3		
		EG020: Arsenic	7440-38-2	1 mg/L	107	105	75	125	2.0		
		EG020: Vanadium	7440-62-2	1 mg/L	106	105	75	125	0.7		
		EG020: Zinc	7440-66-6	1 mg/L	103	99.4	75	125	3.8		
		EG020: Barium	7440-39-3	1 mg/L	89.0	86.7	75	125	2.6		
		EG020: Beryllium	7440-41-7	1 mg/L	96.5	95.9	75	125	0.6		
		EG020: Cadmium	7440-43-9	1 mg/L	93.7	93.4	75	125	0.3		
		EG020: Chromium	7440-47-3	1 mg/L	106	104	75	125	2.1		
		EG020: Copper	7440-50-8	1 mg/L	102	102	75	125	1.0		

ALS Laboratory Group ANALYTICAL CHEMISTRY & TESTING SERVICES ALS TECHNICHEM (HK) Pty Ltd

Environmental Division



CERTIFICATE OF ANALYSIS

CONTACT: MR SUNNY KWONG CLIENT: GREEN ISLAND INTERNATIONAL (BVI) LTD ADDRESS: NO.7, LUNG YIU STREET, TAP SHEK KOK, TUEN MUN, N.T., HONG KONG PROJECT: (ERM 0071019) SITE: GIC Batch:HKLABORATORY:HORDATE RECEIVED:26/0DATE OF ISSUE:20/0SAMPLE TYPE:ASHNo. of SAMPLES:3

HK0806570 HONG KONG 26/04/2008 20/05/2008 ASH

COMMENTS

Sample(s) were collected by ALS Technichem (HK) staff on 26 April, 2008. Dioxin and Furan were subcontracted and tested by ALS Czech Republic. ALS Czech Republic details report was attached. The attached report contains a total of 4 pages.

Sample Details

ALS Lab ID	Sample ID	Date of Sampling	Time of Sampling
HK0806570-4	S1-S3 MIX	25/04/2008	13:30
HK0806570-6	S4-2	25/04/2008	14:00
HK0806570-11	S7-S8 MIX	25/04/2008	16:00

ISSUING LABORATORY: HONG KONG

Address

ALS Technichem (HK) Pty Ltd

11/F Chung Shun Knitting Centre 1-3 Wing Yip Street Kwai Chung HONG KONG Phone: Fax: Email: 852-2610 1044 852-2610 2021 hongkong@alsenviro.com

Ms Wong Wai Man, Alice

Laboratory Manager - Hong Kong

Other ALS Environmental Laboratories

AUSTRALIA

Brisbane Hong I Melbourne Singap Sydney Kuala Newcastle Bogor

Hong Kong Va Singapore Sa Kuala Lumpur An Bogor Lin

Vancouver Santiago Amtofagasta Lima

AMERICAS

This report may not be reproduced except with prior written approval from ALS Technichem (HK) Pty Ltd.

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

ALS Technichem (HK) Pty Ltd

Part of the **ALS Laboratory Group** 11/F, Chung Shun Knitting Centre, 1-3 Wing Yip Street, Kwai Chung, N.T., H.K.

Phone: 852-2610 1044 Fax: 852-2610 2021 www.alsenviro.com

A Campbell Brothers Limited Company

ALS Laboratory Group

ANALYTICAL CHEMISTRY & TESTING SERVICES





ALS Czech Republic, s.r.o., Na Harfě 336/9, 190 00 Praha 9

 Telephone:
 +420 284 081 645, +420 284 081 646

 Fax:
 +420 284 081 750

 Internet:
 www.alsglobal.com, www.alsglobal.cz

 E-mail:
 info@alsglobal.com

ALS Technichem (HK) Pty Ltd 11/F, Chung Shun Knitting Centre Richard Fung 1-3 Wing Yip Street Kwai Chung Hong Kong

Test Report No.

9413 / 1 / 2008

Prague: 16.5.2008

Project:	Shipment 941708517839
Date of sampling:	
Date of receipt:	30.4.2008
Sampling procedure:	Sampling was performed by the client
Date of test performance:	30.4 16.5.2008
Place of test performance	: ALS Czech Republic, s.r.o., Laboratoř HRMS, V Ráji 906, 530 02 Pardubice - D06_06_175
	ALS Czech Republic, s.r.o., Na Harfé 336/9, 190 00, Praha 9
Test specification, deviati	ons, additions to or exclusions from the test specification and any other information:
Č-I-11465 Determ	signation of dry matter according to internal instructions

 D06_06_175
 Determination of dry matter according to internar instructions

 D06_06_175
 Determination of polychlorinated dibenzo-p-dioxins and dibenzofurans according to US EPA 1613.

 Analysed by technique: HRGC/HRMS system - Agilent 6890N/Finnigan MAT 95XP resp. Trace GC Ultra/DFS. Resolution HRMS: 10000

Measurement results

sample name	HK0806570-4 (S-S3 MIX)	HK0806570-6 (S4-2)	HK0806570-1 1 (S7-S8 MIX)			
matrix parameter	soil result ми	soil result ми	soil result ми	unit	test specification	
Dry matter at 105 °C	100 ±5	100 ±5	98,8 ±5	%	Č-I-11465	A
I-TEQ (PCDD/F) lowerb	0 ±20	0 ±20	0 ±20	ng/g dw	D06 06 175	Α
I-TEO (PCDD/F) upperb	0,0016	0,0017	0,0013	ng/g dw	D06 06 175	A

Measurement uncertainty (MU [%]) is expressed as expanded measurement uncertainty with coverage factor k = 2, representing of 95 % significance level.

Parameters indexed by 'A' in the last column of the table are accredited, parameters indexed by 'N' are not accredited.

The report shall not be reproduced except in full without the written approval of the testing laboratory. The laboratory declares that the test results relate only to the items tested and do not substitute any other documents.



Ing. Emilie Pokorna

Laboratory Manager Prague

ALS Czech Republic, s.r.o., Na Harfé 9, 190 00 Praha 9 tel. +420 284 081 645, +420 284 081 646, fax +420 284 081 750

Page: 1/1

Annex No. 1 to test Report No. 9413/1/2008

Sample: HK0806570-4 (S-S3 MIX)

Measurement results:

Sample:	HK0806570-	4 (S-S3 MIX)			
			Final extract [µl]:		75
Sample weight [g]:	4.5	525	Injection volume $[\mu 1]$:		2
Dry matter [%]:	10	00	Acquisition date [d.m.y	/ h:m]:	9.5.08 10:54
2,3,7,8-PCDD/Fs	Content	Limit of	Limit of	¹ I-TEFs	I-TEQ
		Detection	Quantification		
	[ng/g dw]	[ng/g dw]	[ng/g dw]		[ng/g dw]
2,3,7,8-TCDD	n.d.	0.00026	0.00051	1	0
1,2,3,7,8-PeCDD	n.d.	0.00051	0.0010	0.5	0
1,2,3,4,7,8-HxCDD	n.d.	0.00088	0.0018	0.1	0
1,2,3,6,7,8-HxCDD	n.d.	0.00088	0.0018	0.1	0
1,2,3,7,8,9-HxCDD	n.d.	0.00088	0.0018	0.1	0
1,2,3,4,6,7,8-HpCDD	n.d.	0.0014	0.0027	0.01	0
OCDD	n.d.	0.0017	0.0034	0.001	0
2,3,7,8-TCDF	n.d.	0.00036	0.00072	0.1	0
1,2,3,7,8-PeCDF	n.d.	0.00050	0.0010	0.05	0
2,3,4,7,8-PeCDF	n.d.	0.00050	0.0010	0.5	0
1,2,3,4,7,8-HxCDF	n.d.	0.0011	0.0022	0.1	0
1,2,3,6,7,8-HxCDF	n.d.	0.0011	0.0022	0.1	0
1,2,3,7,8,9-HxCDF	n.d.	0.0011	0.0022	0.1	0
2,3,4,6,7,8-HxCDF	n.d.	0.0011	0.0022	0.1	0
1,2,3,4,6,7,8-HpCDF	n.d.	0.0012	0.0024	0.01	0
1,2,3,4,7,8,9-HpCDF	n.d.	0.0012	0.0024	0.01	0
OCDF	n.d.	0.0021	0.0041	0.001	0
I-TEQ from quantifi	ed 2,3,7,8-PCI	DD/Fs [ng 2,3,	7,8-TCDD/g dw]-"Lowe	erbound"	0
I-TEO from quantified	12,3,7,8-PCDD	Ds [ng 2,3,7,8-7	[CDD/g dw]		0
I-TEO from quantified	12,3,7,8-PCDF	Fs [ng 2,3,7,8-1	CDD/g dw]		0
I-TEO from n.d. and n	on quantified 2	2,3,7,8-PCDD/	Fs [ng 2,3,7,8-TCDD/g d	w]	0.0016
Maximum possible I-	TEQ [ng 2,3,7	,8-TCDD/g d	w]-"Upperbound"		0.0016
PCDDs	Content	[ng/g dw]	PCDFs	Conten	t [ng/g dw]
Tetra-CDDs	n	.d.	Tetra-CDFs		n.d.
Penta-CDDs	n	.d.	Penta-CDFs		n.d.
Hexa-CDDs	n	.d.	Hexa-CDFs	n.d.	
Hepta-CDDs	n	.d.	Hepta-CDFs	n.d.	
OCDD	n	.d.	OCDF		n.d.
Total PCDDs	n	.d.	Total PCDFs		n.d.

¹I-TEF according to NATO.

The limits of quantification are defined as the double of the detection limits.

The limit of detection is defined as the amount of analyte producing a signal with $S/N \ge 3$.

The value of the detection limit is mentioned as the actual value at the acquisition date.

Measurement uncertainty is expressed as a double (k=2) relative standard deviation (RSD%), and corresponds to 95% interval of reliability.

Estimation of uncertainty of each 2,3,7,8-PCDD/F congener is 30% and total I-TEQ is 20%.

These values were ensured by analyses of certified reference material under conditions of internal reproducibility. Results marked "<" are situated in the interval of the limit of detection and the limit of quantification and are not quantified.

Results marked "n.d." are lower than the limit of detection.

"Lowerbound" and "Upperbound" are levels defined in Directive 2002/69/EC and 2002/70/EC.

Annex No. 1 to test Report No. 9413/1/2008

Sample: HK0806570-6 (S4-2)

Measurement results:

Sample:	HK080657	70-6 (S4-2)				
			Final extract [µ1]:		75	
Sample weight [g]:	5.0)88	Injection volume $[\mu l]$:		2	
Dry matter [%]:	10	00	Acquisition date [d.m.y	y h:m]:	9.5.08 11:47	
2,3,7,8-PCDD/Fs	Content	Limit of	Limit of	¹ I-TEFs	I-TEQ	
		Detection	Quantification			
	[ng/g dw]	[ng/g dw]	[ng/g dw]		[ng/g dw]	
2,3,7,8-TCDD	n.d.	0.00035	0.00069	1	0	
1,2,3,7,8-PeCDD	n.d.	0.00068	0.0014	0.5	0	
1,2,3,4,7,8-HxCDD	n.d.	0.00087	0.0017	0.1	0	
1,2,3,6,7,8-HxCDD	n.d.	0.00087	0.0017	0.1	0	
1,2,3,7,8,9-HxCDD	n.d.	0.00087	0.0017	0.1	0	
1,2,3,4,6,7,8-HpCDD	n.d.	0.0012	0.0024	0.01	0	
OCDD	n.d.	0.0016	0.0031	0.001	0	
2,3,7,8-TCDF	n.d.	0.00030	0.00061	0.1	0	
1,2,3,7,8-PeCDF	n.d.	0.00048	0.00097	0.05	0	
2,3,4,7,8-PeCDF	n.d.	0.00048	0.00097	0.5	0	
1,2,3,4,7,8-HxCDF	n.d.	0.0011	0.0021	0.1	0	
1,2,3,6,7,8-HxCDF	n.d.	0.0011	0.0021	0.1	0	
1,2,3,7,8,9-HxCDF	n.d.	0.0011	0.0021	0.1	0	
2,3,4,6,7,8-HxCDF	n.d.	0.0011	0.0021	0.1	0	
1,2,3,4,6,7,8-HpCDF	n.d.	0.0015	0.0030	0.01	0	
1,2,3,4,7,8,9-HpCDF	n.d.	0.0015	0.0030	0.01	0	
OCDF	n.d.	0.0019	0.0038	0.001	0	
I-TEQ from quantifi	ed 2,3,7,8-PCI	DD/Fs [ng 2,3,	7,8-TCDD/g dw]-"Lowe	erbound"	0	
I-TEQ from quantified	d 2,3,7,8-PCDE	Ds [ng 2,3,7,8-7	[CDD/g dw]		0	
I-TEQ from quantified	12,3,7,8-PCDF	s [ng 2,3,7,8-T	CDD/g dw]		0	
I-TEQ from n.d. and 1	non quantified 2	2,3,7,8-PCDD/	Fs [ng 2,3,7,8-TCDD/g d	w]	0.0017	
Maximum possible I	-TEQ [ng 2,3,7	,8-TCDD/g dy	w]-"Upperbound"		0.0017	
PCDDs	Content	[ng/g dw]	PCDFs	Conten	t [ng/g dw]	
Tetra-CDDs	n	.d.	Tetra-CDFs		n.d.	
Penta-CDDs	n	n.d. Penta-CDFs			n.d.	
Hexa-CDDs	n	n.d. Hexa-CDFs n.d.			n.d.	
Hepta-CDDs	n	.d.	Hepta-CDFs	DFs n.d.		
OCDD	n	.d.	OCDF		n.d.	
Total PCDDs	n	.d.	Total PCDFs		n.d.	

¹I-TEF according to NATO.

The limits of quantification are defined as the double of the detection limits.

The limit of detection is defined as the amount of analyte producing a signal with $S/N \ge 3$.

The value of the detection limit is mentioned as the actual value at the acquisition date.

Measurement uncertainty is expressed as a double (k=2) relative standard deviation (RSD%), and corresponds to 95% interval of reliability.

Estimation of uncertainty of each 2,3,7,8-PCDD/F congener is 30% and total I-TEQ is 20%.

These values were ensured by analyses of certified reference material under conditions of internal reproducibility. Results marked "<" are situated in the interval of the limit of detection and the limit of quantification and are not quantified.

Results marked "n.d." are lower than the limit of detection.

"Lowerbound" and "Upperbound" are levels defined in Directive 2002/69/EC and 2002/70/EC.

Annex No. 1 to test Report No. 9413/1/2008

Sample: HK0806570-11 (S7-S8 MIX)

Measurement results:

Sample:	HK0806570-1	1 (S7-S8 MIX)			
			Final extract [µl]:		75
Sample weight [g]:	5.0	001	Injection volume $[\mu 1]$:		2
Dry matter [%]:	98	3.8	Acquisition date [d.m.y	/ h:m]:	9.5.08 12:44
2,3,7,8-PCDD/Fs	Content	Limit of Detection	Limit of Quantification	¹ I-TEFs	I-TEQ
	[ng/g dw]	[ng/g dw]	[ng/g dw]		[ng/g dw]
2,3,7,8-TCDD	n.d.	0.00025	0.00051	1	0
1,2,3,7,8-PeCDD	n.d.	0.00046	0.00092	0.5	0
1,2,3,4,7,8-HxCDD	n.d.	0.00085	0.0017	0.1	0
1,2,3,6,7,8-HxCDD	n.d.	0.00085	0.0017	0.1	0
1,2,3,7,8,9-HxCDD	n.d.	0.00085	0.0017	0.1	0
1,2,3,4,6,7,8-HpCDD	n.d.	0.0011	0.0023	0.01	0
OCDD	n.d.	0.0015	0.0030	0.001	0
2,3,7,8-TCDF	n.d.	0.00028	0.00055	0.1	0
1,2,3,7,8-PeCDF	n.d.	0.00038	0.00075	0.05	0
2,3,4,7,8-PeCDF	n.d.	0.00038	0.00075	0.5	0
1,2,3,4,7,8-HxCDF	n.d.	0.00081	0.0016	0.1	0
1,2,3,6,7,8-HxCDF	n.d.	0.00081	0.0016	0.1	0
1,2,3,7,8,9-HxCDF	n.d.	0.00081	0.0016	0.1	0
2,3,4,6,7,8-HxCDF	n.d.	0.00081	0.0016	0.1	0
1,2,3,4,6,7,8-HpCDF	n.d.	0.0010	0.0020	0.01	0
1,2,3,4,7,8,9-HpCDF	n.d.	0.0010	0.0020	0.01	0
OCDF	n.d.	0.0018	0.0037	0.001	0
I-TEO from quantifi	ed 2,3,7,8-PCI	DD/Fs [ng 2,3,7	7,8-TCDD/g dw]-"Lowe	erbound"	0
I-TEO from quantified	12.3.7.8-PCDD	os [ng 2,3,7,8-1	CDD/g dw]		0
I-TEO from quantified	d 2.3.7.8-PCDF	s [ng 2,3,7,8-T	CDD/g dw]		0
I-TEO from n.d. and r	on quantified 2	.3.7.8-PCDD/I	Fs [ng 2,3,7,8-TCDD/g d	w]	0.0013
Maximum possible I	-TEO [ng 2,3,7	,8-TCDD/g dy	w]-"Upperbound"	-	0.0013
PCDDs	Content	[ng/g dw]	PCDFs	Content	t [ng/g dw]
Tetra-CDDs	n	.d.	Tetra-CDFs		n.d.
Penta-CDDs	n	.d.	Penta-CDFs n.d.		
Hexa-CDDs	n	.d.	Hexa-CDFs	n.d.	
Hepta-CDDs	n	.d.	Hepta-CDFs		n.d.
OCDD	n	.d.	OCDF		n.d.
Total PCDDs	n	.d.	Total PCDFs		n.d.

¹I-TEF according to NATO.

The limits of quantification are defined as the double of the detection limits.

The limit of detection is defined as the amount of analyte producing a signal with $S/N \ge 3$.

The value of the detection limit is mentioned as the actual value at the acquisition date.

Measurement uncertainty is expressed as a double (k=2) relative standard deviation (RSD%), and corresponds to 95% interval of reliability.

Estimation of uncertainty of each 2,3,7,8-PCDD/F congener is 30% and total I-TEQ is 20%.

These values were ensured by analyses of certified reference material under conditions of internal reproducibility. Results marked "<" are situated in the interval of the limit of detection and the limit of quantification and are not quantified.

Results marked "n.d." are lower than the limit of detection.

"Lowerbound" and "Upperbound" are levels defined in Directive 2002/69/EC and 2002/70/EC.

Annex C

Implementation Schedule

C1 IMPLEMENTATION SCHEDULE

C1.1 INTRODUCTION

This *Annex* summarises all the mitigation measures recommended in the *EIA Study* and presents them in the form of an Implementation Schedule in accordance with the requirements of Section 3.4.6.3 of the *EIA Study Brief No. ESB-164/2007*.

The Implementation Schedule has the following column headings:

EIA Ref

This denotes the section number or reference from the EIA Report Main text.

EM&A Ref

This denotes the sequential number of each of the recommended mitigation measures specified in the Implementation Schedule.

Recommended Mitigation Measures

This denotes the recommended mitigation measures, courses of action or subsequent deliverables that are to be adopted, undertaken or delivered to avoid, reduce or ameliorate predicted environmental impacts.

Objectives of the Recommended Measure and Main Concerns to be Addressed

This denotes the objectives of the recommended mitigation measures and main concerns to address.

Location of Measures

This indicates the spatial area in which the recommended mitigation measures are to be implemented.

Who to Implement the Measures?

This denotes where the responsibility lies for the implementation of the recommended mitigation measures.

When to Implement the Measures?

This denotes the stage at which the recommended mitigation measures are to be implemented during the decommissioning phase.

What Requirements or Standards for the Measures to Achieve?

This defines the controlling legislation that is required to be complied with.

Table C1.1aImplementation Schedule

EIA Ref.	EM&A Ref	Recommended mitigation measures	Objectives of the recommended measure &	Location of the measures	Who to implement the	When to implement the measures?		nt What requirements or standards for
			main concerns to be addressed		measures?	Design Stage	Demolition Stage ^(a)	the measures to achieve?
Air Q	uality							
3.6	AQ1	The engine of idling construction plant will be switched off	To minimise potential air nuisance arising from the demolition works.	All works areas	Demolition contractor(s)		✓	Air Pollution Control (Construction Dust) Regulations
3.6	AQ 2	Construction plant will be regularly checked and maintenance to avoid emission of black smoke	To minimise potential air nuisance arising from the demolition works.	All works areas	Demolition contractor(s)		✓	Air Pollution Control (Construction Dust) Regulations
3.6	AQ 3	Wheel washing facilities will be provided at the exit of the Project Site	To minimise potential air nuisance arising from the demolition works.	Worksite exit	Demolition contractor(s)		✓	Air Pollution Control (Construction Dust) Regulations
3.6	AQ 4	Both ends of the individual section of the duct works of the Co-Combustion unit will be sealed with two layers of polyethylene sheet immediately after dismantle and prior to lower down to the ground level	To minimise potential air nuisance arising from the demolition works.	All works areas	Demolition contractor(s)	~	✓	Air Pollution Control (Construction Dust) Regulations
3.6	AQ 5	Internal lining or surface of the Co-Combustion unit (including duct works, and chambers of the rotary kiln, secondary combustion unit, gas cooler, and dust collector) will be damped with water spray and wet wiping to remove any residual dust. Cleaning materials will be placed in sealed bags and disposed of at a landfill designated by the EPD	To minimise potential air nuisance arising from the demolition works.	All works areas	Demolition contractor(s)	*	~	Air Pollution Control (Construction Dust) Regulations
3.6	AQ 6	Filter bags of dust collector will be removed in	To minimise potential	All works areas	Demolition		\checkmark	Air Pollution Control

EIA	EM&A	Recommended mitigation measures	Objectives of the	Location of the	Who to	When to implement W		What requirements
Ker.	Ker		main concerns to be	measures	measures?	Design	Demolition	the measures to
			addressed			Stage	Stage (a)	achieve?
		accordance with the manufacturer's procedures and placed in sealed bags and disposed of with the cleaning materials at a designated landfill	air nuisance arising from the demolition works.		contractor(s)			(Construction Dust) Regulations
3.6	AQ 7	The concrete structures and slab will be damping with water spray prior to and during the demolition works to minimal dust generation	To minimise potential air nuisance arising from the demolition works.	All works areas	Demolition contractor(s)		✓	Air Pollution Control (Construction Dust) Regulations
3.6	AQ 8	Broken concrete and scrap metals will be placed in separate skips. The skips storing broken concrete will be covered with impervious sheet at the end of each working day and where necessary during windy days	To minimise potential air nuisance arising from the demolition works.	All works areas	Demolition contractor(s)		~	Air Pollution Control (Construction Dust) Regulations
3.6	AQ 9	The dropping height of the imported soil during material handling or will be minimised as much as practicable to minimise dust generation	To minimise potential air nuisance arising from the demolition works.	All works areas	Demolition contractor(s)		✓	Air Pollution Control (Construction Dust) Regulations
3.7	AQ10	The cleaning workshop will be provided with forced ventilation and maintained a slight negative pressure, and the exhaust air will be cleaned with a HEPA filter	To minimise potential air nuisance arising from the cleaning works.	All works areas	Demolition contractor(s)		~	Air Pollution Control (Construction Dust) Regulations
3.7	AQ11	Regular environmental site audits will be conducted to ensure that recommended dust control measures are implemented	To minimise potential air nuisance arising from the demolition works	All works areas	Demolition contractors/GIC Project Team		✓	
Land	Contamin	ation						

No potential land contamination impact is anticipated during the CCPP demolition or thereafter. No mitigation measure for land contamination will be required.

EIA Ref.	EM&A Ref	Recommended mitigation measures	Objectives of the recommended measure & main concerns to be	Location of the measures	Who to implement the measures?	When to the m Design	o implement neasures? Demolition	What requirements or standards for the measures to
Water	· Ouality		addressed			Stage	Stage ^(a)	achieve?
6.6	WQ1	Prior to the demolition works, perimeter cut-off drains to direct off-site water around the site will be constructed and internal drainage works and erosion and sedimentation control facilities implemented. The design of any silt removal facilities will be based on the guidelines in Appendix A1 of ProPECC PN 1/94.	To minimise potential water quality impacts arising from the demolition works	All work areas	Demolition contractor(s)	1	•	Water Pollution Control Ordinance / EPD Practice Note for Professional Persons, Construction Site Drainage (ProPECC PN 1/94)
6.6	WQ2	Channels, earth bunds or sand bag barriers will be provided on site to direct potential contaminated stormwater to existing underground wastewater storage tank of the MRRF building. The wastewater will then be pumped to the on-site WWTP for treatment.	To minimise potential water quality impacts arising from the demolition works	All work areas	Demolition contractor(s)	1	✓	Water Pollution Control Ordinance / EPD Practice Note for Professional Persons, Construction Site Drainage (ProPECC PN 1/94)
6.6	WQ3	 Site Runoff All drainage facilities and erosion and sediment control structures will be regularly inspected and maintained to ensure proper and efficient operation at all times and particularly following rainstorms. Deposited silt and grit will be removed regularly and disposed of. 	To minimise potential water quality impacts arising from the demolition and works	All work areas	Demolition contractor(s)	~	✓	Water Pollution Control Ordinance / EPD Practice Note for Professional Persons, Construction Site Drainage (ProPECC PN 1/94)
		• Measures will be taken to reduce the ingress of site drainage into excavations. If the excavation of concrete foundation is to be carried out in wet season, they will be dug and backfilled in short sections wherever practicable. Water pumped				~	✓	

EIA Ref.	EM&A Ref	Recommended mitigation measures	Objectives of the recommended measure &	Location of the measures	Who to implement the	When t the r	o implement neasures?	What requirements or standards for
			main concerns to be addressed		measures?	Design Stage	Demolition Stage ^(a)	the measures to achieve?
		out from trenches or foundation excavations will be discharged into storm drains via silt removal facilities.						
		• Open stockpiles of excavated and demolition materials will be covered with tarpaulin or similar fabric during rainstorms. Measures will be taken to prevent the washing away of residues, chemicals or debris into any drainage system.					~	
		• Manholes (including newly constructed ones) will always be adequately covered and temporarily sealed so as to prevent silt, construction materials or debris being washed into the drainage system.				~	✓	
		• Precautions will be taken when a rainstorm is imminent or forecasted, and actions to be taken during or after rainstorms are summarised in Appendix A2 of ProPECC PN 1/94. Particular attention will be paid to the control of silty surface runoff during storm events.					V	
		• All temporary and permanent drainage pipes and culverts provided to facilitate runoff discharge will be adequately designed for the controlled release of storm flows. All sediment traps will be regularly cleaned and maintained. The temporary diverted drainage will be reinstated to the original condition when the construction work has finished or the temporary diversion is no longer required.				4	~	
6.6	WQ4	 Wastewater from Site Facilities Vehicle and plant servicing areas, vehicle 	To minimise potential water quality impacts arising from the	All work areas	Demolition contractor(s)	~	~	Water Pollution Control Ordinance / EPD Practice Note

EIA Ref	EM&A Ref	Recommended mitigation measures	Objectives of the	Location of the	Who to implement the	When to	o implement	What requirements
Kei.	Kei		main concerns to be addressed	incusures	measures?	Design Stage	Demolition Stage ^(a)	the measures to achieve?
		washing bays and lubrication bays will, as far as possible, be located within roofed areas. The drainage in these covered areas will be connected to foul sewers via a petrol interceptor.	demolition works					for Professional Persons, Construction Site Drainage (ProPECC PN 1/94)
		• Oil leakage or spillage will be contained and cleaned up immediately. Waste oil will be collected and stored for recycling or disposal, in accordance with the Waste Disposal Ordinance.					✓	
6.6	WQ 5	 Storage and Handling of Oil, Other Petroleum Products and Chemicals Waste streams classifiable as chemical wastes will be properly stored, collected and treated for compliance with Waste Disposal Ordinance or Waste Disposal (Chemical Waste) (General) Regulation requirements. 	To minimise potential water quality impacts arising from the demolition works	All work areas	Demolition contractor(s)		~	Waste Disposal Ordinance / Waste Disposal (Chemical Waste) (General) Regulation
		• All fuel tanks and chemical storage areas will be provided with locks and be sited on paved areas.					\checkmark	
		• The storage areas will be surrounded by bunds with a capacity equal to 110% of the storage capacity of the largest tank to prevent spilled oil, fuel and chemicals from reaching the receiving waters.				¥	~	
		• The Contractors will prepare guidelines and procedures for immediate clean-up actions following any spillages of oil, fuel or chemicals.					✓	

EIA EM& Ref. Ref		A Recommended mitigation measures	Objectives of the recommended measure &	Location of the measures	Who to implement the	When to implement the measures?		t What requirements or standards for
			main concerns to be addressed		measures?	Design Stage	Demolition Stage ^(a)	the measures to achieve?
		• Surface run-off from bunded areas will pass through oil/grease traps prior to discharge to the stormwater system.				~	~	
6.6	WQ 6	Sewage from Workforce	To minimise potential	All work areas	Demolition		\checkmark	Water Pollution
		The existing toilet facility of the GICP will be available to the construction workforce. The sewage will be discharged to existing WWTP of the GICP. The effluent discharge from the site will be monitored as part of the routine monitoring under the <i>WPCO</i> licence	arising from the works		contractor(s)			EPD Practice Note for Professional Persons, Construction Site Drainage (ProPECC PN 1/94)
6.8	WQ 7	 Site Audit To carry out monthly site audits to the works areas to monitor the environmental performance of the Project and to enable prompt actions to rectify any malpractice which may give rise to water pollution problem. 	To minimise potential water quality impacts arising from the works	All work areas	Demolition contractor(s)/ GIC Project Team		~	
Waste	e Manager	ment						
5.6	WM1	All the necessary waste disposal permits are obtained prior to the commencement of construction work.	To ensure that adverse environmental impacts are prevented	All work areas	GIC/ Demolition contractor(s)		~	Waste Disposal Ordinance (Cap 354)/Waste Disposal (Chemical Waste) (General) Regulation (Cap 354C)
5.6.1	WM 2	Waste Management Hierarchy						
		The various waste management options are categorised	To ensure that adverse	All work areas	GIC/ Demolition	~	\checkmark	Waste Disposal

EIA	EM&A	Recommended mitigation measures	Objectives of the	Location of the	Who to	When t	o implement	What requirements
Kei.	Ker		main concerns to be	measures	implement the	Design	Demolition	the measures to
			addressed		incubales.	Stage	Stage (a)	achieve?
		 in terms of preference from an environmental viewpoint. The options considered to be most preferable have the least environmental impacts and are more sustainable in the long term. The hierarchy is as follows: Avoidance and reduction; Reuse of materials; Recovery and recycling and Treatment and disposal. 	environmental impacts are prevented		contractor(s)			Ordinance (Cap 354)/Waste Disposal (Chemical Waste) (General) Regulation (Cap 354C) / WBTC Nos. 6/2002 and 6/2002A "Enhanced Specification for Site Cleanliness and Tidiness"
5.6.1	WM 3	Nomination of approved personnel to be responsible for good site practices, arrangements for collection and effective disposal to an appropriate facility of all wastes generated at the site	To ensure that adverse environmental impacts are prevented	All work areas	GIC/ Demolition contractor(s)		~	Waste Disposal Ordinance (Cap 354)
		 Provision of site personnel in proper waste management and chemical handling procedures; 						
		• Provision of sufficient waste disposal points and regular collection for disposal;						
		• Provision appropriate measures to reduce windblown litter and dust transportation of waste by either covering trucks or by transporting wastes in enclosed containers;						
		• Arrangement of separation of chemical wastes for special handling and appropriate treatment at the CWTC;						
		• Arrangement of regular cleaning and maintenance programme for drainage systems, sumps and oil interceptors (if used); and						

EIA EM&A Ref. Ref		M&A Recommended mitigation measures Ref	Objectives of the recommended measure &	Location of the measures	Who to implement the	When to implement the measures?		t What requirements or standards for
			main concerns to be addressed		measures?	Design Stage	Demolition Stage ^(a)	the measures to achieve?
		• Maintain a recording system for the amount of wastes generated, reused on site, recycled and disposed.						
5.6.2	WM 4	Waste Reduction Measures						
		Good management and control can prevent generation of significant amount of waste. Waste reduction is best achieved at the planning and design stage, as well as by ensuring the implementation of good site practices. Recommendations to achieve waste reduction include:	To ensure that adverse environmental impacts are prevented and to minimise the quantity of waste to be disposed of at landfill.	All work areas	GIC/ Demolition contractor(s)		~	Waste Disposal Ordinance (Cap 354)
		• Segregation and storage of different types of waste in different containers, skips or stockpiles to enhance reuse or recycling of material and their proper disposal;						
		• Encourage collection of aluminium cans and waste paper by individual collectors during construction with separate labelled bins provided to segregate these wastes from other general refuse by the workforce;						
		 Unused reagents will be recycled as far as possible; 						
		• The Co-Combustion residues should be reused on-site for cement production in order to avoid the disposal of these wastes at the landfill						
5.6.3	WM 5	Chemical Waste	To ensure proper	All work areas	GIC/ Demolition		\checkmark	Waste Disposal
		GIC is a registered chemical waste producer and will liaise with EPD to determine the need to update the list of chemical wastes to be handled during the	handling of chemical waste		contractor(s)			(Chemical Waste) (Chemical Waste)

EIA	EM&A	Recommended mitigation measures	Objectives of the	Location of the	Who to	When to implement		What requirements
Ref.	Ref		recommended measure &	measures	implement the	the r	neasures?	or standards for
			main concerns to be		measures?	Design Stage	Demolition Stage (a)	the measures to
		demolition works.				Juge	Juge	(General) Regulation (Cap 354C) / Code of Practice on the Packaging, Handling and Storage of Chemical Wastes
5.6.3	WM 6	Chemical waste will be handled in accordance with the Code of Practice on the Packaging, Handling and Storage of Chemical Wastes. The containers to be used for storage of chemical wastes will:	To ensure proper handling of chemical waste	All work areas	GIC/ Demolition contractor(s)		\checkmark	Waste Disposal Ordinance (Cap 354) / Waste Disposal (Chemical Waste)
		• Be suitable for the substance they are holding, resistant to corrosion, maintained in a good condition, and securely closed;						(General) Regulation (Cap 354C) / Code of Practice on the Packaging, Handling
		• Have a capacity of less than 450 L unless the specifications have been approved by the EPD; and						and Storage of Chemical Wastes
		• Display a label in English and Chinese in accordance with instructions prescribed in Schedule 2 of the Regulations.						
5.6.3	WM 7	The storage area for chemical wastes will:	To ensure proper	All work areas	GIC/ Demolition		\checkmark	Waste Disposal
		• Be clearly labelled and used solely for the storage of chemical waste;	handling of chemical waste		contractor(s)			Ordinance (Cap 354) / Waste Disposal (Chemical Waste)
		• Be enclosed on at least 3 sides;						(General) Regulation
		• 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;						(Cap 354C) / Code of Practice on the Packaging, Handling and Storage of Chemical Wastes

EIA Ref.	EM&A Ref	Recommended mitigation measures	Objectives of the recommended measure &	Location of the measures	Who to implement the	When to the n	o implement neasures?	What requirements or standards for
			main concerns to be addressed		measures?	Design Stage	Demolition Stage ^(a)	the measures to achieve?
		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.						
5.6.3	WM 8	Chemical waste will be disposed of:	To ensure proper	All work areas	GIC/ Demolition		\checkmark	Waste Disposal
		• Via a licensed waste collector; and	handling of chemical waste		contractor(s)			/ Waste Disposal
		• To a facility licensed to receive chemical waste, such as the CWTC which also offers a chemical waste collection service and can supply the necessary storage containers.						(Chemical Waste) (General) Regulation (Cap 354C) / Code of Practice on the Packaging, Handling and Storage of Chemical Wastes
5.6.4	WM 9	General Waste						
		General refuse will be stored in enclosed bins separately from construction and chemical wastes. Recycling bins will be provided at strategic locations to facilitate recovery of aluminium can and waste paper from the site. Materials recovered will be sold for recycling.	To ensure that adverse environmental impacts are prevented and to minimise the quantity of waste to be disposed of at landfill	All work areas	Demolition contractor(s)		~	Waste Disposal Ordinance (Cap 354)

EIA	EM&A	Recommended mitigation measures	Objectives of the	Location of the	Who to	When to	o implement	What requirements
Ref.	Ref		recommended measure &	measures	implement the	the n	neasures?	or standards for
			main concerns to be		measures?	Design	Demolition	the measures to
			addressed			Stage	Stage (a)	achieve?
5.8	WM 10	Environmental Monitoring & Audit Requirements						
			To ensure that adverse	All work areas	GIC/ Demolition		\checkmark	
		Monthly audits of the waste management practices will	environmental impacts		contractor(s)			
		be carried out during the Project to determine if wastes are being managed in accordance with the good site practices described in this <i>EIA Report</i> . The audits	are prevented					
		waste generation, storage, recycling, transport and						
		disposal.						
Note: (a) Ir	cluding o	dismantling/demolition of structures or building of the C	CPP, cleaning of the plant and	d equipment, demolitio	n of the slab and bac	kfilling of	the site with	clean soil.

This page is deliberately left blank