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LIST OF ABBREVIATIONS

AAP	Asbestos Abatement Plan
ACM	Asbestos Containing Materials
AIR	Asbestos Investigation Report
AMP	Asbestos Management Plan
ANL	Acceptable Noise Level
AQMS	Air Quality Monitoring Station
AQO	Air Quality Objectives
Arch SD	Architectural Services Department
ASR	Area Sensitivity Rating
ASRs	Air Sensitive Receivers
BOD	Biochemical Oxygen Demand
BPM	Best Practicable Means
C&D	Construction and Demolition
CAP	Contamination Assessment Plan
CAR	Contamination Assessment Report
CARB	Air Resources Board, California
CLP	China Light and Power
CNL	Corrected Noise Level
CNP	Construction Noise Permit
CO	Carbon monoxide
COD	Chemical Oxygen Demand
COP	Code of Practice
CWTC	Chemical Waste Treatment Centre
DA-TM	Technical Memorandum on Noise from Construction Work in Designated Areas
DCM	Dioxin Containing Materials
EIAO	Environmental Impact Assessment Ordinance
EIAO-TM	Technical Memorandum on Environmental Impact Assessment Process
EM&A	Environmental Monitoring and Audit
EMSD	Electrical and Mechanical Services Department
EPD	Environmental Protection Department
ETWBTC(W)	Environment, Transport and Works Bureau Technical Circular (Works)
FEHD	Food and Environmental Hygiene Department
GFA	Gross Floor Area
GW-TM	Technical Memorandum on Noise from Construction Work other than Percussive Piling
HCl	Hydrogen chloride
HEPA	High Efficiency Particulate Air
Hg	Mercury
HMCM	Heavy Metal Containing Materials
IND-TM	Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites
ISCST	Industrial Source Complex Short Tem (Air dispersion modelling)
KCIP	Kwai Chung Incineration Plant
KCRC	Kowloon-Canton Railway Corporation
LD	Labour Department
NCO	Noise Control Ordinance
NO_2/NO_x	Nitrogen Dioxide / Nitrogen oxides
NSR	Noise Sensitive Receiver
OEHHA	Office of Environmental Health Hazard Assessment, California
OU	Odour Unit
PAH	Polyaromatic Hydrocarbons
PAHCM	Polyaromatic Hydrocarbons Containing Materials
PCB	Polyclorinated Biphenyls
PCBCM	Polyclorinated Biphenyls Containing Materials
PCW	Prescribed Construction Works
PME	Powered Mechanical Equipment

PNL	Predicted Noise Level
PP-TM	Technical Memorandum on Noise from Percussive Piling
ProPECC	Practice Note for Professional Persons
RAP	Remediation Action Plan
RNSR	Representative Noise Sensitive Receiver
RSP	Respirable Suspended Particulates
SO2	Sulphur Dioxide
SPME	Specified Powered Mechanical Equipment
SWL	Sound Power Level
TAP	Toxic air pollutant
TCDD	Tetrachloro-p-Dibenzo Dioxin
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxicity equivalent (for dioxin species)
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TPHCM	Total Petroleum Hydrocarbons Containing Materials
TSKH	Ting Siu Kin Hospital
TSP	Total Suspended Particulates
USEPA	United States Environmental Protection Agency
WBTC	Works Branch Technical Circular
WHO	World Health Organization
WPCO	Water Pollution Control Ordinance
WQO	Water Quality Objectives

1 INTRODUCTION

1.1 Background

1.1.1 The demand for cremation service in Kowloon area is catered for by the Diamond Hill Crematorium (hereafter referred to as the Existing Crematorium) which started operation in 1979. The six existing cremators are now approaching the end of their serviceable life and hence the Food and Environmental Hygiene Department (FEHD) proposes to demolish the Existing Crematorium as well as to construct and operate a new crematorium (hereafter referred to as the New Crematorium) *in situ* as a replacement (hereafter referred to as this Project).

1.1.2 The Architectural Services Department (Arch SD) is the works agent for implementing the Project. After completion of construction works, the new cremators will be handed over to FEHD for operation.

1.1.3 The Hong Kong Productivity Council (HKPC) has been commissioned by Arch SD as the Consultants to undertake an Environmental Impact Assessment (EIA) for the Project. HKPC has been supported by Townland Consultants Limited, Scott Wilson (Hong Kong) Limited and Atkins China Limited in this EIA study, who have conducted the landscape and visual impact assessment, contaminated land assessment, and asbestos assessment respectively.

1.1.4 Having examined HKPC's Project Profile (PP-166/2002) for the Project on 25 March 2002, EPD issued the EIA Study Brief No. *ESB-102/2002* under *Section 5(7)(a)* of the *EIA Ordinance* (EIAO) on 7 May 2002. Under the original agreement between Arch SD and the Consultant, the Consultant was commissioned to undertake an EIA on the construction and operation of the New Crematorium. Subsequently, in December 2002, Arch SD commissioned the Consultant to extend the EIA Study to include the assessment of environmental impacts caused by the demolition of the Existing Crematorium as well. Details of the demolition works of the Existing Crematorium as well as the construction and operation of the New Crematorium (i.e. the Project) are provided in *Section 2*.

1.1.5 Based on the definition laid down under the EIAO as well as the nature of the proposed Project, two designated projects (DPs) requiring environmental permit are identified. One DP falls into EIAO *Schedule 2, Part II, Item 3*, which is the decommissioning of a clinical waste incinerator, as the Existing Crematorium once dealt with non-infectious amputated body parts, which is classified as clinical waste under the "Practice Note on the Disposal of Clinical Waste at Landfills" from hospitals during the period of 1994 to 2001. The other DP falls into category *N4* of EIAO *Schedule 2, Part I*, which is the construction and operation of the New Crematorium. This EIA report has been prepared to fulfill all the requirements described in the Study Brief for the EIA for the two DPs as well as the EIAO Technical Memorandum (TM).

1.2 Purpose and Objectives of the EIA

1.2.1 As required by the EIA Study Brief, No. *ESB–102/2002*, the purpose of this EIA Study is to provide information on the nature and extent of environmental impacts arising from the construction and operation of the New Crematorium and related activities taking place concurrently as well as demolition of the Existing Crematorium. In essence, this Study should provide information on:

- The overall acceptability of any adverse environmental consequences that are likely to arise as a result of the proposed Project;
- The conditions and requirements for the detailed design, construction and operation of the proposed Project to mitigate against adverse environmental consequences wherever practicable; and
- Acceptability of residual impacts after the proposed mitigation measures are implemented.

The objectives of the EIA Study are as follows:

- To describe the proposed Project together with the requirements for carrying out the proposed Project;
- To identify and describe elements of community and environment likely to be affected by the proposed Project and/or likely to cause adverse impacts to the proposed Project, including natural and man-made environment and the associated environmental constraints;
- To describe the considerations given in selecting the proposed site, layout, design (including technology to be adopted for the new cremators), and construction and demolition methods; to provide reasons for selecting the preferred option and to describe the part environmental factors played in the selection process;
- To identify and quantify emission sources and determine the significance of impacts on sensitive receivers and potentially affected uses;
- To identify and quantify waste management requirements and propose measures to mitigate or prevent impacts, and measures to be adopted to avoid introducing land contamination at the Project site;
- To identify and quantify any potential landscape and visual impacts and to propose measures to mitigate impacts;
- To identify the negative impacts and propose mitigation measures so as to minimize pollution, environmental disturbance and nuisance during construction, demolition and operation phases of the Project;
- To identify, predict and evaluate the residual (i.e. after practicable mitigation) environmental impacts and the cumulative effects expected to arise during the construction, demolition and operation phases of the proposed Project in relation to the sensitive receivers and potentially affected uses;
- To identify, assess and specify methods, measures and standards, to be included in the detailed design, construction, demolition and operation of the proposed Project, which are necessary to mitigate these environmental impacts and cumulative effects and to reduce them to acceptable levels;
- To identify constraints associated with the mitigation measures recommended in the EIA Study; and
- To design and specify an environmental monitoring programme, and if required, other environmental monitoring and audit requirements, to ensure the implementation and the effectiveness of the recommended environmental protection and pollution control measures.

1.3 Study Area

1.3.1 The area of the Project site is approximately 10,300 m^2. The Existing Crematorium is located along Po Kong Village Road in Diamond Hill, between Hammer Hill Road and Po Leung Lane. The Study area focuses on the immediate environment of the Project but also takes into account the surrounding areas where necessary. Layout and description of the Existing and New Crematorium are provided in *Section 2*.

1.4 Key Environmental Issues and Study Approach

1.4.1 Key environmental issues and concerns as identified in the Project Profile (*PP-166/2002*) as well as in *Clauses 3.2.1*, *3.3.2* and *Appendix A* in *ESB –102/2002* have been evaluated in this EIA, including:

- The consideration given in selecting the proposed site, layout, design (including technology to be adopted for the new cremators), and construction and demolition methods for the Project;
- The air quality impacts arising from the construction, demolition and operation of the Project;
- The measures to be adopted to avoid introducing land contamination at the Project site, as well as the waste management for the construction, demolition and operation of the Project;
- The landscape and visual impacts from the construction and operation of the Project;
- The safety requirements related to storage of fuel;
- The noise impacts from the construction, demolition and operation of the Project;
- Handling of any effluent discharge from the air pollution control system for the New Crematorium during operation stage;
- Potential land contamination of the Existing Crematorium, taking into account the present land use and relevant landuse history in relation to possible land contamination and presence of any contaminated materials requiring disposal, in particular those contaminated by dioxin; and
- Disposal of potential contaminated materials, including demolition of building materials containing asbestos and dioxin.

The scope of this EIA Study covers the combined impacts of the Project and its associated elements as well as the cumulative impacts of existing, committed and planned developments in the vicinity of the Project site including:

- The Diamond Hill No. 2 Freshwater Service Reservoir: construction is scheduled from 4 July 2002 to end of 2005; and
- The proposed KCRC Shatin to Central Link: preliminary feasibility study is underway, and construction is scheduled from 2004 to 2008.

1.4.2 A number of environmental aspects are not considered to be of concern to this Project, they include:

- Ecology
- Fisheries impact
- Cultural heritage

1.5 Structure of the EIA Report

1.5.1 Following this introductory Section, this EIA Report consists of the following sections:

Section 2	Description of the Project
Section 3	Environmental Legislation, Policies, Plans, Standards and Criteria
Section 4	Air Quality Impact Assessment
Section 5	Noise Impact Assessment
Section 6	Land Contamination Impact Assessment
Section 7	Waste Management Implications
Section 8	Landscape and Visual Impact Assessment
Section 9	Water Quality Impact Assessment
Section 10	Hazard to Life
Section 11	Environmental Monitoring and Audit (EM&A) Requirements
Section 12	Summary of Environmental Outcomes
Section 13	Conclusion
Section 14	Implementation Schedule of Mitigation Measures

1.5.2 In addition, detail supplementary information associated with various EIA Study elements is presented in the following Appendices:

Appendix A	Air Quality Modeling Information
Appendix B	Noise Assessment Calculations
Appendix C	Contamination Assessment Plan and Report
Appendix D	Asbestos Investigation Report
Appendix E	Tree Survey
Appendix F	Framework of Environmental Management Plan

2 DESCRIPTION OF THE PROJECT

2.1 Needs for the Project

2.1.1 The Existing Crematorium has been handling the cremation service in Kowloon area since 1979 (i.e. operated for more than 24 years). A total of 105 fault incidents on the 6 cremators in the Existing Crematorium were recorded during the period from April 2002 to March 2003 (i.e., about 2 fault incidents every week), and the downtime incurred due to such faults and the associated repair works was, on average, about 217 hours per cremator over this period, which represent 7.4% of the annual operating hours of each cremator (8 x 365 or 2,920). Judging from the long years of operation and the frequent breakdowns over the past year, it is considered that the cremators in the Existing Crematorium have been approaching the end of their serviceable life. In other words, further continuous operation of the existing cremators for long hours would probably give rise to more frequent breakdowns and even longer down time, thereby adversely affecting the provision of cremation service to the public.

2.1.2 There are now 29 commonly used cremators in the territory and 6 of them are installed at the Existing Crematorium at Diamond Hill. These 6 cremators handled over 20% of the total cremations taken place in 2002. If these cremators were to cease operation eventually without any replacement or reprovisioning, it would be impossible for the other 23 cremators to absorb the current cremation loading. Replacement of the cremators at the Existing Crematorium is therefore essential for maintaining the normal level of service to the public. At a Legislative Council Case Conference meeting held in January 2003, Members urged for early implementation of the Existing Crematorium upgrading on the basis of environmental improvement.

2.1.3 According to FEHD's statistical data derived from population census in 2001, as a result of Government's efforts in promoting cremations, the number of cremations has been rising steadily at about 1% per year. The percentage of cremations to the total number of deaths registered has risen from 47% in 1979, when the Existing Crematorium was commissioned, to 82% in 2002. The actual number of cremations carried out in Hong Kong per year has increased substantially by about 55% over the past 15 years from some 18,400 in 1988 to over 28,400 in 2002. With the increase in the overall population and change in demographic profile, the number of deaths is expected to increase in the coming years and the demand for cremations will follow a continuously rising trend. With the use of present-day technology, the cremation time of the new cremators can be shorter. Similarly, with up-to-date pollution control cremation technologies as demonstrated in later *Sections*, the new cremators are capable to maintain the pollutant emissions within the relevant environmental standards. In other words, with improved environmental performance and greater cremation efficiency, the total handling capacity of the cremators will be enhanced and hence the number of daily cremation sessions will be increased. The replacement of the Existing Crematorium by the New Crematorium will therefore help meet part of the increasing demand for cremations. The adoption of up-to-date cremation technology and air pollution control system will not only increase the cremation efficiency but also improve environmental performance even with increased cremation demand.

2.1.4 There is a demonstrated need for the replacement of the Existing Crematorium by the New Crematorium (i.e. the Project) to upgrade the existing cremators and to meet the increasing cremation demand. Arch SD, in consultation with FEHD, has considered different options in siting, crematorium layout, and cremation and pollution control technologies in order to arrive at the practicable and environmentally sound design and arrangement for the proposed Project. Details of the key considerations leading to this Project are provided in the following sections.

2.2 Considerations on Siting of New Crematorium

2.2.1 To replace the existing cremators that have been approaching the end of their serviceable life and to ensure that future cremation demand will be met, the formerly-USD (presently FEHD) had explored various siting options as described below:

Option 1: Building additional new cremators at existing crematoria

2.2.2 The option of building additional six new cremators at existing crematoria to reprovision the six existing ones at Diamond Hill Crematorium had been considered. After reviewing the space availability of all existing crematoria, it was found that, apart from the Existing Crematorium at Diamond Hill, no other existing crematoria had space readily available for accommodating the additional six cremators. Therefore, this option was considered not feasible.

Option 2: Building a new crematorium at a new site

2.2.3 The formerly-USD conducted a site search for the development of a new crematorium for reprovisioning of the Existing Crematorium. The required site should be easily accessible by the public, and provided with the necessary infrastructure, including water and electricity supplies, drainage and sewerage system and road access. The new crematorium should also be environmentally compatible with the site and satisfy the statutory land requirement. However, as advised by the Planning Department (Plan D), most part of the urban area had been fully developed and no readily available new sites meeting these criteria could be identified. As for the New Territories, Plan D had, in a similar proposal to relocate Fu Shan Crematorium, commented that relocation should not be contemplated if upgrading (i.e. in-situ replacement) was a solution. In the absence of a suitable alternative site, this option was not feasible.

Option 3: Reprovisioning of the cremators at the Existing Crematorium site at Diamond Hill

2.2.4 Having studied the various possible options, to build six new cremators to replace the six existing cremators at the Existing Crematorium at Diamond Hill site is found to be the only feasible option as well as a straight-forward and most efficient approach in providing the proposed replacement cremators for meeting the demand in cremation service. The proposal was supported by the Environmental Committee of the formerly Wong Tai Sin Provisional District Board (PDB). At a Legislative Council Case Conference meeting held in January 2003, Members urged for early implementation of the Project so as to improve local environmental quality.

Proposed Project Site

2.2.5 After consideration of the above 3 options, it is proposed to adopt option 3, i.e., to build the New Crematorium at the Existing Crematorium site at Diamond Hill. As shown in *Figure 2.1*, the Project site is located along Po Kong Village Road in Diamond Hill, between Hammer Hill Road and Po Leung Lane. To the North of the Project site is an urn cemetery. The Diamond Hill Columbarium lies on the Eastern and Western sides of the Project site. The Northern part of the Project site is higher than the Southern part, making it sloping in nature.

2.3 Considerations on Layout of New Crematorium

2.3.1 Layout of the New Crematorium (see *Figures 2.2-2.5*) has been designed with due considerations to the following key factors:

New Crematorium Layout	Rationale Behind/Benefits
• Cremators and related facilities of the New Crematorium to be located at the Southern side of the Project site.	• Main facilities of the Existing Crematorium are currently located at the Northern side of the Project site. To ensure provision of continuous services by the Existing Crematorium before commissioning of the New Crematorium, the cremators of the New Crematorium will have to be located at the Southern side of the Project site. While these new cremators will be moved from the Northern side to the Southern side, it has been assessed that the surrounding air quality will be in full compliance with the relevant standards and guidelines (see Section 4 for details).
• Chimney of the New Crematorium to be located at the Southern side of the Project site	• This proposed arrangement enables the shortest flue length, which can minimize the formation of undesirable pollutant formation inside the flue (e.g. dioxin). The adoption of the new cremators with state-of-the-art technology with air pollution control systems will be able to control the emission within acceptable standards (see Section 4 for details).
• 3-level terraces design	• As mentioned in *Section 2.5.2*, the Project site is sloping in nature. Therefore, the terrace design of the New Crematorium will be able to fully utilize the Project site and to avoid large scale excavation.
• Construction of perimeter road	• This is to provide easy access for the public. Adequate drop off area will be provided for various vehicles segregating vehicular access and parking for the public from those for hearse, mortuary and the diesel unloading to ensure safety for both the public and operators.

2.4 Considerations on Selection of Cremation and Pollution Control Technologies

Cremation Technology

2.4.1 While the design of the New Crematorium has not yet been finalized, the cremation technology to be adopted will be carefully selected with due considerations given to the following key factors:

- Potential air pollution issues (particularly the compliance with relevant legal requirements)
- Minimise the potential odour nuisance and black smoke complaints to be generated by the New Crematorium
- Improvement in local environmental condition and at the same time coping with increasing cremation loading
- Operational efficiency (including the turnaround time for each cremation and energy efficiency)
- Ease of maintenance and serviceability

2.4.2 The cremation technologies under review and recent technologies adopted in other similar projects are as described in *Section 4*.

Pollution Control Technology

2.4.3 Appropriately designed air pollution control system will need to be incorporated into the new cremators in order to control the various air pollutant emissions, including particulate matters, heavy metals, organic gases, acidic gases, dioxins and odour, to levels in compliance with the relevant standards. In particular, considerations have been given to prevent future black smoke / odour nuisance arising from the operation of the New Crematorium. Different control technologies have been reviewed (see *Section 4*) and it has been decided to adopt a dry process (air pollutant removal without the use of water or liquid) for air pollution control so as to avoid generating any effluent discharge from the future control system.

2.4.4 The exact air pollution control technologies to be employed in the dry process will be carefully selected in order to achieve full compliance with the current Guidance Note on the Best Practical Means for Incinerators (Crematoria) (BPM 12/2) issued by EPD, which will govern stack emission of the New Crematorium. The BPM 12/2 is issued by EPD as one of the series to provide guidance for process specified under Part IV of the Air Pollution Control Ordinance. It sets out the basic requirement for the New Crematorium operator to provide and maintain the best practicable means for the prevention of the emission of air pollutants (the target emission level is given in *Table 4.1*). Other new crematoria (e.g. Kwai Chung Crematorium) has also adopted new cremation and air pollution control technologies to maintain the stack emission to BPM 12/2 standard.

2.5 Description of the Existing and New Crematorium

Existing Crematorium

2.5.1 As indicated in *Figure 2.1*, most of the facilities of the Existing Crematorium are provided in the main building at Northern side of the site, which include two (2) service halls and six (6) cremators. According to the drawing from Arch SD, the Existing Crematorium consists of approximately 1,300 m^2 gross floor area (GFA). The Existing Crematorium is a single-storey building with longitudinal section measuring 58.9 m and transverse section measuring 36.2 m. The maximum height of Existing Crematorium building is 5.2 m and the chimney height is 10.4 m. Cremators in the Existing Crematorium are fueled by diesel and there is an underground fuel tank with capacity of 9,092 L. In addition to cremation of the deceased, the Existing Crematorium processed clinical waste collected from hospitals from 1994 to 2001. A checklist of the facilities to be demolished is given in *Section 2.6.*

New Crematorium

2.5.2 The New Crematorium will comprise six (6) cremators, four (4) service halls and a range of supporting facilities. It will be located at a sloping site on three (3) terraces at different levels (from 70 mPD to 80 mPD). The usable site area for accommodation of the major components of the crematorium is limited.

2.5.3 The New Crematorium building will be organized into 2 distinct zones on 3 levels, namely, the podium deck level (service halls and landscaping), arrival hall level (office, public toilets etc) and the ground floor level (building services and cremator plant rooms). The podium level will be devoted to public use and the ground floor level will be mainly for operation/function/office use. The operation areas will be separated from the public area by the podium deck and access road. *Figures 2.2 to 2.5* show the layout of the New Crematorium.

2.5.4 The service halls will sit on a podium deck with landscaping, which will provide a peaceful setting for the ceremony and will help to convey the atmosphere appropriate to a funeral proceeding.

2.5.5 The presence of the landscaped podium deck garden will give opportunity for the funeral participants to experience the ritual in a comfortable environment. Moreover, the spatial arrangement of the new service halls and circulation pattern of the funeral proceeding would avoid the ‘conveyor belt’ type of funeral services offered in the Existing Crematorium.

2.5.6 In terms of traffic arrangement, the road approach and the profile of the Existing Crematorium are similar retained. The New Crematorium will provide adequate drop off area for various vehicles segregating vehicular access and parking for the public from those for hearse, mortuary and diesel unloading to ensure safety for both the operators and the public. The main parking for coaches (2 nos.), visitors' cars (4 nos.) and loading/unloading vehicles for mortuary and fuel service tanks will be provided in Phase I of the Project (see *Section 2.6*). Additional 14 nos. parking spaces will be provided in Phase II of the Project.

2.5.7 It is proposed that Phase I of the Project will be located at the sitting out area and garden of remembrance of the Existing Crematorium, and Phase II of the Project (see *Section 2.6*) would take up the Existing Crematorium main building area. The site area will be approximately 10,300 m^2 with GFA of about 2,084 m^2. The maximum building height will be 18.5 m from the lowest level and the height of chimney will be 28.5 m from the lowest level.

2.5.8 By introducing a new automatic transportation system, the New Crematorium will provide automatic handling of coffins, resulting in greater efficiency and higher-standard services. Based on an 10-hour work shift per day, the estimated number of cremations at the New Crematorium would be about 6 per day for each automatic cremation system. Total capacity of the fuel storage tanks in the New Crematorium will be much larger than that of the existing one (34,000 L vs 9,092 L) so as to reduce the frequency of refuel trips from once per 10 days in the Existing Crematorium to once per month in the New Crematorium. This will help reduce both the traffic loading arising from travelling of fuel vehicles and the potential disturbance to users of the New Crematorium during refueling. The total capacity of fuel storage tanks in the New Crematorium is still substantially lower than the threshold of 10,000 tones or approximately 12,000,000 L, which is considered as potential hazardous installations under the *Hong Kong Planning Standards and Guidelines* (HKPSG).

2.5.9 The buildings of the New Crematorium will be merged with landscaped area. Four lily ponds are integrated into the main stairs of the arrival hall. Various planting areas and slopes with a wide range of plants e.g. trees, climbers are carefully layered into the buildings. Continuous planters along building edges will be adopted to soften the rectilinear building form.

2.5.10 Apart from the above improved features in the New Crematorium as compared to the Existing Crematorium, a framework of environmental management plan (see *Appendix F*) is also proposed to upkeep the environmental management standard in the New Crematorium.

2.6 Construction and Demolition Programme

2.6.1 The construction and demolition programme is constrained by the operation of the Existing Crematorium. For the Existing Crematorium to provide continuous service, the Project will be divided into two phases: Phase I (from September 2004 to February 2006) and Phase II (from October 2006 to November 2007). Boundary of the two phases of works and proposed programme of the Project are provided in *Figures 2.6 and 2.7* respectively. Details of the two phases of works are as follows:

Phase I

(a) Demolition of facilities in Existing Crematorium in the southern side of the Project site, including
- Existing sitting out area
- Garden of remembrance
- Existing building structure, including CLP secondary substation, toilets, pavilion and retaining walls

(b) Construction of the New Crematorium main facilities, including:
- One (1) cremator plant room housing six (6) cremators
- Three (3) fuel tanks (with total capacity of 34,000 L)
- Two (2) service halls (each can hold 120 people)

- One (1) pulverizing room
- One (1) mortuary
- One (1) office
- Toilets for public
- Ancillary service rooms including battery fork lift, transformer and switch room, emergency generator room and joss burners
- Two (2) automatic transportation systems for coffins and part of an underground service tunnel for coffin circulation
- Vehicular loading bay for coffin van, coach
- Landscape area
- Dangerous goods store
- Installation of temporary CLP electricity transformer at Phase II boundary

Phase II

(c) Demolition of Existing Crematorium main facilities, including:
- Two (2) service halls
- One (1) cremation room with six (6) cremators
- One (1) transformer room
- One (1) underground oil fuel storage tank (9,092 L)
- One (1) mortuary
- One (1) machine room
- One (1) general store plus water tank
- One (1) dangerous goods store
- One (1) chimney (10 m in height)

(d) Construction of the rest of the New Crematorium, including:
- Two (2) service halls (each can hold 120 people)
- Two (2) automatic transportation systems for coffins and remaining part of the underground service tunnel for coffin circulation
- Vehicular loading bay for coffin van, coach etc.
- Landscape area

2.6.2 The columbarium next to the Project site will remain untouched throughout both Phase I and Phase II.

2.6.3 To provide cremation service in a continuous manner, operation of the Existing Crematorium will be maintained until the commissioning of the New Crematorium main facilities provided in Phase I of the Project. Nevertheless, to prevent deterioration of environmental performance, in particular air quality, administrative measures to limit the total number of cremators in operation at any one time to not more than 6 are recommended in (see *Section 4*) so as to minimize cumulative impact.

2.6.4 To maintain continuous electricity supply, a temporary electricity transformer will be installed during Phase I (at Phase II site boundary) before the existing CLP secondary substation is decommissioned. As polychlorinated biphenyls (PCBs) containing materials will not be utilized, no land contamination issues related to the installation, operation, decommission and demolition is expected.

2.6.5 The 2-phase work schedule proposed above has been carefully planned to minimize large-scale excavation, particularly with the sloping site, with a view to eliminating the use of extensive retaining structures. The excavated materials will be, as far as practicable, used as backfill for construction of landscaping berms along the access road at the Northern end of the site in order to minimize the materials for dumping and disposal. The new retaining structures will be constructed using the reinforced fill technique as far as conditions permit. The reinforced fill structure is more sustainable in terms of energy consumption for its construction and also allows for better landscaping treatment to improve the visual impact.

2.7 Construction and Demolition Methodology

2.7.1 The demolition and construction works of the Project will be implemented into two phases, namely Phases I and II. Although the detailed demolition and construction plan has not yet been formulated at this stage, the demolition and construction methodology will be based on the following.

Phase I

Demolition Works

2.7.2 Structures to be demolished in Phase I are mainly reinforced concrete structures. These structures will be demolished and removed by traditional top down method utilizing hand held tools and mechanical breaking method commonly used by construction industry in Hong Kong. Demolition by implosion is prohibited.

Construction Works

2.7.3 Site Formation: upon completion of demolition works, new basement walls will be constructed to reform the site into two platforms of level 77 mP.D. and 72 mP.D. to house the New Crematorium with six cremators, 2 service halls and all ancillary facilities. Temporary shoring in the form of sheet pile or soldier pile and open cut excavation are assumed to be employed by the contractor for basement walls construction.

2.7.4 Substructure and Superstructure: simultaneously, pad footings and strip footing for columns and walls of the building will be constructed at their founding level by open cut excavation. Subsequently, the two-storey crematorium building which is in the form of reinforced concrete slabs, beams, walls and columns structures, will then be cast by using conventional construction method without requiring any special technique and equipment. No piling works are required.

2.7.5 AGV Tunnel: part of the underground AGV tunnel which is in the form of reinforced concrete box structure, will be founded 4m below ground level by open cut excavation.

Phase II

Demolition Works

2.7.6 Phase II demolition works will then be carried out using top down method similar to that used in Phase I. Demolition by implosion is prohibited.

Construction Works

2.7.7 AGV Tunnel: having finished the demolition works, the rest of the AGV tunnel will be constructed to meet the AGV tunnel of Phase I. Open cut excavation will probably be employed by the contractor to put the tunnel down to the required level.

2.7.8 Substructure and superstructure: pad footings and strip footing for columns and walls of the building will be constructed at their founding level by open cut excavation. Retaining walls for the new platform which is 3m above the existing ground level, will also be built. On the platform, two service halls of single-storey in reinforced concrete beams, slabs, walls and columns will then be cast by using the similar construction method as used in Phase I. No piling is required.

2.8 Benefits of this Project

2.8.1 After due consideration of the siting, layout, design, construction and demolition schedule as discussed in the previous sections, the proposed Project will have the following key environmental and social benefits:

- The Project will be able to address the increasing cremation demand without construction of additional cremators as the efficiency of the new cremators is much improved. Furthermore, as there will be appropriate air pollution control system for the new cremators, the emissions of air pollutants from chimney would be much reduced compared with the existing cremators.
- Replacing the Existing Crematorium by the New Crematorium with improved cremation design and air pollution control technologies will lead to the betterment of local air quality (via implementation of the Guidance Note on the Best Practicable Means for Incineration (Crematorium) (BPM 12/2) which strictly control the various air pollutant emission levels) (see *Section 4*)
- The existing cremators are consuming about 547,000 L of diesel per year. The new cremators would be more fuel efficient (36 L of diesel per cremation as compared to 73 L of diesel per cremation in Existing Crematorium) and therefore utilize less natural resources
- Spatial utilization in the Project site will be improved as explained in S.2.3.1
- The Project will be able to address the increasing cremation demand in a relatively shorter timeframe by avoiding the long lead time required to get a piece of vacant and earmarked land for adding a new crematorium in the relevant statutory plan (see S.2.2.1-2.2.4)
- Building the New Crematorium at the same location of the Existing Crematorium will provide a speedy means to replace the existing cremators, which are at the end of their serviceable life, because less time will be needed for making the infrastructure provisions (see S.2.2.2-2.2.4)
- Replacement of the existing cremators by the new cremators would more likely be accepted by the community as evidenced by the support of the Environmental Committee of the formerly Wong Tai Sin PDB in 1997 (see S.2.2.4)

2.9 Interactions with Other Projects

2.9.1 Based on the proposed Project schedule, the demolition and construction programme could overlap with the construction programme of: (i) Diamond Hill No. 2 Freshwater Service Reservoir and (ii) the proposed KCRC Shatin to Central Link. Locations of these projects are illustrated in *Figure 2.8*.

2.10 Scenarios with and without the Project

2.10.1 As explained in Section 2.1, there is a demonstrated need for the Project to replace the Existing Crematorium, which is near the end of its serviceable life, by the New Crematorium that will be equipped with state-of-the-art cremation technology and pollution control facilities. With the Project, it will be able to achieve improved environmental quality (particularly the air quality) in the locality as well as to address the increasing cremation demand without the need of building extra cremators (see Section 2.8). Therefore, it is anticipated that the future air quality in the vicinity of the Project site will tend to be improving after the implementation of the Project. For other environmental aspects, it is expected that there would be no significant adverse changes when compared to the current situation.

2.10.2 Without the Project, on the other hand, the existing cremators that are near the end of their serviceable life will have to continue their operation, which might likely give rise to the following adverse situations:

- The local environmental conditions, particularly the air quality, at the Existing Crematorium might be worsened due to potential reduction in performance of the existing cremators.
- According to the information from FEHD, the total number of odour and black smoke complaints relating to the operation of the Existing Crematorium had risen from 8 in 2000 to 10 in 2002. Continuing the use of existing cremators with likely increasing faults might see a further increase in the number of these complaints in future.
- The likely increasing down-time of the existing cremators might adversely affect the normal provision of cremation service to the public.

3 ENVIRONMENTAL LEGISLATION, POLICIES, PLANS, STANDARDS AND CRITERIA

3.1 Environmental Impact Assessment

3.1.1 The *Environmental Impact Assessment Ordinance* (EIAO) requires all designated projects to be subject to the EIA process and applies to most of the major infrastructure projects. This Project involves demolition of the Existing Crematorium (which processed pathological waste from 1994 to 2001) as well as construction and operation of the New Crematorium. Under the definition of EIAO, the Project is considered to be designated projects under *Schedule 2, Part II (Item 3)* (for demolition of the Existing Crematorium) and *Part I (N.4)* (for construction and operation of the New Crematorium). This EIA report covers both designated projects in a single document. Since this Project is a Government project, reference to *ETWB 13/2003 Guidelines and Procedures for Environmental Impact Assessment of Government Projects and Proposals* should be made.

3.1.2 A *Technical Memorandum on EIA Process* issued under Section 16 of the EIAO (EIAO-TM) sets out the principles, procedures, guidelines requirements and criteria for preparing and reviewing an EIA report.

3.2 Air Quality

3.2.1 The criteria for evaluating air quality impacts and the guidelines for air quality assessment are laid out in *Annexes 4* and *12* of the *Technical Memorandum on Environmental Impact Assessment Process* (EIAO-TM), respectively, whereas the Guidance Note on the Best Practicable Means for Incinerators (Crematoria) (BPM 12/2) governs the stack emission of the New Crematorium.

3.2.2 The *Air Pollution Control Ordinance* (APCO) provides the statutory authority for controlling air pollutants from a variety of sources. The Hong Kong Air Quality Objectives (AQOs) should be satisfied at the Hong Kong SAR. The AQOs stipulate the maximum allowable concentrations for typical pollutants, of which total suspended particulates (TSP), respirable suspended particulates (RSP), sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and carbon monoxide are relevant to this EIA Study. The relevant AQOs are listed in Table 3.1.

Table 3.1 Hong Kong Air Quality Objectives

Pollutant	Maximum Average Concentration (μg m^{-3}) (1)			
	1-Hour (2)	8-Hour (3)	24-Hour (3)	Annual (4)
TSP	-	-	260	80
RSP (5)	-	-	180	55
SO_2	800	-	350	80
NO_2	300	-	150	80
CO	30,000	10,000	----	----

Notes: (1) Measured at 298 K and 101.325 kPa
(2) Not to be exceeded more than three times per year.
(3) Not to be exceeded more that once per year
(4) Arithmetic mean.
(5) Suspended particulates in air with a nominal aerodynamic diameter of 10 μm or smaller.

3.2.3 The State of Connecticut, USA stipulated the *Primary Ambient Air Quality Standard* for chlorinated dioxins and dibenzofurans (expressed as 2,3,7,8 – TCDD) at 1 pgI-TEQ/m3 (annual average). This is adopted for this Study for assessing dioxin impact.

3.2.4 To follow the acceptable criteria as stipulated at Annex 4 of the EIAO-TM, chronic and acute criteria from international organizations, including the *World Health Organization* (WHO), United States Environmental Protection Agency (USEPA) and *California Air Resources Board* (CARB), are employed for this Study. The air quality criteria for non-AQO pollutants employed for this Study are shown in Table 3.2.

Table 3.2 Air Quality Criteria for non-AQO Pollutants

Parameter	**Unit**	**Criteria**	
		1 Hour	**Annual**
Dioxins	pgI-TEQ/m^3	Not applicable	1 (1)
Hydrogen chloride (HCl)	$\mu g/m^3$	2,100 (2)	20(3)
Mercury (Hg)	$\mu g/m^3$	1.8 (2)	1 (4)

Notes (1) Primary Ambient Air Quality Standard for Dioxin, Department of Environmental Protection, State of Connecticut, USA, http://dep.state.ct.us/air2/regs/mainregs.htm
(2) Reference Exposure Limits, Office of Environmental Health Hazard Assessment, California, USA
(3) Integrated Risk Information System, USEPA
(4) WHO Air Quality Guideline

3.2.5 The EIAO-TM also stipulates that the hourly TSP level should not exceed 500 μgm^{-3} (measured at 25ºC and one atmosphere) for construction dust impact assessment. Mitigation measures from construction sites have been specified in the *Air Pollution Control (Construction Dust) Regulation*.

3.2.6 In accordance with the EIAO-TM, odour level at a sensitive receiver should not exceed 5 odour units based on an averaging time of 5 seconds.

3.2.7 Under the *Air Pollution Control (Specified Process) Regulation*, incinerator (including cremator) with installed capacity exceeds 0.5 tonne per hour, is classified as a specified process, and a Specified Process licence is required for its operation.

3.2.8 The *Air Pollution Control Ordinance* provides legislative control on the removal of asbestos-containing materials. Under the APCO, the owner of premises which contain or may reasonable be suspected of containing asbestos containing material shall engage a registered asbestos consultant to curry out an asbestos investigation report and, if asbestos containing material is found, an asbestos abatement plan shall be submitted to Environmental Protection Department (EPD) at least 28 days before the commencement of the asbestos abatement work. The EPD endorses the asbestos investigation report (AIR) and asbestos abatement plan (AAP) prepared in accordance with the relevant codes of practice by registered asbestos consultant. The AAP specifies the proper asbestos abatement procedure that has incorporated mitigation measures to check the asbestos fiber release and hence to minimize the potential impact. Moreover, the APCO requires registered professionals to supervise, audit and air-monitor the asbestos abatement work.

3.2.9 Risk guidelines for the assessment of health risk from exposures to air toxics are given by *California Air Resources Board, California Environmental Protection Agency* (CARB). Guidelines value on acceptability of increased cancer risk from a lifetime exposure to air toxics have been provided and are shown in Table 3.3.

Table 3.3 Health Risk Guidelines for Exposure to Air Toxics (1)

Acceptability of Cancer Risk	Estimated Individual Lifetime Cancer Risk Level (2)
Significant	$> 10^{-4}$
Risk should be reduced to As Low As Reasonably Practicable (ALARP)	$> 10^{-6} – 10^{-4}$
Insignificant	10^{-6}

Notes: (1) *California Air Resources Board, California Environmental Protection Agency* (CARB)
(2) *Assumed as 70 years recommended by World Health Organization* (WHO)

3.3 Noise

3.3.1 The principal legislation for the control of construction and operational noise is the Noise Control Ordinance (NCO) (Cap 400). Guidelines for assessment of construction and operational noise are given in the Environmental Impact Assessment Ordinance (EIAO). Various Technical Memoranda (TMs), which stipulate the control approaches and criteria, were issued under the NCO and EIAO. The following TMs are applicable to the control of noise from construction activities and operation of fixed noise sources:

- Technical Memorandum on Environmental Impact Assessment Process (EIA-TM)
- Technical Memorandum on Noise from Percussive Piling (PP-TM)
- Technical Memorandum on Noise from Construction Work other than Percussive Piling (GW-TM)
- Technical Memorandum on Noise from Construction Work in Designated Areas (DA-TM)
- Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites (IND-TM)

Construction Noise Criteria

General Construction Works

3.3.2 Noise arising from general construction works at daytime is governed by the EIA-TM. The noise standards are dependent on the uses of the NSRs. The daytime construction noise, during 0700 to 1900 hrs on any day not being a Sunday or general holiday, should be limited to 75 dB(A) at the sensitive residential buildings with openable windows and, 70 dB(A) and 65 dB(A) (during examinations) at the school and educational buildings in the neighborhood, as given in Table 3.4.

Table 3.4 EIA-TM Noise Standard for Daytime Construction Activities[1]

Uses	Daytime Construction Noise Standards, Leq(30 mins), dB(A)
Domestic Premises	75
Educational Institutions (normal periods)	70
Educational Institutions (during examination periods)	65

[1] Statutory controls on general construction works during restricted hours (1900-0700 hrs, Monday to Saturday and at any time on Sundays and public holidays) are under the NCO. The use of powered mechanical equipment (PME) for the carrying out of construction activities during restricted hours requires a Construction Noise Permit (CNP) from the Authority.

Operation Noise Criteria

3.3.3 The EIA-TM specifies that noise from fixed sources under planning should be 5dB(A) below the ANL listed in Table 2 of the IND-TM or the prevailing background noise level. Therefore, the ANLs of a fixed source shall be 5dB(A) less than the values given in IND-TM and are shown in Table 3.5.

Table 3.5 Acceptable Noise Levels for Fixed Noise Sources

Area Sensitivity Ratings / Time Period	A	B	C
Day and Evening (0700-2300 hrs)	55 (60)	60 (65)	65 (70)
Night (2300-0700 hrs)	45 (50)	50 (55)	55 (60)

Figures in brackets indicate the noise standards stipulated in IND-TM.

3.3.4 In any event, the ASR assumed in this EIA is for indicative assessment only. It should be noted that fixed noise sources are controlled under section 13 of the NCO. At the time of investigation, the Noise Control Authority shall determine noise impact from concerned fixed noise sources on the basis of prevailing legislation and practices being in force, and taking account of contemporary conditions / situations of adjoining land uses. Nothing in the EIA report shall bind the Noise Control Authority in the context of law enforcement against all the fixed noise sources being assessed.

3.4 Land Contamination

3.4.1 Assessment of land contamination and the potential impacts are guided by EPD's document *Practice Note for Professional Persons* (ProPECC PN 3/94) *Contaminated Land Assessment and Remediation*, the EIAO-TM, and EPD's *Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol Filling Stations, Boatyards and Car Repair / Dismantling Workshops* (1999).

3.4.2 Under the EIAO TM, *Annex 19: Guidelines for Assessment of Other Impacts*, consideration shall be given to a number of potentially contaminating land uses, including petrol filling station, shipyards/boatyards, car repair and dismantling, power plants and gas works. If these land uses are identified, then the applicant is required to generate, based on *Annex 19* of EIAO-TM, a Contamination Assessment Plan (CAP), Contamination Assessment Report (CAR) and Remediation Action Plan (RAP) for land with a high contamination potential.

3.5 Waste Management

3.5.1 The following legislation covers the handling, treatment and disposal of waste in the Hong Kong Special Administration Region (HK SAR), and will be considered in the assessment.

- *Waste Disposal Ordinance* (Cap. 354)
- *Waste Disposal (Chemical Waste) (General) Regulation* (Cap. 354)
- *Land (Miscellaneous Provisions) Ordinance* (Cap. 28)
- *Public Health and Municipal Services Ordinance* (Cap. 132) – *Public Cleansing and Prevention of Nuisances (Urban Council) and (Regional Council) By-laws*

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

- *Waste Disposal Plan for Hong Kong* (December 1989), Planning, Environment and Lands Branch Government Secretariat
- *Environmental Guidelines for Planning In Hong Kong* (1990), Hong Kong Planning and Standards Guidelines, Hong Kong Government

- *New Disposal Arrangements for Construction Waste* (1992), Environmental Protection Department & Civil Engineering Department
- *Code of Practice on Packaging, Labelling and Storage of Chemical Wastes* (1992), Environmental Protection Department
- *Works Branch Technical Circular No. 12/2000, Fill Management;* Works Branch, HK SAR
- *Works Branch Technical Circular 32/92, The Use of Tropical Hard Wood on Construction Site*; Works Branch, Hong Kong Government
- *Works Branch Technical Circular No. 2/93, Public Dumps*
- *Works Branch Technical Circular No. 2 /93B, Public Filling Facilities*
- *Works Branch Technical Circular No. 16/96, Wet Soil in Public Dumps*
- *Works Bureau Technical Circular No. 4/98 & 4/98A, Use of Public Fill in Reclamation and Earth Filling Projects*; Works Bureau, HK SAR Government
- *Works Bureau Technical Circular No. 5/98, On-site Sorting of Construction Waste on Demolition Site*
- *Waste Reduction Framework Plan*, 1998 to 2007, Planning, Environment and Lands Bureau, Government Secretariat, 5 November 1998
- *Works Bureau Technical Circular No. 21/2002, Trip-ticket System for Disposal of Construction and Demolition Material*
- *Works Branch Technical Circular No*. 19/99, Metallic Site Hoardings and Signboards
- *Environment, Transport and Works Bureau Technical Circular (Works) 15/2003, Waste Management On Construction Sites*
- *Works Bureau Technical Circular No. 25/99, Incorporation of Information of Construction and Demolition Material Management in Public Works Sub-committee Papers*
- *Works Bureau Technical Circular No. 29/2000, Waste Management Plan*
- *Works Bureau Technical Circular No. 33/2002, Management of Construction/Demolition Materials including Rock*
- *Works Bureau Technical Circular No. 12/2002, Specifications Facilitating the use of Recycled Aggregates*
- *Code of Practice on Asbestos Control: Preparation Work Using Full Containment or Mini Containment Method*
- *Code of Practice on Asbestos Control: Asbestos Work Using Glove Bag Method*
- *Code of Practice on Asbestos Control: Safe Handling of Low Risk Asbestos Containing Material*
- *Code of Practice on the Handling, Transportation and Disposal of Asbestos Waste*
- *Code of Practice on Asbestos Control: Preparation of Asbestos Investigation Report, Asbestos Management Plan and Asbestos Abatement Plan*
- *ProPECC PN2/97 Handling of Asbestos Containing Materials in Buildings*

Waste Disposal (Chemical Waste) (General) Regulation

3.5.3 Chemical waste is defined under the *Waste Disposal (Chemical Waste) (General) Regulations*, which includes any substance being scrap material, or unwanted substances specified under *Schedule 1* of the *Regulation*. Producers of chemical wastes must treat their wastes, utilizing on-site plant licensed by the EPD or have a licensed collector take the wastes to a licensed facility. The regulation also prescribes the storage facilities to be provided on site, including labeling and warning signs, and requires the preparation of written procedures and training to deal with emergencies such as spillage, leakage or accidents arising from the storage of chemical wastes.

Construction and Demolition (C&D) Materials

3.5.4 The handling of C&D materials is governed by *Works Branch Technical Circular No. 2/93*, *Public Dumps*. Inert C&D materials (i.e. public fill) should not be disposed of at landfills, but to be taken to public filling areas which usually form part of reclamation schemes. The *Land (Miscellaneous Provision) Ordinance* requires that dumping licences are obtained by individuals or companies who deliver public fill to public filling areas. The licences are issued by the Civil Engineering Department (CED) under delegated powers from the Director of Lands.

3.5.5 In addition to the Works Branch Technical Circular, EPD and CED have produced a leaflet entitled '*New Disposal Arrangements for Construction Waste*' (1992) which states that C&D material with less than 30% by weight (or 20% inert material by volume) of inert material (i.e. public fill) will be accepted at landfill. If the material contains more than 30% inert material, the waste must be sorted and sent to a public filling area and the non-inert material (i.e. C&D waste) can be sent to landfill for final disposal.

3.6 Landscape and Visual

3.6.1 Environmental legislation in relation to landscape and visual aspects is guided by the EIAO. The criteria for evaluating Landscape and Visual Impacts are laid out in the EIAO-TM. The relevant criteria for Landscape and Visual Impacts are defined in the EIAO-TM as well as in other documents as listed below:

- *Annex 10*: Criteria for Evaluating Visual and Landscape Impact, and Impact on Sites of Cultural Heritage
- *Annex 18*: Guidelines for Landscape and Visual Impact Assessment
- *EIAO Guidance Note 8/2002, Preparation of Landscape and Visual Impact Assessment*
- *Works Bureau Technical Circular No. 7/2002, Tree Planting in Public Places*
- *Works Bureau Technical Circular No. 14/2002, Management and Maintenance of Natural Vegetation and Landscape Works, and Tree Preservation*

3.7 Water Quality

3.7.1 The following relevant legislation and associated guidance are applicable to the evaluation of water quality impacts associated with the construction and operation phases of this Project:

- *Water Pollution Control Ordinance* (WPCO) (Cap. 358)
- *Technical Memorandum (TM) – Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters*
- *Environmental Impact Assessment Ordinance* (Cap. 499 S. 16), *Technical Memorandum on Environmental Impact Assessment Process* (EIAO-TM), *Annexes 6* and *14*

3.7.2 The *Water Pollution Control Ordinance* (Cap. 358) provides the major statutory framework for the protection and control of water quality in Hong Kong. According to the Ordinance and its subsidiary regulations, all Hong Kong waters are divided into ten Water Control Zones (WCZ). Each WCZ has a designed set of statutory Water Quality Objectives (WQOs). For this Study, the waters of the Victoria Harbour Phase 2 WCZ are applicable.

3.7.3 All discharges during the construction phase are required to comply with the *TM – Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters* issued under *Section 21* of the WPCO which defines acceptable discharge limits to different types of receiving waters. Under the TM, effluents discharged into foul sewers, storm water drains, inland and coastal waters are subject to pollutant concentration standards for particular volumes of discharge. These are defined by EPD and specified in licence conditions for any new discharge within a WCZ.

3.7.4 Apart from the above statutory requirements, the *Practice Note for Professional Persons, Construction Site Drainage* (ProPECC PN 1/94), issued by ProPECC in 1994, also provides useful guidance on the management of construction site drainage and prevention of water pollution associated with construction activities.

3.8 Hazard to Life

3.8.1 The following legislation, standards, guidelines and criteria are relevant to control and evaluation of hazards:

- *Hong Kong Planning Standards and Guidelines* (HKPSG)
- EIAO-TM *Annexes 4* and *22*
- *Dangerous Goods Ordinance* (Cap. 295)
- *Dangerous Goods (Application and Exemption) Regulations*

3.8.2 The risk assessment requirement for the potentially hazardous installation (PHI) is described in Chapter 11 of the *Hong Kong Planning Standards and Guidelines* (HKPSG). According to the definition, a PHI is an installation for the storage of hazardous material with quantities equal to or greater than a substance-specified threshold quantity. The threshold quantity related to this Study is petrol or naphtha storage which is 10,000 tonnes. As the diesel storage on site for the new crematorium is much less than the threshold quantity, the new crematorium is not a PHI.

4 AIR QUALITY IMPACT ASSESSMENT

4.1 Introduction

4.1.1 This Section exhibits an assessment of air quality impact from the construction, demolition and operation of the Project which may impose on the nearby sensitive receivers.

4.2 Overview of the Project

Background of the Project

4.2.1 The Project is to replace the six existing cremators at Diamond Hill Crematorium with 6 advanced new cremators, and the Existing Crematorium building will be demolished when the new cremators are commissioned. The Existing Crematorium has been operating for over 24 years. The existing cremators are approaching the end of their serviceable life and reprovisioning is required. FEHD intends to replace these existing cremators with 6 new ones, including 4 cremators with a capacity of 170 kg each and another 2 with a capacity of 250 kg each. The new cremators will be designed with advanced cremation technology and equipped with adequate air pollution control system to minimize the emissions of air pollutants. The environmental performance of the New Crematorium should therefore be much improved compared to the existing facility.

Description of the Proposed Project

4.2.2 The project will be implemented in two phases. Phase I will involve site formation of the southern part of the work area, the construction of the main facilities of the New Crematorium and the installation of new cremator E&M equipment. Phase II will involve the decommissioning and demolition of the Existing Crematorium building and the construction of the remaining facilities of the New Crematorium building.

4.2.3 Phase I construction work will be carried out in the southern part of the site during the period between September 2004 and February 2006, which will provide 6 new cremators, service halls and associated facilities. During this period, the existing cremators will continue operation until the new cremators are commissioned.

4.2.4 When the new cremators are put into operation, Phase II work will commence. This will involve the decommissioning of the existing cremators and demolition of the crematorium building. Then the construction work of the remaining facilities of the New Crematorium building will be carried out. Phase II work will be carried out between October 2006 and November 2007.

4.2.5 The total operating capacity of the new cremators will be about 0.7 tonne/hour, based on 6 cremations a day, 6 cremators in full operation and 10 working hours a day. As the operating capacity of the new cremators would exceed the exempted capacity of Specified Process – Incinerators under the Air Pollution Control Ordinance, i.e. 0.5 tonne/hour, FEHD is required to obtain a specified process licence from EPD for the operation of the new cremators. The Specified Process Licence under APCO will provide overall control of the design, operation, emission limits, monitoring and maintenance of the New Crematorium. It should be noted that the New Crematorium would be used for cremation of coffins and human bodies, and would not process any pathological waste.

4.2.6 Besides replacement of 6 new cremators, 4 units of joss paper burners will be installed near the service halls for Chinese memorial ceremonies. Burning of joss paper usually emits smoke which may affect the nearby environment. Therefore the operation of joss paper burner is also an issue of the EIA study.

4.3 Introduction to Cremation and Air Pollution Control Technology

Introduction to Cremation Technology

4.3.1 Cremation is widely adopted in Hong Kong as a means to dispose of the dead. In general, cremation is a process of burning the dead body at high temperature to decompose organic matters and thus incombustible ash and bone materials remain after the cremation process. A complete cremation normally takes about 2 to 2.5 hours. During cremation, exhaust flue gas containing air pollutants is discharged into the atmosphere. In recent years, cremators are designed with two combustion chambers, namely the primary chamber and the secondary chamber, to enhance the combustion efficiency and reduce air pollutant emissions. Cremators with single combustion chamber are outdated and not acceptable according to the up-to-date environmental requirement.

4.3.2 Nowadays, cremators of flat-bed type and free-falling type are most commonly available in the market. These are widely adopted because of their high combustion efficiency. Higher combustion efficiency of new cremators help to decompose organic matters more completely, hence reduction in air pollutants emissions, minimizing dark smoke, dioxin and odour emissions from chimneys could be achieved.

Flat-bed Cremator

4.3.3 Flat-bed cremator usually consists of a furnace slide door, a cremation chamber (primary combustion chamber), an afterburning chamber (secondary combustion chamber), a cease-burning chamber and an ash cooling zone. The combustion chambers are usually made of high quality fire-bricks and insulating materials including shaped bricks. The quality materials are selected according to the different thermal, chemical and mechanical requirements.

4.3.4 The main combustion chamber and the afterburning chamber are located upon each other in a compact construction way with optimum heat exchange between the combustion chambers.

Free-falling Cremator

4.3.5 For free-falling cremators, the cremains will "fall" from the primary combustion chamber at high level to the cremains collection chamber at a lower level. In order to accommodate the free-falling cremators, a two-storey building is required. When the cremain is transferred to the secondary combustion chamber, another coffin can be fed into the primary chamber for cremation. The operations of the primary and secondary combustion chambers are independent.

4.3.6 Therefore streamlined operation of the cremator is possible and the efficiency of cremation is improved.

4.3.7 The newly built Kwai Chung Crematorium is equipped with 4 units of free-falling cremators provides an example of new cremation technology that could be adopted in the new Diamond Hill Crematorium. However, the final selection of cremation technology for the new Diamond Hill Crematorium would be subject to the tendering process. Nevertheless, the emission limits of air pollutant emissions from the new crematorium as specified in the existing *Best Practical Means for Incinerators (Cremator)* published by EPD (BPM 12/2) and the target emission levels as listed in Table 4.1 would be adopted in the design specifications of the new cremators. The air pollutant emission limits as stipulated in the existing BPM 12/2 and the target emission levels of the New Crematorium are as follows:

Table 4.1 Air Pollutant Emission Limited as Stipulated in the Existing BPM 12/2 and the Target Emission Levels of the New Crematorium

Air Pollutants	Unit	Emission Limit of Existing BPM 12/2	Target Emission Levels of the New Crematorium
Particulate matters	mg/m^3	100	100
Hydrogen chloride	mg/m^3	100	100
Carbon monoxide	mg/m^3	100	100
Total organic carbon	mg/m^3	20	20
Mercury	mg/m^3	-	0.2 [(a)]
Sulphur dioxide	mg/m^3	-	180 [(a)]
Nitrogen Oxides (NOx as NO_2)	mg/m^3	-	380 (NOx) [(a)]
Dioxins	ng I-TEQ/m^3	1.0	1.0

Note : The emission limits are corrected to 273 K, 101.325 kPa, dry and oxygen 11%
[(a)] Crematorium Operation and Emissions, Cemetery and Funeral Services Information Sheet, Ministry of Public Safety and Solicitor General, British Columbia, Canada

Other major design requirements of the new cremators as stipulated by BPM 12/2 are summarized as follows:

- Cremators shall have a secondary combustion chamber. Sufficient secondary air shall be supplied to cremators in order to maintain good combustion efficiency;
- The combustion temperature of the secondary combustion chamber shall be maintained at least 850°C (at all time) and the residence of gas shall not be less than 2 seconds;
- The oxygen level of flue gas shall be greater than 6%;
- The current requirement of linear efflux velocity at chimney is not less than 7 m/s. However, a more stringent requirement linear efflux velocity not less than 15 m/s would be adopted for the new cremators.

The above design requirements of the new cremators would enhance combustion efficiency, hence to reduce emission of air pollutants. Further the dispersion of air pollutant emissions would be much improved by emission through high chimneys.

Introduction to the Available Air Pollution Control Technology

4.3.8 The flue gas emissions from the New Crematorium would have the most significant environmental impact to the general public. Air pollutants such as particulate matters, heavy metals, organic gases, acidic gases, dioxins, etc, would be emitted from the New Crematorium. Dioxins is highly toxic and is a suspected carcinogen to humans. Special air pollution control systems shall be installed to reduce the emissions of these air pollutants to acceptable levels.

4.3.9 As the final design of the New Crematorium is not yet available, the air pollution control technology for the New Crematorium is not yet confirmed. However, applicable air pollution control technologies to control the emissions from cremators are discussed below:

Wet Scrubbing

4.3.10 The principle of wet scrubbing is to remove air pollutants in flue gas through dissolution and chemical absorption by the scrubbing solution. The scrubbing solution may be water or other chemical solutions. Sodium hydroxide solution, acidified potassium permanganate, hypochlorite and other acidic solutions are common scrubbing solutions for air pollution control.

4.3.11 The flow direction of flue gas is arranged counter flow to the scrubbing solution to enhance the absorption efficiency. The cleaned flue gas is emitted to the atmosphere through the discharge while the scrubbing solution may be recycled or discharged as waste solution.

Carbon Injection

4.3.12 Carbon injection is a common air pollution control technology to remove organic air pollutants in flue gas. Fine charcoal power is injected into the flue gas ducting and organic air pollutants in flue gas are adsorbed by the charcoal power. The fine charcoal power is then collected with bag filter. Carbon injection is commonly adopted to control the emissions of dioxins. This is a dry air pollution control process.

Neutralization with Chemical

4.3.13 Neutralization is required if the flue gas is highly acidic or alkaline. For acidic gases, neutralization is accomplished by spraying of lime or soda lime solution to the flue gas. On the other hand, inorganic acids are usually used to neutralize highly alkaline flue gas. Spray nozzle or jet nozzles are usually used to spray neutralizing solution to the flue gas stream. This is a dry air pollution control process.

Electrostatic Precipitation

4.3.14 Electrostatic precipitators are usually used to collect fine particulate matters in flue gas. The equipment maintains a several kilowatt electric field to charge up fine particulates. Then the charged particulates are collected with the following oppositely charged collector plates. Electrostatic precipitators are highly efficient in collecting fine particulates. Collected dust is easily handled and disposed of to waste facilities.. This is a dry air pollution control process.

Bag Filters

4.3.15 Bag filters are also commonly used equipment to control particulate emissions. Particulate matters are collected with the filter medium. The filter bags may be made of cotton or fabric material. Filter bags shall be cleaned up regularly to avoid clogging. This is a dry air pollution control process.

Quenching

4.3.16 Quenching is a specific air pollution technology to control dioxin emissions. This is to reduce the temperature of the flue gas in a short period of time to avoid the formation of dioxins molecules. When the flue gas is cooled down to about 400 to 600°C (the dioxin “formation window”), atoms of carbon, oxygen, hydrogen and chlorine will re-combine to form dioxins molecules, which is the most thermodynamically favourable chemical species. Quenching is to cool down the flue gas suddenly, to shorten the time expose to the “formation window” and so to avoid the formation of dioxins. Quenching is usually achieved by drawing in a large amount of fresh air or spraying of water.

Air Pollution Control Technology to be Adopted by the New Crematorium

4.3.17 The newly built Kwai Chung Crematorium installed cyclone and bag filter, and is using dry chemical process for controlling the stack emission. This air pollutant control system is performing satisfactorily to reduce air pollutant emission as there is no complaint received since the operation of the Crematorium, and the stack emission test results during testing and commissioning met all the requirements of BPM 12/2. It could be referenced in the selection of the appropriate air pollution control system for the New Crematorium in Diamond Hill. However, the final selection of the air pollution control system for the New Crematorium would be subject to the tendering process but dry process will be adopted for air pollution control.

4.4 Description of the Nearby Environment

4.4.1 This sub-section describes the background information, the nearby environment and the air sensitive receivers which might be affected by the construction and operation of the New Crematorium and the demolition of the Existing Crematorium.

Geographic Conditions of the Site

4.4.2 The proposed site is located at the existing Diamond Hill Crematorium at Po Kong Village Road, Diamond Hill, Kowloon. The north to the southeast side of the crematorium is the Diamond Hill Urn Cemetery on the hillside. The closest housing estate is about 200 m at the south of the site. A school village, which consists of 5 primary and secondary schools, is located at about 200 m west of the site. There are several schools at about 300 m to the northwest of the Crematorium; and a nunnery, Chi Lin Nunnery, is located about 500 m south of the Crematorium. Residential buildings are located northwest and southeast to the Crematorium.

Background Ambient Air Quality

4.4.3 The proposed site is located at urban residential area in Kowloon. The background ambient air quality as summarized in Table 4.2 is adopted for the air quality assessment due to the operation of the New Crematorium:

Table 4.2 Background Air Pollutant Levels Adopted for Air Quality Assessment

Pollutant	Unit	Background Concentration
RSP	$\mu g/m^3$	60 (1)
CO	$\mu g/m^3$	1,051 (2)
SO_2	$\mu g/m^3$	21 (1)
NO_2	$\mu g/m^3$	59 (1)
Hg	$\mu g/m^3$	0.00022 (3)
Dioxin	pg I-TEQ/m^3	0.055 (2)

Note: (1) Guidelines on Assessing the 'TOTAL' Air Quality Impacts, HKEPD
(2) Annual air pollutant concentrations in Tsuen Wan, Air Quality in Hong Kong 2001, HKEPD
(3) Annual Hg concentration in Tsuen Wan, Air Quality in Hong Kong, 2000, HKEPD

Air Sensitive Receivers

4.4.4 Air sensitive receivers (ASR) within the study area were identified based on the nature and use of the premises/facilities. Furthermore, ASRs were also identified according to the latest Outline Zoning Plan and Outline Development Plan. Sensitive locations in the future developments were also identified as ASR. The representative air sensitive receivers are summarized in Table 4.3.

Table 4.3 Details of the ASRs

ASR ID	Air Sensitive Receiver	Building Height (no. of floor)	Distance from Crematorium (m)	Angle, From North (Degree)	Elevation, mP.D.
A1	The Salvation Army William Booth Secondary School	6	316	322	84.1
A2	Tak Oi Secondary School	6	422	313	85.2
A3	Po Leung Kuk No. 1 W. H. Cheung Collage	6	272	315	87.4
A4	Heep Woh College	6	369	305	83.5
A5	Tsz Wan Shan Catholic Primary School	8	381	290	85.6
A6	Po Leung Kok Celine Ho Yam Ho Tong College	8	406	270	85.6
A7	St. Patrick Catholic Primary School	8	313	261	85.6
A8	Po Leung Kok Grandmont Primary School	8	237	270	85.6
A9	(New school under construction)	8	234	292	85.6
A10	Fu Yan Hse	20	188	160	61.0
A11	Fu Lai Hse	20	291	165	61.0
A12	Fu Shun Hse	22	234	145	61.0
A13	S.K.H. Kei Sum Primary School	6	313	136	61.0
A14	King Pik Hse (Blk B)	33	406	140	64.4
A15	Blk E, King Shan Court	33	453	153	61.5
A16	The HK Sea Cadet Corp Centre	2	150	140	62.2
A17	Staff Quarter for Diamond Hill Crematorium	2	78	120	60.4
A18	Grand View Garden (Blk 1)	39	297	180	39.7
A19	Grand View Garden (Blk 6)	28	422	192	39.7
A20	Grand View Garden (Blk 3)	35	391	175	38.3
A21	Hong Kong School For The Deaf	3	406	195	37.8
A22	Chi Lin Nunnery	3	438	200	31.4
A23	Park over the Diamond Hill No. 2 Fresh Water Reservoir (under planning)	0	156	210	84.0
A24	Diamond Hill Funeral Parlour	4	156	315	79.0

The locations of the ASRs are shown in Figure 4.1.

Existing and Future Construction Projects Near the Site

Diamond Hill No. 2 Freshwater Service Reservoir

4.4.5 The Diamond Hill No. 2 Freshwater Service Reservoir is under construction currently. The site of the Service Reservoir is located at about 156 m to the southwest of the Crematorium and the construction works would continue up to the end of 2005. Landscape works would commence upon completion of the service reservoir works. The future land use of the site will be a park and open space.

KCRC Shatin to Central Link

4.4.6 The KCRC Shatin to Central Link is under planning stage currently. The proposed railway between Tsz Wan Shan Station and Diamond Hill Station of the Shatin and Central Link would be built about 800 m to the west of the Crematorium. At this moment, the final alignment of the track is not yet confirmed, the work schedule of the new railway is also not available but it is anticipated that the construction works would delay and to be completed in 2008 or later.

4.5 Methodology of the Air Quality Assessment

Background Information of the Construction Works of the Project

4.5.1 The proposed works for the reprovisioning of the Diamond Hill Crematorium would last for about 38 months, between September 2004 and November 2007. The construction would be divided into 2 phases in order to ensure continuity of cremation services to the public during the entire works period. Table 4.4 summarizes the tentative work programme of the Project.

Table 4.4 Tentative Work Schedule of the Project

Duration	Description	Activity Concerned
9/2004 – 2/2006	Phase I Building works for new cremators and service halls	Site formation, demolition of the existing CLP substation, building works, installation major E&M components
3/2006 – 5/2006	Commissioning and operation of new cremators	Testing and Commissioning Operation
10/2006 – 11/2007	Phase II Decommissioning of the Existing Crematorium and construction of the remaining facilities for the New Crematorium	Demolition of the Existing Crematorium, building works for the remaining facilities

Construction Works of Phase I

4.5.2 The major impacts to the ASRs during Phase I construction works would be fugitive dust emissions from the site formation, demolition of the existing CLP secondary substation and building works. It is anticipated that fugitive dust would be generated from excavation, foundation works, site clearance, material handling and wind erosion.

4.5.3 The *Industrial Source Complex Short-Term, (ISCST3)* developed by USEPA was employed to assess the potential fugitive dust impact to the ASRs due to the construction works. The assessment was based on the emission factors from the USEPA Compilation of Air Pollution Emission Factors (AP-42), 5th Edition, January 1995. General construction activities and wind erosion of open sites were considered to be the major dust emission sources.

4.5.4 The dust emission rate of general construction activities is determined based on 30 working days a month, 12 working hours a day, while the dust emission rate of wind erosion is determined based on 365 days a year, 24 hours a day. In addition, for conservative prediction, dust control measures were not applied to wind erosion dust. The dust emission factors adopted for the air quality assessment are summarized in Table 4.5.

Table 4.5 Dust Emission Factors Adopted for the Air Quality Assessment of the Phase I Construction Works

Activities	Dust Emission Factors (1)	Dust Emission Rates for Air Dispersion Modelling
General construction activities	2.69 Mg/hectare/month (Section 13.2.3)(1)	2.076×10^{-4} g/m^2/s
Wind erosion of open site	0.85 Mg/hectare/year (Table 11.9.4)(1)	2.695×10^{-6} g/m^2/s

Note: (1) Compilation of Air Pollutant Emission Factors, USEPA AP-42, 5th Edition, January 1995

4.5.5 The whole year of 2000 meteorological data at the Hong Kong Observatory in Tsim Sha Tsui was used for the air quality impact assessment. The hourly data of wind direction, wind speed, stability class, temperature and mixing height were collected.

4.5.6 Whole year of 2000 meteorological data collected at the Hong Kong Observatory in Tsim Sha Tsui were input for the modelling work. Although the nearest anemometer station to the site is located at ex-Kai Tak airport, the Consultant considered that the meteorological data collected by the Headquarters of Hong Kong Observatory in Tsim Sha Tsui (TST) is more representative than that of Kai Tak Anemometer Station. The considerations are summarized as follows:

a. The TST meteorological station is located in busy urban area, which is surrounded by high-rise buildings. The geographical conditions are similar to the Diamond Hill Crematorium, which is also surrounded by many buildings including schools, high-rise residential blocks and other buildings. On the other hand, the Kai Tak anemometer station is located at the end of the ex-airport runway and there is an open area with no hill and building. The topography of the Kai Tak Station is not similar to the Crematorium;

b. The distances between the Crematorium and TST and the Kai Tak Station are similar, just 5.3 km and 4.8 km respectively, there is no significant difference in distance.

c. The meteorological data recorded at the TST Hong Kong Observatory Headquarters are more complete and representative for a facility located in Kowloon urban area, as compared with Kai Tak anemometer station.

4.5.7 Based on the above discussion, the Consultant considered that the meteorological data collected at TST Hong Kong Observatory Headquarters are more representative for air quality assessment for the New Crematorium.

4.5.8 According to *Guidelines on Assessing the "Total" Air Quality Impacts*, issued by HKEPD, the background TSP level of 98 μg/m^3 was adopted for assessment of cumulative impact.

Commissioning and Operation of New Crematorium

4.5.9 The major impact to the ambient air quality during the commissioning and operation of New Crematorium would be the chimney emissions from the cremators. During cremation, a number of air pollutants and odour would be emitted to the atmosphere through the chimneys.

4.5.10 The Consultants have checked that there was no other chimney emission source identified within 500 m radius of the Crematorium. Therefore the air quality impact assessment is based on the Cremator emissions only. It was noticed that there are two ventilation buildings of the Tate's Cairn Tunnel (TCT) located within the 500 m study area, the cumulative air quality may be affected if the ventilation buildings are air pollution emission sources. The Consultant has consulted the operator of the TCT and noted that the ventilation buildings are for delivering fresh air into the TCT most of the time. Therefore it is concluded that the ventilation buildings are not significant air pollutant emission sources and were not taken into account in the cumulative impact.

4.5.11 The Existing Crematorium would still be operating to serve the public during the testing and commissioning of the new cremators. However, special arrangement would be made to ensure there would be no more than six cremators in operation at any time (no more than 6 of both existing and new cremators will be in operation at the same time) during this period to avoid additional loading of chimney emissions to the environment.

4.5.12 The impact of air pollutant emissions from the chimneys during operation of the New Crematorium would be evaluated by air dispersion modelling technique.

Concerned Air Pollutants

4.5.13 The major concerned air pollutants are included in the air quality impact assessment to evaluate the impact of the chimney emissions to the ASRs. These include :

- Respirable suspended particulates (RSP)
- Hydrogen chloride (HCl)
- Carbon monoxide (CO)
- Total organic compounds (TOC)
- Sulphur dioxide (SO_2)
- Nitrogen dioxide (NO_2)
- Mercury (Hg)
- Dioxins

In addition, the impact of odour and excessive cancer risk due to the operation of the New Crematorium would be assessed.

Air Quality Acceptable Criteria

4.5.14 The air quality acceptable criteria for the study was established by adoption of Hong Kong Air Quality Objective, relevant Technical Memoranda issued by EPD and other ambient air quality guidelines established by WHO and other overseas governments. The acceptable air quality criteria adopted in this study are summarized in Table 4.6.

Table 4.6 Acceptable Air Quality Criteria of the Air Quality Impact Assessment

Air Pollutant	Unit	Air Quality Acceptable Criteria		
		1-hour average	24-hour average	Annual Average
Total suspended particulates	$\mu g/m^3$	500 (1)	260 (2)	80 (2)
Respirable suspended particulates	$\mu g/m^3$	(not established)	180 (2)	55 (2)
Hydrogen chloride	$\mu g/m^3$	2,100 (3)	(not established)	20 (4)
Carbon monoxide	$\mu g/m^3$	30,000 (2)	10,000 (2) (8-hr average)	(not established)
Sulphur dioxide	$\mu g/m^3$	800 (2)	350 (2)	80 (2)
Nitrogen dioxide	$\mu g/m^3$	300 (2)	150 (2)	80 (2)
Mercury	$\mu g/m^3$	1.8 (3)	(not established)	1 (5)
Dioxins (2378 TCDD equivalent)	pg I-TEQ/m^3	(not established)	(not established)	1 (6)

Note : The air pollutant concentrations are corrected to 25℃ and 101.325 kPa

Reference :
(1) Technical Memorandum of Environmental Impact Assessment Ordinance, HKEPD
(2) Hong Kong Air Quality Objective
(3) Reference Exposure Limits, Office of Environmental Health Hazard Assessment, California, USA
(4) Integrated Risk Information System, USEPA
(5) WHO Air Quality Guideline, World Health Organization, 1999
(6) Primary Ambient Air Quality Standard for Dioxin, Department of Environmental Protection, State of Connecticut, USA, http://dep.state.ct.us/air2/regs/mainregs.htm

Design of the Cremators

4.5.15 The proposed New Crematorium would replace the Existing Crematorium in Diamond Hill, with 6 new cremators[a] to replace the 6 existing ones. The new cremators would be operated daily during normal working hours between 9:30 and 19:30. The capacity of 4 out of the 6 cremators would be 170 kg and 250 kg for the remaining 2 cremators. The total operating capacity will be about 0.7 tonne/hour when all the cremators are in full load operation. The burning fuel of the new cremators would be light diesel. With the advancement in the recent cremation technology and the strict control of the quality of diesel according to local legislative requirements, the performance and exhaust emissions of diesel-fueled cremators will fully comply with the BPM 12/2 and other environmental requirements.

4.5.16 The flue gas volumetric flow rate of the 170 kg and 250 kg cremators are 2500 m^3/hour (at 6.3% oxygen, 15.5% moisture, 200°C) and 4600 m^3/hour (at 11% oxygen, 12.7% moisture, 200°C) respectively as referenced to the design of the new Fu Shan Crematorium as stipulated in the *EIA Report for the Fu Shan Crematorium*.

4.5.17 The height of the chimney for the cremators is designed at 28.5 m above ground level. It is estimated that the temperature of the flue gas discharge after passing through the pollution control system would be 120°C at an efflux velocity of 15 m/s. The chimney diameters would be 0.22 m and 0.30 m for 170 kg and 250 kg cremators respectively.

[a] The new cremators will be fired by light diesel with sulphur content less than 0.5% by weight and viscosity of less than 6 centistokes at 40 °C or better. Arch SD had considered whether to use gas-fired or diesel-fired cremators. In view of the advanced cremator design and the installation of air pollution control system to treat the flue gas from the cremators, it is expected that emissions from the diesel-fired cremators can comply with the BPM requirement and there would be no excessive dark smoke emissions. FEHD therefore decided to use diesel-fired cremators instead of gas-fired cremators.

4.5.18 The new cremators would each consist of a primary and a secondary combustion chamber. The temperature of the secondary chamber would be over 850°C during cremation and the residence time would be at least 2 seconds. Appropriate air pollution control system would be installed at the outlet of the cremator to remove excessive air pollutants including dioxins prior to discharge. Although the final selection of cremators and air pollution control system would depend on the final selection in open tendering procedure, the performance and specifications of the new cremators must comply fully with the BPM 12/2 published by EPD. It is noted that the design and technology adopted by the new Kwai Chung Crematorium would be referenced when preparing the open tender.

Air Quality Impact Assessment

Calculation of Air Pollutant Emission Rates

4.5.19 According to the BPM 12/2, the emission rates of particulates, hydrogen chloride, carbon monoxide, TOC and dioxins are regulated. The maximum air pollutant emission rates are calculated based on the maximum allowed emission concentration as tabulated in Table 4.7. The target emission levels of nitrogen oxides (380 mg/m^3), sulphur dioxide (180 mg/m^3) and mercury (0.2 mg/m^3) are adopted for the air pollution impact assessment.

Air pollutant emission rate = emission standard x flue gas emission rate

Table 4.7 Calculation of Emission Rates of Air Pollutants

Parameter	**Emission Rate Guideline mg/m^3**	**Emission rate, g/s**	
		170 kg cremator	**250 kg cremator**
Particulates (regarded as 100% RSP)	100 (3)	0.04994	0.06439
Hydrogen chloride	100 (3)	0.04994	0.06439
Carbon monoxide	100 (3)	0.04994	0.06439
TOC	20 (3)	0.00999	0.01288
SO_2	180 (4)	0.08990	0.1159
NO_2	380 (4)	0.03796	0.04894
Mercury	0.2 (4)	0.0000999	0.0001288
Dioxins (expressed as 2,3,7,8-TCDD equivalent)	1 ng I-TEQ/m^3 (3)	0.4994×10^{-9}	0.6439×10^{-9}

Notes :
(1) Note : The emission limits are corrected to 273 K, 101.325 kPa, dry and oxygen 11%
(2) Volumetric flow rates of 1,798 and 2,318 m^3/hour at reference conditions are adopted for 170 kg and 250 kg cremators respectively
(3) Emission limits as stipulated in the current BPM standard.
(4) 20% of nitrogen oxides are assumed to be present as NO_2 in this study. The emission limits for SO_2, NO_x and mercury of 180 mg/m^3, 380 mg/m^3 and 0.2 mg/m^3 are adopted from the Ministry of Public Safety & Solicitor General, British Columbia, Canada – Crematorium Operations and Emissions (Canada).

Air Dispersion Modeling Prediction

4.5.20 The air quality impact assessment of the chimney emissions was carried out with the *Industrial Source Complex Short-Term, (ISCST3)* developed by USEPA. The ISCST3 is accepted by EPD for air impact assessment in Hong Kong. Concentrations of respirable suspended particulates (assuming that 100% particulate emission from the chimneys is RSP), SO_2, NO_2, CO, HCl, TOC, Hg and dioxins at the area within the radius of 500 m of the proposed chimney were estimated by ISCST3.

Assessment of Health Risk

4.5.21 The major health risk arising from the operation of the Crematorium would be due to the emissions of toxic air pollutants (TAP). The most representative TAP emissions from the chimney would be dioxins. The *California Air Resources Board (CARB)* identified that the unit cancer risk factor of dioxins (expressed as 2,3,7,8-TCDD equivalent) associated to lifetime exposure of 70 years is 38 $(\mu g/m^3)^{-1}$. The excess cancer risk is calculated by multiplying the excessive annual dioxin concentration contributed by the New Crematorium at the ASR with the unit cancer risk factor. The excess cancer risk should aim at not significant level according to Table 3.3.

Odour Assessment

4.5.22 Odour has been one of the environmental concerns of the Existing Crematorium. A number of complaints on odour emissions from the existing facility were received by EPD. An odour assessment was carried out for the New Crematorium by ISCST3 to determine the odour impact.

4.5.23 To estimate the odour level in the New Crematorium, estimation was made with reference to the odour level at Kwai Chung Crematorium. A measurement of odour emission from the new Kwai Chung Crematorium was taken during the commissioning test in January 2003. Three separate 15-minute average odour levels of the flue gas emission were measured. The odour measurement was carried out by the Odour Laboratory of the Hong Kong Polytechnic University. The maximum 15-minute average odour level of flue gas emission was 325 odour unit (OU). The odour measurement report is enclosed in Appendix A4

4.5.24 As the newly built Kwai Chung Crematorium is equipped with up-to-date cremators and air pollution control system, it passed all the acceptance criteria of the testing and commissioning test including stack emission measurement, it fulfilled all the requirements of BPM 12/2. It is considered that the facility could be a good reference example to the future Diamond Hill Crematorium. Also the odour measurement was conducted during commissioning test where the cremators were running at design conditions, the operation of cremators and air pollution control system, including lime injection system and bag filter system were in normal operation at the design conditions. So the odour measurement at Kwai Chung Crematorium is considered representative of the likely odour level of the new Diamond Hill Crematorium. Furthermore, while the Kwai Chung Crematorium is operating for a certain period, the cremators and air pollution control system will be in the most optimum conditions, the odour emission will be further reduced. Therefore, the odour measurement results is representative to a worse conditions than that of normal operation.

4.5.25 The odour emission rates of the new cremators were calculated based on the volumetric flow rates of the new cremators at 25°C and the maximum odour concentration of 325 OU. The odour emission rates are exhibited in Table 4.8

Table 4.8 Calculation of Emission Rates of Odour

Parameter	**Average Odour Conc. Of Flue Gas (OU)[1]**	**Emission rate, (OU-m^3/s) [2]**	
		170 kg cremator	**250 kg cremator**
Odour	325	142.2	261.6

Note: (1) *Measurement Report of the Odour Emissions from the Kwai Chung Crematorium in January 2003*, HKPU

(2) The emission rates are calculated based on the conditions of odour analysis at laboratory, i.e. 298 K and 1 atmospheric pressure which are the same as the testing condition of the odour measurement was carried out at laboratory. The flue gas volumetric flow rates were calculated as 1575.4 m^3/hour for 170 kg cremators and 2898.5 m^3/hour for 250 kg cremators respectively

4.5.26 The odour assessment was carried out with ISCST3 model at different stability classes of the meteorological data, namely A&B, C, D and E&F separately. The odour level predicted by the ISCST3 model can actually be equated to 15-minute average. This assumption made by Engel *et al (1997)* is widely adopted. The 5-second odour average is calculated by conversion of 15-minute average to 3-minute average with a conversion factor, and then the 5-second average odour is then calculated by multiplying the 3-minute average with a second conversion factor to 5-second. The conversion factors are summarized below:

Stability Class	Conversion Factor from 15-minute to 3-minute average	Conversion Factor from 3-minute to 5-second average	Overall Conversion Factor from 15-minute to 5-second average
Class A,B	2.23	10	22.3
Class C	1.70	5	8.5
Class D	1.38	5	6.9
Class E,F	1.31	5	6.55

4.5.27 The acceptable air quality criterion for 5-second average odour exposure at the ASRs should not exceed 5 OU.

Decommissioning of the Existing Crematorium and Phase II Building Works

4.5.28 The major air quality impact of Phase II building works would be fugitive dust emission similar to Phase I. Phase II work would consist of the demolition of the Existing Crematorium and then building of other facilities of the New Crematorium. The assessment of fugitive dust impact is similar to Phase I construction work and the assessment methodology is referenced to the S. 4.5.2 through 4.5.8. The dust emission rates and the site area adopted for the assessment are summarized in Table 4.18.

4.5.29 In addition, if dioxin deposition is found at the interior surface of the chimney, flue gas piping and combustion chambers of cremators, special demolition method would be adopted to avoid fugitive emission of dioxins-contaminated materials in the environment during the decommissioning of the Existing Crematorium. The management of special demolition waste should refer to Section 7. In order to confirm whether the interior wall of the existing chimney and combustion chambers of cremators, confirmatory test would be carried out to collect deposition samples for analysis when the facility is shut down.

4.6 Results of the Air Quality Impact Assessment

Construction Works of Phase I

Maximum Impact to the Air Quality Due to the Phase I Construction Works

4.6.1 The impact of fugitive dust emissions from Phase I construction works was assessed by ISCST3. The data input and assumptions of the ISCST are listed as below:

Table 4.9 Data Input for ISCST Analysis – Phase I Construction Work

Item	Descriptions
Area of the Phase I site	40 m x 55 m (Southern half of the site)
No. of working hours	7:00 – 19:00, Monday to Saturday
Emission factor	2.69 Mg/hectare/month 0.85 Mg/hectare/year
Dust emission rate	2.076×10^{-4} g/m^2/s (general construction activities) 2.695×10^{-6} g/m^2/s (wind erosion)
Source of meteorological data	Duration : Whole year of 2000, hourly data Meteorological station : HK Observatory in TST Height of anemometer : 42.0 mA.G.
Surface roughness	0.5 m

4.6.2 The highest levels of 1-hour and 24-hour TSP levels (for both unmitigated and mitigated conditions) at the 24 ASRs in ambient air during the construction phase are summarized in Table 4.10. Under mitigated conditions where sufficient water spraying is applied to the construction site with an assumed dust control efficiency of 90%, the 1-hour and 24-hour average TSP levels at all the ASRs meet the air quality acceptable criteria under mitigated condition. According to literature, when sufficient water spraying is applied during the construction work, the fugitive dust generated from general construction dust would be reduced by 90%[(c), (d)]. The control of fugitive dust by water spraying is applicable to dust generated from general construction activities but not for wind erosion dust as water spray is not applied in night time and holidays. In the air quality impact assessment, the dust control efficiency for wind erosion dust is set to zero. Contour plots of fugitive dust level under mitigated and unmitigated conditions are shown in Figure 4.2 through Figure 4.5.

4.6.3 In evaluating the fugitive dust impact with dust control measures with 90% efficiency, the dust emission rate of general construction activity as listed in Table 4.9 was multiplied by 0.1 to obtain the controlled dust emission rate. The TSP level at each ASR is added with the background level of 98 μg/m^3 to evaluate the residual TSP levels at ASRs.

(c) *Overview of Fugitive Dust Emissions*, May 2000 - Section 3, by Mary Hewitt Daly and Jennifer Franco, http://www.pirnie.com/docs/resources_pubs_air_may00_6.html

(d) *Summary of Minimum Dust Control Parameter*, Mine Safety and Health Administration, Pittsburgh Safety and Health Technology Centre, http://www.msha.gov/S&HINFO/TECHRPT/DUST/MINPAR.pdf

Table 4.10 Fugitive Dust Impact to the ASRs at 1.5 m above ground due to the Phase I Construction Work

ASR ID	Fugitive Dust Impact, μg/m³ (Unmitigated)		Fugitive Dust Impact, μg/m³ (Mitigated)	
	1-hr TSP	24-hr TSP	1-hr TSP	24-hr TSP
Air Quality Acceptable Criteria	*500*	*260*	*500*	*260*
A1	291	139	120	99
A2	206	121	110	99
A3	346	151	126	99
A4	260	133	116	99
A5	241	130	114	100
A6	227	126	112	99
A7	289	139	119	100
A8	395	162	131	102
A9	424	168	134	102
A10	482	181	141	102
A11	299	141	120	100
A12	382	159	130	102
A13	281	137	118	100
A14	219	124	112	100
A15	199	120	109	99
A16	629	212	157	106
A17	1260	348	228	112
A18	291	139	119	100
A19	210	122	111	99
A20	225	125	112	99
A21	218	126	111	99
A22	205	121	110	99
A23	600	206	154	103
A24	723	232	168	102

Notes : (1) TSP background level of 98 μg/m³ was included
(2) Based on the air dispersion modelling results, the maximum TSP levels are found at 1.5 m above ground at each of the ASR.

4.6.4 The residual TSP level at the ASRs will meet the respective acceptable air quality criteria when proper dust control measures are implemented.

Cumulative Impact Including Background due to the Nearby Projects

4.6.5 The Diamond Hill No. 2 Freshwater Service Reservoir would be under construction between July 2002 and the end of the 2005. The works would consist of excavation work, concrete works for the super-structure and landscape work. During Phase I construction work of the New Crematorium, excavation work for the service reservoir construction would have been completed and concreting work would be carried out. On the other hand, the KCRC Shatin Central Link project is now under planning stage and the project is likely to delay. As the construction site will be about 800 m away from the Crematorium and are far away from the air sensitive receivers, it is anticipated that the dust emission from the work site would be minimal and therefore the cumulative impact to the nearby ASRs would be mainly due to Phase I construction work of the Crematorium as discussed in above paragraphs. It is expected that the cumulative impact including background due to nearby projects would not be significant and the dust level would comply with applicable air quality acceptable criteria.

Testing and Commissioning of the New Crematorium

4.6.6 During the testing/commissioning of the newly built cremators, FEHD would implement managerial arrangement to ensure that no more than 6 cremators (no more than 6 of both existing and new ones) are in operation. The combination of the operation of the existing and new cremators would be variable and quantitative air quality assessment on testing stage could not be conducted due to lack of emission data from existing cremators. Please refer to S. 4.6.35 – 4.6.41 for further details. Nevertheless, as the new cremators are designed and built with advanced cremation and air pollution control technology, air pollutants emitted from new cremators would be much improved as compared with the existing cremators. The emission of air pollutants during the testing stage would be improved as compared with the existing condition when all the 6 existing cremators are operating. Details of the operation of the Existing Crematorium please refer to Table 4.17.

4.6.7 During commissioning test of the new cremators, human dead body with coffin would be put to cremation under specific test conditions. Since the commissioning test would be carried out similar to typical cremation process, FEHD will limit the total number of cremators in operation, including both existing and new cremators, to no more than 6 at any time. For example, when two units of new cremators are under commissioning test, no more than 4 existing cremators would be available for service.

4.6.8 When the New Crematorium is under commissioning test, training on operation of the cremator system would be provided to the responsible staff to ensure proper operation of the system. Furthermore, the operation of the air pollution control system and monitoring equipment would be tested and evaluated as well.

Operation of the New Crematorium

4.6.9 The major air quality impact to the nearby environment during the operation of the new cremators would be the chimney emissions from the Crematorium. An air quality assessment was carried out with air quality modelling technique.

4.6.10 ISCST3 developed by US Environmental Protection Agency was employed for the air dispersion modelling work. The following assumptions were made:

Table 4.11 Data Input for ISCST3 Modelling Work

No. of Cremator	170 kg Cremator x 4	250 kg cremator x 2
Efflux velocity	15 m/s	
Stack exit diameter	0.22 m	0.30 m
Exit temperature of flue gas	120 ºC	
Elevation (mP.D.)	72.5 m	
Stack height	28.5m (101 m.P.D.)	
Fuel of Cremators	Light Diesel	

Air Quality Impact Assessment Results

4.6.11 The predicted maximum concentrations of concerned air pollutants at the ASRs are summarized in Table 4.12.

4.6.12 The air quality acceptable criteria for RSP, carbon monoxide, nitrogen dioxide and sulphur dioxide are adopted from the Hong Kong Air Quality Objective. For the air quality acceptable criteria for hydrogen chloride, mercury and dioxins, the risk assessment health value, air quality guidelines established by WHO, USEPA, California government and other overseas governments are adopted for the study. The acute inhalation exposure reference is adopted as 1-hour concentration limit and the chronic inhalation exposure reference is adopted as annual average concentration limit respectively.

4.6.13 According to the air modelling results at ASRs, the worst hit level (height above ground) of different air pollutants of 1-hour average and 24-hour average are determined. Contour plots of various air pollutants on ground level, worst hit levels of 1-hour average and 24-hour average exposure are prepared and shown in Figure 4.10 through 4.30. The air quality assessment results show that the worst hit levels of 1-hour and 24-hour average exposure are at 61.5 mA.G. and 58.5 mA.G. respectively.

4.6.14 The annual averages of AQO pollutants (i.e. RSP, SO_2 and NO_2) are mainly dominated by background levels and hence only the short-term impacts (i.e. hourly and daily average) of these AQO pollutants were presented. As the New Crematorium will be equipped with advanced air pollution control system, the emissions of air pollutant will be much reduced compared with the Existing Crematorium. With the reduction of air pollutant emissions, the background air pollutant levels would be gradually improved. In the long run, the ambient air quality at the nearby area would be improved.

Table 4.12 Maximum Air Quality Impact at the 24 ASRs

Air Pollutant	**RSP (μg/m³)**		**Carbon monoxide (μg/m³)**				**Hydrogen Chloride (μg/m³)**				**Nitrogen Dioxide (μg/m³)**				**TOC (μg/m³)**			
Averaging Period	**24-hour**		**1-hour**		**8-hour**		**1-hour**		**Annual**		**1-hour**		**24- hour**		**1-hour**		**24-hour**	
Acceptable Criteria / **ASR**	***180***		***30,000***		***10,000***		***2,100***		***20***		***300***		***150***		**--**		**--**	
	Conc	***mA.G.***	***Conc***	***mA.G.***	***Conc***	***mA.G.***	***Conc***	***mA.G.***	***Conc***	***mA.G.***	***Conc***	***mA.G.***	***Conc***	***mA.G.***	***Conc***	***mA.G.***	***Conc***	***mA.G.***
A1	64	1.5	1091	1.5	1059	1.5	40	1.5	0.1	1.5	89	1.5	62	1.5	8.0	1.5	0.88	1.5
A2	62	1.5	1074	1.5	1056	1.5	23	1.5	0.0	1.5	77	1.5	61	1.5	4.7	1.5	0.45	1.5
A3	65	1.5	1102	1.5	1061	1.5	51	1.5	0.1	1.5	98	1.5	63	1.5	10.3	1.5	1.05	1.5
A4	63	1.5	1082	1.5	1058	1.5	31	1.5	0.1	1.5	83	1.5	61	1.5	6.3	1.5	0.52	1.5
A5	62	1.5	1081	1.5	1057	1.5	30	1.5	0.2	1.5	82	1.5	61	1.5	6.2	1.5	0.41	1.5
A6	64	1.5	1095	25.5	1058	1.5	44	25.5	0.7	1.5	93	25.5	62	1.5	9.1	25.5	0.77	1.5
A7	68	19.5	1117	25.5	1066	25.5	66	25.5	1.3	1.5	109	25.5	65	1.5	13.5	25.5	1.64	25.5
A8	68	1.5	1145	25.5	1068	1.5	94	25.5	1.9	1.5	130	25.5	65	1.5	19.3	25.5	1.66	25.5
A9	65	1.5	1107	1.5	1065	1.5	56	1.5	0.5	1.5	102	1.5	63	1.5	11.6	1.5	1.01	1.5
A10	71	58.5	1218	61.5	1079	61.5	167	61.5	0.7	55.5	186	61.5	67	58.5	33.3	61.5	2.14	58.5
A11	68	61.5	1133	61.5	1065	61.5	82	61.5	0.3	55.5	121	61.5	65	61.5	16.3	61.5	1.56	61.5
A12	68	58.5	1164	61.5	1071	55.5	113	61.5	0.4	55.5	145	61.5	65	58.5	22.6	61.5	1.55	58.5
A13	62	19.5	1075	19.5	1057	19.5	24	19.5	0.1	19.5	77	19.5	61	19.5	5.0	19.5	0.42	19.5
A14	62	55.5	1097	55.5	1057	55.5	47	55.5	0.1	49.5	94	55.5	61	55.5	9.3	55.5	0.45	55.5
A15	63	61.5	1082	55.5	1058	1.5	31	55.5	0.2	49.5	83	61.5	61	61.5	6.2	55.5	0.61	49.5
A16	64	7.5	1074	7.5	1064	7.5	23	7.5	0.2	7.5	77	7.5	62	7.5	4.8	7.5	0.90	7.5
A17	61	7.5	1059	7.5	1063	7.5	8	7.5	0.0	7.5	65	7.5	59	7.5	1.8	7.5	0.12	7.5
A18	64	79.5	1130	79.5	1062	79.5	79	79.5	0.2	79.5	119	79.5	62	79.5	15.8	79.5	0.90	79.5
A19	63	79.5	1095	79.5	1059	79.5	44	79.5	0.1	79.5	92	79.5	61	79.5	8.8	79.5	0.52	79.5
A20	63	79.5	1101	79.5	1058	79.5	50	79.5	0.2	79.5	97	79.5	61	79.5	10.0	79.5	0.56	79.5
A21	62	13.5	1062	13.5	1055	13.5	11	13.5	0.1	13.5	68	13.5	60	13.5	2.3	13.5	0.39	13.5
A22	62	1.5	1061	13.5	1054	13.5	10	13.5	0.1	13.5	67	13.5	60	1.5	2.0	13.5	0.31	1.5
A23	68	1.5	1122	1.5	1072	1.5	71	1.5	0.7	1.5	113	1.5	65	1.5	15.0	1.5	1.76	1.5
A24	68	13.5	1116	13.5	1065	13.5	65	13.5	0.2	13.5	108	13.5	65	13.5	13.7	13.5	1.61	13.5

Note: (1) Assuming the particulate emissions from the chimney are all RSP

(2) The background level of RSP (60 μg/m³), carbon monoxide (1,051 μg/m³) and NO_2 (59 μg/m³) were included

Table 4.12 Maximum Air Quality Impact at the 24 ASRs (Con't)

Air Pollutant	**Sulphur Dioxide (μg/m³)**				**Mercury (μg/m³)**				**Dioxins (pg I-TEQ/m³)**		**Excess cancer risk (per 1,000,000)**	
Averaging Period	**1-hour**		**24-hour**		**1-hour**		**Annual**		**Annual**			
Acceptable Criteria	***800***		***350***		***1.8***		***1.0***		***1.0***		***100***	
ASR (Elevation, m)	***Conc***	***mA.G.***	***Conc***	***mA.G.***	***Conc***	***mA.G.***	***Conc***	***mA.G.***	***Conc***	***mA.G.***	***Risk Level***	***mA.G.***
A1	92	1.5	29	1.5	0.08	1.5	0.000	1.5	0.056	1.5	0.02	1.5
A2	63	1.5	25	1.5	0.05	1.5	0.000	1.5	0.055	1.5	0.01	1.5
A3	120	13.5	30	1.5	0.11	1.5	0.000	1.5	0.056	1.5	0.03	1.5
A4	77	1.5	26	1.5	0.07	1.5	0.000	1.5	0.056	1.5	0.03	1.5
A5	76	1.5	25	1.5	0.06	1.5	0.001	1.5	0.057	1.5	0.09	1.5
A6	101	25.5	28	1.5	0.09	25.5	0.002	1.5	0.062	1.5	0.28	1.5
A7	139	25.5	36	25.5	0.14	25.5	0.003	1.5	0.068	1.5	0.51	1.5
A8	189	25.5	36	25.5	0.20	25.5	0.004	1.5	0.074	1.5	0.72	1.5
A9	122	1.5	30	1.5	0.12	1.5	0.001	1.5	0.060	1.5	0.20	1.5
A10	322	61.5	40	58.5	0.35	61.5	0.002	55.5	0.062	55.5	0.25	55.5
A11	168	61.5	35	61.5	0.17	61.5	0.001	55.5	0.058	55.5	0.11	55.5
A12	225	61.5	35	58.5	0.24	61.5	0.001	55.5	0.059	55.5	0.14	55.5
A13	64	19.5	25	19.5	0.05	19.5	0.000	19.5	0.056	19.5	0.05	19.5
A14	105	55.5	25	55.5	0.10	55.5	0.000	49.5	0.056	49.5	0.05	49.5
A15	77	55.5	27	61.5	0.07	55.5	0.003	49.5	0.057	49.5	0.06	49.5
A16	63	7.5	29	7.5	0.05	7.5	0.001	7.5	0.057	7.5	0.09	7.5
A17	35	7.5	22	7.5	0.02	7.5	0.000	7.5	0.055	7.5	0.01	7.5
A18	162	79.5	29	79.5	0.16	79.5	0.005	79.5	0.057	79.5	0.09	79.5
A19	100	79.5	26	79.5	0.09	79.5	0.003	79.5	0.056	79.5	0.05	79.5
A20	111	79.5	26	79.5	0.10	79.5	0.003	79.5	0.057	79.5	0.06	79.5
A21	42	13.5	24	13.5	0.02	13.5	0.000	13.5	0.056	13.5	0.04	13.5
A22	39	13.5	24	1.5	0.02	13.5	0.000	13.5	0.056	13.5	0.03	13.5
A23	148	1.5	36	1.5	0.15	1.5	0.002	1.5	0.062	1.5	0.28	1.5
A24	138	13.5	35	13.5	0.14	13.5	0.001	13.5	0.057	13.5	0.06	13.5

Note: (1) The background level of SO_2 (21 μg/m³), Hg (0.00022μg/m³) and dioxins (0.055 pg I-TEQ/m³) were included

4.6.15 The detailed results of the air quality impact assessment are enclosed in Appendix A2 and contour plots showing the air quality levels in the vicinity are enclosed in the Figures 4.10 through 4.30.

4.6.16 The contour plots showing the 1-hour average of NO_2 at 61.5 mA.G., (as shown in Figure 4.17) shows that the 1-hour average NO_2 at some area at the level of 61.5 mA.G. exceed the air quality acceptable criteria. However, it is noted that the affected areas are in mid air and there is no high-rise building nor ASR within the affected area in mid air. If ASR A17 (which falls within the footprint of the exceedance zone but currently is a 2-storey structure) is to be redeveloped, the future development may subject to adverse air quality impact should it be redeveloped to high rise building. Though there is currently no plan for its redevelopment, in order to identify the possible future development constraints, a separate modeling was conducted to predict the 1-hour NO_2 concentration at various elevations. According to the air quality modelling results as shown in Appendix A5 and the required additional safety margin of 10 m (ref : Guidelines on Estimating Height Restriction and Position of Fresh Air Intake Using Gaussian Plume Models", HKEPD), the maximum heights for re-development of ASR A17 is recommended not to exceed 36.5 mA.G. to avoid the impact of NO_2 due to the operation of the New Crematorium. The above height restriction is recommended based on the air quality assessment results of this EIA report. Whenever re-development of ASR A17 is required, it is suggested that the future developer should conduct a special air quality assessment at the planning stage to evaluate whether the recommended height restriction at the location is still applicable regarding the chimney emissions and the ambient air quality at that time.

4.6.17 Comparing the predicted concentrations including background concentrations of each air pollutant with the relevant ambient air quality standards, there is no significant impact to the ambient air quality and the operation of the Crematorium would not cause significant deterioration to the ambient air quality at the nearby ASRs.

Health Risk Assessment

4.6.18 A health risk assessment was carried out by evaluating the excess cancer risk due to exposure to dioxins at the ASRs. The excess cancer risk assessment was carried out by multiplying the unit cancer risk factor (38 $(\mu g/m^3)^{-1}$) with the highest annual dioxin concentration in ambient air due to emissions from the cremators.

4.6.19 Referring to the air quality assessment results, the highest annual dioxins concentration would increase by 0.019 pg I-TEQ/m^3 (0.074 – 0.055 = 0.019 pg I-TEQ/m^3). The excess cancer risk is therefore calculated to be 0.72 x 10^{-6}, which is lower than the significant risk level of 100 x 10^{-6} (See Table 4.13). The cancer risk associated with the operation of the Crematorium is not significant at all the ASRs.

Table 4.13 Increased Risk to Lifetime Exposure of 70 years to Dioxins

	Cancer Risk
Maximum annual dioxins level at air sensitive receiver A8	0.074 – 0.055 = 0.019 pg I-TEQ/m^3
Maximum excess cancer risk (A8)	0.019 x 38 x 10^{-6} 0.72 x 10^{-6}
Cancer risk impact	Not significant

4.6.20 For inventory purpose, the emission of dioxins from the New Crematorium is calculated as follows:

Annual emission of dioxins	=	Emission concentration x volumetric flow rate x 10 hours x 365 days
	=	1.0 ng/m^3 x (1,798 m^3/hr x 4 + 2,318 m^3/hr x 2) x 10 hours x 365 days
	=	43.2 mg I-TEQ/year

4.6.21 The estimated annual emission of dioxins from the New Crematorium is 43.2 mg I-TEQ per year.

Odour Assessment

4.6.22 Based on the operational experience of the old style cremators or waste incinerators, odour emission from the chimneys may affect the nearby air sensitive receivers since such old style cremators are not equipped with appropriate air pollution control system.

4.6.23 EPD and FEHD have received a number of complaints on the emissions from the existing cremators from the general public in the past few years. The complaints are mainly related to the dark smoke emissions and the odour nuisance during the operation of the existing cremators. Odour is one of the major environmental aspect of the New Crematorium. With the adoption of advanced incineration technology and installation of effective air pollution control system, it is anticipated that emission of air pollutants from the new Cremators would be reduced to an acceptable level.

4.6.24 Since the odour emissions from cremators is a concern of the general public, an odour assessment was carried out to assess the odour impact of the New Crematorium. The assessment was carried out by ISCST3 to determine the 5-second average odour at the ASRs. The data input for the air modelling are summarized in Table 4.14

Table 4.14 Data Input for ISCST3 Modelling Work for Odour Assessment

No. of Cremator	170 kg Cremator x 4	250 kg cremator x 2
Efflux velocity	15 m/s	
Stack exit diameter	0.22 m	0.30 m
Odour emission rate	142.2 OU-m^3/sec	261.6 OU-m^3/sec
Atmosphere stability class	Class A,B Class C Class D Class E,F	
Ambient temperature of at ASRs	25 ^oC	
Elevation (mP.D.)	72.5 m	
Stack height	28.5 m (101 mP.D.)	

4.6.25 Air modelling work was carried out at different stability classes. The maximum 5-second average odour exposure is compared with the air quality acceptable criteria as specified in the EIAO TM Annex 4. The odour assessment results are summarized in Table 4.15.

Table 4.15 Results of the Odour Assessment at Different Atmospheric Stability Classes

Atmosphere Stability Class	ASR with Max Odour Impact	15-minute Average Odour (OU)	Multiplying Factor	5-second Average Odour (OU)
Class A,B	A23 (1.5 m)	0.12060	22.3	2.69
Class C	A23 (1.5 m)	0.11446	8.5	0.97
Class D	A10 (55.5 m)	0.22362	6.9	1.54
Class E,F	A10 (61.5 m)	0.55358	6.55	3.63
Air Quality Acceptable Criteria – 5-second Average Odour Exposure				*5*
Maximum 5-second Average Odour Exposure				***3.63***

4.6.26 It is found that the maximum odour exposure is under the stability class E,F at 61.5 mA.G. of A10. The 5-second average odour exposure (stability class E,F) at all the ASRs is exhibited in Table 4.16. The maximum 5 second average odour exposure at all the ASRs are well below the acceptable criterion as specified in the Annex 4 of the EIAO TM and so there is no significant odour impact on the ASRs.

Table 4.16 Maximum 5-second Odour Exposure at ASRs Under Stability Class E,F

ASR	1-hour Average Odour (OU)	Multiplying Factor	5-second Average Odour (OU)
Air Quality Acceptable Criterion (EIAO TM Annex 4)			*5 OU over 5 seconds*
A1 (19.5 m)	0.0573	6.55	0.38
A2 (19.5 m)	0.0010		0.01
A3 (19.5 m)	0.0069		0.05
A4 (19.5 m)	0.0001		0.00
A5 (25.5 m)	0.0477		0.31
A6 (25.5 m)	0.1465		0.96
A7 (25.5 m)	0.2160		1.41
A8 (25.5 m)	0.3063		2.01
A9 (25.5 m)	0.0629		0.41
A10 (61.5 m)	0.5536		3.63
A11 (61.5 m)	0.2714		1.78
A12 (61.5 m)	0.3762		2.46
A13 (19.5m)	0.0386		0.25
A14 (55.5 m)	0.1546		1.01
A15 (61.5 m)	0.1040		0.68
A16 ((7.5 m)	0.0001		0.00
A17 (7.5 m)	0.0000		0.00
A18 (79.5 m)	0.2599		1.70
A19 (79.5 m)	0.1447		0.95
A20 (85.5 m)	0.1665		1.09
A21 (7.5 m)	0.0026		0.02
A22 (13.5 m)	0.0019		0.01
A23 (1.5 m)	0.0257		0.17
A24 (13.5 m)	0.0022		0.01

Note: (1) Figures in brackets are the levels of ASR above ground

4.6.27 The contour plotting of 5-second odour level at ground level and at 61.5 mA.G.. (worst hit level) under the stability class E,F and at the ground level under the stability class A,B (worst hit level as well) are shown in Figures 4.29 to 4.30. The 5-second average odour level at all ASRs meet the acceptable air quality criterion of 5 OU. Although there is exceedance noted at 61.5 mA.G. under stability class E,F, it is noted that there is no high rise building within the affected area in mid air, so there is no impact to ASRs. If ASR A16 and A17 (which fall within the footprint of the exceedance zone but currently are 2-storey structures) are to be redeveloped, the future development may subject to adverse air quality impact should they be redeveloped to high rise buildings. Though there is currently no plan for their redevelopment, in order to identify the possible future development constraints, a separate modeling was conducted to predict the odour concentration at these two locations at various elevations. According to the air quality modelling results as shown in Appendix A5 and the required additional safety margin of 10 m (ref : Guidelines on Estimating Height Restriction and Position of Fresh Air Intake Using Gaussian Plume Models", HKEPD), the maximum heights for re-development of ASR A16 and ASR A17 is recommended not to exceed 45.5 mA.G. and 36.5 mA.G. respectively. Whenever if re-development of ASR A16 and A17 is required, it is suggested that the future developer should conduct a special air quality assessment at the planning stage to evaluate whether the recommended height restriction at the locations is still applicable regarding the chimney emissions and the ambient air quality at that time.

4.6.28 Besides odour emissions from chimneys, fugitive emissions of odour from the daily operation of the Crematorium is assessed. In view of the operation of Crematorium, coffins from the general public are totally enclosed, and unclaimed dead bodies are properly packaged when delivered to the Crematorium. Coffins and other dead bodies will not be further processed until cremation. Therefore there should be no other fugitive odour emission other than the chimney emissions.

4.6.29 In order to prevent odour impact to the near ASRs, regular odour patrol will be carried out at the site boundary during the operation of the New Crematorium. Corrective actions would be carried out immediately if significant odour emission is detected by the odour patrol team.

Air Quality Assessment for the Operation of Joss Paper Burners

4.6.30 According to the planning of the New Crematorium, 4 units of joss paper burners will be installed near the service halls for Chinese memorial ceremonies. Burning of joss paper and joss stick usually generate smoke emissions. The dimensions of the joss paper burners will be 1.5 m (L) x 1.5 m (W) x 1.1 m (H). Assuming 6 cremation time slots are available a day, the duration of a typical memorial ceremony is 30 minutes and the burning material is assumed to be 2 kg per ceremony, the maximum operation time for each of joss paper burner is 3 hours a day. 12 kg of burning material will be combusted for each joss paper burner per day. This is the worst case scenario, as some memorial ceremonies do not burn joss paper and joss stick.

4.6.31 In general, joss paper burners being used nowadays are just simple combustion chamber without air pollution control, the flue gas emission may affect the nearby ASRs.

4.6.32 In order to reduce the nuisance due to the emissions from joss paper burners, administrative mitigation measures would be adopted as follows:

- FEHD will limit the use of joss paper burners. Joss paper burners will be only allowed for the use of memorial ceremonies upon request by the relatives. Other usage of joss paper burners will not be allowed;
- Guidance will be provided to the users to advise them to minimize the quantity of burning material;
- FEHD staff will advise the users to ensure better combustion of the joss paper in order to reduce smoke emission.

It is anticipated that the emission of air pollutants would be much improved by administrative management measures to reduce the usage of joss paper burners to minimal and to improve the combustion efficiency. Whenever necessary, FEHD will advice users to reduce the quantity of burning materials through proper education channels.

Comparison of the Environmental Performance with the Existing Crematorium

4.6.33 In comparing the environmental performance of existing cremators and new cremators, the following 3 different approaches, in order of preference, could be adopted:-

(a) Approach 1 - Actual measurement of air pollutant emissions (including dioxins) from the existing cremators;
(b) Approach 2 - Making reference to air pollutant emissions measurement results for other operating cremators with similar design, either locally or in overseas countries; or
(c) Approach 3 - Qualitative comparison by assessing the extent of air quality improvement that will be brought about by replacing the existing cremators with new ones.

Both Approach 1 and Approach 2 can give quantitative estimates of air pollutant emissions from the existing cremators, although strictly speaking Approach 2 is only an indication of the possible emission levels from existing cremators because there is no actual emission measurement done for the existing cremators. In comparison, Approach 3 cannot provide any quantitative estimates of air pollutant emissions from existing cremators.

4.6.34 The following paragraphs demonstrate that both Approach 1 and Approach 2 are not practicable in this EIA study and so only Approach 3 could be adopted.

Approach 1 - actual measurement of air pollutant emissions

4.6.35 The Existing Crematorium in Diamond Hill is not classified as Specified Process under the Air Pollution Control Ordinance due to the small processing capacities of the cremators (<0.5 tonne per hour). It is therefore not subject to licensing control and there is no requirement of regular air pollutant emission measurement for the existing cremators. FEHD is not in possession of relevant air pollutant emission measurement results for the existing cremators. If this approach is adopted, it is necessary to arrange stack emission test specifically for the purpose of getting actual emission levels from the existing cremators.

4.6.36 The Consultants have investigated the site and concluded that it is not practicable to carry out stack measurement due to the following constraints. FEHD also confirmed these constraints:-

- The design of the Existing Crematorium Chimney is 10 m above ground, there is an ejector fan installed inside the chimney to exhaust flue gas and no sampling facility is available to carry out stack sampling work. The existing stack for the cremators in the Existing Crematorium in Diamond Hill is not suitable for carrying out air pollutant emission sampling work because (1) there is an ejector fan in the stack which disturbs the air flow pattern, (2) there is not sufficient straight run of the stack to even out the air flow, (3) sampling could only be done along one axis instead of perpendicular axes as required in stack measurement. In conclusion, the design and facility of the Existing Crematorium failed to provide representative stack emission data.

- To overcome these constraints, it is necessary to extend the stack sufficiently long to achieve uniform air flow free of the influence of the ejector fan and to conduct the stack sampling on a temporarily erected sampling platform above the roof. Unfortunately, the existing roof could not support the additional loading of the temporary platform and so it is necessary to construct an extensive steel portal across the crematorium hall with truss supports from the ground and the truss supports will be massive concrete blocks. It is expected that this will take about six months to design the temporary structure and process the application. Furthermore, the sampling work and laboratory analysis of the collected samples will take another two months. This will affect the master programme of the Project significantly.

- Furthermore, the massive concrete support for the temporary structure for stack sampling work will obstruct the only access road to the Existing Crematorium. FEHD/Arch SD confirmed that temporary blocking of the access road, and hence temporary closure of the Crematorium, is needed to construct the structure and conduct the stack sampling. It is estimated that the Existing Crematorium has to be closed for at least four weeks to facilitate the stack sampling work. This will seriously affect the operation of the Crematorium and the normal provision of cremation service to the public will be accordingly affected.

4.6.37 In view of the above constraints, it is not practicable to get actual air pollutant emission measurement results from the existing cremators.

Approach 2 – Making reference to air pollutant emission results for other operating cremators with similar design

4.6.38 We conducted a detailed search on the availability of air pollutant emission measurement results from local or overseas cremators with similar design to the existing cremators in the Existing Crematorium in Diamond Hill. We could not find any such measurement results in overseas countries. The only available cremator emission measurement results in Hong Kong are those from (i) the Fu Shan Crematorium (Year 2001 measurement results); and (ii) the Cape Collinson Crematorium (Year 2002 measurement results)

4.6.39 Having reviewed the air pollutant emission measurement results and the design of the cremators in Fu Shan and Cape Collinson Crematoria, we concluded that these measurement results could not be used to indicate the emission levels of the existing cremators in the Existing Crematorium in Diamond Hill because of the following reasons:-

- The cremators in the Existing Crematorium in Diamond Hill are diesel-fired cremators while the cremators in Fu Shan Crematorium are gas-fired;

- Four of the cremators in the Existing Crematorium in Diamond Hill are designed with single combustion chamber only while the cremators in Fu Shan Creamtorium and Cape Collinson Crematorium are designed with both primary and secondary combustion chambers.

4.6.40 As there is no other available emission measurement results in the public domain, we conclude that there is no comparable air pollutant emission measurement data to indicate the emission levels of the existing cremators in the Existing Crematorium in Diamond Hill.

Approach 3 – Qualitative comparison

4.6.41 As both Approach 1 and Approach 2 could not be used to indicate the air pollutant emission levels of the cremators in the Existing Crematorium in Diamond Hill, it is concluded that it is not possible to quantify the emission levels of the existing cremators. Approach 3 therefore becomes the only practicable means to qualitatively compare air pollutant emission levels of the existing cremators and the new cremators to be installed in the New Crematorium in future.

The following table summarizes the comparison of the performance of the existing cremators and the future new cremators in terms of cremator design, air pollutant emissions control and monitoring practices, and crematorium management practices.

Table 4.17 Comparison of Existing and New Cremators

		Existing Cremators	Future New Cremators
Cremator Design	Combustion chambers	Primary chamber only	Primary and secondary chambers
	Combustion temperature	Around 800 ^{o}C	At least 850 ^{o}C for 2 seconds in secondary combustion chamber to ensure complete combustion
	Monitoring of sufficient combustion air in combustion zone	Not provided	Continuous monitoring by oxygen and carbon monoxide sensors in secondary chamber
Air Pollutant Emission and Monitoring	Air pollution control system	Nil	Adequate air pollution control system including cyclone, bag filter with lime and activated carbon injection will be installed to treat the flue gas before dispersion to the atmosphere. Alternative air pollution control system with equivalent performance may be installed subject to final selection in the open tender process
	Air pollutant emission monitoring	Smoke density meter to monitor smoke emission only	Smoke density at the chimney will be continuously monitored. In addition, regular stack monitoring will be conducted according to the future Specified Process Licence
	Compliance with BPM emission limits	Not applicable	Must comply with stipulated emission limits for various air pollutants including dioxin
Cremator Management Practices	Environmental management programme	Nil	Will be established and implemented to control the operation and maintenance practice of the crematorium in order to achieve better environmental performance

The above table clearly demonstrates that the future new cremators are of better design and equipped with adequate air pollution control system. They will also fully comply with all the requirements of the BPM 12/2. On the other hand, complaint of dark smoke emission and odour associated with the existing cremators are received occasionally. This shows that the existing cremators are not performing ideally in environmental perspective. Obviously, when the existing cremators are replaced by the new cremators in future, there would be substantial improvement in the air quality in the district and we expect there will not be dark smoke and odour emissions from the cremators.

Demolition of the Existing Crematorium and Phase II Building Works

Maximum Impact to the Air Quality Due to Phase II Construction Works

4.6.42 Phase II construction work would consist of the demolition of the Existing Crematorium building and building works for two service halls and other facilities of the New Crematorium. The impact of fugitive dust emissions from Phase II construction works was evaluated by ISCST3 similar to Phase I construction work. The data input and assumptions of the ISCST3 are listed as below:

Table 4.18 Data Input for ISCST3 Analysis – Phase II Construction Work

Item	Descriptions
Area of the Phase II site	65 m x 75 m (Northern half of the site)
No. of working hours	7:00 – 19:00, Monday to Saturday
Emission factor	2.69 Mg/hectare/month (Section 13.2.3) 0.85 Mg/hectare/year (Table 11.9.4)
Dust emission rate	2.076×10^{-4} g/m^2/s (general construction activities) 2.695×10^{-6} g/m^2/s (wind erosion)
Source of meteorological data	Duration : Whole year of 2000, hourly data Meteorological station : HK Observatory in TST Height of anemometer : 42.0 m A.G.
Surface roughness	0.5 m

4.6.43 The 1-hour and 24-hour TSP in ambient air (for both unmitigated and mitigated conditions) at the 24 ASRs during Phase II construction work are summarized in Table 4.19. The 1-hour and 24-hour average TSP levels at all the ASRs under the mitigated conditions meet the relevant standard and air quality objective. During the construction work, water spraying would be applied to the construction site regularly according to the APCO (Construction Dust) regulation. Similar to the situation in Phase I construction work, the dust control efficiency of water spraying is 90%. Contour plots showing the ambient TSP level under unmitigated and mitigated conditions are enclosed in Figures 4.6 to 4.9.

Table 4.19 Fugitive Dust Impact to the ASRs at 1.5 mA.G. due to Phase II Construction Work

ASR ID	Fugitive Dust Impact, μg/m³ (Unmitigated)		Fugitive Dust Impact, μg/m³ (Mitigated)	
	1-hr TSP	24-hr TSP	1-hr TSP	24-hr TSP
Air Quality Acceptable Guideline	*500*	*260*	*500*	*260*
A1	529	121	146	101
A2	413	113	133	100
A3	743	134	170	103
A4	463	119	139	101
A5	424	133	134	102
A6	357	126	127	101
A7	457	156	138	105
A8	650	181	160	108
A9	775	164	174	106
A10	585	147	152	124
A11	387	126	130	102
A12	517	143	145	103
A13	405	129	132	102
A14	314	119	122	101
A15	278	113	118	100
A16	755	174	171	107
A17	1245	264	226	118
A18	389	126	130	101
A19	288	112	119	100
A20	309	115	121	100
A21	300	114	120	100
A22	276	112	118	100
A23	688	153	164	105
A24	1542	307	259	123

Notes : (1) TSP background level of 98 μg/m³ was included
(2) Based on the air dispersion modelling results, the maximum TSP levels are found on the ground level (1.5 m) at each of the ASR.

4.6.44 The contour plots show that under the mitigated scenario, the construction works would not impose significant dust impact on nearby ASRs.. Therefore it is anticipated that the construction work would not impose significant impact to the nearby citizens.

Fugitive Emission of Dioxin Contaminated Dust during Decommissioning of the Existing Crematorium

4.6.45 The Existing Crematorium has been operated for more than 24 years and the interior surface of the chimney, flue gas ducting and combustion chambers may be contaminated with heavy metals and dioxins, etc. The demolition of the Existing Crematorium may generate fugitive emissions of toxic air pollutants to the atmosphere. Since the Existing Crematorium is still under normal operation, the Consultant was not able to collect samples of surface deposition to verify whether the interior surface of the chimney is contaminated with toxic air pollutants.

4.6.46 Fugitive emission of dioxin-contaminated materials during demolition of the Existing Crematorium will be a concern when the existing facility is demolished. A confirmatory test of dioxins in the depositions on chimney wall, flue gas ducting and combustion chambers will be carried out when the Existing Crematorium is shut down. Sampling of surface deposition for chemical analysis will be arranged. If the dioxin level is between 1 and 10 ppb I-TEQ, it is classified as moderately contaminated with dioxins. The demolition work site should be covered up to avoid emission of fugitive dust during demolition. The management of demolition waste is referred to in the waste management plan as discussed in Section 7.

4.6.47 If the dioxin level exceeds 10 ppb I-TEQ, it is classified as severely dioxin-contaminated waste. If it is confirmed that the existing facilities are severely contaminated with dioxins, a special decommissioning method – Containment method – would be adopted. The principle of containment method is to enclose the whole decommissioning site with containment. The containment would be maintained at negative air pressure to prevent emission of dioxin contaminated dust into the atmosphere. The chimney would be lined with 3 layers of fire retardant polythene sheets. An air mover would be provided to maintain a negative pressure of 0.05-0.15 inches of water within the work area throughout the entire course of the decommissioning works. A pressure monitor with printout facility and audible alarm would be installed at any easily accessible location to monitor the internal pressure. Pre-filter and high efficiency air particulate filter shall be installed at the air exhausts to avoid emission of fugitive dust to the atmosphere.

4.6.48 Before the commencement of the decommissioning work, a smoke test would be carried out to ensure there is no air-leakage of the containment. The containment would be commissioned only when the smoke test is passed. When the containment is commissioned, a ventilation rate of 6 air changes per hour shall be maintained. A "dirty room", a shower room and a "clean room" would be provided for workers to clean up before leaving the work site.

4.6.49 As the demolition waste would be carefully handled to avoid potential fugitive emission of dioxin according to the waste management practices as discussed in Section 7, it is anticipated that the fugitive emission of dioxin contaminated dust during demolition of the Existing Crematorium building would be properly controlled and the impact to the air quality would be insignificant.

Demolition and Removal of Asbestos Containing Material

4.6.50 An asbestos assessment at the Existing Crematorium in 2003confirmed that asbestos was found in the existing building structure. A registered asbestos contractor would be employed to remove asbestos containing material during the demolition of the Existing Crematorium building in accordance with the requirements of APCO in order to avoid leakage of asbestos to the atmosphere during the demolition works. An asbestos investigation report (AIR) for the demolition of the Existing Crematorium is enclosed in Appendix D. A formal AIR and Asbestos Abatement plan signed by a registered asbestos consultant shall be submitted to the Authority for approval under APCO 28 days prior to the start of any asbestos abatement work.

4.6.51 As asbestos containing material (ACM) will not be handled until the Phase II construction work in March 2006, therefore control of ACM during the Phase I construction work is not required. When ACM is handled, such as demolition and handling of demolition waste, all ACMs will be properly labelled by a registered asbestos consultant. Furthermore, staffs working at the Crematorium will be well informed of the presence of ACM and to take proper precaution. In case of any disturbance of ACM, staff of the Crematorium will seek advice from a registered asbestos consultant immediately.

4.6.52 Under the APCO, the following precautionary and mitigation measures would be taken during removal of asbestos containing materials:

- ❑ Enclosure of the work area
- ❑ Containment and sealing for the asbestos containing waste
- ❑ Provision of personal decontamination facility
- ❑ Use of personal respiratory/protection equipment
- ❑ Use of vacuum cleaner equipped with high-efficiency air particulate (HEPA) filter for cleaning up the work area
- ❑ Carrying out air quality monitoring during the asbestos abatement work

4.6.53 In addition, APCO also requires the appointment of qualified personnel to carry out the asbestos containing material removal work:

- ❑ A registered asbestos contractor to carry out the work;
- ❑ A registered asbestos supervisor to supervise the work;
- ❑ A registered asbestos laboratory to monitor the air quality, and
- ❑ A registered asbestos consultant to supervise and certify the asbestos abatement work.

4.6.54 The impact of asbestos exposure due to the decommissioning of the Existing Crematorium would be insignificant when all the above precaution and mitigation measures are taken during the demolition work.

Site Management When Handling Asbestos Containing Materials

4.6.55 The asbestos materials in each building / premises must be abated before other contractors / trades are allowed to work in the building / premises;

4.6.56 Tight security measures should be taken at the asbestos abatement work site to prevent any disturbance to asbestos materials that may be resulted from the stealing of electrical cable and copper pipes. Also, it is recommended that all friable asbestos containing materials, in this case the cloth insulation and gasket, be abated first.

4.6.57 As different contractors may be working on site at the same time, the following extra measures should be considered:

- if there is sensitive receptor around the area, conduct environmental air monitoring at this off-site sensitive receptors
- Submit to EPD a completion report, include photos and air monitoring results, immediately after completion of asbestos abatement work for each work zone

Cumulative Impact due to the Nearby Projects

4.6.58 During Phase II building works, there would be the construction work of the proposed KCRC's Shatin to Central Link about 800 m to the west of the Crematorium. The KCRC project is now under planning stage, the final alignment of the track and detail works programme is still not available. Since the construction site is about 800 m away from the Crematorium, there are long distances to the ASRs. Therefore the cumulative impact contributed by the railway works would be insignificant.

4.7 Mitigation Measures to Reduce Adverse Environmental Impacts

4.7.1 A number of mitigation measures are proposed to relieve the air quality impact due to the construction and operational of the proposed crematorium.

Construction Works of Phase I

4.7.2 The fugitive dust emission would be the most significant impact to the air quality during Phase I Construction Works. According to the Air Pollution Control (Construction Dust) Regulation, the following mitigation measures would be implemented:

1. Erect a site barrier with the height of no less than 2.4 m at the construction site boundary to enclose the work area;
2. Apply frequent water spraying to ensure the surface of the construction site sufficiently wet to reduce fugitive dust due to wind erosion and transportation on unpaved haul road;
3. Cover up stockpiles of fill material and dusty material;
4. Install a vehicle-cleaning system at the main entrance of the construction site to clean up the vehicles before leaving the site.

4.7.3 It is expected that the fugitive dust emission would be reduced by at least 90% when the above mitigation measures are taken.

Commissioning of New Crematorium

4.7.4 In order to prevent additional loading of chimney emissions to the environment, administrative control measures would be taken to ensure that there would be no more than six cremators, including new and existing ones under commissioning test, in operation at any one time.

4.7.5 Specifically, the following testing and commissioning schedule will be adopted:

a. Commissioning test of the new cremators would be carried out one by one, with no more than 2 new cremators undergoing commissioning test at the same time;
b. The total number of operating cremators, including both new and existing cremators, would not be more than 6.

An operational log book would be maintained to record the operational time of each of the new and existing cremators.

Operation of New Crematorium

4.7.6 The proposed cremators would be designed with advanced technology in combustion as well as equipped with appropriate air pollution control system. As discussed above, the chimney emissions would not impose significant impact on the nearby environment. The most important mitigation measures would be to ensure proper operation of the Crematorium and the air pollution control system. In case of failure of any part of the cremator system, the operation should be suspended and the failure rectified as soon as possible. Furthermore, a stringent management of the New Crematorium will be implement to ensure proper operation of the facility, the areas of staff training, emission monitoring, inspection and maintenance arrangements will be strengthened.

Demolition of the Existing Crematorium and Phase II Construction Work

4.7.7 The mitigation measures for fugitive dust emissions due to the Phase II works would be similar to those adopted for Phase I. Proposed mitigation measures are referred to in S. 4.7.2.

4.7.8 If the interior deposition of the existing chimney, flue gas piping and cremation chambers are confirmed contaminated with dioxin, special demolition method would be adopted to avoid fugitive emission of dioxin contaminated dust. Special precaution method for demolition of dioxin contaminated material is discussed in S. 4.6.47 through 4.6.51 and the management of waste should refer to Section 7.

4.8 Evaluation of Residual Impacts

Construction and Demolition Phase

4.8.1 Based on the discussion of the above sections, the construction of the New Crematorium and the decommissioning of the Existing Crematorium will not impose adverse residual impact to the nearby environment when all the requirements of the Air Pollution Control (Construction Dust) Regulation are properly implemented during the construction works.

Operation Phase

4.8.2 The design of the new cremators and the emissions of air pollutants will meet the requirements of the BPM 12/2, and the air quality at the ASRs has been assessed and should satisfy the respective air quality and risk guidelines. As a result, it is anticipated that there would be no adverse residual impact due to the operation of the New Crematorium.

5 NOISE IMPACT ASSESSMENT

5.1.1 This section presents the key findings of the assessment of potential noise impacts arising from the construction and operational phases of the proposed crematorium and demolition of the existing crematorium. The primary objectives are:

- to determine the assessment area;
- to describe the existing noise environment in the vicinity of the proposed crematorium;
- to identify existing and planned noise sensitive receivers (NSRs) that will be potentially affected by the noise emission of the proposed crematorium;
- to present an emission inventory of noise sources;
- to describe the assessment methodology employed to predict construction and operational noise impacts, and the predicted noise impacts;
- to evaluate the predicted noise impacts against recognized criteria; and
- to recommend noise mitigation measures where necessary to satisfy the acceptable noise levels.

5.2 Study Area

Description of the Noise Environment

5.2.1 Major land uses close to the proposed development are mainly residential, recreational and educational. The existing noise climate in the Study Area is dominated mostly by the community activities and traffic of Po Kong Village Road. To the northwest of the project site are school complex developments (i.e. Po Kong Village Road School Village and others). To the south are high-rise residential developments (i.e. Grand View Garden and Fu Shan Estate). To the east is the hillside of Nam Shan Mei whilst the northern side is the Diamond Hill Urn Crematory.

Determination of Assessment Area

5.2.2 As defined in Clause 3.6.5.2(i) of the Study Brief, the Assessment Area for the noise impact assessment included all areas within 300m from the boundary of the proposed crematorium. Generally, noise at distances beyond 300m from a fixed noise source would not be significant. The area of concern has covered a majority of residential uses and educational institutions in the vicinity of the proposed crematorium, and noise impact on this area can reflect the worst case scenario arising from the noise of construction and operational phases of the proposed crematorium.

Identification of Representative Noise Sensitive Receivers

5.2.3 Site surveys and desktop study of government survey maps, the latest Outline Zoning Plan (as shown in Figure 8.1) and Outline Development Plans were conducted to check the existing and planned/ committed land uses within 300 m from the boundary of the Study Area. Representative Noise Sensitive Receivers (RNSRs) defined by the EIAO-TM and NCO were selected to represent both the existing and future land uses which are potentially affected by the implementation of the Project.

5.2.4 The RNSRs identified for the construction/ demolition and operational noise assessment for different stages of the Project are tabulated in Table 5.1. Geographical locations of these RNSRs are shown in Figure 5.1.

Table 5.1 Details of the Representative Noise Sensitive Receivers

Representative NSRs		Status (1), (2)	No. of Storey	Ground Level, mPD	Horizontal Distance to Notional Source, m		Uses
					Phase I Site	Phase II Site	
SR1	The Salvation Army William Booth Secondary School	E	6	84.1	210	170	School
SR2	Po Leung Kuk No1. W. H. Cheung College	E	6	87.4	180	170	School
SR3	(New school under construction)	F	8	85.6	170	160	School
SR4	Po Leung Kuk Grandmont Primary School	E	8	85.6	210	220	School
SR5	St. Patrick Catholic Primary School	E	8	85.6	280	290	School
SR6	Staff Quarter for Diamond Hill Crematorium	E	2	60.4	75	110	Residential
SR7	Fu Yan Hse	E	20	61	180	260	Residential
SR8	Fu Shun Hse	E	22	61	220	300	Residential
SR9	Grand View Garden (Blk 1)	E	39	39.7	280	--(3),	Residential

Note: (1) Status "E" denotes as the existing sensitive receivers
(2) Status "F" denotes as the future sensitive receivers
(3) "--" denotes as RNSRs with horizontal distance to the notional source more than 300 metres.

5.3 Construction and Demolition Noise Assessment

Methodology of Assessment and Assumptions

5.3.1 The construction noise assessment was conducted based on standard acoustic principles and the methodology stated in the GW-TM and Sections 5 of Annex 13 of the EIAO-TM. The assessment also made reference to the BS5228:Part 1:1997 Noise Control on Construction and Open Sites (hereafter stated as BS5228). In general, the assessment methodology was conducted as follows:

(i) Identification of the nearest RNSRs to the work site;

(ii) Identification of the items and number of PMEs likely to be used during the course of project implementation;

(iii) Determination of the total Sound Power Level (SWL) of the PMEs;

(iv) Determination of distance attenuation, barrier corrections and reflection corrections to the RNSRs from notional source position of each construction phase;

(v) Calculation of the Predicted Noise Level (PNL) at the respective RNSRs; and

(vi) Comparison of the PNL with the corresponding noise criteria.

Potential Sources of Impact and Emission Inventory

5.3.2 To indicate the potential noise impact at different stages of the project, the emission inventories of the construction noise sources and their corresponding construction/ demolition noise levels are suggested according to the programme of works shown in Figure 2.7. The on-site project activities which would cause potential construction/ demolition noise impacts include:

Phase I works (southern part of the construction site)

- Site formation (including demolition of the minor facilities, eg. demolition of the existing CLP secondary station, toilets, etc., as addressed in Section 2.6.1) and
- Construction of building and cremators

Phase II works (northern part of the construction site)

- Demolition of the existing buildings and cremators;
- Site formation and
- Construction of building

Works under different Phases will be carried out in different period of time, i.e. demolition work of Phase II will be carried out after completion of the Phase I construction works. Besides, construction activities for each type of work under a particular Work Phase are scheduled to be carried out in series, e.g. demolition works and site formation works under Phase I will not be conducted concurrently , as confirmed by the project proponent.

5.3.3 No piling works is expected during the construction and demolition stages of the crematorium. The inventories of the PMEs expected to be used during each stage of construction/ demolition works are summarised in Appendix B1. The project proponent has advised that these equipment represent a realistic and practicable approach to meet the construction / demolition programme. It should be noted that they are the assumed inventories of the most likely used PMEs.

5.3.4 The assessment was undertaken on the basis of the assumption that all construction equipment will be located on a notional noise source point for each phase of works and to be operating simultaneously to simulate the worst scenario.

Assessment Results

5.3.5 The unmitigated PNLs at the identified RNSRs at each stage are summarised in Table 5.2. Detailed calculations are shown in Appendix B2.

Table 5.2 Predicted (Unmitigated) Noise Levels of Phase I and II Construction Works

RNSR	Predicted (Unmitigated) Construction Noise Level, dB(A)					Daytime Noise Standard (EIAO-TM), dB(A)
	Phase I		Phase II			
	Site Formation	Construction of Building and/ or Cremators	Demolition	Site Formation	Construction of Building and/ or Cremators	
SR1	69	64	**72**	70	66	70
SR2	70	65	**72**	70	66	70
SR3	**75**	**71**	**78**	**76**	**71**	70
SR4	**74**	69	**75**	**73**	68	70
SR5	**71**	66	**73**	**71**	66	70
SR6	**82**	**78**	**81**	**79**	74	75
SR7	75	70	74	72	67	75
SR8	73	68	72	70	66	75
SR9	71	66	--	--	--	75

Notes: (1) Bolded figures in the shaded cells denote exceedance of the daytime noise standards in EIAO-TM.

Phase I Works

5.3.6 RNSRs, except SR1, SR2, SR7, SR8 and SR9, are expected to be subject to construction noise levels above the daytime noise standards contributed from the Phase I site. Mitigation measures are thus required to alleviate the noise impacts for these stages of works.

Phase II Works

5.3.7 Due to the close proximity, it is expected that SR1 to SR6 would be subject to noise levels above the daytime noise standards during the demolition of the existing crematorium of the Phase II site. In addition, similar to the noise impacts in Phase I works, SR3, SR4, SR5 and SR6 are expected to be affected by the Construction works of Building and/ or Cremators and site formation works. Mitigation measures are thus also required to alleviate the noise impacts for these stages of Phase II works.

Proposed Construction/Demolition Noise Mitigation Measures

5.3.8 As the PNLs showed that both Phases I and II works would give rise to adverse daytime noise impacts to some of the RNSRs, practicable mitigation measures to alleviate noise impact are required and detailed below.

Selection of Quiet Plant

5.3.9 Quiet plant is defined as PME with a sound power level lower than that specified in GW-TM. For the sake of flexible construction/ demolition arrangement to suit the actual site situation, it is not recommended to restrict specific types of quiet equipment to confine the Contractor's selections at this preliminary stage. For easy reference, however, examples of quiet plant can be referred to those listed in British Standard BS5228 which are also listed in Table 5.3 below. Various items of these quiet plants are available in Hong Kong. However, the Noise Control Authority, when processing a Construction Noise Permit (CNP) application, would refer to the noise levels stipulated in the relevant TM unless the noise emission of the claimed quiet plant can be validated by certificate or demonstration.

Table 5.3 Examples of Quiet PME

PME	**BS 5228 Reference no.**	**SWL/unit, dB(A)**
Air compressor	C.7-43	102
Breaker, excavator mounted	C.2-4	119
Breaker, hand-held	C.2-10	110
Bulldozer	C.3-65	111
Concrete pump	C.6-36	106
Crane, mobile	C.7-110	106
Excavator	C.3-97	105
Poker, vibratory, hand-held	C.6-32	100

5.3.10 Since the use of quiet plant is generally considered to be one of the most effective ways of alleviating construction/ demolition noise, this control measure is recommended as the first level mitigation (Mitigation 1) for the construction/ demolition works. Calculations of the construction noise levels for the quiet plant are shown in Appendix B2.

Use of Movable (Mobile) Barriers

5.3.11 Where practicable, movable (mobile) barriers can be used to screen NSRs from particular items of plant or noisy operations. Movable barriers of 3 to 5 m in height with a small cantilevered upper portion and skid footing can be located within a few metres from the stationary plant (e.g. generator, compressor, etc.) and within about 5 m for a mobile equipment (e.g. breaker, excavator, etc.), such that the line of sight to the NSRs is blocked by the barriers. It would be possible for the Contractor to provide purpose-built noise barriers or screens constructed of appropriate material with a minimum superficial density of 15 kg/m^2 located close to the operating equipment.

5.3.12 For those activities which still potentially affect the NSRs after applying the quiet plant, the use of movable (mobile) noise barriers for the construction equipment is recommended as the second level mitigation (Mitigation 2). Calculations of the construction noise levels for the quiet plants with movable (mobile) noise barriers are shown in Appendix B2. Such mitigation should be applied to the site activities that are in close proximity to NSRs, specifically to SR3 (the new school), SR4 (Po Leung Kuk Grandmont Primary School) and SR6 (Staff Quarter for Diamond Hill Crematorium) during the site formation works of Phase I and II and demolition works in Phase II. For assessment purpose, the noise reduction of such barrier is assumed to be 5 dB(A) and an example of movable (mobile) noise barrier arrangement is illustrated in Figure B1 in Appendix B1.

Good Site Practice

5.3.13 Good site practice and noise management can be readily applied to achieve additional reductions in the construction noise emissions, which include:

- only well-maintained plant should be operated on site and the plant should be regularly serviced during the construction works;
- plant that is used intermittently, should be turned off or throttled down when not in active use;
- plant that is known to emit noise strongly in one direction should be oriented to face away from NSRs;
- silencers, mufflers and enclosures for plant should be used where possible and maintained adequately throughout the works;
- where possible mobile plant should be sited away from NSRs; and
- stockpiles of excavated materials and other structures such as site buildings should be used effectively to screen noise from the works.

5.3.14 Such noise reduction was not included in the noise assessment as it cannot be quantified. Nevertheless, these measures would help to achieve further noise reduction.

Residual Impacts

5.3.15 The PNLs with the implementation of the proposed mitigation measures for different stages of the Project are summarized in Tables 5.4 and 5.5. The results show that :

(i) the noise impacts due to the activities of the construction of building and/ or cremators in both Phase I and II sites can be mitigated to the noise standards by using quiet equipment and;

(ii) the noise impact due to the demolition and site formation works of the Phase I and Phase II can be mitigated to the noise standards by using quiet equipment as well as applying movable noise barriers, specifically towards SR3, SR4 and SR6.

(iii) It should be noted that the noise standard for educational institutions is lower during examination periods (i.e. 65 dB(A)). The contractor should therefore minimize construction noise exposure to SR1 to SR5 (i.e. the northwest side of the construction site), especially during examination periods as far as possible. In addition, the contractor should liaise with the schools and the Hong Kong Examinations and Assessment Authority to ascertain the dates and times of examination periods during the course of the construction/ demolition works. It is suggested that the Contractor should hold regular liaision meeting with the schools regarding the impact of construction noise during the construction periods. Programme of the on-site works should hence be well programmed such that the noisier construction activities would not be coincided with the examination periods of the schools. With implementation of the above suggested measures, no residual impact would be expected.

Table 5.4 Predicted (Mitigated) Noise Levels of Phase I Works

RNSR/ Mitigation Measures	Predicted (Mitigated) Construction Noise Level, dB(A)			Daytime Noise Standard (EIAO-TM), dB(A)
	Site Formation		Construction of Building and/ or Cremators	
	Mitigation 1	Mitigation 1 & 2	Mitigation 1	
SR1	65	--	58	70
SR2	66	--	60	70
SR3	**72**	67	65	70
SR4	70	--	63	70
SR5	67	--	61	70
SR6	**79**	75	72	75
SR7	71	--	65	75
SR8	69	--	63	75
SR9	67	--	61	75

Notes: (1) Bolded figures in the shaded cells denote exceedance of EIAO-TM daytime noise standards.
(2) "Mitigation 1" = use of quiet equipment only
(3) "Mitigation 1 & 2" = use of quiet equipment and movable noise barrier.

Table 5.5 Predicted (Mitigated) Noise Levels of Phase II Works

RNSR/ Mitigation Measures	Predicted (Mitigated) Construction Noise Level, dB(A)					Daytime Noise Standard (EIAO-TM), dB(A)
	Demolition		Site Formation		Construction of Building and/ or Cremators	
	Mitigation 1	Mitigation 1 & 2	Mitigation 1	Mitigation 1 & 2	Mitigation 1	
SR1	69	--	67	--	60	70
SR2	69	--	67	--	60	70
SR3	**74**	70	**72**	68	66	70
SR4	**71**	67	69	--	63	70
SR5	69	--	67	--	61	70
SR6	**77**	73	75	--	69	75
SR7	70	--	68	--	62	75
SR8	69	--	67	--	60	75

Notes: (1) Bolded figures in the shaded cells denote exceedance of EIAO-TM daytime noise standards.
(2) "Mitigation 1" = use of quiet equipment only
(3) "Mitigation 1 & 2" = use of quiet equipment and movable noise barrier.

5.4 Operation Noise Assessment

Methodology of Assessment and Assumptions

5.4.1 Noise from future fixed plants associated with the proposed crematorium were assessed and presented in this section. Noise prediction was based on the assumed plant inventories and utilization schedule for the worst-case scenario. The noise impact assessment was undertaken according to the standard acoustic principle with reference to IND-TM.

Potential Fixed-noise Sources

5.4.2 According to the information given by the project proponent on the electrical and mechanical provisions of the Crematorium (including Phase I and Phase II development), fixed-noise sources potentially affecting the nearby NSRs during the operation stage include condensers of split air-conditioning units, radiators for cremators, general exhaust air fans and exhaust fans for the air pollution control system of the cremators as summarised in Appendix B3. The sound power levels adopted in the assessment were given and confirmed by the engineer of the project proponent. Requirements of the sound power levels of these equipment will be incorporated into the tender specification.

5.4.3 All these systems are expected to be operated during the daytime period, i.e. within 0700 to 2300 hour daily. As such, the potential operation noise impact for the daytime is assessed.

5.4.4 The prevailing daytime noise levels as measured on 1- 2 August 2003 in the proximity of the representative NSRs and the area sensitivity ratings (ASR) are tabulated in Table 5.6.

Table 5.6 Prevailing Daytime Noise Levels and ASR of the Representative NSRs

Representative NSRs	Uses	ASR[(1)]	ANL– 5 dB(A)	Prevailing Daytime Noise Level[(2)] $L_{Aeq(30min)}$
SR1 The Salvation Army William Booth Secondary School	School	B	60	61-72
SR2 Po Leung Kuk No1. W. H. Cheung College	School	B	60	61-72
SR3 (New school under construction)	School	B	60	60-65
SR4 Po Leung Kuk Grandmont Primary School	School	B	60	60-65
SR5 St. Patrick Catholic Primary School	School	B	60	60-65
SR6 Staff Quarter for Diamond Hill Crematorium	Residential	B	60	60-63
SR7 Fu Yan Hse	Residential	B	60	63-71
SR8 Fu Shun Hse	Residential	B	60	63-71
SR9 Grand View Garden (Blk 1)	Residential	B	60	63-71

Note:

(1) The suggested classifications are determined based on the the following factors as stipulated in IND-TM:
- (i) Type of area within which the NSR is located - All the above representative NSRs are located in a residential area at which majority of the uses are institutional and high-rise residential developments.
- (ii) Influencing factor - All the above representative NSRs are located in close proximity to Po Kong Village Road, which is classified as a district distributor. According to the Annual Traffic Census 2002 issued by the Transport Department on June 2003, the annual average daily traffic (AADT) of Po Kong Village Road (from Tsz Wan Sha Road to Lung Cheung Road) in year 2001 is 32,270. This road is thus considered as an influencing factor which directly or indirectly affects the representative NSRs as recommended under the IND-TM.

Under such circumstances, the Area Sensitivity Ratings (ASR) for these representative NSRs are hence classified as "B" hereby for the conservative assessment. In any event, the ASR assumed here is for indicative assessment only.

(2) Summary of the measured prevailing noise levels at each representative NSR conducted by the Consultant are tabulated in Table B3-ab of Appendix B3.

5.4.5 Since the prevailing noise levels of the representative NSRs are higher than or equal to the "ANL - 5dB(A)" (i.e. 60dB(A) for area sensitivity rating "B"), the daytime noise limit of 60dB(A) as discussed in Subsection 3.3.3 is adopted as the noise criteria for compliance check.

5.4.6 To simulate the worst scenario, the following conservative assumptions were made for the operation noise impact assessment:

- the fixed-noise sources to be located at the outdoor area of the concerned premises
- the fixed-noise sources to be located at the respective notional source positions[a] of the Phase I and Phase II sites
- all the fixed-noise sources to be operated simultaneously during the operation period
- tonality correction of 6dB(A) was applied to the noise levels of all the fixed-noise sources[b].

Assessment Results

5.4.7 The predicted operation noise levels at the representative NSRs are summarised in Table 5.7 below. Detailed noise calculation is provided in Appendix B3 and the quantitative assessment of the façade noise levels at various representative floor levels of the RNSRs are conducted. All the predicted noise levels at these RNSRs are found to be within the noise limit of EIAO-TM. As such, it is expected that there would be no significant noise impacts on the nearby NSRs when the specified noise levels and the quantities of the fixed plants are strictly followed in the detailed design. In general, noise from the operation of the concerned fixed-noise sources can be further reduced by locating them as far as practical from the NSRs, and/ or by orientating the noise emission points (e.g. discharge points of ventilation, etc.) away from the NSRs, and/ or by application of silencers, acoustic barriers or enclosures to the concerned equipment.

Table 5.7 Predicted Noise Impacts Contributed from the Operation of the Crematorium

RNSR	Location	Predicted Operation Noise Level $L_{Aeq(30min)}$, dB(A)			Daytime Noise Standard - ASR "B" (EIAO-TM) $L_{Aeq(30min)}$, dB(A)
		Representative Floor Levels[(1)]			
		High Level	Mid Level	Low Level	
SR1	The Salvation Army William Booth Secondary School	52	52	52	60
SR2	Po Leung Kuk No1. W. H. Cheung College	52	52	52	
SR3	(New school under construction)	53	53	53	
SR4	Po Leung Kuk Grandmont Primary School	50	50	51	
SR5	St. Patrick Catholic Primary School	48	48	48	
SR6	Staff Quarter for Diamond Hill Crematorium	58	58	58	
SR7	Fu Yan Hse	51	51	51	
SR8	Fu Shun Hse	49	49	49	
SR9	Grand View Garden (Blk 1)	45	45	45	

Note:
(1) The representative floor levels of each RNSR for the assessment are detailed in Appendix B3.

[a] Some of these prescribed fixed-noise sources are shown in the preliminary design layouts as depicted in figure 2.2 to 2.5 of this EIA report, these locations are however indicative only at this preliminary stage. As a conservative evaluation without affecting the flexibility of the building design, notional source positions (i.e. grouping all fixed noise sources at a position mid-way between the approximate geographical centre of the concerned site and its boundary to the NSR, are thus adopted for the assessment.

[b] Under normal operating conditions, the concerned fixed-noise sources, i.e. building services equipment or air pollution control equipment, are commonly operated steadily without rapid changes on their operation modes and conditions, e.g. suddenly or intermittently turning on and off. Characteristic of impulsiveness or intermittency is not likely to be observed for the building operation and thus such correction factor is not applied.

5.4.8 As the recorded prevailing daytime noise levels of each RNSR are much higher than the respective predicted operation noise levels (i.e. with differences ranging from 2 to 20 dB), the future noise levels at these RNSRs are not expected to have much deviation from the existing noise levels for the daytime operation of the new crematorium.

Transitional Impacts (Testing and Commissioning of New Cremators)

5.4.9 During testing and commissioning of the new cremators in Phase I site, the existing crematorium in Phase II site would be still operative for the public use. To minimize the potential environmental impacts at this transitional stage, special operation arrangement would be implemented by FEHD such that no more than six cremators, including both the existing and new cremators, and the associated air pollution control system are operated simultaneously. Under such arrangement, the potential transitional noise level caused by the trail run of the new cremators and operation of the existing units would be similar to, if not less than, the full operation of the new crematorium of the Phase I and Phase II. As such, no adverse noise impact is expected during the transitional stage.

5.5 Summary

Construction and Demolition Noise

5.5.1 The use of powered mechanical equipment during the construction/ demolition activities of Phase I and II works of the Project is expected to create potential construction noise nuisance to the nearby residential premises and schools. Practical mitigation measures are available to reduce the construction noise levels to acceptable levels. The recommended mitigation measures include the use of quiet plant, the use of movable noise barriers and good site practices. The contractor should also cease the noisy works as far as possible especially during examination periods of the nearby schools to further reduce the noise impact to them. When the contractor implements the recommended mitigation measures with good care on their working conditions, the construction noise will be much reduced during the construction/ demolition stage of works. In addition, regular noise monitoring is recommended at the selected NSRs in the EM&A manual during the construction period to check the compliance of the statutory noise requirements. Details of the monitoring requirements are addressed in the EM&A manual.

Operation Noise

5.5.2 No adverse noise impact on the nearby NSRs by the given potential fixed noise sources, including mainly the condensers of split air-conditioning units, radiators for cremators, general exhaust air fans and exhaust fan for the air pollution control system of the cremators in the crematorium, would likely exist. Noise levels of the concerned equipment can be further reduced by locating them as far as practical from the NSRs, and/ or by orientating the noise emission points away from the NSRs, and/ or by application of silencers, acoustic barriers or enclosures to the concerned equipment.

6 LAND CONTAMINATION ASSESSMENT

6.1 Introduction

6.1.1 Based on the tentative Project programme, the Existing Crematorium will be decommissioned and demolished within the period of October 2006 to November 2007. Since the Existing Crematorium is a registered pathological incinerator, its decommissioning is classified as a Designated Project under EIAO *Schedule 2 Part II (Item 3)*.

6.1.2 Scott Wilson Limited was commissioned by the HKPC as a sub-consultant to carry out an assessment of land contamination at the site of the Diamond Hill Crematorium.

6.1.3 The Contaminated Land Assessment has been carried out in accordance with the guidance given in the following documents:

- Annex 19 of the Environmental Impact Assessment Ordinance – Technical Memorandum
- *Practical Note for Professional Persons* (ProPECC) Note PN 3/94, "*Contaminated Land Assessment and Remediation*"
- "*Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol Filling Stations, Boatyards and Car Repair/Dismantling Workshops*", Environmental Protection Department, EPD/TR1/99.

6.1.4 A Contamination Assessment Plan (CAP) has been prepared and endorsed by EPD. This report is included as Appendix C1. The objectives of the CAP are to:

- Determine the previous landuses of the site
- Outline the current environmental setting of the site, in terms of surrounding landuses, geology and hydrogeology
- Describe the processes carried out at the site
- Identify potential sources of ground contamination
- Outline potential contaminant sources, receptors, and the potential pathways between sources and receptors
- Determine a suitable site investigation strategy to identify, quantify and delineate areas of ground contamination

6.1.5 Site investigation works were carried out in March 2003, and the results are documented in the Contamination Assessment Report (CAR) and Remediation Action Plan (RAP) as attached in Appendix C2. The objectives of the CAR and RAP are to:

- Present the findings of the site investigation
- Assess the concentrations of contaminants found against relevant criteria
- Determine the requirement for any remedial works
- Specify the extent and nature of remedial works

6.1.6 Summaries of findings in CAP, CAR and RAP are given below.

6.2 Geology, Hydrogeology and Hydrology

6.2.1 The geology of this part of Kowloon comprises Quaternary colluvial (debris flow) deposits of the Fanling Formation, overlying granite bedrock of the Kowloon Granite Formation.

6.2.2 Ground conditions of the project site were found to consist of sandy fill material with rock fragments, to depths of up to 2m below ground level, overlying completely decomposed medium grained granite or colluvium.

6.2.3 A watercourse is present immediately to the east of the site, which consists of a natural rocky channel. Immediately to the south of the site, this watercourse passes into an underground drainage channel, prior to ultimately discharging into Victoria Harbour. However, during site investigation, no groundwater was encountered.

6.3 Current Landuses

6.3.1 The site is currently used as a crematorium, and consists of a central building for carrying out services and cremations and a number of smaller structures such as stores and a CLP secondary substation. The grounds of the site are landscaped with many trees and shrubs.

6.4 Surrounding Landuses

6.4.1 The site is bounded to the north and east by cemeteries and grave sites, with Hammer Hill Road also lying to the east of the site. There are a number of buildings to the west, which include a columbarium for cremated remains and a CLP secondary substation. Above ground high-voltage electricity cables are situated to the north of the site. Po Kong Village Road runs along the southwestern edge of the site. Tate's Cairn Tunnel passes beneath the area, to the north and west of the site boundary.

6.5 Previous Landuses

6.5.1 Historical landuses have been determined by examination of historical aerial photographs and site plans and by interviews with current employees.

6.5.2 A total of six historical aerial photographs have been reviewed, as listed below:

- 81A/177, April 1949;
- 1935 Y72, 1972;
- 14304, June 1976;
- A18296, September 1989;
- A35622, July 1993;
- CN23166, June 1999.

6.5.3 The earliest aerial photo indicates that the site was, at this time, predominantly grassed, boulder-strewn hillside. A number of tracks crossed the site, and the photograph suggests that graves were present to the west and north.

6.5.4 By the time of the 1972 photo, the area of graves had spread southwards, over part of the current crematorium site. The area to the southwest of the site (outside the current site boundary) appears to have been used as a car dismantling and repair facility. There were a number of buildings in the southeastern corner of the site, comprising the previous Diamond Hill Crematorium and the associated staff accommodation. The 1976 photo shows the vehicles to the southwest had been removed, and construction work appeared to be underway. There is an area in the southwest of the current site which consisted of irregular-shaped plots of land, and may represent a squatter area or small agricultural plots.

6.5.5 Construction of the current crematorium took place between the photos of 1976 and 1989 were taken. Many of the grave plots shown in earlier photos were covered by the new crematorium development, and the structures in the southeastern corner of the site were also removed. The basic layout of the crematorium in the 1989 photo was the same as at present. A large new building is also shown to the northwest of the site. The layout of the area does not appear to have altered significantly between the 1989 photo and the most recent photo of 1999.

6.5.6 A number of drawings have been provided by Arch SD, dating from the construction of the present crematorium in 1977/78. These drawings indicate the locations of the previous crematorium, the underground fuel storage tank, and the dangerous goods store. The drawings indicate that considerable earthworks and disturbance of the natural topography should have occurred during these construction works.

6.6 Site Walkover Survey

6.6.1 A site inspection was carried out on 21st November 2002. The locations of the dangerous goods store, underground fuel tank and CLP secondary substation were confirmed, although access to the interior of these buildings was not available. No visible evidence of contamination was noted during this site visit. A further site visit was undertaken on 11th December 2002, when access to all areas (excluding the CLP secondary substation) was possible. Site operatives were present during the site visits and provided verbal information on current and previous site practices. This information has been taken account of in determining the likely sources of contamination.

6.7 Contaminant Sources

6.7.1 On the basis of a review of historical information and current practices, and following the site inspection, the principal potential sources of contamination at the site were identified. These are associated with the site's current and former use as a crematorium. Other land uses within and beyond the site boundary are considered unlikely to give rise to significant contamination within the site. The locations of potential contaminant sources are shown in Figure 6.1.

6.7.2 Facilities or activities which may result in contamination, and the contaminants which may be present, are listed below.

Fuel Storage Tank

Potential Contaminants:	Total Petroleum hydrocarbons (diesel range) (TPH); Polyaromatic hydrocarbons (PAH).

The fuel tank has been used for storage of diesel rather than petrol, so lighter range petroleum fractions (e.g. BTEX) are not likely to be present. An underground fuel pipe is believed to lead from the main buried tank to a small tank inside the main building, in the roof space. The exact alignment of this pipe could not be precisely determined either from the available plans or from the site visit.

Dangerous Goods Store

Potential Contaminants:	Total Petroleum hydrocarbons (diesel range); Polyaromatic hydrocarbons.

The interior of the Dangerous Goods Store was inspected during the site visit. The Store has a concrete floor, which appears largely free from staining or cracking. The contents of the store were found to be mainly non-hazardous items, although a small number of sealed plastic containers thought to contain oil were noted. There was no visual or olfactory evidence of any contamination within the Store or the immediate vicinity.

Electricity Sub-station (on site)

Potential Contaminants:	Polychlorinated biphenyls (PCBs) Total Petroleum hydrocarbons

It is not possible to ascertain with certainty whether PCB-containing transformer oils have been used in this CLP secondary substation. In the absence of further information, it has been assumed that PCBs are potential contaminants in this area. Sampling beneath the sub-station is not possible whilst the sub-station is still in use, as this would lead to unacceptable safety risks. Sampling and analysis will be carried out following decommissioning of the sub-station.

Areas impacted by aerial deposition from stack emissions

Potential Contaminants:	Polyaromatic hydrocarbons; Dioxins; Metals ("Dutch List": Cr, Co, Ni, Cu, Zn, As, Mo, Cd, Sn, Ba, Hg, Pb)

It is considered unlikely that stack emissions would give rise to significantly elevated concentrations of soil contaminants under normal conditions. However, the possibility cannot be discounted and hence sampling and analysis was carried out. Aerial deposition of contaminants arising from stack emissions would be greatest in the downwind direction from the stack. The prevailing wind direction is from east to west, meaning that aerial emissions from the stack would be predominantly carried to the west. Sampling effort was therefore concentrated to the west of the stack, although confirmatory sampling was also carried out to the north, south and east of the stack.

Cremators

Potential Contaminants:	Polyaromatic hydrocarbons; Dioxins; Metals ("Dutch List": Cr, Co, Ni, Cu, Zn, As, Mo, Cd, Sn, Ba, Hg, Pb)

The cremators are situated within the building and above a concrete floor slab. Since the potential contaminants are predominantly in the solid phase (e.g. particulate matter) it is considered very unlikely that they could migrate through the slab into the underlying soil and sampling and analysis beneath the slab was therefore not considered necessary. Particulate contamination may however be present within the cremators and flues.

Former Crematorium

Potential Contaminants:	Total Petroleum hydrocarbons; Polyaromatic hydrocarbons; Dioxins; Metals ("Dutch List": Cr, Co, Ni, Cu, Zn, As, Mo, Cd, Sn, Ba, Hg, Pb)

No information is available on the layout or operation of the former crematorium. The site has undergone considerable disturbance due to site formation for the current facility. It is not therefore possible to identify specific features of the former crematorium where sampling and analysis is required. The former crematorium lies at depth within part of the Project site that will undergo minimal disturbance as part of the construction works, and therefore sampling was not considered necessary.

6.8 Site Investigations

6.8.1 Exploratory holes were sited to investigate the potential sources of contamination identified above.

6.8.2 Intrusive investigations were not carried out beneath the floor slab of the Existing Crematorium building, since it was considered that there is a negligible likelihood that any particulate contamination within the crematorium building could have migrated through the concrete floor slab into the underlying soil.

6.8.3 The locations of exploratory holes are shown in Figure 6.2. The sampling depths and analytical requirements are shown in Table 6.1 below.

Table 6.1 Exploratory Holes

Location	**Exploratory Hole (depth)**	**Sampling Depths (mbgl)**	**Analytical Requirements**
Fuel storage tank	DH1 (7m) DH2 (7m) TP1 (3m) (1)	4.5m; 5.5m; 7m 4.5m; 5.5m; 7m 0.5m; 1.5m; 3m	TPH PAH
Dangerous Goods store	TP2 (3m)	0.5m; 1.5m; 3m	TPH PAH
West of stack	S1 (0.1m) S2 (0.1m) S3 (0.1m)	0.1m 0.1m 0.1m	Metals PAH Dioxins
North of stack	S4 (0.1m)	0.1m	
South of stack	S5 (0.1m)	0.1m	
East of stack	S6 (0.1m)	0.1m	

Note: (1) Trial pit TP1 was terminated at 0.9m due to the presence of large boulders preventing further excavation. Samples were taken from 0.5m and 0.9m depth below ground level. No evidence of fuel pipelines or fuel contamination was noted in this area. It is therefore considered that the samples taken from this trial pit are adequate to determine whether contamination is present in this area.

6.8.4 Due to operation constraints as described in *Section 7.5*, the CAP recommended additional site investigations in areas of the site that are currently in use and cannot be readily accessed. These investigations will be carried out once the existing facility has been decommissioned. The additional site investigations are required in the vicinity of the existing CLP secondary substation during Phase I of the construction and demolition works, and around the cremators and flues inside the crematorium building during Phase II of the construction and demolition works. Once access to these areas is available, a sampling and analysis plan will be prepared for approval by EPD, additional investigations will take place, and the need for remedial works will be determined. Any remedial works required will be in addition to those described in this current report.

6.8.5 The Existing Crematorium will continue operation until 2006, and there is the possibility that further contamination could occur between the time of the current investigations (2003) and 2006, particularly as a result of continuing aerial deposition. It is therefore proposed that, once the Existing Crematorium has ceased operating during Phase II, confirmatory surface samples will be taken from the samples points S1 to S6 at a depth of 0.1m, and these samples will be analysed for the same suite of determinands (i.e. dioxins, metals and PAH) in order to confirm that no further contamination has occurred. The Remediation Action Plan will be revised on the basis of these results.

6.8.6 The underground fuel storage tank and associated pipework will be removed as part of the site formation works. The base of the excavations will be inspected during and after tank removal by a suitably experienced environmental specialist in order to determine whether there is any visual or olfactory evidence of fuel contamination. If such contamination is suspected, then confirmatory soil sampling will be carried out, and the samples analysed for TPH.

6.9 Assessment Results

6.9.1 Total petroleum hydrocarbons, polyaromatic hydrocarbons, metals and dioxins in the soil samples tested fell within the relevant assessment criteria except the following samples:

- S3: lead (180 mg/kg); tin (190 mg/kg)
- S5: tin (160 mg/kg)

6.9.2 Details of the assessment criteria and results are documented in Appendix C2 and summarised in Table 6.2.

Table 6.2 Summary of Soil Testing Results

Parameter	Units	Assessment Criteria	Range
Dioxin	ng/g, TEQ	1	0.00378 - 0.00894
Silver	mg/kg	NA	<1
Arsenic	mg/kg	30	1.4 - 5.9
Barium	mg/kg	400	5.7 - 50
Beryllium	mg/kg	NA	<1
Cadmium	mg/kg	5	<0.05 - 0.09
Cobalt	mg/kg	50	0.8 - 3
Chromium	mg/kg	250	0.5 - 11
Copper	mg/kg	100	0.5 - 29
Mercury	mg/kg	2	<0.05 - 0.5
Molybdenum	mg/kg	40	<1 - 3
Nickel	mg/kg	100	0.8 - 5
Lead	mg/kg	150	14 - ***180***
Antimony	mg/kg	NA	<1
Selenium	mg/kg	NA	<1 - 4
Tin	mg/kg	50	<1 - ***190***
Thallium	mg/kg	NA	<1
Vanadium	mg/kg	NA	1 - 15
Zinc	mg/kg	500	15 - 77
C6-C9 TPH	mg/kg	1000	<2
C10-C28 TPH	mg/kg	1000	<25
C28-C36 TPH	mg/kg	1000	<25
Total PAH	mg/kg	20	<DL - 0.3042

6.9.3 Toxicity Characteristic Leaching Procedure (TCLP) tests were carried out on samples S3 and S5, to determine the solubility and mobility of lead and tin in these samples and hence determine the suitability for landfill disposal. The TCLP test results are shown in Table 6.3.

Table 6.3 Results of TCLP Tests for Parameters Exceeding Assessment Criteria

	Lead (ppm)	Tin (ppm)
Landfill Disposal Criteria	50	250
S3	0.03	0.015
S5	<0.01	<0.01

6.10 Proposed Remediation Action Plan

6.10.1 TCLP testing has been undertaken, and the concentrations of lead and tin in the TCLP tests were several orders of magnitude lower than the Landfill Disposal Criteria. Hence pre-treatment of the soil prior to landfill disposal is not deemed necessary.

6.10.2 The remedial works will consist of removing soil from an area of 5m radius around the sampling locations S3 and S5, to a depth of 0.5m. The removed soil will then be disposed of at landfill. Following excavation, confirmatory testing will be undertaken to confirm that all contaminated soil has been removed, and a Remediation Report will be submitted to EPD, detailing the remedial work undertaken.

6.10.3 The estimated volume of soil that needs removal is small (less than $100m^3$), and therefore it is considered that landfill disposal is the most appropriate remedial measure.

6.10.4 Summary of the remediation works is shown in the flowchart in Figure 6.3. Details of the remediation plan (RAP) are provided in Appendix C2. This includes measures to prevent any adverse water quality impacts during remediation by minimising the possibility of contaminated run-off being generated.

6.10.5 During removal of the underground fuel storage tank, appropriate precautions should be taken to avoid contamination. All fuel tanks and associated pipework should be emptied prior to any demolition work being undertaken. Any remaining sludge or sediment in the tanks or pipework should be removed and disposed of as chemical waste in accordance with the appropriate regulations for disposal of such material.

6.10.6 Should contamination be encountered beneath the fuel tank or the CLP sub-station, further remedial work will be required. Such potential contamination would consist of either TPH (in the case of the fuel tank) or PCBs (in the case of the CLP secondary substation).

6.10.7 Although there is no evidence to date of contamination associated with the fuel tank, and the drillholes around the fuel tank do not indicate contamination, there is the possibility that the material directly underlying the fuel tank may be contaminated with petroleum hydrocarbons. A realistic worst case estimate is that the volume of contaminated material would be no more than $100m^3$ (i.e. approximately 7m x 5m x 3m depth). For this volume of material, treatment by bioremediation is likely to be uneconomic, and the recommended remedial strategy would be landfill disposal. The actual remedial strategy to be adopted is subject to the findings of the supplementary investigations.

6.10.8 The likelihood of significant widespread PCB contamination beneath the CLP secondary substation is considered to be low, due to the low mobility of PCBs in the environment and the low likelihood of a spillage occurring. As a realistic worst-case estimate, it could be assumed that less than $25m^3$ (i.e. 5m x 5m x 1m depth) of material could be contaminated, and may require stabilisation with cement prior to disposal to landfill. The actual remedial strategy to be adopted is subject to the findings of the supplementary investigations.

6.11 Potential for Future Land Contamination

6.11.1 The proposed development is a replacement for the Existing Crematorium. There is the potential for the development to give rise to land contamination in the future, if appropriate environmental standards are not followed.

6.11.2 The most potentially significant future sources of contamination are:

- Spills or leakage of fuel stored for the cremators; and
- Aerial deposition of metals and dioxins.

6.11.3 Provided the New Crematorium complies with the prescribed air emissions limits, it is considered very unlikely that aerial deposition would give rise to significant land contamination, due to the very small quantities of metals and dioxins that would be emitted.

6.11.4 The fuel storage facilities to be provided in the New Crematorium should be constructed, maintained and inspected in accordance with the provisions of the Dangerous Goods (General) Regulations (Cap. 295B) and the guidelines presented in "Guidance for the Design, Construction, Modification and Maintenance of Petrol Filling Stations" (Institute of Petroleum, 1999), and with the necessary approvals from the Fire Services Department. To mitigate the environmental impacts from operational land contamination, the following mitigation measures shall be implemented for installation and operation of any underground fuel tanks:

- The underground fuel tank(s) shall be of a specified durability and placed within a concrete pit to avoid direct contact of the tank surface with soil.

- The concrete pit shall be accessible to allow tank integrity test to be carried out on an annual basis, or when deemed necessary by an independent qualified surveyor or structural engineer. Any potential problems such as potential cracking shall be rectified as far as practicable.
- Diesel fuel pipelines shall preferably be installed above ground. If underground piping is unavoidable, concrete lined trenches shall be constructed to contain the pipelines. The distance between the cremators and the underground tanks shall be minimized as appropriate to avoid the need for long pipelines.
- Proper installation and use of meters (e.g. at the two ends of any pipeline) would allow any unexpected pressure drop or difference and signs of leakage be detected from routine inspection or during diesel fuel pumping. Any identified leakage shall be reported to the plant manager in-charge.
- Any spillage of fuel shall be removed immediately by portable pump when the quantity is large or by absorbing materials when the quantity is low or with similar effective tools as appropriate. Used absorbing material shall be properly stored and disposed of as chemical waste.
- The underground tanks refueling (from tank trucks) shall only be undertaken by authorized staff of the fuel company using the company's standard procedures to avoid spillage of diesel fuel.

6.11.5 Provided the above measures are implemented properly, the likelihood of uncontrolled leakage of fuel giving rise to land contamination is low. If in the future such facilities are decommissioned, contamination testing will be required in order to identify and delineate any contamination that may have occurred. No additional land contamination impacts are envisaged during the transitional stage of the project.

7 WASTE MANAGEMENT IMPLICATIONS

7.1.1 This *Section* identifies the wastes arising from the demolition of the Existing Crematorium as well as the construction and operation of the New Crematorium at Diamond Hill and assesses the potential environmental impacts associated with the handling and disposal of waste. Where appropriate, procedures for waste reduction and management are considered and environmental control measures for avoiding and minimizing the potential impacts are recommended.

7.2 Assessment Methodology

7.2.1 The potential environmental impacts associated with the handling and disposal of waste arising from this Project have been assessed in accordance with the criteria given in *Annexes 7* and *15* of the *EIAO TM,* and are summarized as follows:

- Estimation of the types and quantities of the waste generated and identification of the disposal options for each type of waste
- Assessment of secondary environmental impacts due to the management of waste with respect to potential hazards, air and odour emissions, transportation and wastewater discharges
- Assessment of the potential impacts on the capacity of waste collection, transfer and disposal facilities

7.3 Identification of Potential Environmental Impacts During Construction and Demolition Phase

7.3.1 Based on the tentative construction and demolition programme, the construction and demolition activities will be divided into two phases: Phase I – from September 2004 to February 2006 and Phase II –from October 2006 to November 2007. To handle the cremation demand, operation of the Existing Crematorium will be maintained until full operation of the new cremators and other main facilities to be provided under Phase I of the Project. Facilities to be constructed / demolished under each phase are given below:

Phase I

- Demolition of facilities in Existing Crematorium in the southern side of the Project site, including
  - Existing sitting out area
  - Garden of remembrance
  - Existing building structure, including CLP secondary substation, toilets, pavilion and retaining walls

- Construction of the New Crematorium main facilities, including:
  - One (1) cremator plant room housing six (6) cremators
  - Three (3) fuel tanks (with total capacity of 34,000 L)
  - Two (2) service halls
  - One (1) pulverizing room
  - One (1) mortuary
  - One (1) office
  - Toilets for public
  - Ancillary service rooms including battery fork lift, transformer and switch room, emergency generator room and joss burners
  - Two (2) automatic transportation systems for coffins and part of an underground service tunnel for coffin circulation
  - Vehicular loading bay for coffin van and coach
  - Landscape area
  - Dangerous goods store
  - Installation of temporary CLP electricity transformer at Phase II boundary

Phase II

- Demolition of the Existing Crematorium main facilities, including:
  - Two (2) service halls
  - One (1) cremation room with six (6) cremators
  - One (1) transformer room
  - One (1) underground oil fuel storage tank (9,092 L)
  - One (1) mortuary
  - One (1) machine room
  - One (1) general store plus water tank
  - One (1) dangerous goods store
  - One (1) chimney (approximately 10 m in height)

- Construction of the rest of the New Crematorium, including:
  - Two (2) service halls
  - Two (2) automatic transportation systems for coffins and part of an underground service tunnel for coffin circulation
  - Vehicular loading bay for coffin van and coach
  - Landscape area

7.3.2 The columbarium next to the Project site will remain untouched.

7.3.3 Activities conducted during Phase I and Phase II will result in generation of the following types of waste:

- Excavated materials
- Construction and demolition (C&D) materials
- Contaminated materials (including: ash waste, building structures and soil contaminated by asbestos, dioxin, heavy metals, hydrocarbons or polychlorinated biphenyls (PCB))
- Chemical waste
- General refuse

7.3.4 No additional environmental impact related to waste management is envisaged during transitional stage between the operation of Existing Crematorium and commissioning of New Crematorium.

7.3.5 If not properly managed, the handling and disposal of these wastes may cause environmental impact and nuisance. The nature of each type of waste is discussed in *Section 7.5* together with an evaluation of the potential environmental impacts associated with these waste types.

7.4 Identification of Potential Environmental Impacts During Operation Phase

7.4.1 During operation phase of the New Crematorium, the following key types of waste are expected:

- Ash and non-combustible residues generated from cremators during combustion
- Chemical waste generated from the air pollution control system, machinery maintenance and servicing
- General refuse generated by visitors and staff during daily operation

7.4.2 Since the tendering process for the air pollution control system in the New Crematorium is yet to commence, the exact type and design of the system to be employed can not be confirmed at this stage. Nevertheless, based on experience of other similar projects, 'dry' type air pollution control system will be adopted. There will, therefore, be no liquid effluent from the air pollution control system.

7.4.3 To estimate the likely types and quantities of wastes generated from the 'dry' air pollution control system, new cremators with air pollution control system using 'dry' process should therefore be referenced. With this in mind, references have been made to the Fu Shan Crematorium for the purpose of assessing the chemical waste arising from the air pollution control system.

7.4.4 Based on the information provided in the *Replacement of Cremators at Fu Shan Crematorium EIA Report* (EIA-063/2001), the major types of chemical wastes generated from the air pollution control system of the New Crematorium will include (i) activated carbon and un-reacted lime used for flue gas treatment; and (ii) particulate matter collected from dust removal facilities. Environmental impacts and nuisance may arise if these wastes are not properly managed. The relevant quantity estimation and evaluation of potential impacts of the wastes are discussed in *Section 7.6.*

7.5 Prediction and Evaluation of Environmental Impacts for Construction and Demolition Phase

Excavated Materials

7.5.1 Demolition of the Existing Crematorium and site formation for the New Crematorium will require slope excavation and fill material. A small amount of excavated material will also be generated during construction of building foundations. Therefore, the majority of the excavated materials are expected to be generated during the Phase I construction and demolition works (from September 2004 to February 2006). According to the information provided by Architectural Services Department (Arch SD), approximately 12,300 m^3 (10,300 m^3 from geotechnical works and 2,000 m^3 for foundation works) of excavated materials will be generated during the construction and demolition works.

7.5.2 The fill requirement for site formation is approximately 10,200 m^3, according to Arch SD, and provides a good opportunity to utilize the excavated materials generated on-site. The design of the site formation of this Project should ensure a cut and fill balance as far as practical. The excavated materials will consist of clean rock and soil, which could be reused on-site. Approximately 2,100 m^3 of surplus excavated materials will be generated from the construction and demolition works and they should be used for landscaping works in the New Crematorium, as far as practicable. in order to minimize the need for any off-site disposal of excavated materials.

7.5.3 Therefore, with careful planning for reusing excavated materials on-site, the secondary environmental impacts and potential impacts on waste handling capacity of excavated materials is expected to be minimal.

Construction and Demolition Materials

7.5.4 Construction and demolition (C&D) materials generated from the construction and demolition works will mainly comprise unwanted materials, including:

- Existing Crematorium structures (e.g. concrete, steel, glass, bricks, wood, plastics, etc.)
- Wood from formwork and falsework
- Materials and equipment wrappings
- Unusable/surplus concrete/grouting mixes
- Damaged construction materials

7.5.5 The above C&D materials of the Project will be generated during both Phase I and Phase II periods.

7.5.6 According to the architectural drawings and information provided by Arch SD, the gross floor area (GFA) of the Existing Crematorium and New Crematorium are approximately 1,300 m^2 and 2,100 m^2 respectively. Based on the generation rate of 0.1 m^3 per 1 m^2 of GFA[(1)], the estimated quantity of C&D materials to be produced from the construction and demolition works will be approximately 340 m^3, which may vary depending on the exact types of the buildings and the construction and demolition methods adopted. A more detailed account of C&D material to be generated will be provided in the Waste Management Plan to be prepared by the contractor.

[(1)] Reduction of Construction Waste Final Report (March 1993), Hong Kong Polytechnic.

7.5.7 The C&D materials can be divided into two portions: (i) inert portion such as rock and concrete (i.e. public fill), which can be used as fill material for reclamation and earth filling projects; and (ii) non-inert portion such as timber, glass, plastics (i.e. C&D waste), which can be recycled before disposal at landfills. It is estimated that around 80%[(2)] of the C&D material generated (i.e. 272 m^3) will be categorized as public fill and the remaining 20% (i.e. 68 m^3) will be categorized as C&D waste.

7.5.8 The C&D materials can be minimized with careful planning during the detailed design stage as well as during construction and demolition works. For example, the contractor should use reusable non-timber formwork and temporary works wherever practicable. In addition, the contractor should, as far as possible, carry out on-site sorting of public fill from C&D materials and reuse public fill in this Project, before disposal at public filling areas. The C&D waste generated in this Project should also be reused or recycled as much as possible before disposal at landfill.

7.5.9 With reuse of the public fill on-site as well as reuse and recycling of the C&D waste, the surplus public fill and C&D waste requiring disposal is expected to be small and hence the extra loading on public filling areas and landfills will be minimal. For similar reasons, the potential impacts from transportation of the surplus public fill and C&D waste by road, such as noise impact, possible congestion due to increased traffic flows, and dust and exhaust emissions from haul vehicles, will not be significant. Provided that waste management practices as detailed in *Section 7.7* are properly implemented, the secondary environmental impacts arising from on-site handling of the C&D materials would be minimal.

Contaminated Materials

7.5.10 Contaminated materials are expected to be mainly generated during demolition of the Existing Crematorium during Phases I and II. The key types of such contaminated materials will include:

- Asbestos containing materials (ACM) – likely from building structures
- Dioxin containing materials (DCM) – likely from ash wastes and from contaminated soil
- Heavy metal containing materials (HMCM) whose heavy metal content(s) exceed the 'Dutch B' level as quoted in the *Practice Note for Professional Persons (ProPECC) Note PN 3/94, "Contaminated Land Assessment and Remediation"* – likely from ash waste and from contaminated soil
- Hydrocarbons containing materials – polyaromatic hydrocarbons (PAHs) likely from ash waste; PAHs and total petroleum hydrocarbon (diesel range) (TPH) likely from contaminated soil
- Polychlorinated biphenyls containing materials (PCBCM) – likely from contaminated soil around CLP secondary substation

7.5.11 All of the above contaminated materials are classified as chemical waste under the *Part A* of *Schedule 1* under the *Waste Disposal (Chemical Waste)(General) Regulation*. Prior to disposal of these types of waste, EPD must be notified.

7.5.12 The contaminated materials are expected to be concentrated around cremators /flues /chimney. The Consultants have tried to conduct sampling around these areas, however, the cremators and the flange of the chimney could not be accessed because the Existing Crematorium is still in operation and the lowest temperature inside the cremators /flues /chimney is above 200ºC, even at 7 am in the morning when the cremators have been shut down since 6 pm in the previous day. The Consultants have explored several ways to conduct sampling and findings are listed as follows:

- Sampling during routine maintenance: the Consultants contacted the Electrical and Mechanical Services Department (EMSD) to see if sampling during routine maintenance can be made. However, information from EMSD indicates that the monthly routine maintenance of cremators does not require shutting down of cremators

[(2)] Monitoring of Solid Waste in Hong Kong 2001, Environmental Protection Department.

- Sampling during annual servicing: according to EMSD, the only time when cremators would be turned off is during annual servicing, and the next opportunity is due at the end of 2003
- Sampling by shutting down the whole crematorium: according to FEHD, shutting down all the cremators at the Existing Crematorium would severely affect the cremation services in the district (please refer to *Section 2.1* for cremation demand in the district). It is also estimated that a period of at least seven days would be required to cool down the chimney to enable safe entry. Therefore the interruption of cremation services due to sampling may last from 8 to 10 days
- Sampling by shutting down one or two cremators: the Consultants also investigated the possibility of shutting down one or two cremators for sampling purpose. The cremators have to shut down in pairs and have to cool down for at least three days before any person can enter for sampling (i.e. each pair of cremators have to crease operation for at least 4 days). Therefore it may affect the cremation services in the district (please see *Section 2.1* for cremation demand in the district). In addition, sampling cannot be conducted for flues/ chimney because the other cremators would still in operation

7.5.13 A land contamination site investigation was carried out to assess disposal options for contaminated soil (see *Section 6* for details). However, no soil sample was taken around CLP secondary substation as it is still operational.

7.5.14 Based on the above findings, further site investigation after decommissioning of these facilities is recommended.

Asbestos Containing Materials (ACM)

7.5.15 An Asbestos investigation has been carried out at readily accessible areas by a registered asbestos consultant. ACM has been found in the following facilities:

- Cremator room (cloth insulation on chimney duct) (Type 2 asbestos materials, according to *Code of Practice on the Handling, Transportation and Disposal of Asbestos Waste*)
- Machine room (gaskets on air burners and fan ducts) (Type 2 asbestos materials)
- Offices of the Existing Crematorium (vinyl floor tile adhesive in offices and waiting rooms) (Type 1 asbestos materials)

7.5.16 The overall hazard is considered to be low due to good physical condition of the ACM. Details of the asbestos assessment are given in the Asbestos Investigation Report attached in *Appendix D.*

7.5.17 The quantity of ACM will be detailed in the Asbestos Management Plan (AMP), which should be prepared prior to the decommissioning work. The AMP will also include the Asbestos Abatement Plan (AAP) prepared by a registered asbestos consultant and submitted to EPD for approval under the Air Pollution Control Ordinance (APCO). The asbestos abatement work shall be carried out by a registered asbestos contractor according to the future AMP.

7.5.18 When the handling, storage, transportation and disposal of ACM are in line with the mitigation measures provided in *Section 7.7*, environmental impacts associated with ACM are expected to be minimal.

Dioxin Containing Materials (DCM) / Heavy Metal Containing Materials (HMCM) / Polyaromatic Hydrocarbon Containing Materials (PAHCM) from Demolition of the Existing Crematorium

7.5.19 According to the information provided by FEHD, the Existing Crematorium accepted amputated body parts from hospitals from 1994 (around 2,000 kg/year) to 2001 (around 120 kg/year) and this operation ceased in 2002. DCM / HMCM / PAHCM may be found in ash waste and particulate matter within the cremators, chimney walls, flues and surrounding areas of the Existing Crematorium. Hence building structures of cremators / flues/ chimney would also likely to be contaminated by DCM / HMCM / PAHCM. However, it is currently impossible to conduct inspection and sampling within the cremators, chimney and flues to assess the levels of contamination due to the operational constraints mentioned above. As such, it is recommended that the contractor should collect samples from the aforementioned potential areas of contamination for testing of dioxin, heavy metals (the "Dutch List") and PAH after decommissioning but prior to the demolition of the Existing Crematorium.

7.5.20 There is no criterion in Hong Kong regarding the dioxin level in DCM requiring special disposal. However, it is proposed to use the USEPA criterion of 1 ppb TEQ (1 ng/g, Toxicity Equivalent Unit) as the assessment criterion, above which special disposal option would be required. This criterion has been used as the land contamination remediation target for residential sites in the USA. The criteria used for HMCM / PAHCM are the Dutch "B" levels as quoted in the ProPECC PN3/94. If the dioxin level of DCM exceeds the 1 ppb TEQ criterion or the levels of HMCM / PAHCM exceed the Dutch "B" levels, the relevant measures as recommended in *Section 7.7* should be implemented.

7.5.21 Although it is not possible to analyze the levels of the DCM / HMCM / PAHCM at this stage, reference to demolition projects of similar nature (i.e. ash waste requiring disposal) was made to provide an estimation of the potential level of contamination. Two documents identified are the *Demolition of Kwai Chung Incineration Plant EIA Report* and the *Project Profile for Decommissioning and Disposal of a Clinical Waste Incinerator at Tang Siu Kin Hospital.*

7.5.22 The dioxin level in ash waste and quantity requiring remediation in the Kwai Chung Incineration Plant (KCIP) and the Tang Siu Kin Hospital (TSKH) clinical waste incinerator were different, as shown in Table 7.1.

Table 7.1 Level and Volume of Contaminated Ash Waste in KCIP and TSKH Clinical Waste Incinerator

Project	Parameter Measured and Concentration	Volume Required Special Disposal	Location where Contaminated Ash was Found
KCIP	DCM: 3-22 ppb TEQ HMCM: not measured PAHCM: not measured	Approximately 20m^3	Near main hall ash bunker wall and main hall floors
TSKH Clinical Waste Incinerator	DCM: <0.1 ppb TEQ HMCM: Copper exceeded the Dutch "B" List PAHCM: Naphthalene exceeded the Dutch "B" List	Approximately 0.15m^3	Bottom of the furnace
	DCM: 7-13 ppb TEQ (samples usually found in the order of 10 ppb TEQ) HMCM: not measured PAHCM: not measured	Approximately 0.12 m^3	In flues

7.5.23 Considering the nature of materials for incineration, the KCIP was used to incinerate municipal solid waste, whereas the TSKH clinical waste incinerator was used to treat waste from laboratories, tissues or organs or other wastes from the operating theatre, dressings with blood and unused drug waste. As such, it is expected that the dioxin level in the ash waste in the Existing Crematorium would be similar to that in the TSKH clinical waste incinerator (i.e. in the order of 10 ppb TEQ). In terms of the scale of operation, the Existing Crematorium (with 10 m chimney) is much smaller than the KCIP (with 150 m chimney). Therefore, it is expected that the amount of ash with DCM / HMCM / PAHCM in the

Existing Crematorium, if any, would be much less than that in the KCIP, i.e., much less than 20 m^3.

7.5.24 It should, however, be noted that the quantity and dioxin level of the ash waste in the Existing Crematorium as mentioned above are only indicative estimates. The exact volume of contaminated ash waste (if any) and its levels of contamination will only be determined upon completion of further sampling and testing of the ash waste in the cremator/flue/chimney of the Existing Crematorium.

7.5.25 Based on the experience in KCIP and TSKH, the level of DCM would be the main factor in determining ash waste remediation requirements and disposal options. Details of the contamination classification, demolition, handling, treatment and disposal methodologies for the Existing Crematorium are given in *Section 7.7*.

7.5.26 Building structures where ash waste with DCM / HMCM / PAHCM is located are also likely to be contaminated with dioxin / heavy metals / PAHs, e.g. cremators, chimney, flues and surrounding areas. For building structures where ash waste is classified as moderately/severely contaminated, ash waste would be required to be carefully removed from these building structures before disposal at landfill. In particular, building structures where severe DCM contaminated ash is found should be sealed before disposal at landfill. More importantly, these same building structures would also likely contain asbestos. Subject to further asbestos investigations, these multiple contaminated building structures would require combined treatment and disposal methods for ACM/DCM/HMCM/PAHCM mentioned in *Section 7.7*.

7.5.27 With appropriate handling, treatment and disposal of contaminated ash waste and building structures, the associated environmental impact is expected to be minimal.

Dioxin Containing Materials (DCM) / Heavy Metal Containing Materials (HMCM) / Polyaromatic Hydrocarbon Containing Materials (PAHCM) / Total Petroleum Hydrocarbon Containing Materials (TPHCM) / Polychlorinated Biphenyls Containing Materials (PCBCM) from Soil Remediation at the Project Site

7.5.28 As detailed in *Section 6* and the CAR in Appendix C2, soil samples were collected from within the site boundary for testing of dioxin, heavy metals, TPH and PAH. According to the test results, no exceedance of the assessment criteria was found in any of the soil samples, except the two samples collected at sampling locations S3 and S5 that were found to be contaminated with lead and tin. Toxicity Characteristic Leaching Procedure (TCLP) testing was also carried out for the two samples and the testing results have confirmed that the contaminated soil can be disposed of at landfill without any pretreatment. It is estimated that the amount of HMCM to be removed from the vicinity of these two locations would be small (less than 100 m^3). Details of the arrangement for disposal of this HMCM are given in the RAP (*Appendix C2*).

7.5.29 Nevertheless, since the vicinity of the CLP secondary substation could not be readily accessed at the moment, further investigations of TPH and PCB should be carried out when decommissioned during Phase I of the work. Such recommendations have been included in the CAP and CAR/RAP (see *Appendix C*). For this, a sampling and analysis plan will need to be prepared for approval by EPD. Subject to the results of additional investigations, the need for any further remedial works, in addition to those described in the current RAP (*Appendix C2*), will be determined. In addition, confirmatory testing on dioxin levels in locations S1 to S6 should be carried out to determine further remediation if required.

Potential Hazards of ACM, DCM, HMCM, Hydrocarbon Containing Materials and PCBCM

7.5.30 Mishandling of the ACM, DCM, HMCM, PAHCM, TPHCM and PCBCM may pose toxic effects as well as health hazards to workers. It is considered that the possibilities for contact with these contaminated materials would be relatively low, provided appropriate precautionary measures are implemented. Nevertheless, the ash waste must be cleaned up under modified controlled/containment method prior to demolition, depending on its level of contamination in cremators /flues /chimney. Possibilities for workers to contact contaminated soil can be controlled by implementation of appropriate safety precautions recommended in *Section 7.7*.

7.5.31 When the handling, storage, transportation and disposal of materials contaminated with asbestos, dioxin, heavy metals, hydrocarbon and PCB containing materials are in accordance with the mitigation measures provided in *Section 7.7*, environmental impacts associated with these waste types are expected to be minimal.

Chemical Wastes

7.5.32 Throughout the whole construction and demolition works, construction plant and equipment will require regular maintenance and servicing, which will generate chemical waste such as cleaning fluids, solvents, lubrication oil and fuel. Maintenance for on-site equipment will also involve the use of a variety of chemicals and lubricants, including heavy-duty cleaners, organic solvents, degreasers, brake fluids, battery acid and soldering fluids.

7.5.33 Chemical waste may pose serious 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 Packing, Labelling and Storage of Chemical Wastes*. These hazards may include:

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

7.5.34 The amount of chemical waste that will arise from the construction activities will vary depending on the contractor's on-site maintenance requirements and the amount of plant utilized. It is anticipated that the quantity of chemical waste, such as lubricating oil and solvent, produced from plant maintenance will be relatively small. If chemical waste generation is expected, the contractor must register with the EPD as chemical waste producer. These types of waste will be readily accepted for disposal at the Chemical Waste Treatment Centre (CWTC) at Tsing Yi. A detailed account of chemical waste generation should be provided by the contractor during preparation of the site Waste Management Plan.

7.5.35 Whenever possible, the contractor should reuse or recycle chemical waste. When chemical waste is properly managed in accordance with the relevant mitigation and control measures in *Section 7.7*, the potential environmental impacts arising from the storage, handling and disposal of a small amount of chemical waste generated from the construction and demolition activities will be minimal.

General Refuse

7.5.36 Staff working at the construction site will generate general refuse requiring disposal during Phases I and II works. General refuse will mainly consist of food wastes, aluminium cans, plastic bottles and waste paper. The storage of general refuse may give rise to adverse environmental impacts. These could include water quality (if waste enters nearby water bodies); odour, (if waste is not collected frequently) and visual impact; and in the form of windblown litter. The Project site may also attract pests and vermin if the storage areas are not well maintained and cleaned regularly. In addition, disposal of waste at sites other than approved waste transfer or disposal facilities can also have environmental impacts.

7.5.37 Based on the Consultants' experience, the amount of general refuse generated by the site workers during construction and demolition activities will not be significant. If the refuse is stored and transported in accordance with relevant good practices as specified in *Section 7.7* and disposed of at licensed landfills, the potential environmental impacts will be minimal.

Cumulative Impacts

7.5.38 According to the information provided by Planning Department and Water Services Department and the *KCRC Shatin to Central Link Project Profile* submitted under EIA Study Brief *ESB-106/2002*, two other projects will be implemented during the construction and demolition phase of this Project. They are (i) The Diamond Hill No. 2 Freshwater Service Reservoir, which is scheduled from 4 July 2002 to end of 2005, and (ii) the KCRC Shatin to Central Link, which is undergoing preliminary feasibility study and the construction is scheduled from 2004 to 2008.

7.5.39 Given the amounts of wastes requiring disposal to be generated from this Project as reviewed above and with the proper implementation of the mitigation measures as specified in *Section 7.7*, it is expected that the contribution to cumulative impacts from this Project would not be significant compared to other projects in the area.

7.6 Prediction and Evaluation of Environmental Impacts for Operation Phase

Ash and Non-combustible Residues

7.6.1 After cremation, bone ash and non-combustible residues remain. According to FEHD, the weights of bone ash and non-combustible residues after each cremation are about 2.2 kg and 1.8 kg respectively. Under current practice, bone ash is stored in covered containers to be collected by the deceased's relatives within 2 months. Based on the analytical results of non-combustible residues (i.e. furnace bottom ash) in TSKH, which contain less than 0.1 ppb TEQ of dioxin, the non-combustible residues in the New Crematorium should be collected in polyethene bags and disposed of to landfill. This practice is expected to continue for the New Crematorium. Under full load operation, each of the 6 cremators can handle 6 cremations per day, therefore the maximum generation of bone ash and non-combustible residues per day are 79.2 kg (2.2 x 6 x 6) and 64.8 kg (1.8 x 6 x 6) respectively. Given the small quantity of waste requiring disposal and with the appropriate waste management practices as detailed in *Section 7.8*, the associated environmental impacts are expected to be minimal.

Chemical Waste

7.6.2 As discussed in *Section 7.8*, chemical wastes, including used activated carbon, un-reacted lime and collected particulate matter would likely be generated by the dry air pollution control system expected to be used at the New Crematorium. The following chemical waste generation rates as contained in the *Replacement of Cremators at Fu Shan Crematorium EIA Report* are used for estimating the amounts of chemical wastes that would be produced by the air pollution control system of the New Crematorium:

- Used activated carbon and un-reacted lime – 0.6 kg/hr
- Collected particulate matter – 0.95 kg/hr

7.6.3 Taking the cremation time of 100 minutes and 6 cremations per cremator per day for the 6 new cremators, it can be calculated that the daily chemical waste arisings associated with operation of the air pollution control system of the New Crematorium would be 36 kg (0.6 x 100/60 x 6 x 6) of used activated carbon and un-reacted lime and 57 kg (0.95 x 100/60 x 6 x 6) of collected particulate matter. Therefore, the estimated total generation of such chemical wastes would be about 93 kg/day.

7.6.4 In addition, a small amount of chemical waste in form of cleaning fluids, solvents, lubrication oil and fuel will be generated during regular maintenance and servicing of battery fork lift, transformer and switch room, emergency generator room and hydraulic lifts.

7.6.5 The chemical wastes generated from the air pollution control system would be in form of ash and those generated during maintenance and servicing would mainly be in form of liquid. Chemical waste may pose serious 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 Packing, Labelling and Storage of Chemical Wastes*. These hazards may include:

- Toxic effects to operators
- Adverse effects on air, water and land from spills
- Fire hazards

7.6.6 As chemical waste generation is expected, the operator must register with the EPD as chemical waste producer.

7.6.7 Chemical wastes generated from the New Crematorium can be readily accepted for disposal at the CWTC at Tsing Yi. These chemical wastes should be collected in drum-type containers and will be removed by licensed chemical waste contractor periodically. With proper storage, handling and disposal of small amount of chemical wastes, as detailed in *Section 7.8*, adverse environmental impacts are not anticipated.

General Refuse

7.6.8 According to the experience from operation of the Existing Crematorium, it is anticipated that the quantity of general refuse generated by visitors and staff during daily operation at the New Crematorium will not be substantial. Therefore, with the proper waste management facilities as detailed in *Section 7.8* in place, it is expected that the potential environmental impacts arising from the handling and disposal of the general refuse will be negligible, and thus will not cause any major environmental concerns.

7.7 Mitigation of Adverse Environmental Impacts for Construction and Demolition Phase

General - Good Site Practice and Waste Reduction Measures

7.7.1 If good site practices are strictly followed, it is expected that adverse environmental impacts due to waste generation would not arise. The following recommendations for good site practice should be included in the Contract Specifications for the Project during the construction activities:

- Obtain relevant waste disposal permits from the appropriate authorities, in accordance with the *Waste Disposal Ordinance (Cap. 354)*, *Waste Disposal (Chemical Waste) (General) Regulation (Cap. 354)* and the *Land (Miscellaneous Provision) Ordinance (Cap. 28)*
- Prepare a Waste Management Plan approved by the Engineers/Supervising Officer of the Project in accordance with *Environment, Transport and Works Bureau Technical Circular (Works)* (ETWBTC(W)) *15/2003, Waste Management On Construction Sites*
- Nominate an approved person, such as site manager, to be responsible for good site practice, arrangements for collection and effective disposal of all types of wastes generated on-site to appropriate facility
- Use waste haulier authorized or licensed to collect specific category of waste

- Establish trip ticket system as contractual requirement (with reference to *Works Branch Technical Circular* (WBTC) *No. 21/2002*) for monitoring of public fill and C&D waste at public filling facilities and landfills. Such activities should be monitored by the Environmental Team
- Provide training to site staff in terms of proper waste management and chemical waste handling procedures
- Separate chemical wastes for special handling and dispose them at licensed facility for treatment
- Establish routine cleaning and maintenance programme for drainage systems, sumps and oil interceptors
- Provide sufficient waste disposal points and regular collection for disposal
- Adopt measures to minimize windblown litter and dust during transportation of waste, such as covering trucks or transporting wastes in enclosed containers
- Establish recording system for the amount of wastes generated, recycled and disposed of (including the disposal sites)

7.7.2 The contractor should submit the Waste Management Plan to Engineer/Supervising Officer of the Project for approval. The Waste Management Plan should describe the arrangements for avoidance, reuse, recovery and recycling, storage, collection, treatment and disposal of different categories of waste to be generated from the activities of the Project and indicate the disposal location(s) of all waste. A trip ticket system shall be included in the Waste Management Plan.

7.7.3 Waste reduction is the most effective when considered during planning and design stage, provided those suggested measures are implemented. Good management and control can prevent the generation of significant amount of waste. It is therefore recommended to include the following practice in the Contract Specifications to ensure waste reduction:

- Minimize the damage or contamination of construction material by proper storage and site practices
- Plan and stock construction materials carefully to minimize amount of waste generated and avoid unnecessary generation of waste
- Prior to disposal of C&D waste, wood, steel and other metals should be separated for reuse and / or recycling to minimize the quantity of waste to be disposed of to landfill
- Minimize use of wood and reuse non-timber formwork to reduce the amount of C&D waste
- Recycle any unused chemicals or those with remaining functional capacity as far as practicable
- As far as practicable, segregate and store different types of waste in different containers, skips or stockpiles to enhance reuse or recycling of materials and their proper disposal
- Encourage collection of aluminium cans, plastic bottles and packaging material (e.g. carton boxes) and office paper by individual collectors, separate labeled bins should be provided to help segregate this waste from other general refuse generated by the work force

7.7.4 In addition to the above, specific mitigation measures are recommended below for the identified waste to minimize environmental impacts during handling, transportation and disposal of these wastes.

Excavated Material

7.7.5 Rock and soil generated from excavation should be reused for site formation as far as possible. In addition, excavated material from foundation work can be reused for landscaping as far as practicable to avoid disposal off-site.

Construction and Demolition Material

7.7.6 Careful design, planning and good site management can minimize over-ordering and generation of waste materials such as concrete, mortar and cement grouts. Standard formwork should be used as far as practicable, wooden formwork should be replaced by metal ones whenever possible. Alternatives such as plastic fencing and reusable site office structures can also minimize C&D waste generation.

7.7.7 The contractor should recycle as much as possible of the C&D material on-site. Public fill and C&D waste should be segregated and stored in different containers or skips to enhance reuse or recycling of materials and their proper disposal. Materials such as concrete and masonry can be crushed and used as fill and steel reinforcing bar can be used by scrap steel mills. Different areas of sites should be designated for such segregation and storage.

7.7.8 To maximize landfill life, government policy discourages the disposal of C&D materials with more than 20% inert material by volume (or 30% inert material by weight) at landfill. Inert C&D material (public fill) should be directed to an approved public filling area, where it has the added benefit of offsetting the need for removal of materials from borrow areas for reclamation purposes.

Contaminated Materials

Further Contamination Investigation

7.7.9 After decommissioning but prior to demolition of the Existing Crematorium, further contamination investigation should be carried out to confirm the quality and quantity ash waste, building structures and contaminated soil requiring treatment and disposal (see Table 7.2 for details). Further contamination investigation shall provide information on the extent of contamination (DCM / HMCM / PAHCM) at cremators /flues / chimney as well as the quantity of contaminated materials requiring treatment and disposal. Regarding ACM, future AIR, AMP/AAP should be submitted to EPD for approval under the APCO.

Table 7.2 Further Contamination Investigation Requirements

Location	Investigation Parameter	Investigation Period	Responsible Party	Investigation Procedure
Cremators / flue / chimney and surrounding areas	Asbestos (building structures)	Phase II	The contractor	See *S.7.7.16*
CLP secondary substation	PCB, TPH (soil samples)	Phase I	The contractor	See *Section 6.8* and *Appendix C2*
Cremators / flue / chimney and surrounding areas	Dioxins, heavy metals, PAH (ash waste)	Phase II	The contractor	See *S.7.7.9 – S.7.7.12*
Surface soil around Existing Crematorium	Dioxins, heavy metal, PAH (soil sample)	Phase II	The contractor	See *S.7.7.9 – S.7.7.12*

7.7.10 For DCM / HMCM / PAHCM in ash waste, as discussed in *Section 7.5*, samples of ash/particulate matters should be collected from within the cremators (including the bottom ash), chimney walls, flues and surrounding area of the Existing Crematorium for analysis of dioxin, heavy metals and PAHs by a HOKLAS accredited laboratory. It is recommended that a consultant experienced in the abatement of chemical wastes particularly the handling of DCM, should be appointed in order to assist with the evaluation of the information and prepare an abatement plan for the ash waste. Such a plan shall be submitted to EPD and the Labour Department (LD) to establish an acceptable and safe method for these potentially hazardous wastes. The abatement plan for ash waste should identify the method of abatement, the performance criteria for the protection of workers and the environment and any emergency procedures and contingency measures required. The plan should also quantify the amount of material that will require removal. The abatement plan should be agreed with EPD and LD.

7.7.11 It must be ensured that the treatment of ash wastes will comply with all routine construction site safety procedures as well as statutory requirements under the Occupational Safety and Health Ordinance and Factories and Industrial Undertakings Ordinance. Due to the difficulties in establishing permanent and effective engineering controls, the protection of workers is likely to be at the worker level. A safe system of work must be provided, and training and suitable personal protective equipment as well as hygienic decontamination facilities should be provided. It is recommended that the methods to be adopted by the contractor for disposal of the ash waste should be agreed with LD and EPD.

7.7.12 Sufficient time should be allocated to abate all ash waste with DCM / HMCM / PAHCM. The contractor should ensure the implications of dust containing DCM / HMCM / PAHCM on air quality and workers health during the clean up work are mitigated.

7.7.13 Since DCM is chemically related to PCB wastes, the requirements of the *Code of Practice on the Handling, Transportation and Disposal of (PCB) Wastes* should be referenced when developing the abatement plan. Reference should also be made to the safety procedure mentioned in *Appendix C2.*

7.7.14 A land contamination site investigation was carried out under this EIA to determine disposal requirements for contaminated soil (see *Section 6* for detail). Further site investigation on soil around CLP secondary substation is needed when decommissioned, which will be during Phase I of the works. In addition, confirmatory testing on DCM level in locations S1 to S6 will be required to identify the appropriate remediation and disposal requirements during Phase II of the works.

7.7.15 The key measures for handling, transportation, treatment and disposal of the ACM/DCM/HMCM/PCBCM/PAHCM and TPHCM are described below:

Asbestos Containing Materials (ACM)

7.7.16 Further asbestos assessment should be carried out when access to the cremators /flue /chimney is accessible after decommissioning and before demolition. An AMP should be prepared. The AAP should be prepared and submitted to EPD for approval prior to commencement of demolition works in accordance to the APCO. It is preferable to remove all ACM before actual demolition. A registered asbestos removal contractor should be employed to remove all ACM in accordance with the approved AAP which will be prepared in due course in accordance with the *Code of Practice* (COP) *on Asbestos Control* for *Safe Handling of Low Risk ACM* and *Asbestos Work Using Full Containment or Mini Containment Method* published by EPD. A registered asbestos consultant should also be employed to supervise abatement works. For the disposal of ACM, the contractor should observe the *COP on Handling, Transportation and Disposal of Asbestos Waste* under the *Waste Disposal (Chemical Waste) (General) Regulation*.

Dioxin Containing Materials (DCM) / Heavy Metal Containing Materials (HMCM) / Polyaromatic Hydrocarbon Containing Materials (PAHCM) from Demolition of the Existing Crematorium

7.7.17 According to the experience in KCIP and TSKH, the level of dioxin was the prime factor affecting the ash waste treatment and disposal options. With reference to the remediation and disposal methods in KCIP and TSKH clinical waste incinerator, different contamination classifications based on the levels of DCM / HMCM / PAHCM in ash waste are proposed in Table 7.3, and their corresponding handling, transportation, treatment and disposal methodologies are described in the subsequent paragraphs.

Table 7.3 Proposed Contamination Classification for Ash Waste with DCM/HMCM

Classification of Contamination	**Dioxin Level in Ash Waste**	**Heavy Metal Level / Polyaromatic Hydrocarbon in Ash Waste**
Low/Non Contaminated DCM / HMCM / PAHCM	< 1 ppb TEQ	< Dutch "B" List
Moderately/Severely Contaminated HMCM / PAHCM	< 1 ppb TEQ	≥ Dutch "B" List
Moderately Contaminated DCM	≥ 1 and <10 ppb TEQ	Any level
Severely Contaminated DCM	≥ 10 ppb TEQ	Any level

Demolition, Handling, Treatment and Disposal of Low/Non Contaminated DCM / HMCM / PAHCM from Demolition of Existing Crematorium

7.7.18 Where the ash waste contains low/non contaminated DCM/HMCM/PAHCM, the contractor should avoid ash waste becoming airborne during demolition. General dust suppression measures mentioned in *Section 4* should be followed. All such ash waste can be directly disposal of at landfill.

7.7.19 Subject to the findings of the further asbestos investigation, building structures where such ash waste is found but contaminated with asbestos should be dealt in accordance to *S.7.7.16*.

Demolition, Handling, Treatment and Disposal of Moderately Contaminated DCM and Moderately/Severely Contaminated HMCM / PAHCM from Demolition of the Existing Crematorium

7.7.20 The demolition, handling, treatment and disposal of moderately contaminated DCM and moderately/severely contaminated HMCM / PAHCM with reference to the *Demolition of Kwai Chung Incineration Plant EIA Report* and the *Project Profile for the Decommissioning and Disposal of a Clinical Waste Incinerator at Tang Siu King Hospital* is given in Table 7.4.

Table 7.4 Demolition, Handling, Treatment and Disposal of Moderately Contaminated DCM and Moderately/Severely Contaminated HMCM / PAHCM

Item	**Procedure**
Site Preparation	The contractor should ensure the impacts of dust containing dioxin and/or heavy metals on air quality and workers health during the handling and transportation of the contaminated materials are mitigated. Except the cremators/flue/chimney, all removable items where moderately contaminated DCM or moderately/severely contaminated HMCM / PAHCM is identified should be removed as far as practicable to avoid obstructing the decontamination activities. Preliminary site decontamination of all debris shall be carried out using (High Efficiency Particulate Air) HEPA vacuum cleaner. The top portion of the chimney above the roof shall be enclosed by a chamber with three layers of polyethene sheets. At the entrance to the cremators /flues /chimney, a 3-chamber decontamination unit shall be constructed for entry and exit from the work area. The 3-chamber decontamination unit shall comprise a dirty room, a shower room and a clean room of at least 1m x 1m base each with 3 layers of fire retardant polyethene sheet where all workers shall carry out decontamination procedures before leaving the work area. Warning signs in both Chinese and English should be put up in conspicuous areas.
	All workers shall wear full protective equipment, disposable protective coverall (such as Tyvek) (with hood and shoe covers), nitrile gloves, rubber boots (or boot covers), and full-face positive pressure respirators equipped with a combination cartridge that filters particulate and removes organic vapour. The organic vapour protection is an added protection against the unlikely exposure to any vapour.
	If ACM is identified in building structures where moderately contaminated DCM or moderately/severely contaminated HMCM / PAHCM is found, relevant abatement measures for building structures described in the AAP (see *S.7.7.16*) should be implemented prior to the above site preparation.
Demolition and handling	The cremators/flue/chimney shall be removed from top down starting from the chimney. Any ash or residues attached to the cremators/flue/chimney or any other building structures shall be removed by scrubbing and HEPA vacuuming. Wastes generated from the containment or decontamination unit including the protection clothing of the workers such as the coverall, nitrile glove, rubber boots and materials used for wet wiping shall be disposed of at landfill site.
	After completion of removal, decontaminate all surfaces by HEPA vacuum.
	If ACM is identified in building structures where moderately contaminated DCM or moderately/severely contaminated HMCM / PAHCM is found, relevant abatement measures for building structures described in the AAP (see *S.7.7.16*) should be implemented prior to the above decontamination, demolition and handling measures.

Item	Procedure
Treatment	The ash waste contains dioxin/heavy metals and in its untreated state would be classified as a chemical waste under the *Waste Disposal (Chemical Waste) (General) Regulation*. While the quantity of DCM/HMCM is not expected to be significant, the levels of dioxin and heavy metals would affect the treatment option. With reference to the *Demolition of Kwai Chung Incineration Plant EIA Report*, immobilization of the contaminated materials by mixing with cement followed by disposal at landfill (if landfill disposal criteria can be met) would be the most preferable option.
	Rather than treating the already incinerated ash waste by incineration, the ash waste with moderately contaminated DCM or moderately/severely contaminated HMCM / PAHCM should be collected and stabilized to meet landfill disposal criteria of the Facilities Management Group (FMG) of EPD. In this case it is envisaged that the process would involve collection and mixing of the ash waste with cement. Pilot mixing and TCLP tests should be carried out done to establish the appropriate ratio of cement to ash waste to the satisfaction of EPD. It is envisaged that the pilot tests would involve the mixing of say 5%, 10% and 15% ratios of cement to ash waste and three replicate of 300 mm cube blocks for each ratio. TCLP tests should then be used to establish the correct ratio of cement to ash waste to the satisfaction of EPD.
Disposal	After immobilization of the ash waste by mixing with cement in the correct ratio as determined by the pilot mixing and TCLP test, the waste materials should be placed inside polyethene lined steel drums for disposal at landfill. Transparent plastic sheeting of 0.15 mm thickness low-density polyethene or PVC should be employed. The drums should be 16 gauge steel or thicker and fitted with double bung fixed ends adequately sealed and well labelled in new or good condition. The drums should be clearly marked "DANGEROUS CHEMICAL WASTE" in English and Chinese. Prior agreement of the disposal criteria from the FMG of EPD and agreement to disposal from the landfill operator must be obtained.
	As a fall back option, if the landfill disposal criteria cannot be met after immobilization of the ash waste, disposal at the CWTC should be considered.
	The building structures will be disposal of at landfill.
	If ACM is identified in building structures where moderately contaminated DCM or moderately/severely contaminated HMCM / PAHCM is found, relevant disposal measures for building structures described in the AAP (see *S.7.7.16*) should be implemented instead.

Demolition, Handling, Treatment and Disposal of Severely Contaminated DCM from Demolition of the Existing Crematorium

7.7.21 The areas with severely contaminated DCM shall be removed under containment as a prudent approach to avoid the release of any ash waste to the environment, which could be generated during the demolition of cremators/flue/chimney of the Existing Crematorium. The demolition, handling, treatment and disposal of severely contaminated DCM with reference to the *Project Profile for the Decommissioning and Disposal of a Clinical Waste Incinerator at Tang Siu King Hospital* is given in Table 7.5.

Table 7.5 Demolition, Handling, Treatment and Disposal of Severely Contaminated DCM

Item	**Procedure**
Site Preparation	Except the cremators/flue/chimney, all removable items where severely contaminated DCM is identified should be removed from the cremator room as far as practicable to avoid obstructing the decontamination activities. Preliminary site decontamination of all debris shall be carried out using HEPA vacuum cleaner. The walls, floor and ceiling of the cremator room where severely contaminated DCM located shall be lined with 3 layers of fire retardant polyethene sheets. The top portion of the chimney above the roof shall be enclosed by a chamber with three layers of polyethene sheets. At the entrance to the cremators/flues/chimney, a 3-chamber decontamination unit shall be constructed for entry and exit from the work area. The 3-chamber decontamination unit shall comprise a dirty room, a shower room and a clean room of at least 1m x 1m base each with 3 layers of fire retardant polyethene sheet where all workers shall carry out decontamination procedures before leaving the work area. Warning signs in both Chinese and English should be put up in conspicuous areas. Air movers should be installed at the cremator room, and at the bottom of the chimney to exhaust air from the work area. A stand-by air mover shall also be installed with each of the air movers. Sufficient air movement shall be maintained to give a minimum of 6 air changes per hour to the work area, and maintain a negative pressure of 0.05-0.15 inches of water within the work area throughout the entire course of the decommissioning works. A pressure monitor with printout records and audible alarm shall be installed at an easily accessible location to demonstrate that negative pressure is maintained. New pre-filters and HEPA filters shall be used on the air movers. A copy of the maintenance records of the air movers should be kept on site for inspection upon request. The appointed contractor shall also check the differential pressure of the air mover to make sure the filter is not blocked. A differential pressure above 0.2 inches of water indicates that the filters would need to be changed. Smoke Test: before commencement of the decommissioning work, a smoke test with non-toxic smoke shall be carried out to ensure the air-tightness of the containment. Also check whether there are stagnant air pockets indicated by an aggregate of smoke that cannot effectively be extracted. After a successful test, switch on the air mover to exhaust smoke from the containment and to give a minimum of 6 air changes per hour, and check visually to see that the filters screen out the smoke effectively and if the pressure gauges read normal. If not, the air mover shall be sealed up and returned to the supplier workshop for necessary servicing, and replaced by a tested air mover. The normal reading pressure range for maintaining 6 air changes per hour shall be 1.5-4 mm/0.05-0.15 inches of water or equivalent (negative pressure). The audible alarm's integrity should also be checked and the trigger shall be at <1.5 mm/0.05 inches of water (negative pressure). Otherwise securely seal up all openings before switching off the air mover. Treatment of Waste/Workers Safety Protection: the contractor shall be required to register as a Chemical Waste Producer. All workers shall wear full protective equipment, disposable protective coverall (such as Tyvek) (with hood and shoe covers), nitrile gloves, rubber boots (or boot covers), and full-face positive pressure respirators equipped with a combination cartridge that filters particulate and removes organic vapour. The organic vapour protection is an added protection against the unlikely exposure to any vapour as a necessary measure. If ACM is identified in building structures where severely contaminated DCM is found, relevant abatement measures for building structures described in the AAP (see *S.7.7.16*) should be implemented prior to the above site preparation.
Decontamination, demolition and handling	The cremators/flue/chimney shall be removed from top down starting from the chimney. Any ash or residues attaching to the cremators/flue/chimney or any other building structures shall be removed by scrubbing and HEPA vacuuming. The detached sections of the building structures where severely contaminated DCM is located shall be wrapped with 2 layers of fire retardant polyethene sheets. A third layer shall then be wrapped and secured with duct tape. Decontaminate the outer layer of the wrapped flue sections by wet wiping.

Item	Procedure
	Wastes generated from the containment or decontamination unit including the fire retardant polyethene sheets, protection clothing of the workers such as the coverall, nitrile glove, rubber boots and materials used for wet wiping shall be disposed of at landfill site. The quantity of wastewater generated from the decontaminated process will be very small but the contractor should take precautionary measures as to minimize the quantity of contaminated water arising. Nevertheless, if any contaminated wastewater needs to be discharged out of the site, it has to be properly treated to WPCO requirements with prior agreement from EPD on discharge standards. After completion of removal, decontaminate the surface where severely contaminated DCM was located, including the wrapped incinerator furnace and flue sections left within the containment, by wet wiping and HEPA vacuum. Then spray the innermost layer of the fire retardant polyethene sheet covering the wall, ceiling and floor with PVA. Upon drying, peel off this innermost layer of the polyethene sheet covering the containment and dispose of at landfill site. Repeat the above decontamination procedure for the second innermost layer of fire retardant polyethene sheet by wet wiping and HEPA vacuuming. After spraying with PVA, peel off this second innermost layer of the polyethene sheet covering the wall, ceiling and floor and dispose of at landfill site. Finally, the last layer of polyethene sheet shall then be taken down after spaying with PVA and be disposed as contaminated wastes. If ACM is identified in building structures where severely contaminated DCM is found, relevant abatement measures for building structures described in the AAP (see *S.7.7.16*) should be implemented prior to the above decontamination, demolition and handling measures.
Treatment and disposal	Waste to be disposed to CWTC: all contaminated ash waste with severely contaminated DCM removed and the used HEPA filters shall be sent to CWTC in Tsing Yi. The total volume should be confirmed by further site investigation. Waste to be Disposed of at Landfill: other wastes including the building structures and its associated panels as well as wastes generated from this decommissioning works are also considered as contaminated waste and shall be disposed of at a designated landfill. Wastes generated from this decommissioning works refer to the polyethene wrapping sheets for the building structures, waste generated from the dismantlement of the containment and decontamination units, and cloth used in wet wrapping, etc. as previously described in this section. They shall be placed into appropriate containers such as drums, jerricans, or heavy duty and leak-proof plastic as a prudent approach. A disposal permit has to be obtained from the Authority. The disposal trip ticket is required to be made available as record after disposal. If ACM is identified in building structures where severely contaminated DCM is found, relevant disposal measures for building structures described in the AAP (see *S.7.7.16*) should be implemented in prior to the above disposal measures.

Dioxin Containing Materials (DCM) / Heavy Metal Containing Materials (HMCM) / Polyaromatic Hydrocarbon Containing Materials (PAHCM) / Total Petroleum Hydrocarbon Containing Materials (TPHCM) / Polychlorinated Biphenyls Containing Materials (PCBCM) from Soil Remediation at the Project Site

7.7.22 According to the CAR and RAP provided in *Appendix C2*, less than 100 m^3 of soil would require disposal at landfill. Relevant health and safety procedure, waste disposal requirements and compliance report are as detailed in *Appendix C2*. Mitigation measures to avoid fugitive dust emission mentioned in *Section 4* should also be observed.

7.7.23 In addition, after decommissioning but before demolition of the Existing Crematorium, further investigations during Phase I of the works at the vicinity of CLP secondary substation should also be carried out to determine if additional remediation (in addition to the current RAP) is required. Confirmatory test on levels of DCM, HMCM and PAHCM in locations S1 to S6 during Phase II of the works is also required to determine any further remediation /treatment/disposal. In addition, the ash waste in cremator/chimney/flues should also be collected for the testing of DCM/HMCM/PAHCM during Phase II of the works. The sampling and analysis plan should be prepared and submitted to EPD for approval.

7.7.24 All the aforementioned ACM/DCM/HMCM/PAHCM/TPHCM/PCBCM are classified as chemical waste. In addition to the measures mentioned above, the packaging, labelling and storage practices of chemical waste as stipulated in the following paragraphs should also be applied to these contaminated materials.

Chemical Waste

7.7.25 All the chemical waste should be handled according to the *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes*. The chemical waste should be stored and collected by an approved contractor for disposal at a licensed facility in accordance with the *Waste Disposal (Chemical Waste) (General) Regulation*. Containers used for the storage of chemical waste should:

- Be suitable for the substance they are holding, resistant to corrosion, maintained in 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 *Waste Disposal (Chemical Waste) (General) Regulation.*

7.7.26 The storage area for chemical waste should:

- Be clearly labeled 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 from entering (water collected within the bund must be tested and disposal as chemical waste if necessary); and
- Be properly arranged so that incompatible materials are adequately separated.

7.7.27 The chemical waste should be disposed of by:

- A licensed waste collector;
- A facility licensed to receive chemical waste, such as the CWTC at Tsing Yi, which offers chemical waste collection service and can supply the necessary storage containers; and/or
- A waste recycling plant as approved by EPD.

General Refuse

7.7.28 General refuse should be stored in enclosed bins or compaction units separated from C&D and chemical wastes. A reliable waste collector should be employed by the contractor to remove general refuse from the site, separately from C&D and chemical wastes, on a daily or every second day basis to minimize odour, pest and litter impacts. The burning of refuse on construction sites is prohibited by law.

7.7.29 Aluminum cans are often recovered from the waste stream by individual collectors if they are segregated or easily accessible. Therefore, separately labeled bins for deposit of these cans should be provided if feasible. Similarly, plastic bottles and carton package material generated on-site should be separated for recycling as far as practicable. Site office waste should be reduced through recycling of paper if volumes are large enough to warrant collection. Participation in a local collection scheme should be considered if one is available.

7.8 Mitigation of Adverse Environmental Impacts for Operation Phase

Ash and Non-combustible Residues

7.8.1 The disposal of bone ash and non-combustible residues should be properly collected and handled to avoid dust emissions. In line with the current practices, the bone ash will be stored in covered containers for collection by the deceased's relatives within 2 months upon appointment while the non-combustible residues will be collected in sealed heavy-duty polyethene bags for disposal at landfill. Provided that these good practices continue, the potential secondary environmental impacts will be kept to a minimum.

Chemical Waste

7.8.2 The chemical wastes generated from the air pollution control system would mainly include used activated carbon, un-reacted lime and collected particulate matter. To prevent health hazards to operators, all such chemical wastes should be carefully collected and handled to avoid dust emissions.

7.8.3 All the chemical wastes generated from the air pollution control system as well as from machinery maintenance and servicing should be dealt with according to the *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes* under the provisions of the *Waste Disposal (Chemical Waste)(General) Regulation*. The chemical wastes should be collected by drum-type containers and removed by a licensed chemical waste contractor. In addition, the relevant measures as provided in *Section 7.7* should be followed.

General Refuse

7.8.4 Waste generated in offices should be reduced through segregation and collection of recyclable waste materials (such as paper and carton packages) if the volumes are large enough to warrant collection. Participation in a local collection scheme should be considered if one is available.

7.8.5 To promote recycling of waste paper, aluminum cans and plastic bottles by the visitors, it is recommended to place clearly labeled recycling bins (such as those available from EPD) at convenient locations within the New Crematorium area. The recyclable waste materials should then be collected by reliable waste recycling agents on a regular basis.

7.8.6 The general refuse (other than those segregated recyclable wastes) should be separated from any chemical wastes and stored in covered waste skips. Food and Environmental Hygiene Department (FEHD) should remove general refuse from the site, separately from chemical wastes, on daily basis to minimize odour, pest and litter impacts. Burning of refuse must be strictly prohibited.

7.9 Conclusions

7.9.1 This assessment has considered the waste management implications on the demolition of Existing Crematorium as well as the construction and operation of New Crematorium. The potential environmental impacts arising from the handling and disposal of various types of waste materials have been identified. With effective implementation of the recommended mitigation measures, it is anticipated that the associated secondary impacts on the environment and the potential impacts on the capacity of waste collection, transfer and disposal facilities will not be significant.

8 LANDSCAPE AND VISUAL IMPACT ASSESSMENT

8.1 Assessment Methodology

Landscape Impact Assessment Methodology

8.1.1 The assessment of the potential impacts of the proposed works on the existing landscape comprises two distinct sections as follows:

- Baseline survey; and
- Potential landscape impact assessment

8.1.2 A baseline survey of the existing landscape character and quality within a 500 m radius of the proposed development has been undertaken by a combination of site inspections and desktop surveys. The impact assessment and associated mitigation works cover areas within permanent land take and temporary works / disturbed areas. The landscape elements considered include where applicable:

- Local topography
- Woodland and other vegetation types
- Built form, land use patterns of settlement
- Scenic spots
- Details of local materials, architectural styles and streetscapes
- Prominent watercourses
- Cultural and religious identity, including feng shui features

8.1.3 The landscape baseline survey formed the basis of the landscape context by describing broadly homogenous units of similar character (Landscape Character Units). These have been clearly delineated on plan. The landscape character has been rated into low, medium or high depending not only upon the quality of the landscape elements present but also according to their sensitivity to change and local or regional importance.

8.1.4 The assessment of the potential landscape impacts of the proposed crematorium reprovisioning will result from:

- Identification of the sources and magnitude of impacts that would be generated during construction and operation.
- Identification of the principal landscape impacts, primarily in consideration of the degree of change to the baseline conditions.

8.1.5 Some common factors that have been considered in deriving the magnitude of change and sensitivity in assessing landscape impacts are as follows:

8.1.6 Factors affecting magnitude of change:

- Compatibility of the crematorium with the surrounding landscape
- Duration of impacts under construction and operation phases
- Scale of development
- Reversibility of change

8.1.7 Factors affecting sensitivity:

- Quality of landscape character / resources
- Importance and rarity of special landscape elements
- Ability of the landscape to accommodate change

- Significance of the change in local and regional context
- Maturity of the landscape

8.1.8 The sensitivity / quality of the landscape has been assessed as follows:

- *High*: e.g. important components of a landscape of particularly distinctive character susceptible to relatively small changes
- *Medium*: e.g. a landscape of moderately valued characteristics reasonable tolerant to change
- *Low*: e.g. a relatively unimportant landscape able to absorb significant change

8.1.9 The magnitude of change in the landscape has been classified as follows:

- *Large*: Notable change in the landscape characteristics over an extensive area ranging to very intensive change over a more limited area
- *Intermediate*: moderate changes in a local area
- *Small*: Virtually imperceptible change in any components of the landscape
- *Negligible*: Indiscernible change to landscape characteristics

8.1.10 The degree of impact or significance threshold has been considered as follows:

- *Significant*: adverse / beneficial impact where the proposal would cause significant deterioration or improvement in existing landscape quality
- *Moderate*: adverse / beneficial impact where the proposal would cause a noticeable deterioration or improvement in existing landscape quality
- *Slight*: adverse / beneficial impact where the proposal would cause a barely perceptible deterioration or improvement in the existing landscape quality
- *Negligible*: no discernible change in the existing landscape quality

8.1.11 The analysis of the significance threshold for the landscape and visual impacts during construction and operation has been presented in the following form of matrix. A 'nil' rating means that the impact is not applicable to the particular LCU.

Table 8.1 Matrix for Analysis of the Significance Threshold for the Landscape and Visual Impact

		Sensitivity / Quality		
		Low	**Medium**	**High**
Magnitude of Change	***Negligible***	Negligible Impact	Negligible Impact	Negligible Impact
	Small	Slight Impact	Slight / Moderate Impact	Moderate Impact
	Intermediate	Slight / Moderate Impact	Moderate Impact	Moderate / Significant Impact
	Large	Moderate Impact	Moderate / Significant Impact	Significant Impact

Visual Impact Assessment Methodology

8.1.12 Similar to the landscape impact assessment, the assessment of the potential visual impacts of the proposed works has two distinct stages as follows:

- Baseline survey
- Potential visual impact assessment

8.1.13 The baseline survey of views towards the proposed crematorium reprovisioning has been carried out by identifying:

a) The visual envelope (2km distance or defined by natural or manmade features) within which the proposed development may be contained whether wholly or partially within views, including indirect effects such as temporary contractor's works areas.

b) The visually sensitive receivers (VSRs) within the visual envelope whose views will be affected by the scheme. The sensitivity of each VSR group is also influenced by the distance and direction of view to the proposed development. The potential receivers have been divided into three groups:

a) *View from residences*. This group is the most sensitive due to the high potential intrusion on the visual amenity and quality of life. Sensitivity is 'high'.
b) *View from workplaces*. This group including, e.g. schools, institutions and factories are less sensitive than a) since visual amenity is less important within the work environment with less emphasis on external views. Sensitivity is 'medium'.
c) *Views from public areas not included in a) or b).* This group includes, e.g., public parks, footpaths and roads. Sensitivity of this group is relatively low and will depend on the transitory nature of the receiver with views being typically glimpsed rather than sustained for long periods. Sensitivity is 'low'.

8.1.14 The baseline survey describes and records by photograph typical views from within visual envelopes for low-level viewpoints (street level) and high level viewpoints (high-rise buildings / hillsides). Wherever possible, future VSRs have also been considered.

8.1.15 The assessment of potential visual impacts results from the following:

- Identification of the sources of visual impacts and their magnitude that would be generated during construction and operation
- Identification of the principal visual impacts with particular consideration given to the degree of change to the baseline conditions

8.1.16 The impact assessment compared the typical existing views identified in the baseline survey of the key receiver groups and the potential view after the proposed works are complete. Some typical factors affecting the magnitude of changes and sensitivity for assessing visual impacts include the following:

8.1.17 Factors affecting the magnitude of change:

- Compatibility of the project with the surrounding landscape
- Duration of impacts under construction and operation phases
- Scale of development
- Reversibility of change
- Viewing distance
- Potential blockage of view

8.1.18 Factors affecting the sensitivity of receivers:

- Value and quality of existing views
- Availability and amenity of alternative views
- Type and estimated number of receiver population
- Duration and frequency of view
- Degree of visibility

8.1.19 The magnitude of change to the views have been classified as follows:

- *Large*: e.g. the majority of viewers affected / major change in view
- *Intermediate*: e.g. many viewers affected / moderate change in view
- *Small*: e.g. few viewers affected / minor change in view
- *Negligible*: e.g. very few viewers affected / no discernible change in view

8.1.20 The degree of visual impact or significance threshold has been rated in a similar fashion to the landscape impact described above, i.e. significant, moderate, slight and negligible. The impacts may be beneficial or adverse.

Mitigation Measures

8.1.21 The identification of the landscape and visual impacts will highlight those sources of conflict requiring design solutions or modifications to reduce the impacts and, if possible, blend the development with the surrounding landscape. The proposed landscape mitigation measures will be described and illustrated by means of site plans and photomontage and take into account factors including:

- Screen planting
- Transplanting of mature trees with good amenity value where appropriate
- Conservation of topsoil for reuse
- Sensitive alignment of structures to minimise disturbance to surrounding vegetation
- Reinstatement of areas disturbed during construction
- The design and finishes / colours of architectural and engineering structures such as terminals and pylons
- Existing views, views of the development with no mitigation, views with mitigation at day one of operation and after 10 years of operation

Residual Impacts

8.1.22 Residual impacts are those impacts remaining after the proposed mitigation measures have been implemented. This is often 10 to 15 years after operation commences when the planting mitigation measures are deemed to have reached a level of maturity which allow them to perform their original design objectives.

8.1.23 The level of impact is derived from the magnitude of change which the crematorium development will cause to the existing view or landscape character and its ability to tolerate change, i.e. the quality and sensitivity of the view or landscape character taking into account the beneficial effects of the proposed mitigation. The significance threshold is derived from the matrix shown above.

8.1.24 The overall impact for the proposed crematorium scheme has been defined as follows:

Table 8.2 Overall Impact for the Proposed Crematorium Scheme

Beneficial	Acceptable	Acceptable with mitigation measures	Unacceptable	Undetermined
The impact is beneficial if the project will complement the landscape and visual character of its setting, will follow the relevant planning objectives and will improve overall and visual quality	The impact is acceptable if the assessment indicates that there will be no significant effects on the landscape, no significant visual effects caused by the appearance of the project, or no interference with key views	The impact is acceptable with mitigation measures if there will be some adverse effects, but these can be eliminated, reduced or offset to a large extent by specific measures	The impact is unacceptable if the adverse effects are considered too excessive and are unable to mitigate practically	The impact is undetermined if significant adverse effects are likely, but the extent to which they may occur or may be mitigated cannot be determined from the study. Further detailed study will be required for the specific effects in question

Funding, Implementation, Management and Maintenance

8.1.25 It is anticipated that initial funding and implementation of the landscape and visual mitigation measures as well as on-going maintenance within the boundary of the crematorium will be by FEHD. An implementation programme has been prepared as required by the TM of the EIAO. Reference will be made to the *Works Bureau Technical Circular No. 14/2002 – Management and Maintenance of Natural Vegetation and Landscape Works and Tree Preservation* which defines the management and maintenance responsibilities for natural vegetation and landscape works, including both softworks and hardworks, and the authorities for tree preservation and felling.

Photomontage Illustration

8.1.26 The effectiveness of the proposed impact mitigation proposals has been illustrated by means of a set of photomontages showing residual impacts at year 10 of the reprovisioned crematorium operation (see *Figures 8.7 - 8.12*)

8.2 Assessment Results

Review of Planning Development Control Framework

8.2.1 *Figure 8.1* illustrates the existing planning context of the proposed crematorium development. The site is located within an "Other Specified Uses" zone annotated "Cemetery" ("OU-Cemetery") on the Approved Ngau Chi Wan Outline Zoning Plan No. S/K12/14. According to the relevant Statutory Notes attached to the plan, "Crematorium" is a use that is always permitted within the "OU-Cemetery" zone, and no planning permission is required. Accordingly, the proposed use conforms fully with the existing planning intention.

Existing Landscape and Visual Context

8.2.2 To understand better the variety of landscape resources, the Study Area has been subdivided into key landscape character units (LCUs) within 500m of the proposed crematorium development, refer *Figure 8.2*, (Landscape Impact Assessment Survey Plan). *Figure 8.*2 includes photographs to illustrate the typical character of each LCU throughout the Study Area which are described in more detail below.

8.2.3 ***LCU 1. (Cemetery and Crematorium).*** This LCU includes the existing Diamond Hill crematorium complex and cemetery. The landscape resources are typical of most Hong Kong urban cemeteries, i.e. a mix of relatively sparse man-made terraces to accommodate the graves and memorials and mature amenity and ornamental tree and shrub planting at the crematorium entrance, building complex and memorial garden. The portions of the slopes as yet undeveloped for grave terraces still have fairly dense shrub cover with pockets of woodland in the more protected ravines. The only landscape resources which will be affected by the proposed development are located within this LCU and are discussed in more detail below.

8.2.4 ***LCU 2. (Adjacent steep hillside).*** This LCU comprises the undeveloped natural hillside tree and shrub vegetation immediately beyond the cemetery boundary. This LCU is typical of the landscape character or the urban fringe below the Kowloon hills. The proposed crematorium reprovisioning will have no impact on these landscape resources.

8.2.5 ***LCU 3. (High-rise residential development)*** This LCU comprises the high-rise residential estates to the south of the study area. The landscape character of the housing estates is typical of that found throughout Hong Kong, i.e. visually dominant clusters of blocks interspersed with pockets of small scale open space / recreation facilities and amenity planting. The proposed crematorium reprovisioning will have no impact on these landscape resources.

8.2.6 ***LCU 4. (Service Reservoir)*** This LCU comprises a grass covered service reservoir. The proposed crematorium reprovisioning will have no impact on these landscape resources.

8.2.7 ***LCU 5. (High-rise residential development)*** This LCU comprises the high-rise residential estates and school bordering Po Kong Village Road to the west of the crematorium as well as the school village on a portion of the service reservoir. Like LCU 3 the landscape character of the housing estates is typical of that found throughout Hong Kong. The proposed crematorium reprovisioning will have no impact on these landscape resources.

Landscape Impacts

8.2.8 The crematorium reprovisioning will be carried out in two phases. Phase I will be located on the existing sitting out area and garden of remembrance and Phase II will occupy the existing crematorium site. To ensure continuity of services the existing cremators will remain in operation until the commissioning of the Phase I development. The anticipated sources of impact on the landscape as a result of the crematorium reprovisioning will arise from the following.

- Temporary works areas for the crematorium construction, hoarding, site formation etc.
- Permanent development footprint of the completed crematorium.
- Removal of mature trees and areas of shrub and lawn directly beneath the proposed crematorium works, notably the loss of the existing memorial garden.

8.2.9 The impacts have been assessed in terms of both measurable loss of landscape resources as the more subjective impacts of the development on the overall character of the landscape setting. As outlined in the assessment methodology above the landscape impacts are a product of the magnitude of change and the sensitivity of the landscape to change. In this context the following section discusses the anticipated temporary and permanent landscape impacts of the proposed development. Table 8.3 provides a summary of the key anticipated landscape impacts. No additional landscape impact is expected during the transitional stage.

Landscape Resources – Tree Survey

8.2.10 The proposed crematorium reprovisioning will require removal of the existing facility and construction of a bulkier complex extending over a larger area. A detailed tree survey has been carried out to identify the location and quantity of vegetation that will need to be cleared to accommodate the new development. The landscape impact is anticipated to be significant for the following reasons:

- The vegetation cover comprises a mix of planted native and exotic species. There are many mature and semi-mature trees and shrubs of good form and amenity value which will need to be removed either by felling (24 nos.) or transplanting (132 nos.). Felling is regarded as a last resort. Transplanting trees of old and valuable and protected species is considered as the second last alternative. Therefore, only species of poor health or form or which are difficult to transplant due to size or growth habit have been proposed for felling. The tree felling application with i) comprehensive tree survey report, ii) compensatory planing proposals and iii) layout plan indicating the locations of the existing trees at the future development will be supplied to Leisure and Cultural Services Department (LCSD) by the contractor at least four months prior to works

- Of the total 144 trees to be removed, the following 9 mature or semi-mature trees are protected species listed in the Forestry Regulations 1990:

Survey No. (Mature & semi-mature trees)	**Species**
55	*Ailanthus fordii*
56	*Ailanthus fordii*
57	*Ailanthus fordii*
58	*Ailanthus fordii*
59	*Ailanthus fordii*
80	*Rhodoleia championi*
81	*Rhodoleia championi*
136	*Michelia figo*
147	*Magnolia grandiflora*

Survey No. (Immature trees & shrubs)	**Species**
A	*Michelia figo*
B	*Michelia figo*
C	*Rhodoleia championi*
D	*Rhodoleia championi*
E	*Camellia japonica*
F	*Camellia japonica*
G	*Camellia japonica*
H	*Camellia japonica*
I	*Michelia figo*
J	*Osmanthus fragrans*
K	*Camellia japonica*
L	*Magnolia grandiflora*

In addition, there are 12 plants (both shrubs and immature trees), listed above, which are also protected species. These are listed as A to L on the Tree Schedule and comprise 5 nos. Camellia, 3 nos. *Michelia figo*, 2 nos. Rhodoleia, 1 no. Osmanthus and 1 no. Magnolia. All of the above noted 21 nos. protected trees and shrubs are proposed to be transplanted within the cemetery.

- The reprovisioned memorial garden and landscaped areas are smaller than the existing facilities, i.e. there is a net loss of 970m^2 of landscaped area (refer Table 8.3 below) and insufficient space to accommodate transplanting of all the affected trees within the development area or within the cemetery as a whole. Therefore, it is anticipated that the surplus transplants will need to be held in a Wo Hop Shek Cemetery until a suitable site is available.

Table 8.3 Summary of the key anticipated landscape impacts

Landscape Character Unit (LCU)	**Description**	**Quality / Sensitivity**	**Magnitude of Change**	**Impact**	**Significance Threshold without mitigation**	
					During Construction	**During Operation**
LCU 1	Crematorium with amenity and ornamental planting to building complex and access roads. Pockets of hillside vegetation adjacent to upper grave terraces	Medium	Large	Removal of 144 mature and semi-mature trees to accommodate bigger new building Net loss of landscaped area: Ex. planted area = 2,620m^2 New planted area = 1,650m^2	Moderate / Significant-adverse	Moderate / Significant-adverse
LCU 2	Hillside woodland and shrub vegetation	High	Negligible	Negligible	Negligible	Negligible
LCU 3	High-rise housing estate	Low	Negligible	Negligible	Negligible	Negligible
LCU 4	Service Reservoir	Low	Negligible	Negligible	Negligible	Negligible
LCU 5	High-rise housing and schools	Low	Negligible	Negligible	Negligible	Negligible

Visual Impacts

General Assessment

8.2.11 The proposed development comprises 6 cremators, 4 service halls and supporting facilities. The building plans are illustrated in *Figures 2.2* to *2.5*, the master landscape plan is given in *Figure 8.3* and the longitudinal and transverse sections of the New Crematorium is shown in *Figure 8.4*. The design of the building takes the existing site conditions and terraced profile into account to minimise the need for site formation. The building is generally low to medium-rise, the tallest component being the chimney, approximately 28.5 m high. Building colours and finishes have not been finalised, however, it is recommended that generally recessive tones and non-reflective materials are used to minimise the contrast with the surrounding vegetation. Planting areas to the roadside and deck areas bordering the new crematorium will be provided to help reduce the visual mass of the structure and soften the outline of the building. No additional visual imapct is expected during transitional stage.

8.2.12 The crematorium has mature belts of trees along the boundary bordering Po Kong Village Road and Hammer Hill Road which provide a strategic and effective screen to passersby. Although, as noted above, many trees will be affected by the development within the building platform, the screenbelt to the site boundary will not be affected and is expected to mitigate the majority of the potential visual impacts for the identified high level and low level VSR groups noted below.

Detail Assessment

8.2.13 *Figure 8.5* illustrates the visual envelope for both low-level and high-level visually sensitive receivers and *Figure 8.6* includes a selection of existing views to demonstrate the visual character of the site and surroundings. The high-level visual envelope is contained by the adjacent high-rise residential blocks at Fu Shan Estate, King Shan Court, Sun Lai Garden, Grandview Garden, Plaza Hollywood and Fung Tak Estate. Views of the proposed crematorium building from the west, e.g. the nearby schools east of Tsz Man Estate are screened by the intervening columbarium building and multi-storey CLP transformer / sub-station. Low-level views are typically contained by intervening topography, structures or vegetation such as the boundary amenity tree planting within the crematorium. Table 8.4 identifies the key groups of visually sensitive receivers and records the relative impacts of the proposed development on each.

Table 8.4 Summary of the key anticipated visual impacts

Key Visually Sensitive Receivers	**Typical Viewpoint**	**Approx. no. of receivers and distance**	**Quality / Sensitivity**	**Magnitude of Change**	**Impact**	**Significance Threshold without mitigation**	
						During construction	**During operation**
High Level							
(Residential)							
1.Fu Shan Estate	Medium to long distance views over Diamond Hill area dominated by neighbouring housing estates, service reservoir in the near to middle distance and Kowloon hills in background	3 blocks 300m	High	Small	Visual impacts for high and low-level VSRs outside the cemetery will be mitigated to a large extent by the relatively low-rise crematorium building and the screening effect of the belts of mature trees within and around the cemetery. Impact on cemetery visitors is mainly during construction and mitigated in operation by the crematorium being an integral feature in the cemetery.	Moderate-adverse	Moderate-adverse
2.King Shan Court		7 blocks 350m	High	Small		Moderate-adverse	Moderate-adverse
3.Sun Lai Garden		2 blocks 350m	High	Small		Moderate-adverse	Moderate-adverse
4.Grandview Garden		3 blocks 300-350m	High	Small		Moderate-adverse	Moderate-adverse
5.Plaza Hollywood		5 blocks 600m	High	Negligible		Negligible	Negligible
6.Fung Tak Estate		4 blocks 500m	High	Negligible		Negligible	Negligible
(Public Areas)							
7.Cemetery Columbarium	View dominated by nearby crematorium, trees and hillside graves	50m	Low	Intermediate (construction) Small (operation)		Slight / Moderate-adverse	Slight-adverse

Key Visually Sensitive Receivers	Typical Viewpoint	Approx. no. of receivers and distance	Quality / Sensitivity	Magnitude of Change	Impact	Significance Threshold without mitigation	
						During construction	During operation
Low Level ***(Public Areas)***							
8.Po Kong Village Road pedestrians / road users	Views dominated by traffic, service reservoir and roadside planting	50m	Low	Negligible		Negligible	Negligible
9.School village	Views dominated by traffic, adjacent high-rise buildings and roadside planting	200m	Medium	Negligible		Negligible	Negligible
10.Cemetery Visitors	Views dominated by trees and hillside grave terraces	10 - 300m	Low	Intermediate (construction) Small (operation)		Slight / Moderate-adverse	Slight-adverse
11.Service reservoir (possible future recreation use)	Open, medium to long distance views to surrounding estates and Kowloon Hills beyond	100m	Low	Negligible		Negligible	Negligible

Estimated Number of VSRs

8.2.14 Based on the data contained in Table 8.4 it is estimated that there will be the following number of VSRs affected to some extent by the crematorium reprovisioning work.

- Residents on upper floors of 24 high-rise blocks (refer Figure 8.5 for visual envelope)
- Pedestrians and road users in Po Kong Village Road. This number is difficult to quantify but should nevertheless be noted.
- Visitors to the cemetery. This number is difficult to quantify but should nevertheless be noted.

Recommended Mitigation Measures During Construction/Operation

8.2.15 Tree transplanting: The tree survey has identified the trees which will be affected by the development and which could be considered for transplanting prior to commencement of construction work. Felling will only be considered as a last resort and every effort should be made to transplant the many good trees of high amenity value to Wo Hop Shek Cemetery. The feasibility of transplanting will depend on a number of factors such as size, health and species of the tree. Adequate time (a minimum of 4 months) should be allowed for preparing trees for transplanting. Weekly inspection of tree protection measures as well as monitoring of tree transplant operations during both phases should be implemented. Particular care should be taken to save the 9 nos. mature and semi-mature protected tree species and 12 nos. protected shrub and immature tree species identified. To give the protected species the best possible chance of survival it is recommended that they are relocated to sheltered and well maintained planted areas within the cemetery. The following measures for tree transplanting should be adopted:

(a) Appoint a landscape contractor for the establishment and maintenance of the transplanted trees as well as any new tree planting for 12 months upon completion of the works.
(b) Careful co-ordination of Phase I and II works to allow tree transplanting from Phase II site directly to Phase I site.

8.2.16 Tree protection: Trees to be retained adjacent to works areas will be carefully protected by strong hoarding and if necessary additional protection to individual tree trunks to avoid damage by machinery. The hoarding will also prevent contractors from compacting soil around tree roots or dumping materials. Reference should be made to the guidelines for tree protection in the Government publication: Webb, R., (ed.) *Tree Planting and Maintenance in Hong Kong* (Hong Kong: Hong Kong Government, 1991).

8.2.17 Topsoil conservation: Any topsoil excavated during construction will be carefully saved and stored to one side of the works area for reuse upon completion.

8.2.18 Replanting: Upon completion planting of ornamental trees and shrubs will be provided to the periphery of the new crematorium building to help screen and soften the overall appearance of the structure. In addition, a reprovisioned memorial garden with a lotus pond and ornamental planting will be incorporated in the deck area of the building, refer *Figure 8.3* for the Indicative Master Landscape Plan. Since the majority of the new planting will be on the deck structure the selection of species will be more limited with emphasis on smaller trees and ornamental shrubs to comply with loading restrictions. Notwithstanding this site constraint on tree selection, a minimum of 1.2m soil depth will be provided for tree planting on the podium / roof structure for healthy establishment of the new tree planting.

8.2.19 Crematorium Architecture: The building profile has been designed in response to the site terraced topography to minimise site formation which greatly reduces the overall visual impact, (refer to *Figures 2.2-2.5* and *8.3* for building plan and master landscape plan). In addition, it is recommended that the material finishes be non-reflective and low-key in nature using predominantly recessive tones to blend in as far as possible with the surrounding vegetation.

Photomontages

8.2.20 To illustrate the effectiveness of the various landscape and visual mitigation measures described above, photomontages have been prepared for a representative cross-section of the key viewpoints. The photomontage viewpoint locations are indicated on *Figure 8.6* and the photomontages are indicated *Figures 8.7* to *8.12*. As illustrated in the photomontages, the proposed crematorium development, being low-rise, located neatly on the existing terraced landform and for the most part screened by the surrounding mature trees, is not anticipated to be visually intrusive. Accordingly, due to the vegetation and topographical site features noted above for all the key viewpoints, A to F, there is negligible difference in visual impact between the development with no mitigation (no screen planting), with mitigation (with screen planting) and the development with mitigation after 10 years (when the trees are bigger).

8.2.21 Tables 8.5 and 8.6 summarise the residual landscape and visual impacts anticipated after the mitigation measures noted above have been carried out.

Table 8.5 Summary of mitigation measures and residual landscape impacts

Landscape Character Unit (LCU)	Sources of Impact	Magnitude of Change		Landscape Quality/ Sensitivity	Mitigation Measures	Residual impact after implementation of mitigation measures	
		Construction	Operation			Construction	Operation
LCU 1	Removal of 144 mature and semi-mature trees to accommodate bigger new building resulting in net loss of landscape resources	Large	Intermediate	Medium	• Transplant as many of affected trees as practicable within the cemetery. • New tree and shrub planting to new crematorium upon completion	Moderate / Significant -adverse	Moderate-adverse
LCU 2	No direct impact	Negligible	Negligible	High	N/A	Negligible	Negligible
LCU 3	No direct impact	Negligible	Negligible	Low	N/A	Negligible	Negligible
LCU 4	No direct impact	Negligible	Negligible	Low	N/A	Negligible	Negligible
LCU 5	No direct impact	Negligible	Negligible	Low	N/A	Negligible	Negligible

Table 8.6 Summary of mitigation measures and residual visual impacts

Visually Sensitive Receivers (VSRs)	**Sources of Impact**	**Magnitude of Change**		**Visual Quality / Sensitivity**	**Mitigation Measures**	**Residual impact after implementation of mitigation measures**	
		Construction	**Operation**			**Construction**	**Operation**
High Level							
(Residential)							
1.Fu Shan Estate	New, larger building results in net loss of mature trees within the heart of the cemetery though not generally noticeable by more distant VSRs.	Small	Small	High	• Provide hoarding to screen development, particularly from cemetery visitors • Design building as low-rise structure with non-reflective materials / recessive colour tones • Provide new tree and shrub planting around new building to soften outline • Retain as many of the mature trees affected by the development within the cemetery site to supplement the general screening effect and visual amenity.	Moderate-adverse	Moderate-adverse
2.King Shan Court		Small	Small	High		Moderate-adverse	Moderate-adverse
3.Sun Lai Garden		Small	Small	High		Moderate-adverse	Moderate-adverse
4.Grandview Garden		Small	Small	High		Moderate-adverse	Moderate-adverse
5.Plaza Hollywood		Negligible	Negligible	High		Negligible	Negligible
6.Fung Tak Estate		Negligible	Negligible	High		Negligible	Negligible
(Public Areas)	Visual impact of new building and net loss of trees not generally noticeable by low-level VSRs due to screening effect of cemetery's boundary tree belts						
7.Cemetery Columbarium		Intermediate	Small	Low		Slight / Moderate-adverse	Slight-adverse
Low Level							
(Public Areas)							
8.Po Kong Village Road pedestrians / road users		Negligible	Negligible	Low		Negligible	Negligible
9.School village		Negligible	Negligible	Medium		Negligible	Negligible
10.Cemetery visitors		Intermediate	Small	Low		Slight / Moderate-adverse	Slight-adverse
11.Service reservoir (possible future recreation use)		Negligible	Negligible	Low		Negligible	Negligible

Funding, Implementation and Management

8.2.22 The proposed landscape and visual impact mitigation measures are all on-site. No off-site mitigation measures are proposed. Accordingly, the funding, implementation and ongoing management of the planted areas will be by FEHD. Of particular concern is the fate of the trees to be transplanted. The transplanting procedure and transplant locations will need further discussion at the detail design stage. As discussed above, it is recommended to find locations within other areas of the crematorium to accommodate as many of the transplants as possible. Also, depending upon the detailed programme of the crematorium development, it may be possible to transplant designated trees from the Phase 2 site into new planting areas within Phase 1 before commencement of the Phase 2 works. In either scenario, the landscape contractor will be responsible for the establishment and maintenance of the transplanted trees as well as any new planting for 12 months upon completion of the works, after which time the maintenance responsibility would be expected to return to FEHD.

Cumulative Impacts

8.2.23 As shown in *Figures 8.13 – 8.18*, there are no significant cumulative landscape or visual impacts anticipated as a result of the demolition of the existing crematorium and construction of the new crematorium as they are both considered to be one development 'entity', i.e. the new replacing the old in the same general location. The photomontages indicate that the old and new development during construction as well as in operation will not have cumulative impacts for VSRs or the surrounding landscape character. Regarding potential cumulative impacts of other designated projects in the vicinity of the crematorium, no significant landscape or visual impacts are anticipated. Although the Diamond Hill No. 2 Freshwater Service Reservoir project may overlap the crematorium demolition and construction programme the relatively well screened and small-scale crematorium site is not anticipated to contribute any significant cumulative impacts when seen in association with the reservoir works. The KCRC Sha Tin to Central development is below ground in the vicinity of the crematorium and is therefore not anticipated to result in any cumulative landscape or visual impacts.

Conclusion and Summary of Landscape and Visual Impacts

8.2.24 The crematorium reprovisioning works will result in a net loss of soft landscaped area of approximately 970 m^2 including removal of 144 trees (nine of which are protected species) and 12 additional shrubs and immature trees which are protected species . The area of planting in the Existing Crematorium is 2,620 m^2; the areas of planting, lily pond and lawn in the New Crematorium are 1,650 m^2, 751 m^2 and 507 m^2 respectively). It is proposed to minimise the anticipated landscape impacts by transplanting the most suitable specimens, including all of the protected species (total: 21 specimens), to locations within the cemetery. FEHD has advised that if not all the trees can be accommodated within existing planting areas then the surplus can be accommodated in the Wo Hop Shek Cemetery in the New Territories. This will apply mainly to the trees affected by the Phase I development. Careful co-ordination of the two phases of construction will allow transplants from the Phase II site to be transplanted directly into the completed Phase I site. The proposed transplanting coupled with the proposed new planting to the crematorium perimeter and open space areas will help mitigate the overall landscape impacts. Although the new development will result in a larger building footprint and the landscaped areas are generally more compact, it is estimated that new tree planting can be provided on a one-for-one basis to replace the 144 trees to be removed.

8.2.25 The visual impacts arising from the tree removal and construction of the new building are not anticipated to be significant due to the retention of the cemetery's dense and mature boundary tree belt which provides a strategic screen to low-level VSRs. The building is generally low to medium rise and nestles neatly into the existing topography and surrounding amenity planting thus reducing the overall visual impacts for high-level VSRs. As a result it is anticipated that the overall residual landscape and visual impacts will be acceptable with the proposed mitigation measures.

9 WATER QUALITY IMPACT ASSESSMENT

9.1 Introduction

9.1.1 This section provides an assessment of potential water quality impacts associated with the demolition of Existing Crematorium as well as construction and operation of the New Crematorium, in accordance with the Study Brief as well as *Annexes 6* and *14* of the *EIAO-TM*.

9.2 Assessment Methodology

9.2.1 The assessment of potential impacts of land based construction, demolition and operation activities on water quality at identified Water Sensitive Receivers (WSRs) have been carried out in a qualitative manner. Consideration had been given to control potentially harmful impacts from the Project and mitigation measures are recommended to minimize the potential for discharges of pollutants to nearby receiving watercourses in vicinity of the Project site.

9.3 Baseline Condition

Existing Water Quality

9.3.1 The location of the Project site is shown in *Figure 2.1*. Along the eastern side of the Project site, there is a stream approximately 20 m away. The Project site is located inland and falls within the Victoria Harbour (Phase Two) Water Control Zone (WCZ).

9.3.2 Based on the visual inspection during site visits, water in the streams appears to be clear during dry weather. A small amount of rubbish and debris was observed on the sides of stream. No river quality monitoring data is available from this stream.

9.3.3 According to EPD's *River Water Quality in Hong Kong in 2001*, this stream should connect to Kai Tak Nullah as it is the major storm water channel in the South-East Kowloon, and its catchment includes San Po Kong, Diamond Hill, Tsz Wan Shan, Wan Shan, Wong Tai Sin, Wang Tau Hom, Lok Fu and Kowloon City. The Nullah also receives about 29,000 m^3/day of treated secondary effluent from Sha Tin and Tai Po Sewage Treatment Works (STWs) under the Tolo Harbour Effluent Export Scheme.

9.3.4 The river water quality monitoring station closest to the Project site is KN7 of Kai Tak Nullah. The location of KN7 is illustrated in *Figure 9.1*. Summary of the selected KN7 monitoring data for 2001 is given in *Table 9.1*.

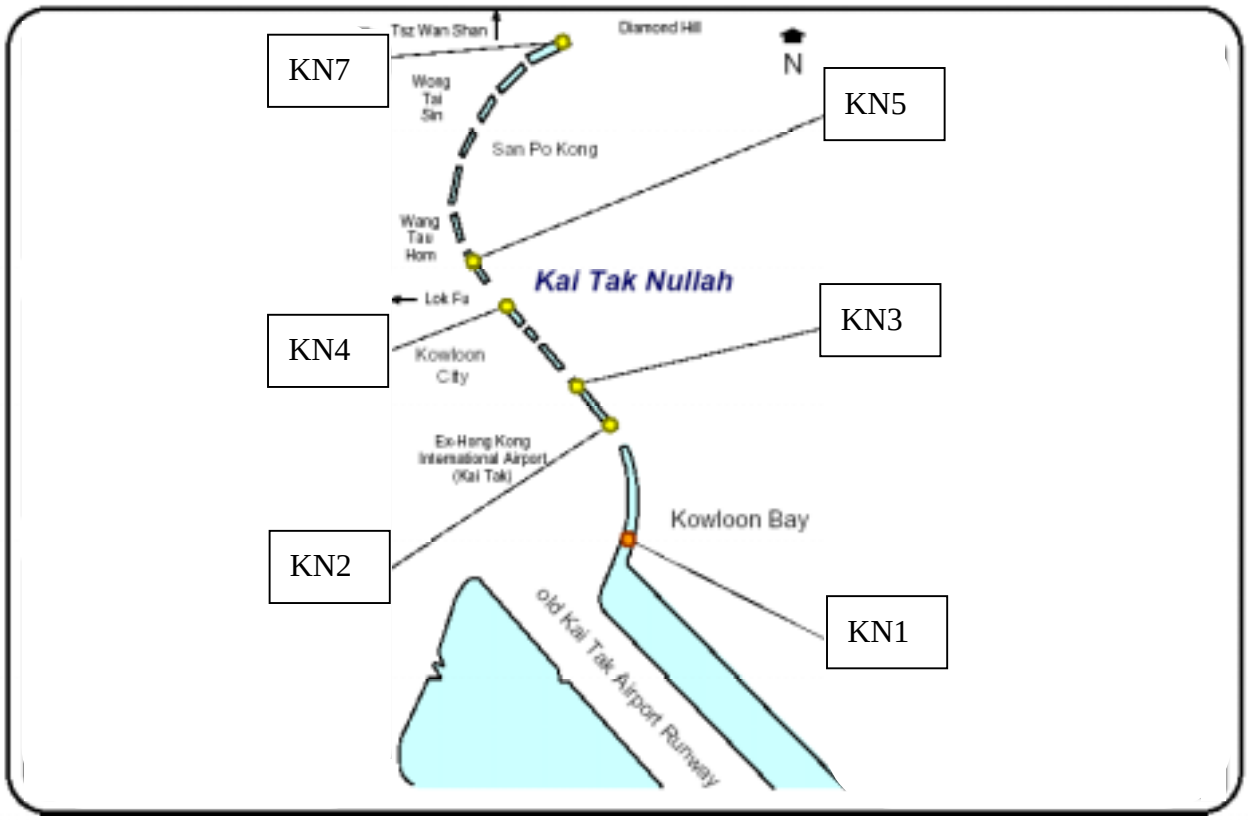

Figure 9.1 River Water Quality Monitoring Stations of Kai Tak Nullah

Table 9.1 Summary of Water Quality Monitoring Data for Kai Tak Nullah Monitoring Station KN7 in 2001

Parameter	**Unit**	**Sampling Station**	
		Kai Tak Nullah –KN7	
		WQOs	**Monitoring data**
Dissolved oxygen	mg / L	≥ 4	7.4 (6.7-8.1)
PH		6.0-9.0	7.3 (6.8-7.9)
Suspended solids (SS)	mg / L	≤ 25	16 (6-75)
5-day Biochemical Oxygen Demand (BOD_5)	mg / L	≤ 5	14 (8-30)
Chemical Oxygen Demand (COD)	mg / L	≤ 30	32 (11-42)
Oil & Grease	mg / L		0.5 (0.5-2.0)
Faecal Coliforms	cfu / 100mL		130,000 (58,000-530,000)
E. coli	cfu / 100mL	≤ 1,000	48,000 (20,000-420,000)
Ammonia-nitrogen	mg / L		5.70 (0.34-14.00)
Nitrate-nitrogen	mg / L		2.45 (1.40-4.40)
Total Kjeldahl nitrogen, SP	mg / L		7.15 (1.40-16.00)
Flow	L / s		No Measurement Taken

Notes: (1) Data presented are in annual medians of monthly samples; exempt those from faecal coliforms and *E. coli* which are in annual geometric means
(2) Figures in brackets are annual ranges
(3) cfu – colony forming unit
(4) SP – soluble and particulate fractions i.e. total value
(5) Shaded cells indicate non-compliance with Water Quality Objectives (WQOs)

9.3.5 According to the Water Quality Index published by EPD, the water quality at KN7 is generally ranked as fair. Based on the monitoring results, water in KN7 is characterized with high organic aggregates (as reflected by BOD_5 and COD values) and *E. coli* counts, indicating its close linkage with sewerage.

Water Sensitive Receivers

9.3.6 As shown in *Figure 9.2*, the key water sensitive receivers (WSRs) during the construction and demolition phase are: (i) the stream on the eastern side of the Project site and (ii) storm drains near the Project site. During the operation phase, all the sewage should be connected to sewer and therefore the WSR will be the receiving water body of the relevant Preliminary Treatment Works (i.e. Victoria Harbour).

9.4 Potential Sources of Impacts

Construction and Demolition Phase

9.4.1 The major potential sources of impacts upon water quality from the construction and demolition works would include the following activities:

- Construction and demolition run-off and drainage
- General construction and demolition activities
- Sewage generated from on-site workforce
- Soil remediation procedures

Operation Phase

9.4.2 The potential water quality impact during operation of the New Crematorium include:

- Wastewater generate from air pollution control system
- Sewage generated from staff and visitors as well as wastewater from general cleaning activities

9.4.3 Since the tendering process for the air pollution control system in the New Crematorium is yet to be commenced, the type and design of air pollution control system could not be confirmed at this stage. However, the air pollution control system in the New Crematorium would only adopt "dry" process (see *Sections 4* and *7*) and would not generate any effluent. Therefore the potential impact during operation phase will mainly be sewage generated from staff and visitors as well as wastewater from general cleaning activities.

9.5 Prediction and Evaluation of Environmental Impacts

Construction and Demolition Phase

Construction and Demolition Run-off and Drainage

9.5.1 Run-off and drainage from the construction and demolition activities may mainly contain increased loads of SS. The key potential sources of such water pollution will include:

- Run-off and erosion from site surfaces, drainage channels, earth working areas, construction and demolition stockpiles
- Release of any bentonite slurries and other grouting materials with construction and demolition run-off
- Wastewater from dust suppression sprays and wheel washing facilities
- Fuel, oil and lubricants from maintenance of on-site vehicles and equipment.

9.5.2 The construction and demolition run-off and drainage may cause physical, chemical and biological effects on the downstream water quality in the Kai Tak Nullah. Although the construction and demolition run-off is considered to be small (except during heavy rain storm), water quality impacts could be significant due to the sloping nature of the site and if the run-off and drainage are allowed to discharge directly into the receiving water body without any treatment.

9.5.3 It is important that the mitigation measures, as described in *Section 9.6*, should be strictly followed to prevent run-off and drainage water with high levels of SS from entering the nearby WSRs.

General Construction and Demolition Activities

9.5.4 General construction and demolition activities have the potential to cause water pollution as a result of stockpile, debris and rubbish, concrete dust and demolish materials entering the water body. This could result in increased SS in the water body or floating refuse at the stream nearby that reduce the aesthetic quality of the receiving water body. Spillage of chemicals, such as oil and diesel for construction and demolition equipment, could also result in water quality impacts if they enter the soil or nearby WSRs.

9.5.5 However, the effects on water quality from general construction and demolition activities are likely to be minimal, provided that the site boundaries are well maintained and good construction practices are observed to ensure that litter, fuels and solvents are managed, stored and handled properly (see *Section 9.6*).

Sewage Generated From On-site Workforce

9.5.6 Sewage will be generated through on-site workforce and thus have the potential to cause water pollution. Sewage is characterized by high levels of BOD_5, ammonia and *E. coli* counts. Provided that adequate and proper sewage collection and disposal facilities are installed (see *Section 9.6*), no adverse water quality impact to nearby WSRs is anticipated.

Soil Remediation Activities

9.5.7 According to the CAR and RAP stipulated in Appendix C2, no ground water was detected during site investigation and no pretreatment is required for soil remediation (disposal of at landfill) at locations S3 and S5. Therefore the presence of ground water would be limited and no water quality impacts associated with dewatering in the soil remediation activities is expected. Provided the contractor implementing the mitigation measures described in *Section 9.6*, minimal water quality impact associating with soil excavation works of the currently identified soil remediaiton activities would be expected.

9.5.8 Nevertheless, with reference to the CAP and RAP, as further land contamination investigation (around CLP secondary substation during Phase I and locations S1 to S6 during Phase II) will be required before demolition of the Existing Crematorium, relevant water quality impact may need to be identified by the contractor prior to demolition, if further soil remediation is found to be necessary.

Transitional Stage

9.5.9 As “dry” process will be adopted in the air pollution control system of the New Crematorium, wastewater generated from the operation of new cremators is expected to be minimal. With administrative measures controlling no more than 6 cremators operating at any one time, no substantial increment in visitors is also expected. Therefore, no additional water quality impact is anticipated during the transitional stage between the operation of Existing Crematorium and commissioning of New Crematorium.

Cumulative Impacts

9.5.10 According to the information provided by Planning Department, Water Supplies Department and *KCRC Shatin to Central Link Project Profile* submitted under EIA Study Brief *ESB-106/2002*, two other projects will be implemented during the construction and demolition phase of this Project. They are (i) The Diamond Hill No. 2 Freshwater Service Reservoir, which is scheduled from 4 July 2002 to end of 2005, and (ii) the KCRC Shatin to Central Link, which is undergoing preliminary feasibility study and the construction is scheduled from 2004 to 2008.

9.5.11 With the proper implementation of the mitigation measures as specified in *Section 9.6*, it is expected that the extra water pollution impacts that this Project would add to those of the other two projects will not be significant.

Operation Phase

Wastewater Generate from Air Pollution Control System

9.5.12 No effluent will be generated from the air pollution control system in the New Crematorium as 'dry' process would be adopted for the control system.

Sewage Generated from Staff and Visitors as well as Wastewater from General Cleaning Activities

9.5.13 All the sewage generated by visitors and workers as well as from cleaning activities in the New Crematorium will be connected to sewer and directed to Preliminary Treatment Works. Due to the unavailability of existing sewage generation rate of the Existing Crematorium, estimation is made based on the volume of water consumed. According to FEHD, average monthly water consumption of the Existing Crematorium from March 2002 to March 2003 was about 420 m^3. Assuming the water consumption would be doubled in the New Crematorium due to the increase in the number of service halls from 2 to 4, the generation of sewage by the New Crematorium would be 840 m^3 per month or 28 m^3 per day. It is expected that the corresponding Preliminary Treatment Works should be able to deal with the increased sewage loading, and no adverse water quality impacts to receiving water body will be anticipated.

9.6 Mitigation of Adverse Environmental Impacts

Construction and Demolition Phase

9.6.1 To safeguard the water quality of the WSRs potentially affected by the Project works, the contractor should implement appropriate mitigation measures with reference to the *Practice Note for Professional Persons, Construction Site Drainage* (*ProPECC PN 1/94*) published by EPD. Such measures are highlighted as follows.

Construction and Demolition Run-off and Drainage

9.6.2 Exposed soil areas should be minimized to reduce the potential for increased siltation, contamination of run-off and erosion. Any effluent discharge from the Project site is subject to the control of Water Pollution Control Ordinance (WPCO) discharge license and should be treated to meet the discharge standard set out in the relevant license. In addition, no site run-off should enter the stream on the eastern side of the Project site. Run-off impacts associated with the construction and demolition activities can be readily controlled through the use of appropriate mitigation measures, which include:

- Temporary ditches should be provided to facilitate run-off discharge into appropriate watercourses, via a silt retention pond
- Boundaries of earthworks should be marked and surrounded by dykes
- Open material storage stockpiles should be covered with tarpaulin or similar fabric to prevent material washing away
- Exposed soil areas should be minimized to reduce the potential for increased siltation and contamination of run-off
- Earthwork final surfaces should be well compacted and subsequent permanent work should be immediately performed
- Use of sediment traps wherever necessary

- Maintenance of drainage systems to prevent flooding and overflow

9.6.3 All temporary drainage pipes and culverts provided to facilitate run-off discharge should be adequately designed to facilitate rapid discharge of storm flows. All sediment traps should be regularly cleaned and maintained. The temporarily diverted drainage should be reinstated to its original condition, when the construction/demolition work is completed.

9.6.4 Sand and silt in wash water from wheel washing facilities should be settled out and removed from discharge into temporary drainage pipes or culverts. A section of the haul road between the wheel washing bay and the public road should be paved with backfall to prevent wash water or other site run-off from entering public road drains.

9.6.5 Oil interceptors should be provided in the drainage system downstream of any significant oil and grease sources. They should be regularly maintained to prevent the release of oil and grease into the storm water drainage system after accidental spillage. The inceptor should have a bypass to prevent flooding during periods of heavy rain, as specified in *ProPECC PN 1/94*.

General Construction and Demolition Activities

9.6.6 All the solid waste and chemical waste generated on site should be collected, handled and disposed of properly to avoid affecting the water quality of the nearby WSRs. The proper waste management measures are detailed in *S.7.7.6 – S.7.7.8.*

Sewage Generated from On-site Workforce

9.6.7 The sewage from construction work force is expected to be handled by portable chemical toilets if the existing toilets in the Project site are not adequate. Appropriate and adequate portable toilets should be provided by licensed contractors who will be responsible for appropriate disposal and maintenance of these facilities.

Soil Remediation Activities

9.6.8 Mitigation measures will need to be implemented during the currently identified soil remediation activities. If further land contamination investigation results (at CLP secondary substation during Phase I and at locations S1 to S6 during Phase II) confirm the needs for further soil remediation prior to demolition of the Existing Crematorium, relevant water quality mitigation measures (in addition to the current RAP) will need to be identified and implemented by the contractor. In addition, the mitigation measures recommended for minimizing water quality impacts for construction and demolition run-off and drainage as well as for general construction and demolition activities should also be adopted where applicable.

9.6.9 In order to avoid impacts on water quality during further remedial works, care will be taken to minimise the mobilisation of sediment during excavation and transport. Measures to be adopted will be based on the recommendations set out in *Practice Note for Professional Persons ProPECC PN1/94 "Construction Site Drainage"*. The results of the site investigation suggest that there is unlikely to be any requirement for dewatering of excavations, since groundwater was not encountered in any of the exploratory holes.

9.6.10 The contractor carrying out the remedial works will be required to submit a method statement detailing the measures to be taken to avoid water quality impacts. Typical measures would include:

- Carry out the works during the dry season (i.e. October to March) if possible
- Use bunds or perimeter drains to prevent run-off water entering excavations
- Sheet or otherwise cover excavations whenever rainstorms are expected to occur
- Minimise the requirements for stockpiling of material and ensure any stockpiles are covered
- Temporary on-site stockpiling of contaminated materials should be avoided, all excavated contaminated soils/materials should be disposed of on a daily basis

- Ensure that any discharges to storm drains pass through an appropriate silt trap

Operation Phase

9.6.11 While the sewage generation in the New Crematorium (28 m^3 per day) is estimated to be doubled that of the Existing Crematorium (14 m^3 per day), the quantitative increase in sewage generation is not substantial. At this stage the actual location of public sewerage connection in the New Crematorium has not been fixed yet. However, Arch SD will, during detail design stage, ensure the public sewer where the connection will be made is capable of handling the extra sewage (i.e., 14 m^3 per day) generated by the New Crematorium. Given that this extra quantity is not substantial, it is expected that the sewerage system of the corresponding Government Sewage Treatment Work will be able to accommodate the loading, and hence no adverse impacts to the receiving water body would result.

9.7 Conclusions

9.7.1 This assessment has considered the water quality impacts from the demolition of Existing Crematorium as well as the construction and operation of New Crematorium. No significant residual environmental impacts are anticipated to occur, provided that the mitigation measures, as described in *Section 9.6* are properly implemented.

10 HAZARD TO LIFE

10.1 Introduction

10.1.1 This section provides an account on the safety measures to be observed during operation of the New Crematorium. Reference had been made on *Hong Kong Planning Standards and Guidelines* (HKPSG), EIAO-TM *Annexes 4* and *22, Dangerous Goods Ordinance* (Cap. 295) and *Dangerous Goods (Application and Exemption) Regulations.*

10.2 Potential Hazard of the Project

10.2.1 Under the proposed plans provided by Arch SD, the New Crematorium would include a total of three (3) diesel fuel tanks and one (1) Dangerous Goods (DG) store (Category 3/4 Dangerous Goods under the DGO). Potential hazard may arise during operation of the New Crematorium, when diesel is stored at fuel tanks (such as fire hazards); as well as from the DG store where chemicals will be stored (such as health hazards, fire hazards etc). No addition hazard is anticipated during the transitional stage between the operation of Existing Crematorium and commissioning of New Crematorium.

10.2.2 Diesel will be used as fuel for cremators in the New Crematorium. According to the current design layout of the New Crematorium, which is provided in *Figures 2.2* to *2.5*, a total of three fuel tanks would be installed and are listed below:

- One underground fuel tank with capacity of 30,000 L, located at the eastern side of absorption chiller (see *Figure 2.3*)
- One daily service fuel tank for cremators, located east of the radiators with capacity of 2,000 L (see *Figure 2.4*)
- One fuel tank (with capacity of 2,000 L) for emergency generator next to the emergency generator room (see *Figure 2.3*)

10.2.3 The DG store in the New Crematorium will be located next to the control room (see *Figure 2.3*). Chemicals likely to be stored in the DG store include lime (to be used to neutralise acidic pollutants in cremators emissions) as well as 30% open-berth furnace coke or activated carbon (for removing pollutants such as dioxin in cremators emissions). These chemicals will be stored separately.

10.2.4 Safety measures and design for these fuel tanks and DG store are presented below.

10.3 Recommended Safety Measures

Fuel Tanks Design

10.3.1 The total design capacity (34,000 L) of the fuel tanks in New Crematorium is larger than that in Existing Crematorium (9,000 L). However, the total capacity in New Crematorium is substantially lower than the threshold of 10,000 tones or approximately 12,000,000 L, which is considered as potential hazardous installations under the HKPSG. To avoid potential hazards to nearby uses, the underground fuel tank will be at least more than 300 mm from the nearest wall of any basement, pit or property line, and will be at least 4.25 m from any parking space. Protected lobby and mechanical ventilation system shall be provided for the fuel tank room on G/F. The purpose of increasing the capacity of the fuel tanks is to reduce the frequency of refilling from once per 10 days in the Existing Crematorium to once per month in the New Crematorium. With less frequent refilling, the associated potential hazards and disturbance to normal operation can be significantly reduced.

10.3.2 In addition, the following safety provisions are included in the fuel tank designs of the New Crematorium:

Underground Fuel Tank for Cremators (30,000 L)

- The underground fuel tank will be buried underground in concrete chamber with vent pipe (vent

pipe outlet will be at a level about 4 m above ground)

Daily Service Fuel Tank for Cremators and Fuel Tank for Emergency Generator (2,000 L each)

- For generator, vent pipe with outlet will be at a distance of 1.5 m from other air intake louvers and public access
- For cremators installation, the daily services fuel tank will be located at roof top
- Door louvers equipped with electro-thermal link will be provided at the fuel tank room (with door sill) for natural ventilation
- Fire services installations including heat detection system, auto-spray unit and sand buckets will be provided for genset room
- Quick closing mechanism (fuel shut off valve) will be installed outside the fuel tank room of generator to cut the diesel supply in case of fire at fuel tank room /generator room

Fuel Storage and Transportation

10.3.3 The storage, transportation and handling of diesel fuel is under the control of DGO (Cap 295) and compliance with the DGO requirements should be ensured. Diesel leaks from the diesel fuel tanks or pipework systems may seep into the ground and enter chambers such as tunnels, drains and sewers. The undetected build-up of diesel in a confined space will create a fire hazard. The following safety measures should be observed around the diesel storage tanks during operation of the New Crematorium:

- Inventory check should be conducted by staff regularly to identify any signs of fuel leakage
- Regular visual inspections to detect any early signs of fuel spillage
- Precautionary exercises, including fire drills, should be regularly undertaken to enhance staff capability to handle emergencies

DG Storage

10.3.4 The design of DG store and its operation must comply with the requirements set in Cap 295. Precautionary measures mentioned below should also be followed, when relevant chemical is stored at the dangerous goods storage:

Handling and Labeling

- Obtain details for the handling, storage and control of impurities and spills from supplier or manufacturer (e.g. MSDS[(1)]).
- Obtain details of the chemical composition of the substances, and correct treatment with eyes, skin, ingestion, etc from the supplier or manufacturer (usually available in a MSDS)
- Ensure the correct and complete labelling and classification of chemical substances and guidelines are adopted (see Labour Department's reference booklet on "Labelling and Classification of Dangerous Substances Commonly used in Industry")
- Ensure that the information is up to date, provided to the relevant staff, and easily accessible in case of emergency in accordance with the site safety guidelines
- Register dates (receiving date, manufacturing date, expiry date, shelf life whereas applicable) and quantities of all purchases on receipt to minimise surplus and spoilt orders

(1) Material Safety Data Sheet

Containers for Storage of Chemicals and Dangerous Goods (DGs)

10.3.5 The following practices shall be followed in ensuring the use of suitable containers for chemicals.

- Designed to minimise spills
- Ensure container is appropriate for its contents, resistant to corrosions, maintained in good conditions and securely closed
- Provide proper labelling

Storage Requirements

10.3.6 The following practices shall be followed in ensuring suitable storage (including temporary store for goods to be delivered) and transportation of chemicals and DGs.

- No smoking in storage areas
- No naked light and no heating equipment shall be used in any store.
- No electrical equipment shall be used or installed in any store other than equipment of a type approved by the Authority.
- There shall be at all times conspicuously displayed outside any store a notice, in English and Chinese, prohibiting smoking and the use of naked light
- Segregate chemical substances to prevent reaction and contamination
- Use proper racks, storage bins and shelves to contain leaks
- Storage areas must be locked to prevent unauthorised access, clearly labelled and solely for the storage (except for the temporary store for goods to be delivered) of chemicals/dangerous goods
- Adequate ventilation in storage areas as necessary
- Provide appropriate equipment and manpower to avoid the likelihood of spillage
- DGs must be stored in the designated stores and the storage quantities must be within limits
- All containers shall be kept upright to minimise the likelihood of spillage

Handling and Spill Prevention

10.3.7 The following practices shall be followed in ensuring suitable handling and spill prevention of chemicals and dangerous goods:

- Follow the safety instructions provided by site management and chemical label
- Do not misuse or interfere with safety equipment or appliance provided
- Do not smoke, eat or drink in any place where chemical substances / DGs are stored or used

10.4 Conclusion

10.4.1 With the safety design features of the fuel tanks and the safety / precautionary measures implemented by the New Crematorium, the hazard level should be kept to minimal.

11 ENVIRONMENTAL MONITORING AND AUDIT (EM&A) REQUIREMENTS

11.1.1 This section outlines the recommendations for the environmental monitoring and audit (EM&A) programme for the demolition of the Existing Crematorium as well as construction and operation of the New Crematorium, based on the findings of this Study. This EM&A programme is formulated based on the recommendations of the "Environmental Monitoring and Audit Guidelines for Development Projects in Hong Kong" published by EPD in 1998. A separate EM&A Manual Report has been prepared in accordance with Annex 21 of the EIAO-TM.

11.1.2 The objectives of carrying out EM&A programme for the Project are as follows:

- To establish a database of any short or long term environmental impacts of the Project
- To provide an early indication if there is any of the environmental control measures or practices fail to achieve the acceptable standards
- To monitor the performance of the environmental mitigation measures of the Project and the effectiveness of mitigation measures
- To verify the environmental impacts predicted in this EIA
- To determine project compliance with regulatory requirements, standards and government policies
- To take remedial action if unexpected problems or unacceptable impacts arise
- To provide data to enable an environmental audit

11.1.3 According to assessment results, no adverse environmental impacts are anticipated during construction and demolition phases of Existing Crematorium as well as operational phase of the New Crematorium. Certain environmental monitoring measures are recommended to closely monitor the environmental performance of the Project. The suggested EM&A requirements during the construction and operation phases are summarized as follows.

11.2 EM&A Requirements for Construction and Demolition Phases I & II

11.2.1 According to the environmental assessment results, there would be no adverse environmental impact of the air quality, waste and water quality on the surrounding sensitive receivers. However, fugitive dust emission and construction noise would be major concerns to the nearby sensitive receivers during construction phases, EM&A of air quality and construction noise is recommended. Details of the EM&A programme are described in *Sections 3* and *4* in the EM&A Manual.

Air Quality

11.2.2 Total suspended particulates (TSP) monitoring should be carried out at two representative locations at the ASRs A8 and A17. . 1-hour and 24-hour monitoring should be carried out at 2 measurement locations at the frequency of every 6 days to monitor the impact of fugitive dust to the nearby environment. The limit levels of 1-hour and 24-hour TSP levels are summarized in Table 11.1 while the proposed TSP measurement locations are listed in Table 11.2.

Table 11.1 Limit Levels of TSP Monitoring

Monitoring Period	Limit Level ($\mu g/m^3$)
1-hour	500
24-hour	260

Table 11.2 Location of TSP Monitoring

Air Sensitive Receivers	Location
A8	Po Leung Kok Grandmont Primary School
A17	Staff Quarter for Diamond Hill Crematorium

A baseline monitoring should be carried out for 14 consecutive days prior to the commencement of the construction works.

11.2.3 The demolition of the existing cremator facilities and the crematorium building may involve removal of ACM. When the demolition material is confirmed to have ACM, the method of removal and details of asbestos abatement works would be provided in the Asbestos Study Report, AIR and AAP to be submitted under the APCO. Whereas it is not expected that asbestos fibre would be liberated from the demolition of the Existing Crematorium building, the EM&A for asbestos fibre would be carried out at the boundary of the construction site for reassurance purposes as per the requirement of future license for asbestos abatement.

Noise

11.2.4 Monitoring of noise should be carried out during the construction and demolition works. The noise monitoring locations are summarized in Table 11.3

Table 11.3 Location of Noise Monitoring

Noise Sensitive Receivers	Location
SR 3	(New school under construction) Po Kong Village Road School Village
SR 4	Po Leung Kuk Grandmont Primary School
SR 6	Staff Quarter for Diamond Hill Crematorium

11.2.5 Noise monitoring should be carried out weekly during the working hours of the construction site. The noise limit of construction or demolition activities for the time period other than the restricted hours is shown in Table 11.4

Table 11.4 Limit Levels of Noise Monitoring

Monitoring Period	Limit Level (dB(A)) (Domestic Premises/ Schools)
0700 – 1900 on normal working days	75/ 70 [(1)]

Note: [(1)] Reduced to 65 dB(A) during school examination periods

Land Contamination

Supplementary Site Investigations

11.2.6 The CAR and RAP have recommended supplementary site investigations at the CLP secondary substation that is currently in use and cannot readily be accessed. In addition, the ash waste in cremator/chimney/flues should also be collected for the testing of DCM/HMCM/PAHCM during Phase II of the works. These investigations will be carried out once the existing facility has been decommissioned but prior to demolition.

11.2.7 Details of the supplementary site investigation are described in *Section 6* of the EM&A Manual. The scope of the supplementary site investigations is to recover soil samples from around the CLP secondary substation during Phase I of the works and determine the relevant handling/treatment/disposal method.

Confirmatory Site Investigations

11.2.8 In addition to these supplementary site investigations, confirmatory testing is required of the soil around the crematorium chimney, to ensure that no additional contamination has occurred due to aerial deposition between the current time (2003) and closure of the facility in 2006. The confirmatory testing will consist of surface sampling (i.e. 0.1m depth) at points S1 to S6, and analysis for dioxins, metals and PAH.

11.2.9 The underground fuel storage tank and associated pipework will be removed as part of the site formation works. The base of the excavations will be inspected by a suitably experienced environmental specialist in order to determine whether there is any visual or olfactory evidence of fuel contamination. If such contamination is suspected, then confirmatory soil sampling will be carried out, and the samples analyzed for TPH.

11.2.10 Once access to these areas is available, a sampling and analysis plan should be prepared for approval by EPD, additional investigations will take place, and the need for remedial works will be determined. Any remedial works required will be in addition to those described in the CAR and RAP. The analysis should include, as a minimum, the parameters detailed in Table 11.5 below;

Table 11.5 Supplementary and Confirmatory Site Investigations Locations, Timing and Parameters

Timing	Location	Parameters
Phase I	CLP Secondary Substation: (soil samples)	Polychlorinated biphenyls (PCBs) Total petroleum hydrocarbons (TPH) (diesel range)
Phase II	Locations S1 – S6 described in CAR/RAP: (soil samples)	Polyaromatic hydrocarbons (PAH) Dioxins Metals (“Dutch List”: Cr, Co, Ni, Cu, Zn, As, Mo, Cd, Sn, Ba, Hg, Pb)
Phase II	Underneath underground fuel tank (if visual or olfactory evidence of fuel contamination is identified): (soil samples)	Total petroleum hydrocarbons (TPH) (diesel range)

11.2.11 These supplementary and confirmatory site investigations should be conducted by consultants experienced in abatement of the corresponding chemical waste.

Remedial Works

11.2.12 The scope of remedial works is described in the CAR/RAP, and consists of excavation and landfill disposal of small "hotspots" of contaminated material.

11.2.13 As tin and lead was found in locations S3 and S5, confirmatory testing will be carried out following excavation at each location, in order to confirm that all contaminated material has been removed. The confirmatory testing will consist of five samples in each location, situated immediately to the north, south, east and west of each location, and at the base of the excavation, to be analyzed for lead and tin. If the results of analysis are less than the Dutch B Levels, no further excavation will be required. If the concentrations exceed the Dutch B Level, then the area of excavation should be extended, and further confirmatory testing should be carried out following this excavation. In this event, the area of excavation should be extended by a further 5m radius in the quadrant where the contaminated sample is encountered, or by a further 0.5m depth if the contaminated sample is from the base of the excavation. This procedure should be followed until no further contamination is encountered.

11.2.14 If contamination is found in supplementary / confirmatory site investigations, appropriate remediation measures approved by EPD should be implemented.

11.2.15 A Remediation Report should be prepared once remedial works have been completed, to demonstrate compliance with the CAR/RAP.

Waste Management

Supplementary Site Investigation

11.2.16 Due to the accessibility issues of the cremator room, supplementary site investigation is recommended in *Section 7* of this Report and details are provided in *Section 7* of the EM&A Manual. A list of supplementary site investigation locations, timing and parameters is given in the table below:

Table 11.6 Supplementary Site Investigations Locations, Timing and Parameters

Timing	**Location**	**Parameters**
Phase II	Around cremators, chimney and flues inside cremator room: (building structures)	Asbestos
Phase II	Around cremators, chimneys and flues inside cremator room: (Ash/particulate matter samples)	Dioxins Metals ("Dutch List": Cr, Co, Ni, Cu, Zn, As, Mo, Cd, Sn, Ba, Hg, Pb) Polyaromatic hydrocarbons (PAH)

11.2.17 The supplementary site investigation plan, devised by consultants experienced in abatement of corresponding chemical waste, should be submitted to EPD for approval prior to the sampling works.

11.2.18 If contamination is found, relevant mitigation suggested in *Section 7* should be implemented. During the Phases I and II, a waste management audit should be carried out to check compliance with all appropriate environmental protection and pollution control measures. Details of the waste management audit are provided in *Section 7* of EM&A Manual.

11.3 Operation Phase

Air Quality

11.3.1 During the operation of the new crematorium, it is anticipated that the major environmental concern would be the chimney emission. RSP, CO, HCl, Hg, organic compounds and dioxins would be generated from the cremators during the operation. Referring to the air quality impact assessment as discussed in *Section 4*, the air quality at the nearby air sensitive receivers is predicted to comply with the relevant air quality guidelines with the implementation of the recommended mitigation measures. There would be no odour nuisance from the new Crematorium. Furthermore, with proper operation of the cremators and air pollution control system, minimum dark smoke emission is expected.

11.3.2 In order to ensure compliance of the legislation requirements, the conditions and the continuous monitoring stipulated in BPM 12/2 - A Guidance Note on the Best Practicable Means for Incinerators (Crematoria), published by EPD, shall be conducted. Real time data acquisition facilities shall be provided at each stack or inside each cremator for continuous monitoring on the following pollutants and processes:

- Temperature inside the primary combustion zone;
- Temperature at the outlet from the secondary combustion zone;
- Oxygen concentration at the outlet from the secondary combustion zone;
- Carbon Monoxide concentration at the outlet from the secondary combustion zone;
- Smoke density at the chimney of the cremator; and
- Other essential operating parameter(s) which may affect the performance of air pollution control measures.

11.3.3 The continuous monitoring equipment to be provided should meet the specifications specified by EPD. They should be maintained and calibrated according to the manufacturer's recommendations. Unless otherwise agreed by EPD, zero and span checks should be carried out every 24 hours.

11.3.4 The monitoring of the above air pollutants shall comply with the Specified Process License of the new Crematorium, to be issued by EPD under the APCO. All continuous monitor readings shall be continuously recorded and the readings shall be on immediate display to the operating staff for the monitoring of cremation process.

11.3.5 As required in BPM 12/2, all real time data as required in BPM 12/2 shall be transmitted to a remote display unit installed at the corresponding EPD Local Control Office by means of telemetry transmission when requested by EPD.

11.3.6 All the real time monitoring equipment shall be properly maintained and calibrated. All the real time monitoring data shall be recorded and stored up in accordance with the requirement of the future Specified Process License.

11.3.7 There may be possible odour impact during the operational phase due to chimney emissions, and therefore routine odour patrol at the site boundary shall be carried out to detect any offensive odour. Corrective actions shall be taken if offensive odour is noted during odour patrols.

11.3.8 Results of all monitoring and inspections should be recorded in a manner specified by EPD. These records should be retained at the premises for a minimum of two years, or other period specified by EPD, after the date of last entry and be made available for examination as and when required by the Authority.

11.3.9 A commissioning test shall be arranged prior to the normal operation of the crematorium, in order to evaluate the performance and the emission of air pollutants meet the requirements under the Specified Process License.

11.3.10 Other stack emissions listed in the BPM 12/2 but not covered in the continuous monitoring shall be subject to routine monitoring during the operation phase for every 12 months interval but the stack emission monitoring frequency shall be based on the Specified Process License for the new Crematorium. Permanent provisions in the stacks or cremators, which are necessary in terms of accessibility, gaseous sampling facilities, shall be provided. Table 11.7 presents the summary of the requirements for different kinds of pollutants and process monitoring.

Table 11.7 Summary of the Requirements for Monitoring of Air Pollution Emissions and Cremation Process

Type of monitoring	Monitoring Parameter	Methodology of Continuous Monitoring	Data Logging	Regular Compliance Monitoring
In-Stack Monitoring	Particulate matters	-	-	Isokinetic stack sampling USEPA method 5
	Hydrogen chloride	-	-	Isokinetic sampling USEPA method 26A
	Carbon monoxide	Infra-red spectrophotometry	Yes	Electrochemical CO analyzer, modified USEPA method 10
	Mercury	-	-	Isokinetic stack sampling USEPA method 29
	Organic compounds		-	Sampling of stack gas and analyzed with FID, USEPA method 25
	Dioxins	-	-	Isokintic stack sampling USEPA method 23
	Smoke density	Stack gas opacity meter	Yes	Visual assessment by Ringelmann chart
Process Monitoring	Temperature of primary chamber	Thermocouple	Yes	Provision of continuous monitoring
	Temperature of secondary chamber	Thermocouple	Yes	Provision of continuous monitoring
	Oxygen concentration at secondary chamber	Paramagnetic analysis USEPA method 3A	Yes	Provision of continuous monitoring

11.3.11 The instruments for smoke density monitoring should be fitted with audible or visual alarms, which should activate at a reference level agreed by EPD. Emission events that lead to the alarms being activated should be properly recorded in a manner and format agreed with EPD. These instruments should be checked to ensure that they are functioning correctly in accordance with the manufacturer's instructions.

11.3.12 Smoke emission from the cremators during normal operations (including start up and shut down) shall not exceed Shade 1 on the Ringelmann Chart.

11.3.13 In addition to the automatic feedback system, manual override of the operation should be allowed for the new cremators. In case of emergency or failure of the automatic feedback system, the operation of the individual cremators should be manually suspended until the problem has been fixed and faulty equipment repaired. Also EPD should be informed of the event as soon as possible. The implementation of such contingency and arrangements should be controlled under the Specified Process License of the APCO.

Landscape and Visual

11.3.14 The project landscape architect would be responsible for inspection of the following:

- Tree felling and transplanting operations to ensure the correct trees are felled, prepared and transplanted in accordance with the landscape specification and agreed transplant locations.
- Existing planting to be retained is properly protected by hoarding, or other means specified, at the commencement of the works and such protection measures are properly maintained throughout the construction period.
- Any topsoil excavated during construction is carefully saved and stored to one side of the works area for reuse upon completion.
- New planting is provided in accordance with the specification and detailed planting plan.
- Growth of plants in accordance with the landscape plan to make sure mitigation method is effective and the landscape enhanced after the first, the sixth and the twelfth month of the completion of all recommended planting works

11.4 Summary for All Monitoring Parameters

11.4.1 A summary for all parameters to be monitored and audited during construction phase and operational phases are summarized in Table 11.8.

Table 11.8 Summary for All Monitoring Parameters

Monitoring Area	Construction and Demolition Phases I & II	Operation Phase
Air Quality	Monitoring of 24-hour and 1-hour TSP every 6 days at 2 selected sampling locations at nearby ASRs	Continuous monitoring Temperature of primary chamber Temperature of secondary chamber Smoke density Carbon monoxide and oxygen Commissioning stage & routine compliance checking Particulate matters Hydrogen chloride Carbon monoxide Organic compounds Mercury Dioxins Smoke density
Noise	Weekly monitoring of noise level at 3 selected sampling locations at the sensitive receiver	Not required
Land Contamination	Supplementary site investigation Soil: At the CLP secondary substation during Phase I (TPH and PCB) Confirmatory site investigation Soil: Locations S1 to S6 during Phase II (dioxin, heavy metals, PAH) Soil: Underneath underground fuel tank during Phase II (if visual or olfactory evidence of fuel contamination by experienced environmental specialist) (TPH) Remedial work Soil: Around locations S3 and S5 during Phase II (tin and lead)	Not required
Waste Management	Supplementary site investigation Ash: At cremators/chimney/flues during Phase II (dioxin, heavy metals, PAH) Building Structures: cremators/chimney/flues during Phase II (asbestos)	Not required
Landscape & Visual Impact	Weekly inspections of tree protection measures as well as monitoring of tree transplant operations during both phases	The 1st, 6th and 12th months inspection of maintenance after the completion of all the recommended planting work

11.5 Environmental Management Plan

11.5.1 While the environmental impacts arising from the New Crematorium are assessed based on certain assumptions e.g. cremator will be able to achieve the emission standard set out in the BPM 12/2, the maximum allowable sound power level recommended can be met, it is essential to ensure these targets are continuously met by the selection of a proper design and the proper operation / maintenance of the equipment. In view of the above, it is desirable for FEHD to adopt environmental management plan for the operation of New Crematorium as a means to ensure satisfactory environmental performance of the facilities at all times. A framework for environmental management plan is provided in Appendix F. In particular, the following items would be considered to be implemented in the New Crematorium operations:

- Clear allocation of roles and responsibilities for environmental management issues
- Provision of definitive procedures for proper operation and maintenance of various facilities, e.g. the cremators and air pollution control systems

- Planning and provision of adequate training to equip the staff about the relevant competence for carrying the operation and maintenance
- Planning and carrying out regular compliance monitoring and audits to ensure satisfactory environmental performance and to identify any area for rectification or further inspection
- Establishment of public enquiry /complaint handling mechanism

12 SUMMARY OF ENVIRONMENTAL OUTCOMES

12.1 The Project

12.1.1 The Diamond Hill Crematorium has been handling the cremation service in Kowloon area since 1979 (i.e. operated for more than 24 years) and dealt with clinical waste (mostly amputated body parts) from 1994 to 2001. Judging from the long operation period and the fairly frequent fault incidents recorded in the past year, the existing cremators have been approaching the end of their serviceable life and should be replaced with new ones to cater for the increasing demand of cremation service (Section 2.1). This Project therefore proposes to demolish the Existing Crematorium and to build the New Crematorium at the Existing Crematorium site.

12.1.2 Demolition of the Existing Crematorium at Diamond Hill will include the following:

- Existing sitting out area
- Garden of remembrance
- Existing building structure, including CLP secondary substation, toilets, pavilion and retaining walls
- Two (2) service halls
- One (1) cremation room with six (6) cremators
- One (1) transformer room
- One (1) underground oil fuel storage tank (9,092 L)
- One (1) mortuary
- One (1) machine room
- One (1) general store plus water tank
- One (1) dangerous goods store
- One (1) chimney (10 m in height)

12.1.3 Construction of the New Crematorium at the current location of the Existing Crematorium would include:

- One (1) cremator plant room housing six (6) cremators
- Three (3) fuel tanks (with total capacity of 34,000 L)
- Four (4) service halls (each can hold 120 people)
- One (1) pulverizing room
- One (1) mortuary
- One (1) office
- Toilets for public
- Ancillary service rooms including battery fork lift, transformer and switch room, emergency generator room and joss burners
- Four (4) automatic transportation systems for coffins and part of an underground service tunnel for coffin circulation
- Vehicular loading bay for coffin van, coach
- Landscape area
- Dangerous goods store
- Installation of temporary CLP electricity transformer at Phase II boundary
- Vehicular loading bay for coffin van, coach etc.
- Landscape area

12.1.4 The Project includes two designated projects, one is under the EIAO *Schedule 2, Part II, Item 3*, (decommissioning of clinical waste incinerator) and the other under EIAO *Schedule 2, Part I, N4* (construction and operation of crematorium). An EIA Study Brief has been issued for the Project under Section 5(7)(a) of the EIAO (references no. ESB-102/2002).

12.2 Key Environmental Impact

A summary of the key environmental impacts arising from the Project is listed in Table 12.1.

Table 12.1 Summary of Key Environmental Impacts

Key Environmental Impacts	**Construction and Demolition Phase**	**Operation Phase**
Air Quality	Phase I TSP: no predicted exceedance of EIAO-TM guideline Phase II TSP: no predicted exceedance of EIAO-TM guideline	RSP, CO, HCl, TOC, SO_2, NO_2, Hg, Dioxins, Excess cancer risk and odour : no predicted exceedance of respective acceptable air quality criteria
Noise	Phase I Without mitigation, exceedance in daytime noise standards might be found at SR2, SR3, SR4, SR5, SR6 and SR7. With mitigation measures, no predicted exceedance of EIAO-TM. Phase II Without mitigation, exceedance in daytime noise standards might be found at SR1, SR2, SR3, SR4, SR5 and SR6. With the recommended mitigation measures, no predicted exceedance of EIAO-TM.	No significant noise impact to nearby NSRs
Land Contamination	Less than 100 m^3 of soil contaminated with tin/lead requiring disposal of at landfill*. With the recommended remediation measures, no adverse environmental impacts anticipated.	Not expected.
Waste Management	Surplus excavated materials: 2,100 m^3 Public fill: 272 m^3 C&D waste: 68 m^3 ACM: small amount DCM: to be confirmed* HMCM: to be confirmed* PAHCM: to be confirmed* TPHCM: to be confirmed* PCBCM: to be confirmed* Chemical waste: small amount General refuse: small amount With the recommended mitigation measures, environmental impacts anticipated to be not significant.	Non-combustible residues: 64.8 kg/day Chemical Waste: dosed chemical (36 kg/day); particulate matter from cyclone separator (9 kg/day) and particulate matter from bag filter (48 kg/day) With the recommended mitigation measures, environmental impacts anticipated to be not significant.
Landscape and Visual	Landscape: A total of 132 nos. of trees/shrubs will be transplanted (including 4 species, 9 nos. of protected tree species) and 24 nos. of tree/shrub will be fell (none of them is protected species). Felling is regarded as last resort and the number of tree/shrub requiring felling is small. Net loss of soft landscape area: 970 m^2 Visual: not significant	Landscape: nil Visual: not significant
Water Quality	With the recommended mitigation measures, no adverse impact expected	Anticipated sewage volume is small (28 m^3 per day) and the environmental impact is negligible.
Hazard to Life	Nil	3 fuel tanks (with total capacity of 34,000 L) will be installed. With the recommended safety measures, minimal hazard level expected

*Note : Prior to demolition but after decommissioning of the Existing Crematorium, supplementary site investigation will be carried out at sites currently not accessible. In addition, confirmatory site investigation will also be conducted to confirm the level of contamination before demolition of the Existing Crematorium. Through these supplementary/confirmatory site investigations, the remediation methodology of contaminated soil as well as handling and disposal options for contaminated materials can be confirmed.

12.3 Key Environmental Outcomes

Population and Environmental Sensitive Areas Protected

12.3.1 Environmental impacts arising from the Project, if not mitigated properly, might affect the nearby population during the construction, demolition and operation periods, for example, dust emission from construction and demolition activities, noise from construction machinery, emissions from chimney of the New Crematorium, etc. Dwellings within 500 m of the Project site boundary would contain a population of approximately 20,000, of which approximately 10,000 population is from schools. In addition there will be workers accessing the Project work sites during the construction and demolition phases. With proper implementation of the environmental mitigation measures, all such surrounding population and site staff will be protected from being adversely affected by the undesirable impacts.

Key Environmental Problems Avoided

12.3.2 In order to avoid or minimize the environmental impacts of the Project, a number of preventive measures have been recommended in the previous sections and are highlighted below:

- The use of dust suppression measures during the construction and demolition works will avoid causing nuisance to adjacent sensitive receivers and will also protect the health of on-site workers.
- During the construction and demolition phase, the surplus excavated materials will be reused on site as far as practical to minimize the amount of waste requiring disposal at landfill.
- Of the 156 trees/shrubs requiring removal during the construction and demolition works, majority (132) of them (including the 9 trees of protected species) will be transplanted to minimize the needs for tree felling.
- During commissioning of the new cremators, the total number of existing cremators in operation plus new cremators under trial-run will be maintained at no more than six at any time so as to avoid releasing additional air pollutants to the atmosphere.
- In the New Crematorium, the new cremators will be designed and equipped with advanced combustion technology with a view to minimizing the amount of air pollutant emissions. Dark smoke and odour emissions would be much improved compared with the existing Crematorium.
- All the noisy equipment of the New Crematorium (e.g. condensers of split-type air-conditioning units, radiators for cremators, general exhaust air fans and exhaust fans for the air pollution control system of the cremators) will be located in enclosed area so as to avoid causing noise nuisances to surrounding sensitive receivers.
- Adoption of air pollution control technology based on ‘dry process’ significantly reduces wastewater production.
- The 3 fuel tanks of the New Crematorium will be incorporated with adequate safety design features and provided with proper safety / precautionary measures to minimize the hazard level and to prevent fuel spillage/leakage, which will otherwise cause land contamination.

Adoption of Environmentally Friendly Designs

In addition to the aforementioned preventive measures, the New Crematorium has been designed with environmentally friendly features, including:

New Crematorium Layout	Rationale Behind/Benefits
• Cremators and related facilities of the New Crematorium to be located at the Southern side of the Project site.	• Main facilities of the Existing Crematorium are currently located at the Northern side of the Project site. To ensure provision of continuous services by the Existing Crematorium before commissioning of the New Crematorium, the cremators of the New Crematorium will have to be located at the Southern side of the Project site. While these new cremators will be moved from the Northern side to the Southern side, it has been assessed that the surrounding air quality will be in full compliance with the relevant standards and guidelines (see Section 4 for details).
• Chimney of the New Crematorium to be located at the Southern side of the Project site	• This proposed arrangement enables the shortest flue length, which can minimize the formation of undesirable pollutant formation inside the flue (e.g. dioxin). The adoption of the new cremators with state-of-the-art technology with air pollution control systems will be able to control the emission within acceptable standards (see Section 4 for details).
• 3-level terraces design	• As mentioned in *Section 2.5.2*, the Project site is sloping in nature. Therefore, the terrace design of the New Crematorium will be able to fully utilize the Project site and to avoid large scale excavation.
• Construction of perimeter road	• This is to provide easy access for the public. Adequate drop off area will be provided for various vehicles segregating vehicular access and parking for the public from those for hearse, mortuary and the diesel unloading to ensure safety for both the public and operators.

Compensation Areas Not Needed

12.3.3 No compensation area will be required for this Project.

Key Environmental Benefits of Environmental Protection Measures Recommended

12.3.4 The key environmental benefits of implementing the recommended preventive and mitigation measures during construction, demolition and operation phases can be summarized as follows:

- The air, noise, water quality, and visual impacts at the sensitive receivers will all be minimized or mitigated to within the acceptable norms.
- The amount of waste materials requiring disposal will be minimized through reduction, reuse and/or recycling of waste.
- The potential secondary environmental impacts arising from the handling and disposal of various types of waste materials as well as the potential impacts on the capacity of waste collection, transfer and disposal facilities will be controlled to acceptable levels.
- All the contaminated soil and waste materials, though expected to be of relatively small quantities, will be properly handled, treated on-site (if necessary) and disposed of, and hence minimizing the associated environmental impacts.
- The landscape impacts will be minimized by transplanting the most suitable specimens, including all of the protected species, to locations within the cemetery.
- The potential hazards of the new fuel tanks will be maintained at minimal level.

Potential New Environmental Benefits Due to the Reprovisioning of the Existing Crematorium

12.3.5 The potential new environmental benefits that will be brought about by reprovisioning of the Existing Crematorium, i.e., the Project, include the following:

- The Project will be able to help address the increasing cremation demand without construction of additional cremators, which will otherwise incur extra pollution loading
- Replacing the Existing Crematorium by the New Crematorium with improved cremation design and air pollution control technologies will lead to the betterment of local air quality
- Building the New Crematorium at the same location of the Existing Crematorium will provide a speedy means to replace the existing cremators, which are near the end of their serviceable life, because less time will be needed for making the infrastructure provisions
- Replacement of the existing cremators by the new cremators would more likely be accepted by the community as evidenced by the support of the Environmental Committee of the formerly Wong Tai Sin PDB in 1997
- The existing cremators are consuming about 547,000 L of diesel per year. The new cremators would be more fuel efficient and therefore utilize less natural resources.
- Spatial utilization in the Project site will be improved

13 CONCLUSION

13.1.1 It has been assessed that the environmental impacts arising from the Project are either considered minimal or can be mitigated to an extent where the impacts on the sensitive receivers are acceptable. An environmental monitoring and audit programme is therefore recommended to ensure that the mitigation measures have been properly implemented and environmental quality has not been seriously affected throughout the Project.

14 IMPLEMENTATION SCHEDULE OF MITIGATION MEASURES

Under the requirement of the Study Brief, all mitigation measures recommended in the EIA Report should be extracted and presented in a checklist form. This *Section* presents the Implementation Schedule of these mitigation measures.

Table 14.1 Implementation Schedule for Reprovisioning of Diamond Hill Crematorium

EIA ref.	Environmental Protection Measures/Mitigation Measures	Location/Timing	Implementation Agent	Implementation Stages				Relevant Legislation and Guidelines
				Des	Con	Dem	Ope	
Air (Design)								
S.4.3.7	The proposed cremators should be designed with advanced technology in combustion as well as equipped with appropriate air pollution control system which meet the requirements of BPM 12/2 and the target emission levels set in Table 4.1.	New Cremators in New Crematorium / design stage	Arch SD	✓				BPM/APCO
S.4.3.8	Special air pollution control systems shall be installed and operate to reduce the emissions of air pollutants to acceptable levels	New cremators in New Crematorium / all stages	Arch SD	✓	✓	✓	✓	BPM/APCO
S.4.5.17	The efflux velocity of chimney shall be at least 15 m/s, the design chimney height shall be 101 mP.D. (28.5m above ground). The design diameter of the chimneys shall be 0.22 m and 0.30 m for 170 kg and 250 kg cremators respectively	Chimney of New Crematorium / design and construction stages	Arch SD	✓	✓			BPM/APCO
S4.5.18	New cremators shall have primary and secondary chambers, the temperature of secondary combustion chamber shall be at least 850°C and the residence time at least 2 seconds	New cremators in New Crematorium / design stage	Arch SD	✓				BPM/APCO
Air (Construction and Demolition)								
S.4.3.8	Special air pollution control systems shall be installed and operate to reduce the emissions of air pollutants to acceptable levels	New cremators in New Crematorium / all stages	Arch SD	✓	✓	✓	✓	BPM/APCO
S.4.2.5	FEHD shall apply for a Specified Process License under the APCO	New Cremators in the New Crematorium / prior to operation	FEHD		✓	✓	✓	APCO
S.4.5.17	The efflux velocity of chimney shall be at least 15 m/s, the design diameter of the chimneys shall be 0.22 m and 0.30 m, the design chimney height shall be 101mP.D. (28.5m above ground), for 170 kg and 250 kg cremators respectively	Chimney of New Crematorium / design and construction stages	Arch SD	✓	✓			BPM/APCO

EIA ref.	Environmental Protection Measures/Mitigation Measures	Location/Timing	Implementation Agent	Implementation Stages				Relevant Legislation and Guidelines
				Des	Con	Dem	Ope	
S.4.5.30	If the interior wall of existing cremators and chimney are confirmed dioxins contaminated, special precautions shall be taken avoid fugitive emissions of dioxin contaminated materials	Cremator room and chimney in Existing Crematorium / demolition	Arch SD/Contractor			✓		
S.4.6.2	Sufficient water spraying should be applied during the construction work, the fugitive dust generated from general construction dust would be reduced by 90%	Project site / construction and demolition stages	Arch SD, contractor		✓	✓		APCO
S.4.6.45	Carry out a confirmatory test of dioxins in the depositions on chimney wall, flue gas ducting and combustion chambers when the existing Crematorium is shut down	Chimney, flue and cremators in Existing Crematorium / decommissioning	FEHD, Arch SD			✓		
S.4.6.46	If the dioxin level of surface deposition is between 1 and 10 ppb I-TEQ, it is classified as moderately contaminated with dioxins. The demolition work site should be covered up to avoid emission of fugitive dust during demolition	Chimney, flue and cremators in Existing Crematorium / decommissioning	Arch SD			✓		
S.4.6.47	If the dioxin level of surface deposition exceeds 10 ppb I-TEQ, it is classified as severely dioxin-contaminated waste. If it is confirmed that the existing facilities are severely contaminated with dioxins, a special decommissioning method – Containment method – would be adopted	Chimney, flue and cremators in Existing Crematorium / decommissioning	Arch SD			✓		
S.4.6.49	All the demolition waste would be carefully handled, sealed and treated as chemical waste. The waste collector shall be responsible for preventing fugitive dust emission when handling the demolition waste	Chimney, flue and cremators in Existing Crematorium / demolition stage	Arch SD, contractor			✓		
S.4.6.54	Employ a registered asbestos contractor to remove asbestos containing material during the demolition of the existing crematorium building	Cremator room in Existing Crematorium / decommissioning	Arch SD, contractor			✓		APCO
S.4.6.54	Submit a formal AIR and Asbestos Abatement plan signed by a registered asbestos consultant to the Authority for approval under APCO 28 days prior to the start of any asbestos abatement work.	Cremator room in Existing Crematorium / decommissioning	Arch SD, consultant			✓		APCO

EIA ref.	Environmental Protection Measures/Mitigation Measures	Location/Timing	Implementation Agent	Implementation Stages				Relevant Legislation and Guidelines
				Des	Con	Dem	Ope	
S.4.6.55	When removing asbestos containing materials, enclosure of the work area; containment and sealing for the asbestos containing waste; provision of personal decontamination facility; use of personal respiratory/protection equipment; use of vacuum cleaner equipped with high-efficiency air particulate (HEPA) filter for cleaning up the work area; and carry out air quality monitoring during the asbestos abatement work	Cremator room in Existing Crematorium / decommissioning	Arch SD, consultant			✓		APCO
S.4.6.56	Appoint qualified personnel to carry out the asbestos containing material removal work, including a registered asbestos contractor to carry out the work; a registered asbestos supervisor to supervise the work; a registered asbestos laboratory to monitor the air quality, and a registered asbestos consultant to supervise and certify the asbestos abatement work.	Cremator room in Existing Crematorium / decommissioning	Arch SD, consultant			✓		APCO
S.4.7.2	Erect a site barrier with the height of no less than 2.4 m to enclose the construction site Apply frequent water spraying to ensure the surface of the construction site sufficiently wet to reduce fugitive dust due to wind erosion and transportation on unpaved haul road Cover up stockpiles of fill material and dusty material Install a vehicle-cleaning system at the main entrance of the construction site to clean up the vehicles before leaving the site The Air Pollution Control (Construction Dust) Regulation shall be followed for fugitive dust control	Project site / construction and demolition stages	Contractor		✓	✓		APCO, Air Pollution Control (Construction Dust) Regulation
Air (Testing and Commissioning)								
S.4.7.4 & S.4.7.5	No more than 6 cremators (including both the existing and new ones) are in operation during commissioning test of new cremators. The commissioning test of each new cremator shall be recorded by a log book	Existing and new cremators in Exiting and New Crematorium / text and commissioning	Arch SD/FEHD/Contractor		✓			
S.4.5.9	Managerial arrangement should be made that no more than six cremators in operation at any time (including both existing and new cremators) during testing and commissioning period	New cremators in New Crematorium / testing and commissioning	FEHD				✓	-
Air (Operation)								
S.4.3.8	Special air pollution control systems shall be installed and operate to reduce the emissions of air pollutants to acceptable levels	New cremators in New Crematorium / all stages	Arch SD	✓	✓	✓	✓	BPM/APCO

EIA ref.	Environmental Protection Measures/Mitigation Measures	Location/Timing	Implementation Agent	Implementation Stages				Relevant Legislation and Guidelines
				Des	Con	Dem	Ope	
S.4.6.7	Training on operation of the cremator system would be provided to the responsible staff., to ensure proper operation of the system	New Cremators in New Crematorium / testing and commissioning	FEHD, EMSD				✓	BPM/APCO
S.4.6.7	Air pollution control system and monitoring equipment would be tested and evaluated during testing and commissioning stage	New Cremators in New Crematorium / testing and commissioning	FEHD, EMSD				✓	BPM/APCO
S.4.6.28	FEHD would implement stringent managerial programme to ensure proper operation and to provide adequate maintenance to the cremators in order to avoid emission of nuisance odour	New Cremators in New Crematorium / operation	FEHD				✓	BPM/APCO
S.4.6.30	FEHD will carry out regular odour patrol at the site boundary during the operation of the new Crematorium. Corrective actions will be carried out immediately if significant odour emission is detected by the odour patrol team	New Cremators in New Crematorium / operation	FEHD				✓	BPM/APCO
S.4.6.32	FEHD will limit the use of joss paper burners. Joss paper burners will be only allowed for the use of memorial ceremonies upon requested by the relatives. Other usage of joss paper burners will not be allowed	Joss burners in New Crematorium / operation	FEHD				✓	BPM/APCO
S.4.6.32	Guidance will be provided to users of joss paper burners to advise them to minimize the quantity of burning material	Joss burner in New Crematorium / operation	FEHD				✓	BPM/APCO
S.4.6.32	FEHD staff will advise users of joss paper burners to ensure better combustion of joss paper to reduce smoke emission	Joss burner in New Crematorium / operation	FEHD				✓	BPM/APCO
S.4.5.2	Ensuring proper operation of the Crematorium and the air pollution control system. In case of failure of any part of the cremator system, suspend the operation and rectify the failure as soon as possible.	Cremators in New Crematorium / operation	FEHD				✓	BPM/APCO
Air	(EM&A for Construction and Demolition)							
S.11.2.2	Conduct baseline and regular 1-hour and 24-hour TSP monitoring.	A8 and A17 / baseline monitoring prior to Phase I & II works and regular monitoring throughout Phase I & II works	Contractor		✓	✓		APCO, EM&A Guidelines for Development Projects in Hong Kong

EIA ref.	Environmental Protection Measures/Mitigation Measures	Location/Timing	Implementation Agent	Implementation Stages				Relevant Legislation and Guidelines
				Des	Con	Dem	Ope	
S.11.2.3	When the demolition material is confirmed to have ACM, monitoring for asbestos fibre would be carried out at the boundary of the construction site for reassurance purposes as per the requirement of future license for asbestos abatement, though it is not expected that asbestos fibre would be liberated from the demolition of the Existing Crematorium building.	Construction site boundary / demolition	Contractor			✓		Asbestos Study Report, AIR and AAP to be submitted under APCO, future licence for asbestos abatement (if any)
Air	(EM&A for Operation)							
S.11.3.2	Conduct continuous monitoring for the following pollutants and processes: • Temperature inside the primary combustion zone; • Temperature at the outlet from the secondary combustion zone; • Oxygen concentration at the outlet from the secondary combustion zone; • Carbon Monoxide concentration at the outlet from the secondary combustion zone; • Smoke density at the chimney of the cremator; and • Other essential operating parameter(s) which may affect the performance of air pollution control measures.	Cremators and chimney of the New Crematorium / operation	FEHD				✓	APCO, BPM 12/2, future Specified Process Licence
S.11.3.10	Conduct regular monitoring for stack emissions as per the requirements of future Specified Process License to be issued by EPD.	Chimney of the New Crematorium / operation	FEHD				✓	APCO, BPM 12/2, future Specified Process Licence
Noise	(Construction and Demolition)							
S.5.3.9	Select quiet plant, which is defined as PME with a sound power level lower than that specified in GW-TM. Examples of quiet plant can be referred to those listed in British Standard BS5228.	Project site / construction and demolition stages	Contractor		✓	✓		GW-TM
S.5.3.11 & S.5.3.12	Where practicable, use movable barriers of 3 to 5 m height with a small cantilevered upper portion and skid footing can be located within a few metres from a stationary plant (e.g. generator, compressor, etc.) and within about 5 m for a mobile equipment (e.g. breaker, excavator, etc.), especially in the vicinity of SR3, SR4 and SR6. The purpose-built noise barriers or screens shall be constructed of appropriate materials with a minimum superficial density of 15kg/m^2.		Contractor		✓	✓		NCO

EIA ref.	Environmental Protection Measures/Mitigation Measures	Location/Timing	Implementation Agent	Implementation Stages				Relevant Legislation and Guidelines
				Des	Con	Dem	Ope	
S.5.3.13	• Only well-maintained plant should be operated on site and plant should be regularly serviced during the construction works • Plant that is used intermittently should be turned off or throttled down when not in active use • Plant that is known to emit noise strongly in one direction should be oriented to face away from NSRs • Silencers, mufflers and enclosures for plant should be used where possible and maintained adequately throughout the works • Where possible mobile plant should be sited away from NSRs • Stockpiles of excavated materials and other structures such as site buildings should be used effectively to screen noise from the works	Project site / construction and demolition stages	Contractor		✓	✓		NCO
S.5.3.15 (iii)	Liaise with the school and the Examination Authority to ascertain the dates and times of examination periods during the course of the construction/ demolition works so as to avoid any noisy activities during these periods. Programme of the on-site works should hence be well programmed such that the noisier construction activities would not be coincided with the examination of the schools.	Project site / construction and demolition stages	Contractor		✓	✓		NCO
Noise (Operation)								
S.5.4.7	The quantities and the maximum sound power level of the fixed plants should not exceed the plant inventory information given by the project proponent as assessed in the EIA report.. In general, noise from the operation of the concerned fixed-noise sources can be reduced by locating it as far as practical from the NSRs, and/ or by orientating the noise emission points (e.g. discharge points of ventilation etc.) away from the NSRs, and/ or by implementation of silencers and acoustic barriers to the concerned system.	All fixed-noise sources in New Crematorium / design and operation stages	Arch SD and FEHD	✓			✓	NCO
Noise (EM&A for Construction and Demolition)								
S.11.2.4	Conduct regular noise monitoring.	SR 3, SR 4 and SR 6 / Phase I & II works	Contractor		✓	✓		NCO, EM&A Guidelines for Development Projects in Hong Kong

EIA ref.	Environmental Protection Measures/Mitigation Measures	Location/Timing	Implementation Agent	Implementation Stages				Relevant Legislation and Guidelines
				Des	Con	Dem	Ope	
Land Contamination (Construction and Demolition)								
S.6.8.4	Additional site investigations in areas of the site that are currently in use and cannot be readily accessed. These investigations will be carried out once the existing facility has been decommissioned. The additional site investigations are required in the vicinity of the existing CLP secondary substation, and around the cremators and flues inside the crematorium building. Once access to these areas is available, a sampling and analysis plan will be prepared for approval by EPD, additional investigations will take place, and the need for remedial works will be determined. Any remedial works required will be in addition to those described in this current report.	CLP secondary substation and cremator room/ demolition stage (Phase I – CLP secondary substation; Phase II – cremator room)	Contractor			✓		ProPECC PN 3/94
S.6.8.5	Once the Existing Crematorium has ceased operating during Phase II, confirmatory surface samples will be taken from the samples points S1 to S6 at a depth of 0.1m, and these samples will be analysed for the same suite of determinands (i.e. dioxins, metals and PAH) in order to confirm that no further contamination has occurred. The Remediation Action Plan will be revised on the basis of these results.	Locations S1 to S6 specified in the CAP/demolition	Contractor			✓		ProPECC PN 3/94
S.6.8.6	The underground fuel storage tank and associated pipework will be removed as part of the site formation works. The base of the excavations will be inspected during and after tank removal by a suitably experienced environmental specialist in order to determine whether there is any visual or olfactory evidence of fuel contamination. If such contamination is suspected, then confirmatory soil sampling will be carried out, and the samples analysed for TPH.	Underground fuel storage tank/during and after tank removal	Contractor			✓		ProPECC PN 3/94 and Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol Filling Stations, Boatyards and Car Repair / Dismantling Workshops
Figure 6.3	Summary of remediation works at locations S3 and S5: 1. Mark out 5m radius around S3 and S5 2. Excavate to depth of 0.5m 3. Transport to landfill site for final disposal 4. Take 4 samples from edges of excavation and one sample from base of excavation, analyse for lead and tin 5. If the results exceed Dutch B Levels, extend excavation to a further 5 m radius and 0.5 m depth in the quadrant where the contaminated samples is encountered and repeat steps 3 and 4 6. If the results less than Dutch B Levels, then remediation completed	Locations S3 and S5 specified in CAP/demolition	Contractor			✓		ProPECC PN3/94

EIA ref.	Environmental Protection Measures/Mitigation Measures	Location/Timing	Implementation Agent	Implementation Stages				Relevant Legislation and Guidelines
				Des	Con	Dem	Ope	
S.6.10.5	During removal of the underground fuel storage tank, appropriate precautions should be taken to avoid contamination. All fuel tanks and associated pipework should be emptied prior to any demolition work being undertaken. Any remaining sludge or sediment in the tanks or pipework should be removed and disposed of as chemical waste in accordance with the appropriate regulations for disposal of such material.	Underground fuel storage tank / Phase II demolition	Contractor			✓		ProPECC PN 3/94 and Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol Filling Stations, Boatyards and Car Repair / Dismantling Workshops
S.6.10.6 - S.6.10.8	Should contamination be encountered beneath the fuel tank or the CLP secondary substation, further remedial work will be required. Such potential contamination would consist of either TPH (in the case of the fuel tank) or PCBs (in the case of the CLP secondary substation). As a realistic worst-case estimate, the PCB contaminated soil at CLP secondary substation may require stabilisation with cement prior to disposal to landfill. A realistic worst case estimate is that the volume of TPH contaminated soil at underground storage tank would require landfill disposal.	CLP secondary substation /Phase I demolition and underground fuel tank / Phase II demolition	Contractor			✓		ProPECC PN 3/94 and Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol Filling Stations, Boatyards and Car Repair / Dismantling Workshops
App. C2 4.7	Health and Safety Precautions during Remedial Works The site workers engaged in the remedial works should be provided with adequate personal protective equipment, which should include: • Protective footwear; • Gloves; • Dust masks; and • Overalls. A clean area should be provided, equipped with washing facilities. Eating, drinking and smoking should only be permitted within designated "clean" areas after washing. Excavated material should not be stockpiled, but should immediately be treated/transported to landfill on a daily basis..	All areas requiring remedial works in Project site / demolition during Phases I and II	Contractor			✓		ProPECC PN 3/94 and Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol Filling Stations, Boatyards and Car Repair / Dismantling Workshops

EIA ref.	Environmental Protection Measures/Mitigation Measures	Location/Timing	Implementation Agent	Implementation Stages				Relevant Legislation and Guidelines
				Des	Con	Dem	Ope	
App. C2 4.7	Avoidance of Impacts on Water Quality during Remedial Works In order to avoid impacts on water quality during remedial works, care will be taken to minimise the mobilisation of sediment during excavation and transport. Measures to be adopted will be based on the recommendations set out in Practice Note for Professional Persons ProPECC PN1/94 "Construction Site Drainage". The results of the site investigation suggest that there is unlikely to be any requirement for dewatering of excavations, since groundwater was not encountered in any of the exploratory holes. The contractor carrying out the remedial works will be required to submit a method statement detailing the measures to be taken to avoid water quality impacts. Typical measures would include; • Carry out the works during the dry season (i.e. October to March) if possible; • Use bunds or perimeter drains to prevent run-off water entering excavations; • Sheet or otherwise cover excavations whenever rainstorms are expected to occur; • Minimise the requirements for stockpiling of material and ensure any stockpiles are covered; • Temporary on-wit stockpiling of contaminated materials should be avoided, and all excavated contaminated soils/materials should be disposed of on a daily basis; • Ensure that any discharges to storm drains pass through an appropriate silt trap.	All areas requiring remedial works in Project site / demolition during Phases I and II	Contractor			✓		ProPECC PN 3/94, ProPECC PN1/94 and Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol Filling Stations, Boatyards and Car Repair / Dismantling Workshops
App. C2 4.7	Waste Disposal Requirements during Remedial Works An application for permission to dispose of excavated material should be made to the Facilities Management Group of EPD three months prior to disposal. A "trip-ticket" system should be implemented. Each load of contaminated soil despatched to landfill should be accompanied by an admission ticket. Vehicles leaving the site should be adequately sheeted to prevent dispersion of contaminated material during transport. The wheels of vehicles should be cleaned prior to leaving site, to prevent contaminated material leaving site on the wheels of vehicles.	All areas requiring remedial works in Project site / demolition during Phases I and II	Contractor			✓		ProPECC PN 3/94, Waste Disposal Ordinance (Cap. 354), WBTC No. 21/2002 and Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol Filling Stations, Boatyards and Car Repair / Dismantling Workshops

EIA ref.	Environmental Protection Measures/Mitigation Measures	Location/Timing	Implementation Agent	Implementation Stages				Relevant Legislation and Guidelines
				Des	Con	Dem	Ope	
App. C2 4.7	Compliance Report for Remedial Works Following completion of remediation works, a Remediation Report should be compiled and submitted, to demonstrate that the remediation works have been carried out in accordance with the Remediation Action Plan. The Remediation Report should include details of the excavation works carried out, records of material taken to landfill, and results of confirmatory testing, and should be submitted to EPD for approval before the commencement of building works.	All areas requiring remedial works in Project site / after completion of remediation works	Contractor			✓		ProPECC PN 3/94 and Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol Filling Stations, Boatyards and Car Repair / Dismantling Workshops

EIA ref.	Environmental Protection Measures/Mitigation Measures	Location/Timing	Implementation Agent	Implementation Stages				Relevant Legislation and Guidelines
				Des	Con	Dem	Ope	
Land Contamination (Design and Operation)								
S.6.11.4	The fuel storage facilities to be provided in the New Crematorium should be constructed, maintained and inspected in accordance with the provisions of the Dangerous Goods (General) Regulations (Cap. 295B) and the guidelines presented in "Guidance for the Design, Construction, Modification and Maintenance of Petrol Filling Stations" (Institute of Petroleum, 1999), and with the necessary approvals from the Fire Services Department. To mitigate the environmental impacts from operational land contamination, the following mitigation measures shall be implemented for installation and operation of any underground fuel tanks: • The underground fuel tank(s) shall be of a specified durability and placed within a concrete pit to avoid direct contact of the tank surface with soil. • The concrete pit shall be accessible to allow tank integrity test be carried out on an annual basis, or when deemed necessary by an independent qualified surveyor or structural engineer. Any potential problems such as potential cracking shall be rectified as far as practicable. • Diesel fuel pipelines are preferably to be installed above ground. If underground piping is unavoidable, concrete lined trenches shall be constructed to contain the pipelines. The distance between the cremators and the underground tanks shall be minimized as appropriate to avoid the need for long pipelines. • Proper installation and use of meters (e.g. at the two ends of any pipeline) would allow any unexpected pressure drop or difference and signs of leakage be detected from routine inspection or during diesel fuel pumping. Any identified leakage shall be reported to the plant manager in-charge. • Any spillage of fuel shall be removed immediately by portable pump when the quantity is large or by absorbing materials when the quantity is low or with similar effective tools as appropriate. Used absorbing material shall be properly stored and disposed of as chemical waste. The underground tanks refueling (from tank trucks) shall only be undertaken by authorized staff of the fuel company using the company's standard procedures to avoid spillage of diesel fuel.	Fuel storage tanks in New Crematorium, / design and operation stages	FEHD/Arsh SD	✓			✓	DGO

EIA ref.	Environmental Protection Measures/Mitigation Measures	Location/Timing	Implementation Agent	Implementation Stages				Relevant Legislation and Guidelines
				Des	Con	Dem	Ope	
Land Contamination (EM&A for Construction and Demolition)								
S.11.2.6	Conduct supplementary site investigation for TPH and PCB in soil samples.	CLP substation / after decommissioning but prior to demolition during Phase I work	Contractor			✓		CAR, RAP, future sampling and analysis plan
S.11.2.8	Conduct confirmatory testing of PAH, dioxins and metals (the "Dutch List") in soil samples.	S1 to S6 / Phase II work	Contractor		✓	✓		CAR, RAP, future sampling and analysis plan
S.11.2.9	If fuel contamination underneath the underground fuel tank is suspected, confirmatory soil sampling will be carried out for analysis of TPH.	Underneath the underground fuel tank / Phase II	Contractor			✓		CAR, RAP, future sampling and analysis plan
S.11.2.13	Conduct confirmatory testing of tin and lead in soil samples to confirm all contaminated soil has been excavated.	S3 and S5 / during Phase II work following excavation at each location	Contractor		✓	✓		CAR, RAP, future sampling and analysis plan

EIA ref.	Environmental Protection Measures/Mitigation Measures	Location/Timing	Implementation Agent	Implementation Stages				Relevant Legislation and Guidelines
				Des	Con	Dem	Ope	
Waste Management (Construction and Demolition)								
S.7.7.1	<u>Good Site Practice</u> • Obtain relevant waste disposal permits from the appropriate authorities, in accordance with the Waste Disposal Ordinance (Cap. 354), Waste Disposal (Chemical Waste) (General) Regulation (Cap. 354) and the Land (Miscellaneous Provision) Ordinance (Cap. 28) • Prepare a Waste Management Plan approved by the Engineers / Supervising Officer of the Project in accordance with Environment, Transport and Works Bureau Technical Circular (Works) (ETWBTC(W)) 15/2003, Waste Management On Construction Sites • Nominate an approved person, such as site manager, to be responsible for good site practice, arrangements for collection and effective disposal of all types of wastes generated on-site to appropriate facility • Use waste haulier authorized or licensed to collect specific category of waste • Establish trip ticket system as contractual requirement (with reference to Works Branch Technical Circular (WBTC) No. 21/2002) for monitoring of public fill and C&D waste at public filling facilities and landfills. Such activities should be monitored by the Environmental Team • Provide training to site staff in terms of proper waste management and chemical waste handling procedures • Separate chemical wastes for special handling and dispose them at licensed facility for treatment • Establish routine cleaning and maintenance programme for drainage systems, sumps and oil interceptors • Provide sufficient waste disposal points and regular collection for disposal • Adopt measures to minimize windblown litter and dust during transportation of waste, such as covering trucks or transporting wastes in enclosed containers • Establish recording system for the amount of wastes generated, recycled and disposed of (including the disposal sites)	Project site/ design, construction and demolition stages	Contractor	✓	✓	✓		Waste Disposal Ordinance (Cap. 354), Waste Disposal (Chemical Waste) (General) Regulation (Cap. 354) Land (Miscellaneous Provision) Ordinance (Cap. 28) WDO, ETWBTC(W) 15/2003, WBTC No. 21/2002
S.7.7.2	<u>Waste Management Plan</u> The contractor should submit the Waste Management Plan to Engineer/Supervising Officer of the Project for approval. The Waste Management Plan should describe the arrangements for avoidance, reuse, recovery and recycling, storage, collection, treatment and disposal of different categories of waste to be generated from the activities of the Project and indicate the disposal location(s) of all waste. A trip ticket system shall be included in the Waste Management Plan.	Project site / design, construction and demolition stages	Contractor	✓	✓	✓		Waste Disposal Ordinance (Cap. 354)

EIA ref.	Environmental Protection Measures/Mitigation Measures	Location/Timing	Implementation Agent	Implementation Stages				Relevant Legislation and Guidelines
				Des	Con	Dem	Ope	
S.7.7.3	<u>Waste Reduction Measures</u> • Minimize the damage or contamination of construction material by proper storage and site practices • Plan and stock construction materials carefully to minimize amount of waste generated and avoid unnecessary generation of waste • Prior to disposal of C&D waste, wood, steel and other metals should be separated for reuse and / or recycling to minimize the quantity of waste to be disposed of to landfill • Minimize use of wood and reuse non-timber formwork to reduce the amount of C&D waste • Recycle any unused chemicals or those with remaining functional capacity as far as practicable • As far as practicable, segregate and store different types of waste in different containers, skips or stockpiles to enhance reuse or recycling of materials and their proper disposal • Encourage collection of aluminium cans, plastic bottles and packaging material (e.g. carton boxes) and office paper by individual collectors, separate labeled bins should be provided to help segregate this waste from other general refuse generated by the work force	Project site / construction and demolition stages	Contractor		✓	✓		WBTC No. 32/92, 5/98 and 19/99
S.7.7.5	<u>Excavated Material</u> Rock and soil generated from excavation should be reused for site formation as far as possible. In addition, excavated material from foundation work can be reused for landscaping as far as practicable to avoid disposal off-site.	Project site / construction and demolition stages	Contractor		✓	✓		WBTC 12/2000
S.7.7.6 – S.7.7.8	<u>Construction and Demolition Material</u> Careful design, planning and good site management can minimize over-ordering and generation of waste materials such as concrete, mortar and cement grouts. Standard formwork should be used as far as practicable, wooden formwork should be replaced by metal ones whenever possible. Alternatives such as plastic fencing and reusable site office structures can also minimize C&D waste generation. The contractor should recycle as much as possible of the C&D material on-site. Public fill and C&D waste should be segregated and stored in different containers or skips to enhance reuse or recycling of materials and their proper disposal. Materials such as concrete and masonry can be crushed and used as fill and steel reinforcing bar can be used by scrap steel mills. Different areas of sites should be designated for such segregation and storage.	Project site / construction and demolition stages	Contractor	✓	✓	✓		WBTC 5/98 and 19/99

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<tr><th>EIA ref.</th><th>Environmental Protection Measures/Mitigation Measures</th><th>Location/Timing</th><th>Implementation Agent</th><th colspan="4">Implementation Stages</th><th>Relevant Legislation and Guidelines</th></tr>
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<tr><td></td><td>To maximize landfill life, government policy discourages the disposal of C&D materials with more than 20% inert material by volume (or 30% inert material by weight) at landfill. Inert C&D material (public fill) should be directed to an approved public filling area, where it has the added benefit of offsetting the need for removal of materials from borrow areas for reclamation purposes.</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>S.7.7.9-
S.7.7.14</td><td><u>Contaminated Material – Further Contamination Investigation</u>
After decommissioning but prior to demolition of the Existing Crematorium, further contamination investigation should be carried out to confirm the quality and quantity of ash waste, building structures and contaminated soil requiring treatment and disposal. Further contamination investigation shall provide information on the extent of contamination (DCM / HMCM / PAHCM) at cremators /flues / chimney as well as the quantity of contaminated materials requiring treatment and disposal. Regarding ACM, future AIR, AMP/AAP should be submitted to EPD for approval under the APCO. Asbestos investigation / abatement (including the preparation of AIR and AAP) should be carried out by registered asbestos consultant and contractor. A summary of requirement is given below:
<table>
<tr><th>Location</th><th>Investigation Parameter</th><th>Investigation Period</th></tr>
<tr><td>Cremators/flue/chimney and surrounding areas</td><td>Asbestos (building structure)</td><td>Phase II</td></tr>
<tr><td>CLP secondary substation</td><td>PCB, TPH (soil samples)</td><td>Phase I</td></tr>
<tr><td>Cremators/flue/chimney and surrounding areas</td><td>Dioxins, heavy metals, PAH (ash waste)</td><td>Phase II</td></tr>
<tr><td>Surface soil around Existing Crematorium</td><td>Dioxins, heavy metals, PAH (soil sample)</td><td>Phase II</td></tr>
</table>
Further contamination investigation shall provide information on the extent of contamination at cremators /flues / chimney as well as the quantity of contaminated materials requiring treatment and disposal.</td><td>CLP secondary substation / prior to Phase I demolition; cremator room in Existing Crematorium / prior to Phase II demolition</td><td>Contractor</td><td></td><td></td><td>✓</td><td></td><td>ProPECC PN 3/94
APCO (for asbestos)</td></tr>
</table>

EIA ref.	Environmental Protection Measures/Mitigation Measures	Location/Timing	Implementation Agent	Implementation Stages				Relevant Legislation and Guidelines
				Des	Con	Dem	Ope	
	Samples of ash/particulate matters should be collected from within the cremators (including the bottom ash), chimney walls, flues and surrounding area of the Existing Crematorium for analysis of dioxin, heavy metals and PAHs by a HOKLAS accredited laboratory. A consultant experienced in the abatement of chemical wastes particularly the handling of DCM, should be appointed in order to assist with the evaluation of the information and prepare an abatement plan for the ash waste. Such a plan shall be submitted to EPD and the Labour Department (LD) to establish an acceptable and safe method for these potentially hazardous wastes. The abatement plan should identify the method of abatement, the performance criteria for the protection of workers and the environment and any emergency procedures and contingency measures required.							
	It must be ensured that the treatment of ash wastes will comply with all routine construction site safety procedures would apply as well as statutory requirements under the Occupational Safety and Health Ordinance and Factories and Industrial Undertakings Ordinance. Due to the difficulties in establishing permanent and effective engineering controls, the protection of workers is likely to be at the worker level. A safe system of work must be provided, and training and suitable personal protective equipment as well as hygienic decontamination facilities should be provided. It is recommended that the methods to be adopted by the contractor for disposal of the ash waste should be agreed with LD and EPD.	Cremator room in Existing Crematorium / before demolition and after decommission	Contractor			✓		ProPECC PN 3/94
	Sufficient time should be allocated to abate all ash waste with DCM/HMCM/PAHCM. The contractor should ensure the implications of dust containing DCM/HMCM on air quality and workers health during the clean up work are mitigated.							
	Since DCM is chemically related to Polychlorinated Biphenyl (PCB) wastes, the requirements of the *Code of Practice on the Handling, Transportation and Disposal of (PCB) Wastes* should be referenced when developing the abatement plan.							ProPECC PN 3/94 Code of Practice on the Handling, Transportation and Disposal of (PCB) Wastes
	A land contamination site investigation was carried out under this EIA to determine disposal requirements for contaminated soil. Further site investigation on soil around CLP secondary substation is needed when decommissioned, which will be during Phase I of the works. In addition, confirmatory testing on DCM level in locations S1 to S6 will be required to identify the appropriate remediation and disposal requirements during Phase II of the works.	Locations S1 to S6 in CAP / prior to Phase II demolition				✓		

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<tr><th>EIA ref.</th><th>Environmental Protection Measures/Mitigation Measures</th><th>Location/Timing</th><th>Implementation Agent</th><th colspan="4">Implementation Stages</th><th>Relevant Legislation and Guidelines</th></tr>
<tr><th></th><th></th><th></th><th></th><th>Des</th><th>Con</th><th>Dem</th><th>Ope</th><th></th></tr>
<tr><td>S.7.7.16</td><td><u>Asbestos Containing Materials (ACM)</u>
Further asbestos assessment should be carried out when access to the cremators /flue /chimney is accessible after decommissioning and before demolition. An AMP should be prepared. The AAP should be prepared and submitted to EPD for approval prior to commencement of demolition works in accordance to the APCO. It is preferable to remove all ACM before actual demolition. A registered asbestos removal contractor should be employed to remove all ACM in accordance with the approved AAP which will be prepared in due course in accordance with the Code of Practice (COP) on Asbestos Control for Safe Handling of Low Risk ACM and Asbestos Work Using Full Containment or Mini Containment Method published by EPD. A registered asbestos consultant should also be employed to supervise abatement works. For the disposal of ACM, the contractor should observe the COP on Handling, Transportation and Disposal of Asbestos Waste under the Waste Disposal (Chemical Waste) (General) Regulation.</td><td>Cremator room in Existing Crematorium / before demolition and after decommission</td><td>Contractor</td><td></td><td></td><td>✓</td><td></td><td>Code of Practice (COP) on Asbestos Control for Safe Handling of Low Risk ACM and Asbestos Work Using Full Containment or Mini Containment Method COP on Handling, Transportation and Disposal of Asbestos Waste under the Waste Disposal (Chemical Waste) (General) Regulation
APCO</td></tr>
<tr><td>S.7.7.17</td><td><u>Dioxin Containing Materials (DCM) / Heavy Metal Containing Materials (HMCM) / Polyaromatic Hydrocarbon Containing Materials (PAHCM) from Demolition of the Existing Crematorium</u>
Proposed Contamination Classification for Ash Waste with DCM/HMCM
<table>
<tr><th>Classification of Contamination</th><th>Dioxin Level in Ash Waste</th><th>Heavy Metal Level in Ash Waste</th></tr>
<tr><td>Low/Non Contaminated by DCM / HMCM / PAHCM</td><td>< 1 ppb TEQ</td><td>< Dutch “B” List</td></tr>
<tr><td>Moderately/Severely Contaminated HMCM / PAHCM</td><td>< 1 ppb TEQ</td><td>≥ Dutch “B” List</td></tr>
<tr><td>Moderately Contaminated DCM</td><td>≥ 1 and <10 ppb TEQ</td><td>Any level</td></tr>
<tr><td>Severely Contaminated DCM</td><td>≥ 10 ppb TEQ</td><td>Any level</td></tr>
</table></td><td>Cremator room in Existing Crematorium / before demolition and after decommission</td><td>Contractor</td><td></td><td></td><td>✓</td><td></td><td>ProPECC PN3/94 USEPA dioxin assessment criterion</td></tr>
</table>

EIA ref.	Environmental Protection Measures/Mitigation Measures		Location/Timing	Implementation Agent	Implementation Stages				Relevant Legislation and Guidelines
					Des	Con	Dem	Ope	
S.7.7.18 - 19	*Demolition, Handling, Treatment and Disposal of Low/Non-Contaminated DCM /HMCM / PAHCM from Demolition of Existing Crematorium* Where the ash waste contains low/non contaminated DCM/HMCM/PAHCM, the contractor should avoid ash waste becoming airborne during demolition. General dust suppression measures mentioned in Section 4 should be followed. All such ash waste can be directly disposal of at landfill. Subject to the findings of the further asbestos investigation, building structures where such ash waste is found but contaminated with asbestos should be dealt in accordance to *7.7.16*.		Cremator room in Existing Crematorium / demolition	Contractor			✓		APCO
S.7.7.20	*Demolition, Handling, Treatment and Disposal of Moderately Contaminated DCM and Moderately/Severely Contaminated HMCM / PAHCM from Demolition of the Existing Crematorium* Procedure on demolition, handling, treatment and disposal of Moderately Contaminated DCM and Moderately/Severely Contaminated HMCM / PAHCM is listed below		Cremator room in Existing Crematorium / demolition	Contractor			✓		Waste Disposal (Chemical Waste) (General) Regulation
	Item	**Procedure**							
	Site Preparation	The contractor should ensure the impacts of dust containing dioxin and/or heavy metals on air quality and workers health during the handling and transportation of the contaminated materials are mitigated. Except the cremators/flue/chimney, all removable items where moderately contaminated DCM or moderately/severely contaminated HMCM / PAHCM is identified should be removed as far as practicable to avoid obstructing the decontamination activities. Preliminary site decontamination of all debris shall be carried out using HEPA vacuum cleaner. The top portion of the chimney above the roof shall be enclosed by a chamber with three layers of polyethene sheets. At the entrance to the cremators /flues /chimney, a 3-chamber decontamination unit shall be constructed for entry and exit from the work area. The 3-chamber decontamination unit shall comprise a dirty room, a shower room and a clean room of at least 1m x 1m base each with 3 layers of fire retardant polyethene sheet where all workers shall carry out decontamination procedures before leaving the work area. Warning signs in both Chinese and English should be put up in conspicuous areas.								
		All workers shall wear full protective equipment, disposable protective coverall (such as Tyvek) (with hood and shoe covers), nitrile gloves, rubber boots (or boot covers), and full-face positive pressure respirators equipped with a combination cartridge that filters particulate and removes organic vapour. The organic vapour protection is an added protection against the unlikely exposure to any vapour.							

EIA ref.	Environmental Protection Measures/Mitigation Measures		Location/Timing	Implementation Agent	Implementation Stages				Relevant Legislation and Guidelines
					Des	Con	Dem	Ope	
		If ACM is identified in building structures where moderately contaminated DCM or moderately/severely contaminated HMCM / PAHCM is found, relevant abatement measures for building structures described in the AAP (see *7.7.16*) should be implemented prior to the above site preparation.							
	Decontamination, demolition and handling	The cremators/flue/chimney shall be removed from top down starting from the chimney. Any ash or residues attached to the cremators/flue/chimney or any other building structures shall be removed by scrubbing and HEPA vacuuming. Wastes generated from the containment or decontamination unit including the protection clothing of the workers such as the coverall, nitrile glove, rubber boots and materials used for wet wiping shall be disposed of at landfill site.	Cremator room in Existing Crematorium / demolition	Contractor			✓		Waste Disposal (Chemical Waste) (General) Regulation
		After completion of removal, decontaminate all surfaces by HEPA vacuum.							
		If ACM is identified in building structures where moderately contaminated DCM or moderately/severely contaminated HMCM / PAHCM is found, relevant abatement measures for building structures described in the AAP (see *7.7.16*) should be implemented prior to the above decontamination, demolition and handling measures.							
	Treatment	The ash waste contains dioxin/heavy metals and in its untreated state would be classified as a chemical waste under the *Waste Disposal (Chemical Waste) (General) Regulation*. While the quantity of DCM/HMCM is not expected to be significant, the levels of dioxin and heavy metals would affect the treatment option. Immobilization of the contaminated materials by mixing with cement followed by disposal at landfill (if landfill disposal criteria can be met) would be the most preferable option.							
		Rather than treating the already incinerated ash waste by incineration, the ash waste with moderately contaminated DCM or moderately/severely contaminated HMCM / PAHCM should be collected and stabilized to meet landfill disposal criteria of the Facilities Management Group (FMG) of EPD. In this case it is envisaged that the process would involve collection and mixing of the ash waste with cement. Pilot mixing and TCLP tests should be carried out to establish the appropriate ratio of cement to ash waste to the satisfaction of EPD. It is envisaged that the pilot tests would involve the mixing of say 5%, 10% and 15% ratios of cement to ash waste and three replicate of 300 mm cube blocks for each ratio. TCLP tests should then be used to establish the correct ratio of cement to ash waste to the satisfaction of EPD.							

EIA ref.	Environmental Protection Measures/Mitigation Measures		Location/Timing	Implementation Agent	Implementation Stages				Relevant Legislation and Guidelines
					Des	Con	Dem	Ope	
	Disposal	After immobilization of the ash waste by mixing with cement in the correct ratio as determined by the pilot mixing and TCLP test, the waste materials should be placed inside polyethene lined steel drums for disposal at landfill. Transparent plastic sheeting of 0.15 mm thickness low-density polyethene or PVC should be employed. The drums should be 16 gauge steel or thicker and fitted with double bung fixed ends adequately sealed and well labelled in new or good condition. The drums should be clearly marked "DANGEROUS CHEMICAL WASTE" in English and Chinese. Prior agreement of the disposal criteria from the FMG of EPD and agreement to disposal from the landfill operator must be obtained.	Cremator room in Existing Crematorium / demolition	Contractor			✓		Waste Disposal (Chemical Waste) (General) Regulation
		As a fall back option, if the landfill disposal criteria cannot be met after immobilization of the ash waste, disposal at the CWTC should be considered.							
		The building structures will be disposal of at landfill.							
		If ACM is identified in building structures where moderately contaminated DCM or moderately/severely contaminated HMCM / PAHCM is found, relevant disposal measures for building structures described in the AAP (see *7.7.16*) should be implemented instead.							

EIA ref.	Environmental Protection Measures/Mitigation Measures		Location/Timing	Implementation Agent	Implementation Stages				Relevant Legislation and Guidelines
					Des	Con	Dem	Ope	
S.7.7.21	*Demolition, Handling, Treatment and Disposal of Severely Contaminated DCM from Demolition of the Existing Crematorium* Procedure for demolition, handling, treatment and disposal of Severely Contaminated DCM is listed below		Cremator room in Existing Crematorium / demolition	Contractor			✓		Waste Disposal (Chemical Waste) (General) Regulation
	Item	**Procedure**							
	Site Preparation	Except the cremators/flue/chimney, all removable items where severely contaminated DCM is identified should be removed from the cremator room as far as practicable to avoid obstructing the decontamination activities. Preliminary site decontamination of all debris shall be carried out using HEPA vacuum cleaner. The walls, floor and ceiling of the cremator room where severely contaminated DCM located shall be lined with 3 layers of fire retardant polyethene sheets. The top portion of the chimney above the roof shall be enclosed by a chamber with three layers of polyethene sheets. At the entrance to the cremators/flues/chimney, a 3-chamber decontamination unit shall be constructed for entry and exit from the work area. The 3-chamber decontamination unit shall comprise a dirty room, a shower room and a clean room of at least 1m x 1m base each with 3 layers of fire retardant polyethene sheet where all workers shall carry out decontamination procedures before leaving the work area. Warning signs in both Chinese and English should be put up in conspicuous areas.							
		Air movers should be installed at the cremator room, and at the bottom of the chimney to exhaust air from the work area. A stand-by air mover shall also be installed with each of the air movers. Sufficient air movement shall be maintained to give a minimum of 6 air changes per hour to the work area, and maintain a negative pressure of 0.05-0.15 inches of water within the work area throughout the entire course of the decommissioning works. A pressure monitor with printout records and audible alarm shall be installed at an easily accessible location to demonstrate that negative pressure is maintained. New pre-filters and HEPA filters shall be used on the air movers.							
		A copy of the maintenance records of the air movers should be kept on site for inspection upon request. The appointed contractor shall also check the differential pressure of the air mover to make sure the filter is not blocked. A differential pressure above 0.2 inches of water indicates that the filters would need to be changed.							

EIA ref.	Environmental Protection Measures/Mitigation Measures		Location/Timing	Implementation Agent	Implementation Stages				Relevant Legislation and Guidelines
					Des	Con	Dem	Ope	
	Item	**Procedure**							
S.7.7.21 cont'		Smoke Test: before commencement of the decommissioning work, a smoke test with non-toxic smoke shall be carried out to ensure the air-tightness of the containment. Also check whether there are stagnant air pockets indicated by an aggregate of smoke that cannot effectively be extracted. After a successful test, switch on the air mover to exhaust smoke from the containment and to give a minimum of 6 air changes per hour, and check visually to see that the filters screen out the smoke effectively and if the pressure gauges read normal. If not, the air mover shall be sealed up and returned to the supplier workshop for necessary servicing, and replaced by a tested air mover. The normal reading pressure range for maintaining 6 air changes per hour shall be 1.5-4 mm/0.05-0.15 inches of water or equivalent (negative pressure). The audible alarm's integrity should also be checked and the trigger shall be at <1.5 mm/0.05 inches of water (negative pressure). Otherwise securely seal up all openings before switching off the air mover.	Cremator room in Existing Crematorium / demolition	Contractor			✓		Waste Disposal (Chemical Waste) (General) Regulation
		Treatment of Waste/Workers Safety Protection: the contractor shall be required to register as a Chemical Waste Producer. All workers shall wear full protective equipment, disposable protective coverall (such as Tyvek) (with hood and shoe covers), nitrile gloves, rubber boots (or boot covers), and full-face positive pressure respirators equipped with a combination cartridge that filters particulate and removes organic vapour. The organic vapour protection is an added protection against the unlikely exposure to any vapour as a necessary measure.							
		If ACM is identified in building structures where severely contaminated DCM is found, relevant abatement measures for building structures described in the AAP (see *7.7.16*) should be implemented prior to the above site preparation.							
	Decontamination, demolition and handling	The cremators/flue/chimney shall be removed from top down starting from the chimney. Any ash or residues attaching to the cremators/flue/chimney or any other building structures shall be removed by scrubbing and HEPA vacuuming. The detached sections of the building structures where severely contaminated DCM is located shall be wrapped with 2 layers of fire retardant polyethene sheets. A third layer shall then be wrapped and secured with duct tape. Decontaminate the outer layer of the wrapped flue sections by wet wiping.							

EIA ref.	Environmental Protection Measures/Mitigation Measures		Location/Timing	Implementation Agent	Implementation Stages				Relevant Legislation and Guidelines
					Des	Con	Dem	Ope	
		Wastes generated from the containment or decontamination unit including the fire retardant polyethene sheets, protection clothing of the workers such as the coverall, nitrile glove, rubber boots and materials used for wet wiping shall be disposed of at landfill site.	Cremator room in Existing Crematorium / demolition	Contractor			✓		Waste Disposal (Chemical Waste) (General) Regulation
		The quantity of wastewater generated from the decontaminated process will be very small but the contractor should take precautionary measures as to minimize the quantity of contaminated water arising. Nevertheless, if any contaminated wastewater needs to be discharged out of the site, it has to be properly treated to WPCO requirements with prior agreement from EPD on discharge standards.							
		After completion of removal, decontaminate the surface where severely contaminated DCM was located, including the wrapped incinerator furnace and flue sections left within the containment, by wet wiping and HEPA vacuum. Then spray the innermost layer of the fire retardant polyethene sheet covering the wall, ceiling and floor with PVA. Upon drying, peel off this innermost layer of the polyethene sheet covering the containment and dispose of at landfill site.							
		Repeat the above decontamination procedure for the second innermost layer of fire retardant polyethene sheet by wet wiping and HEPA vacuuming. After spraying with PVA, peel off this second innermost layer of the polyethene sheet covering the wall, ceiling and floor and dispose of at landfill site. Finally, the last layer of polyethene sheet shall then be taken down after spaying with PVA and be disposed as contaminated wastes.							
		If ACM is identified in building structures where severely contaminated DCM is found, relevant abatement measures for building structures described in the AAP (see *7.7.16*) should be implemented prior to the above decontamination, demolition and handling measures.							
	Treatment and disposal	Waste to be disposed to CWTC: all contaminated ash waste with severely contaminated DCM removed and the used HEPA filters shall be sent to CWTC in Tsing Yi. The total volume should be confirmed by further site investigation.							

EIA ref.	Environmental Protection Measures/Mitigation Measures		Location/Timing	Implementation Agent	Implementation Stages				Relevant Legislation and Guidelines
					Des	Con	Dem	Ope	
		Waste to be Disposed of at Landfill: other wastes including the building structures and its associated panels as well as wastes generated from this decommissioning works are also considered as contaminated waste and shall be disposed of at a designated landfill. Wastes generated from this decommissioning works refer to the polyethene wrapping sheets for the building structures, waste generated from the dismantlement of the containment and decontamination units, and cloth used in wet wrapping, etc. as previously described in this section. They shall be placed into appropriate containers such as drums, jerricans, or heavy duty and leak-proof plastic as a prudent approach. A disposal permit has to be obtained from the Authority. The disposal trip ticket is required to be made available as record after disposal.	Cremator room in Existing Crematorium / demolition	Contractor			✓		Waste Disposal (Chemical Waste) (General) Regulation
		If ACM is identified in building structures where severely contaminated DCM is found, relevant disposal measures for building structures described in the AAP (see *7.7.16*) should be implemented in prior to the above disposal measures.							
S.7.7.22 - S.7.7.24	*Dioxin Containing Materials (DCM) / Heavy Metal Containing Materials (HMCM) /Polyaromatic Hydrocarbon Containing Materials (PAHCM) / Total Petroleum Hydrocarbon Containing Materials (TPHCM) / Polychlorinated Biphenyls Containing Materials (PCBCM) from Soil Remediation at the Project Site*								
	According to the CAR and RAP, less than 100 m^3 of soil would require disposal at landfill. Relevant health and safety procedure, waste disposal requirements and compliance report are as detailed in Figure 6.3. Mitigation measures to avoid fugitive dust emission mentioned in S.4.7.2 should also be observed.		Locations S3 and S5 of CAP / demolition	Contractor			✓		ProPECC PN3/94 APCO
	In addition, after decommissioning but before demolition of the Existing Crematorium, further investigations during Phase I of the works at the vicinity of CLP secondary substation should also be carried out to determine if additional remediation (in addition to the current RAP) is required. Confirmatory test on levels of DCM, HMCM and PAHCM in locations S1 to S6 during Phase II of the works is also required to determine any further remediation /treatment/disposal. In addition, the ash waste in cremator/chimney/flues should also be collected for the testing of DCM/HMCM/PAHCM during Phase II of the works. The sampling and analysis plan should be prepared and submitted to EPD for approval.		CLP secondary substation / after decommission and before demolition	Contractor			✓		ProPECC PN3/94
	All the aforementioned ACM / DCM / HMCM / PAHCM / TPHCM / PCBCM are classified as chemical waste. In addition to the measures mentioned above, the packaging, labelling and storage practices of chemical waste as stipulated in the following paragraphs should also be applied to these contaminated materials.		Project site / demolition	Contractor			✓		Waste Disposal (Chemical Waste) (General) Regulation

EIA ref.	Environmental Protection Measures/Mitigation Measures	Location/Timing	Implementation Agent	Implementation Stages				Relevant Legislation and Guidelines
				Des	Con	Dem	Ope	
S.7.7.25 - S.7.7.27	Chemical Waste All the chemical waste should be handled according to the *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes*. The Contractor should register as a chemical waste producer. The chemical waste should be stored and collected by an approved contractor for disposal at a licensed facility in accordance with the *Waste Disposal (Chemical Waste) (General) Regulation*. Containers used for the storage of chemical waste should:	Project site / demolition	Contractor			✓		Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes. Waste Disposal (Chemical Waste) (General) Regulation.
	• Be suitable for the substance they are holding, resistant to corrosion, maintained in 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 *Waste Disposal (Chemical Waste) (General) Regulation.*							
	The storage area for chemical waste should: • Be clearly labeled 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 from entering (water collected within the bund must be tested and disposal as chemical waste if necessary); and • Be properly arranged so that incompatible materials are adequately separated.							
	The chemical waste should be disposed of by: • A licensed waste collector; • A facility licensed to receive chemical waste, such as the CWTC at Tsing Yi, which offers chemical waste collection service and can supply the necessary storage containers; and/or • A waste recycling plant as approved by EPD.	Project site / demolition	Contractor			✓		Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes. Waste Disposal (Chemical Waste) (General) Regulation.

EIA ref.	Environmental Protection Measures/Mitigation Measures	Location/Timing	Implementation Agent	Implementation Stages				Relevant Legislation and Guidelines
				Des	Con	Dem	Ope	
S.7.7.28 - S.7.7.29	<u>General Refuse</u> General refuse should be stored in enclosed bins or compaction units separated from C&D and chemical wastes. A reliable waste collector should be employed by the contractor to remove general refuse from the site, separately from C&D and chemical wastes, on a daily or every second day basis to minimize odour, pest and litter impacts. The burning of refuse on construction sites is prohibited by law. Aluminum cans are often recovered from the waste stream by individual collectors if they are segregated or easily accessible. Therefore, separately labeled bins for deposit of these cans should be provided if feasible. Similarly, plastic bottles and carton package material generated on-site should be separated for recycling as far as practicable. Site office waste should be reduced through recycling of paper if volumes are large enough to warrant collection. Participation in a local collection scheme should be considered if one is available.	Project site / construction and demolition stages	Contractor		✓	✓		
Waste Management (Operation)								
S.7.8.1	<u>Ash and Non-combustible Residues</u> The disposal of bone ash and non-combustible residues should be properly collected and handled to avoid dust emissions. In line with the current practices, the bone ash will be stored in covered containers for collection by the deceased's relatives within 2 months upon appointment while the non-combustible residues will be collected in sealed heavy-duty polyethene bags for disposal at landfill.	New Crematorium / operation	FEHD				✓	
S.7.8.2- S.7.8.3	<u>Chemical Waste</u> The operator should register as chemical waste producer. The chemical wastes generated from the air pollution control system would mainly include used activated carbon and un-reacted lime and collected particulate matter. To prevent health hazards to operators, all such chemical wastes should be carefully collected and handled to avoid dust emissions. All the chemical wastes generated from the air pollution control system as well as from machinery maintenance and servicing should be dealt with according to the *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes* under the provisions of the *Waste Disposal (Chemical Waste)(General) Regulation*. The chemical wastes should be collected by drum-type containers and removed by a licensed chemical waste contractor. In addition, the relevant measures as provided in S.7.7.22-S.7.7.24 should be followed.	New Crematorium / operation	FEHD				✓	Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes. Waste Disposal (Chemical Waste) (General) Regulation.

EIA ref.	Environmental Protection Measures/Mitigation Measures	Location/Timing	Implementation Agent	Implementation Stages				Relevant Legislation and Guidelines
				Des	Con	Dem	Ope	
S.7.8.4-S.7.8.6	General Refuse Waste generated in offices should be reduced through segregation and collection of recyclable waste materials (such as paper and carton packages) if the volumes are large enough to warrant collection. Participation in a local collection scheme should be considered if one is available. To promote recycling of waste paper, aluminum cans and plastic bottles by the visitors, it is recommended to place clearly labeled recycling bins (such as those available from EPD) at convenient locations within the New Crematorium area. The recyclable waste materials should then be collected by reliable waste recycling agents on a regular basis. The general refuse (other than those segregated recyclable wastes) should be separated from any chemical wastes and stored in covered waste skips. FEHD should remove general refuse from the site, separately from chemical wastes, on daily basis to minimize odour, pest and litter impacts. Burning of refuse must be strictly prohibited.	New Crematorium / operation	FEHD				✓	
Waste Management (EM&A for Construction and Demolition)								
S.11.2.16	Conduct supplementary site investigation for asbestos in building structures and for dioxins, metals (the "Dutch List") and PAH in ash/particular matter samples.	Around existing cremators, chimney and flues inside cremator room / after decommissioning but prior to demolition during Phase II work	Contractor			✓		AIR, AMP/AAP to be submitted under APCO, future supplementary site investigation plan

EIA ref.	Environmental Protection Measures/Mitigation Measures	Location/Timing	Implementation Agent	Implementation Stages				Relevant Legislation and Guidelines
				Des	Con	Dem	Ope	
Landscape and Visual Impact Assessment								
S.8.1.21	The identification of the landscape and visual impacts will highlight those sources of conflict requiring design solutions or modifications to reduce the impacts and, if possible, blend the development with the surrounding landscape. The proposed landscape mitigation measures will be described and illustrated by means of site plans and photomontage and take into account factors including: • Screen planting • Transplanting of mature trees with good amenity value where appropriate • Conservation of topsoil for reuse • Sensitive alignment of structures to minimise disturbance to surrounding vegetation • Reinstatement of areas disturbed during construction • The design and finishes / colours of architectural and engineering structures such as terminals and pylons • Existing views, views of the development with no mitigation, views with mitigation at day one of operation and after 10 years of operation	Project site / design, construction and demolition stages	Contractor/FEHD/Arch SD	✓	✓	✓		EIAO-TM

EIA ref.	Environmental Protection Measures/Mitigation Measures	Location/Timing	Implementation Agent	Implementation Stages				Relevant Legislation and Guidelines
				Des	Con	Dem	Ope	
S.8.2.15 - S.8.2.19	Tree transplanting: The tree survey has identified the trees which will be affected by the development and which could be considered for transplanting prior to commencement of construction work. Felling is considered as a last resort and every effort should be made to transplant the many good trees of high amenity value to either nearby suitable sites within the cemetery or to available space in FEHD's Wo Hop Shek Crematorium pending identification of an alternative site. The feasibility of transplanting will depend on a number of factors such as size, health and species of the tree. Adequate time (a minimum of 4 months) should be allowed for preparing trees for transplanting. Weekly inspection of tree protection measures as well as monitoring of tree transplant operations during both phases should be implemented. Particular care should be taken to save the 9 nos. mature and semi-mature protected tree species and 12 nos. protected shrub and immature tree species identified. To give the protected species the best possible chance of survival it is recommended that they are relocated to sheltered and well maintained planted areas within the cemetery. The following measures for tree transplanting should be adopted: (a) Appoint a landscape contractor for the establishment and maintenance of the transplanted trees as well as any new tree planting for 12 months upon completion of the works. (b) Careful co-ordination of Phase I and II works to allow tree transplanting from Phase II site directly to Phase I site.	Project site / construction and demolition as well as operation stages	Contractor/Arch SD		✓	✓	✓	WBTC 7/2002, WBTC 14/2002, EIAO-TM
	Tree protection: Trees to be retained adjacent to works areas will be carefully protected by strong hoarding and if necessary additional protection to individual tree trunks to avoid damage by machinery. The hoarding will also prevent contractors from compacting soil around tree roots or dumping materials. Reference should be made to the guidelines for tree protection in the Government publication "Tree Planting and Maintenance in Hong Kong".	Project site / construction and demolition stages	Arch SD					
	Topsoil conservation: Any topsoil excavated during construction will be carefully saved and stored to one side of the works area for reuse upon completion.	Project site / upon completion of construction works for each phase	Arch SD					
	Replanting: Upon completion planting of ornamental trees and shrubs will be provided to the periphery of the new crematorium building to help screen and soften the overall appearance of the structure. In addition, a reprovisioned memorial garden with a lotus pond and ornamental planting will be incorporated in the deck area of the building. Since the majority of the new planting will be on the deck structure the selection of species will be more limited with emphasis on smaller trees and ornamental shrubs to comply with loading restrictions. Notwithstanding this site constraint on tree selection, a minimum of 1.2m soil depth will be		Arch SD					

EIA ref.	Environmental Protection Measures/Mitigation Measures	Location/Timing	Implementation Agent	Implementation Stages				Relevant Legislation and Guidelines
				Des	Con	Dem	Ope	
	provide for tree planting on the podium / roof structure for healthy establishment of the new tree planting. Crematorium Architecture: The building profile has been designed in response to the site terraced topography to minimise site formation which greatly reduces the overall visual impact, (refer to *Figures 2.2-2.5* and *8.3* for building plan and master landscape plan). In addition, it is recommended that the material finishes be non-reflective and low-key in nature using predominantly recessive tones to blend in as far as possible with the surrounding vegetation.	Whole Project site/ during design stage	Arch SD	✓				
Landscape and Visual Impact Assessment (EM&A)								
S.11.3.14	Weekly inspections of tree protection measures as well as monitoring of tree transplant operations.	Project site / Phase I & II works	Project Landscape Architect		✓	✓		Landscape Master Plan, Tree Planting and Maintenance in Hong Kong
S.11.3.14	Regular inspection of landscape maintenance work.	Project site / during the 1st, 6th and 12th month after completion of all recommended planting work	Project Landscape Architect				✓	Landscape Master Plan, Tree Planting and Maintenance in Hong Kong
Water Quality								
S.9.6.1	Construction and Demolition Phases – General To safeguard the water quality of the WSRs potentially affected by the Project works, the contractor should implement appropriate mitigation measures with reference to the *Practice Note for Professional Persons, Construction Site Drainage* (*ProPECC PN 1/94*) published by EPD. Such measures are highlighted as follows.	Project site / construction and demolition stages	Contractor		✓	✓		ProPECC PN 1/94
S.9.6.2-S.9.6.5	Construction and Demolition Phases - Construction and Demolition Run-off and Drainage Exposed soil areas should be minimized to reduce the potential for increased siltation, contamination of run-off and erosion. Any effluent discharge from the Project site is subject to the control of Water Pollution Control Ordinance (WPCO) discharge license and should be treated to meet the discharge standard set out in the relevant license. In addition, no site run-off should enter the stream on the eastern side of the Project site. Run-off impacts associated with the construction and demolition activities can be readily controlled through the use of appropriate mitigation measures, which include:	Project site / construction and demolition stages	Contractor		✓	✓		ProPECC PN 1/94

EIA ref.	Environmental Protection Measures/Mitigation Measures	Location/Timing	Implementation Agent	Implementation Stages				Relevant Legislation and Guidelines
				Des	Con	Dem	Ope	
	• Temporary ditches should be provided to facilitate run-off discharge into appropriate watercourses, via a silt retention pond • Boundaries of earthworks should be marked and surrounded by dykes • Open material storage stockpiles should be covered with tarpaulin or similar fabric to prevent material washing away • Exposed soil areas should be minimized to reduce the potential for increased siltation and contamination of run-off • Earthwork final surfaces should be well compacted and subsequent permanent work should be immediately performed • Use of sediment traps wherever necessary • Maintenance of drainage systems to prevent flooding and overflow All temporary drainage pipes and culverts provided to facilitate run-off discharge should be adequately designed to facilitate rapid discharge of storm flows. All sediment traps should be regularly cleaned and maintained. The temporarily diverted drainage should be reinstated to its original condition, when the construction/demolition work is completed.							
	Sand and silt in wash water from wheel washing facilities should be settled out and removed from discharge into temporary drainage pipes or culverts. A section of the haul road between the wheel washing bay and the public road should be paved with backfall to prevent wash water or other site run-off from entering public road drains.							
S.9.6.2-S.9.6.5 cont'	Oil interceptors should be provided in the drainage system downstream of any significant oil and grease sources. They should be regularly maintained to prevent the release of oil and grease into the storm water drainage system after accidental spillage. The inceptor should have a bypass to prevent flooding during periods of heavy rain, as specified in *ProPECC PN 1/94*.	Project site / construction and demolition stages	Contractor		✓	✓		ProPECC PN 1/94
S.9.6.6	Construction and Demolition Phases - General Construction and Demolition Activities All the solid waste and chemical waste generated on site should be collected, handled and disposed of properly to avoid affecting the water quality of the nearby WSRs. The proper waste management measures are detailed in S.7.7.5-S.7.7.6.	Project site / construction and demolition stages	Contractor		✓	✓		ProPECC PN 1/94
S.9.6.7	Construction and Demolition Phases - Sewage Generated from On-site Workforce The sewage from construction work force is expected to be handled by portable chemical toilets if the existing toilets in the Project site are not adequate. Appropriate and adequate portable toilets should be provided by licensed contractors who will be responsible for appropriate disposal and maintenance of these facilities.	Project site / construction and demolition stages	Contractor		✓	✓		ProPECC PN 1/94

EIA ref.	Environmental Protection Measures/Mitigation Measures	Location/Timing	Implementation Agent	Implementation Stages				Relevant Legislation and Guidelines
				Des	Con	Dem	Ope	
S.9.6.8-S.9.6.10	<u>Construction and Demolition Phases - Soil Remediation Activities</u> Mitigation measures will need to be implemented during the currently identified soil remediation activities. If further land contamination investigation results (at CLP secondary substation during Phase I and at locations S1 to S6 during Phase II) confirm the needs for further soil remediation prior to demolition of the Existing Crematorium, relevant water quality mitigation measures (in addition to the current RAP) will need to be identified and implemented by the contractor. In addition, the mitigation measures recommended for minimizing water quality impacts for construction and demolition run-off and drainage as well as for general construction and demolition activities should also be adopted where applicable. In order to avoid impacts on water quality during further remedial works, care will be taken to minimise the mobilisation of sediment during excavation and transport. Measures to be adopted will be based on the recommendations set out in *Practice Note for Professional Persons ProPECC PN1/94 "Construction Site Drainage"*. The results of the site investigation suggest that there is unlikely to be any requirement for dewatering of excavations, since groundwater was not encountered in any of the exploratory holes. The contractor carrying out the remedial works will be required to submit a method statement detailing the measures to be taken to avoid water quality impacts. Typical measures would include: • Carry out the works during the dry season (i.e. October to March) if possible • Use bunds or perimeter drains to prevent run-off water entering excavations • Sheet or otherwise cover excavations whenever rainstorms are expected to occur • Minimise the requirements for stockpiling of material and ensure any stockpiles are covered • Temporary on-site stockpiling of contaminated materials should be avoided, all excavated contaminated soils/materials should be disposed of on a daily basis • Ensure that any discharges to storm drains pass through an appropriate silt trap	Project site / construction and demolition stages	Contractor		✓	✓		ProPECC PN 1/94
S.9.6.11	Arch SD will, during detail design stage, ensure the public sewer where the connection will be made is capable of handling the extra sewage (i.e., 14 m^3 per day) generated by the New Crematorium.	Public sewerage connection / design stage	Arch SD	✓				
Hazard to Life								
S.10.3.2	<u>Fuel Tank Design – Underground Fuel Tank for Cremators (30,000 L)</u> The underground fuel tank will be buried underground in concrete chamber with vent pipe (vent pipe outlet will be at a level about 4 m above ground)	Fuel tank in the New Crematorium / design stage	Arch SD	✓				Dangerous Goods Ordinance (Cap 295)

EIA ref.	Environmental Protection Measures/Mitigation Measures	Location/Timing	Implementation Agent	Implementation Stages				Relevant Legislation and Guidelines
				Des	Con	Dem	Ope	
S.10.3.2	Fuel Tank Design – Daily Service Fuel Tank for Cremators and Fuel Tank for Emergency Generator (2,000 L each) • For generator, vent pipe with outlet will be at a distance of 1.5 m from other air intake louvers and public access • For cremators installation, the daily services fuel tank will be located at roof top • Door louvers quipped with electro-thermal link will be provided at the fuel tank room (with door sill) for natural ventilation • Fire services installations including heat detection system, auto-spray unit and sand buckets will be provided for genset room • Quick closing mechanism (fuel shut off valve) will be installed outside the fuel tank room of generator to cut the diesel supply in case of fire at fuel tank room /generator room	Fuel tank in the New Crematorium / design stage	Arch SD	✓				Dangerous Goods Ordinance (Cap 295)
S.10.3.3	Fuel Storage and Transportation The storage, transportation and handling of diesel fuel is under the control of DGO (Cap 295) and compliance with the DGO requirements should be ensured. Diesel leaks from the diesel fuel tanks or pipework systems may seep into the ground and enter chambers such as tunnels, drains and sewers. The undetected build-up of diesel in a confined space will create a fire hazard. The following safety measures should be observed around the diesel storage tanks during operation of the New Crematorium: • Inventory check should be conducted by staff regularly to identify any signs of fuel leakage • Regular visual inspections to detect any early signs of fuel spillage • Precautionary exercises, including fire drills, should be regularly undertaken to enhance staff capability to handle emergencies	New Crematorium / operation	FEHD				✓	Dangerous Goods Ordinance (Cap 295)
S.10.3.4	DG Storage The design of DG store and its operation must comply with the requirements set in Cap 295. Precautionary measures mentioned below should also be followed, when relevant chemical is stored at the dangerous goods storage:	New Crematorium / operation	FEHD				✓	Dangerous Goods Ordinance (Cap 295)

EIA ref.	Environmental Protection Measures/Mitigation Measures	Location/Timing	Implementation Agent	Implementation Stages				Relevant Legislation and Guidelines
				Des	Con	Dem	Ope	
S.10.3.4	DG Storage -Handling and Labeling • Obtain details for the handling, storage and control of impurities and spills from supplier or manufacturer (e.g. MSDS[1]). • Obtain details of the chemical composition of the substances, and correct treatment with eyes, skin, ingestion, etc from the supplier or manufacturer (usually available in a MSDS) • Ensure the correct and complete labelling and classification of chemical substances and guidelines are adopted (see Labour Department's reference booklet on "Labelling and Classification of Dangerous Substances Commonly used in Industry") • Ensure that the information is up to date, provided to the relevant staff, and easily accessible in case of emergency in accordance with the site safety guidelines • Register dates (receiving date, manufacturing date, expiry date, shelf life whereas applicable) and quantities of all purchases on receipt to minimise surplus and spoilt orders	New Crematorium / operation	FEHD				✓	Dangerous Goods Ordinance (Cap 295) Labelling and Classification of Dangerous Substances Commonly used in Industry
S.10.3.5	DG Storage -Containers for Storage of Chemicals and Dangerous Goods (DGs) The following practices shall be followed in ensuring the use of suitable containers for chemicals. • Designed to minimise spills • Ensure container is appropriate for its contents, resistant to corrosions, maintained in good conditions and securely closed • Provide proper labelling	New Crematorium / operation	FEHD				✓	Dangerous Goods Ordinance (Cap 295) Labelling and Classification of Dangerous Substances Commonly used in Industry

[1] Material Safety Data Sheet

EIA ref.	Environmental Protection Measures/Mitigation Measures	Location/Timing	Implementation Agent	Implementation Stages				Relevant Legislation and Guidelines
				Des	Con	Dem	Ope	
S.10.3.6	<u>DG Storage - Storage Requirements</u> The following practices shall be followed in ensuring suitable storage (including temporary store for goods to be delivered) and transportation of chemicals and DGs. • No smoking in storage areas • No naked light and no heating equipment shall be used in any store. • No electrical equipment shall be used or installed in any store other than equipment of a type approved by the Authority. • There shall be at all times conspicuously displayed outside any store a notice, in English and Chinese, prohibiting smoking and the use of naked light • Segregate chemical substances to prevent reaction and contamination • Use proper racks, storage bins and shelves to contain leaks • Storage areas must be locked to prevent unauthorised access, clearly labelled and solely for the storage (except for the temporary store for goods to be delivered) of chemicals/dangerous goods • Adequate ventilation in storage areas as necessary • Provide appropriate equipment and manpower to avoid the likelihood of spillage • DGs must be stored in the designated stores and the storage quantities must be within limits • All containers shall be kept upright to minimise the likelihood of spillage	New Crematorium / operation	FEHD				✓	Dangerous Goods Ordinance (Cap 295) Labelling and Classification of Dangerous Substances Commonly used in Industry
S.10.3.7	<u>DG Storage – Handling and Spill Prevention</u> The following practices shall be followed in ensuring suitable handling and spill prevention of chemicals and dangerous goods: • Follow the safety instructions provided by site management and chemical label • Do not misuse or interfere with safety equipment or appliance provided • Do not smoke, eat or drink in any place where chemical substances / DGs are stored or used	New Crematorium / operation	FEHD				✓	Dangerous Goods Ordinance (Cap 295) Labelling and Classification of Dangerous Substances Commonly used in Industry
S.11.5.1	The New Crematorium operator should adopt environmental management plan for the operation of New Crematorium as a means to ensure satisfactory environmental performance of the facilities at all times.	New Crematorium / operation	FEHD				✓	

Des – Design, Con – Construction, Dem – Demolition and Ope – Operation