Architectural Services Department

Environmental Consultancy for

Provision of a Poultry Slaughtering Centre in Sheung Shui

Environmental Impact Assessment Report
Volume I – Main Text

5 June 2009

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TABLES

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ABBREVIATIONS

A	AADT	Annual average daily traffic
	AFCD	Agriculture, Fisheries and Conservation Department
	AGR	Agriculture (designation on OZP)
	ANL	Acceptable Noise Levels
	APCO	Air Pollution Control Ordinance
	AQO	Air Quality Objectives
	ArchSD	Architectural Services Department
	ASR	Area Sensitivity Rating
	ASRs	Air Sensitive Receivers
B	BATBREF	Reference Document on Best Available Techniques [in Slaughterhouse and Animal By-products Industries, EU, May 2005
	BNL	Basic Noise Level
	BOD	Biological Oxygen Demand
	BPM	Best Practicable Means
C	CAP	Contamination Assessment Plan
	CAR	Contamination Assessment Report
	CEDD	Civil, Engineering and Development Department
	C&D	Construction & Demolition (Material)
	CIBSE	Chartered Institution of Building Services Engineers (UK)
	CNP	Construction Noise Permit
	COD	Chemical Oxygen Demand
	CSWWM	Cheung Sha Wan Wholesale Market
	CSWPWM	Cheung Sha Wan Poultry Wholesale Market
	CRTN	Calculation of Road Traffic Noise, published by the Department of Transport, UK, 1988
	CWTC	Chemical Waste Treatment Centre
D	DA-TM	Technical Memorandum on Noise from Construction Work other than Percussive Piling
	DAF	Dissolved Air Flotation
E	EB	Environment Bureau
	EIA	Environmental Impact Assessment
	EIAO	Environmental Impact Assessment Ordinance
	EIAO-TM	Environmental Impact Assessment Ordinance Technical Memorandum
	EM&A	Environmental Monitoring and Audit
	EMP	Environmental Management Plan
	EN13725	European Standard Method for Dynamic Olfactometry
	EP	Environmental Permit
	EPD	Environmental Protection Department
	ER	Emission Rate (for Odour)
	ESB	EIA Study Brief
	ET	Environmental Team
	ETWB	Environment, Transport and Works Bureau (forerunner of EB)

F	FAO	Food and Agriculture Organisation (of the United Nations)
	FEHD	Food and Environmental Hygiene Department
	FHB	Food and Health Bureau
G	GB	Green Belt (designation on OZP)
	GFA	Gross Floor Area
	G/IC	Government / Institutional / Community (designation on OZP)
	GP-VS	Good Practices on Ventilation System Noise Control, EPD, 1999
	GW-TM	Technical Memorandum on Noise from Construction Work other than Percussive Piling
H	H5N1, H9N2	Types of avian influenza virus, or bird 'fllu'
	HKPSG	Hong Kong Planning Standards and Guidelines
	HKSAR	Hong Kong Special Administrative Region
	HOKLAS	Hong Kong Laboratory Accreditation Scheme
	HTML	Hyper Text Markup Language
	HVS	High Volume Sampler
I	IEC	Independent Environmental Checker
	IFC	International Finance Corporation
	IND-TM	Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites
	ISCST3	Industrial Source Complex Short-Term (air pollution model) developed by USEPA
L	LandsD	Lands Department
	LCA	Landscape Character Areas
	LIA	Landscape Impact Assessment
	LR	Landscape Resources
M	mAG	Metres Above Ground
	MBR	Membrane Bio-Reactor
	MSW	Municipal Solid Waste
	mPD	Meters per Datum
N	NCO	Noise Control Ordinance
	NENT	Northeast New Territories (Landfill)
	NO_2	Nitrogen dioxide
	NO_X	Nitrogen oxides
	NSRs	Noise Sensitive Receivers
O	OWTF	Organic Waste Treatment Facility
	OS	Open Storage (designation on OZP)
	OU	Odour Unit or Other Specified Use (designation on OZP)
	OZP	Outline Zoning Plan
P	PHI	Potentially Hazardous Installation
	PlanD	Planning Department
	PME	Powered Mechanical Equipment
	PNL	Predicted Noise Level
	PolyU	Hong Kong Polytechnic University
	PPE	Personal Protective Equipment
	PP-TM	Technical Memorandum on Noise from Percussive Piling

	ProPECC	Practice Note for Professional Persons
	PSC	Poultry Slaughtering Centre (this Project)
R	RAP	Remediation Action Plan
	RCV	Refuse Collection Vehicle
	RR	Remediation Report
S	SBR	Sequencing Batch Reactor
	SIA	Sewerage Impact Assessment
	SO_2	Sulphur dioxide
	SP	Specified Process
	SPS	Sewage Pumping Station
	SS	Suspended Solids
	SSWTW	Sheung Shui Water Treatment Works
	SWHSTW	Shek Wu Hui Sewage Treatment Works
	STT	Short-term Tenancy
	SWL	Sound Power Level
T	T&C	Testing and commissioning
	TC	Technical Circular
	TD	Transport Department
	TM	Technical Memorandum
	TPO	Town Planning Ordinance
	TRA	Tree Removal Application
	TSP	Total Suspended Particulates
U	USDA	United States Department of Agriculture
	USEPA	United States Environmental Protection Agency
V	V	Village-type Development (designation on OZP)
	VIA	Visual Impact Assessment
	VOCs	Volatile Organic Compounds
	VSRs	Visual Sensitive Receivers
W	WBTC	Works Bureau/Branch Technical Circular
	WCZ	Water Control Zone
	WHO	World Health Organisation
	WMP	Waste Management Plan
	WPCO	Water Pollution Control Ordinance
	WPCO-TM	Technical Memorandum on the Water Pollution Control Ordinance
	WQO	Water Quality Objectives
	WSRs	Water Sensitive Receivers
	WTF	On-site Wastewater Treatment Facilities

1 INTRODUCTION

1.1 Background

1.1.1 In order to pursue the goal of segregating live poultry and the population so as to minimise the risk of an outbreak of avian influenza, the Government of the HKSAR (the Government) has proposed to develop a Poultry Slaughtering Centre (PSC) for terrestrial poultry. A site in Sheung Shui has been identified for the development of the PSC, which will comprise two identical "stalls" that provide for reception of poultry, slaughter, packing and collection.

1.1.2 The PSC is expected to provide freshly slaughtered chickens and a smaller number of freshly slaughtered "minor" poultry, such as pigeons, chukar, guinea fowl, pheasant, etc. The PSC products will cater for market demand for slaughtered poultry, such as from the restaurant trade, fresh provisions shops, wet markets and supermarkets.

1.1.3 The Food and Environmental Hygiene Department (FEHD) in consultation with the Food and Health Bureau (FHB) will oversee the development of the project, whilst Architectural Services Department (ArchSD) is the works department. Hyder Consulting Limited has been engaged by ArchSD to undertake the Environmental Impact Assessment (EIA) in accordance with EIA Study Brief (ESB) No. ESB-163/2007, which was issued by the Environmental Protection Department (EPD) on 15 February 2007 under Section 5(1)(a) of the Environmental Impact Assessment Ordinance (EIAO).

1.1.4 The Government intends to provide the infrastructure and buildings comprising the PSC and will tender out each stall to a private Operator who will be responsible for fitting out the buildings and operating their stall. Under this arrangement, an Environmental Permit (EP) will be applied for, prior to commencement of site formation and construction, and may reference this EIA Report. The two Operators will each be required to meet the operational requirements of the EP.

1.2 Purpose of EIA Study

1.2.1 The purpose of this EIA Study is to provide information on the nature and extent of environmental impacts likely to arise from the construction and operation stages of the Project and related activities taking place concurrently. The information provided by this EIA Study will contribute to the decision on:

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

1.3 Objectives of the EIA Study

1.3.1 The objectives of this EIA study are to:

- Describe the Project and associated works together with the requirements for carrying out the Project;
- Identify and describe elements of the community and environment likely to be affected by the Project and/or likely to cause adverse impacts to the Project, including natural and man-made environment and the associated environmental constraints;
- Give consideration to selecting alternative Project options, sites, layouts, designs and construction methods with a view to avoiding and minimizing the potential environmental impacts;
- Provide reasons for selecting the preferred option(s) and describe the environmental considerations taken into account in the selection;
- Identify and quantify key environmental issues/impacts and determine the significance of impacts on sensitive receivers and potential affected uses;
- Propose mitigation measures so as to minimise pollution, environmental disturbance and nuisance during construction and operation of the Project;
- Investigate the feasibility, practicability, effectiveness and implications of the proposed mitigation measures;
- Identify, predict and evaluate the residual environmental impacts and the cumulative effects expected to arise during construction and operation stages of the Project in relation to the sensitive receivers and potential affected uses;
- Identify, assess and specify methods, measures and standards, to be included in the detailed design, construction and operation stages of the Project which are necessary to mitigate these environmental impacts and cumulative effects and reduce them to acceptable levels;
- Investigate the extent of the secondary environmental impacts (if any) that may arise from the proposed mitigation measures and to identify constraints associated with the mitigation measures recommended in the EIA Study, as well as the provision of any necessary modification; and
- Design and specify environmental monitoring and audit requirements to ensure the effective implementation of the recommended environmental protection and pollution control measures.

1.4 Study Approach

1.4.1 The EIA Study will address the likely key issues described below, together with any other key issues identified during the course of the EIA Study:

- Potential air quality impact to nearby air sensitive receivers during construction and operation of the Project;
- Potential noise impact to nearby noise sensitive receivers during construction and operation of the Project, including night-time operation and off-site traffic noise along Man Kam To Road and Jockey Club Road from Man Kam To Road to Po Shek Wu Road;

- Potential water quality impact on nearby water sensitive receivers, including Ng Tung River during construction and operation of the Project;
- Sewerage and Sewage Treatment Implications;
- Waste arising as a result of the construction and operation of the Project;
- Potential land contamination from land to be resumed for the Project;
- Potential landscape and visual impacts from construction and operation of the Project; and
- Potential cumulative environmental impacts of the Project, through interaction or in combination with other existing, committed and planned developments in the vicinity of the Project, and that those impacts may have a bearing on the environmental acceptability of the Project.

1.4.2 The EIA Study covers the combined impacts of the Project as well as the cumulative impacts of existing, committed and planned developments in the vicinity of the Project.

1.4.3 The EIA Report has been prepared in accordance with the requirements stipulated in the Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM). This covers relevant project information, relevant legislation, existing environmental conditions, assessment criteria and methods, assessment findings and proposed mitigation measures.

1.5 Structure of EIA Report

1.5.1 The EIA Report is presented in two volumes. Volume I (this report) comprises:

- Section 1: Introduction;
- Section 2: Project Description;
- Section 3: Air Quality Impact Assessment;
- Section 4: Noise Impact Assessment;
- Section 5: Water Quality Impact Assessment;
- Section 6: Sewerage and Sewage Treatment Implications;
- Section 7: Waste Management Implications;
- Section 8: Assessment of Potential Land Contamination
- Section 9: Human Health Risk;
- Section 10: Landscape and Visual Impact Assessment;
- Section 11: Environmental Outcomes;
- Section 12: Environmental Monitoring and Audit Requirements; and
- Section 13: Conclusion and Recommendations.

1.5.2 Volume II contains figures and appendices. The five appendices contain further information relating to air quality modelling; noise modelling; an excerpt from the Draft EIA for Proposed Cheung Sha Wan Wholesale Market Complex; the tree survey; and the project implementation schedule. A stand-alone EM&A Manual has also been prepared, and the entire EIA is summarised in a separate, bi-lingual Executive Summary.

2 PROJECT DESCRIPTION

2.1 The Need for the Project

Impact of Avian Influenza Outbreaks

2.1.1 Avian Influenza (such as H5N1, H9N2, etc.) is a type of influenza A, known previously to infect poultry only. In Hong Kong in 1997, 18 human cases of H5N1 strain were documented, six of which were fatal. In the 1997 outbreak in Hong Kong, all live poultry in retail outlets and chicken farms were depopulated. After that incident, Hong Kong suffered a few more outbreaks in retail markets and chicken farms in 2001, 2002 and 2008, resulting in further culling of poultry.

2.1.2 In early 2004, there were extensive outbreaks of Avian Influenza in over 10 countries or places in Asia. Reports from the World Health Organization (WHO) showed that Avian Influenza affected wide areas in the world other than Asia, including Europe and South Africa.

2.1.3 Although Human-to-Human transmission is inefficient, all influenza viruses have the ability to change genetically, and scientists are concerned that the H5N1 virus could one day be able to spread easily from one person to another.

2.1.4 On 2 April 2004, the Administration briefed the Panel on Food Safety and Environmental Hygiene of the Legislative Council (the Panel) on the public consultation paper on "Prevention of Avian Influenza: consultation on long term direction to minimise the risk of human infection". Apart from enhanced surveillance and monitoring measures put in place to prevent Avian Influenza outbreaks in local farms and wholesale/retail markets, the Administration informed the Panel that, for the protection of public health, the present mode of operation of the live poultry trade would have to be modified. It was the policy to separate humans from live poultry and to minimise the contact between the public and live poultry. The Administration considered that the development of a PSC is the long-term measure to reduce the risk of human infection of H5N1.

Current Situation – the Need for the Project

2.1.5 To prevent Avian Influenza outbreaks in Hong Kong, immediate improvement measures have been put in place over the past few years. These include vaccination of local and Mainland chickens; improved biosecurity measures in farms; daily thorough cleaning and disinfection at poultry retail outlets and wholesale market; banning of backyard poultry keeping in Hong Kong and overnight poultry keeping at retail premises. These measures were backed up by an intensive public education campaign.

2.1.6 Notwithstanding, the presence of live poultry at wholesale/retail markets increases the risk of human infection. When the PSC comes into operation, the sale of live poultry at the Cheung Sha Wan Temporary Wholesale Poultry Market and at all retail outlets will no longer continue.

2.1.7 Avian influenza is now a global issue – according to the WHO *[Ref.1]* as of 2 June 2009, a total of 433 human cases and 262 deaths have been reported world-wide, many in Asia.

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1. http://www.who.int/csr/disease/avian_influenza/country/cases_table_2009_06_02/en/index.html

Absence of the Project

2.1.8 If the Project were not to go ahead then the current practice of poultry slaughtering in wet markets and other smaller facilities would continue. The public would continue to be exposed to live poultry and there is a credible public health risk to continuing this current practice.

2.1.9 With avian influenza in wet markets and a chicken farm confirmed in Hong Kong in June 2008 and December 2008, respectively, and a number of human cases and deaths reported in China earlier this year, the threat of avian influenza to Hong Kong remains high.

2.1.10 The need for the PSC is therefore urgent and forms part of Government's efforts to prevent the resurgence of avian influenza in Hong Kong.

2.2 Consideration of Alternative Locations

2.2.1 Given the activities to be carried out within the PSC and in recognition of the human health issues related to poultry slaughtering, the site for the PSC should:

- Be located in close proximity to local farms and the boundary with the Mainland;
- Be distant from major residential areas;
- Be well-ventilated;
- Result in minimal environmental impact;
- Be easily accessible via a well-developed transportation network;
- Have access to basic infrastructure; and
- Be available within the timeframe of the project.

Territory-wide Site Search in 2004

2.2.2 In consideration of the above, a number of possible areas were identified for the PSC during an initial site search in 2004. ***Table 2-1***, below, describes the results of this site search exercise.

Area	Discussion	Compatibility with Site Requirements
Tuen Mun West	The main border crossing at Man Kam To is a considerable distance from this area and so would result in significant vehicular transport requirements within Hong Kong (causing air and noise impacts). Furthermore, there are no suitable sewage treatment plants in the area and a suitable piece of land available within the timeframe was not identified	This area failed to meet the requirements in terms of ease of transport access, existence of basic infrastructure and availability within the project timeframe. **This area has been rejected.**
Man Kam To – in part of the closed border area that may be opened up for future development	The possible opening up of this area is unlikely to be implemented until 2010 and planning studies to identify appropriate land use have yet to be completed. Thereafter, infrastructure (such as roads) and utilities (such as water, electricity, sewage, communications) would need to be provided, which would take another two and a half years.	This area failed to meet the requirements in terms of existence of basic infrastructure and availability of a suitable site within the project timeframe. **This area has been rejected.**

Area	Discussion	Compatibility with Site Requirements
Lok Ma Chau	The area is currently occupied by fishponds and other habitats of high ecological value. There is little existing infrastructure (in particular for sewage treatment) and a suitable piece of land available within the timeframe was not identified	This area failed to meet the requirements in terms of existence of basic infrastructure, minimising environmental impact and availability of a suitable site. **This area has been rejected.**

Table 2-1 Territory-wide Site Search in 2004

Second Site Search in Sheung Shui Area

2.2.3 Following the territory-wide consultation exercise in 2004, a more detailed site search study for the proposed Plant was carried out in Sheung Shui district. This considered the concerns raised by local residents during the consultation.

2.2.4 Two alternative sites were identified, namely Site A (adjacent to Hung Kiu San Tsuen) and Site B (adjacent to Sheung Shui Water Treatment Works – SSWTW, as indicated in ***Figure 2-1***. ***Table 2-2***, below, describes the results of this second site search exercise.

Area	Discussion	Compatibility with Site Requirements
Site A – Adjacent to Hung Kiu San Tsuen	This open, well-ventilated site is bounded by Man Kam To Road to the southwest, Hung Kiu San Tsuen to the south and vegetated areas to the east and north. The total area is about 13,700m^2. Man Kam To Road provides easy access to the border. The Site is more than 900m from major residential areas but is adjacent to the small village of Hung Kiu San Tsuen to the south, comprising 16 dwellings. Rezoning of the site is needed and will take about 12 months. All major utilities are available, although a sewer to Shek Wu Hui Sewage Treatment Works (SWHSTW) would need to be constructed.	The site has met all of the requirements, although the proximity of Hung Kiu San Tsuen is a concern. **Notwithstanding, this site is considered acceptable.**
Site B – Adjacent to Sheung Shui Water Treatment Works	This site is about 13,000m^2 in area and is bounded by the Sheung Shui Water Treatment Works (SSWTW) to the southwest and small hills on all other sides. The small hills form a natural shelter separating the site from nearby dwellings. The site is rectangular and is about 1,600m from Tsung Pak Long and 950m from Sheung Shui Heung. Access to the site is by way of a 300m long x 11m wide side road leading from Man Kam To Road, but this would need upgrading. The travelling distance to Fanling Highway is about 2.7km. Because of chlorine storage, SSWTW is designated as a Potentially Hazardous Installation (PHI). Stringent protective measures and extensive works may be required to mitigate hazard to life risks and rezoning would likely take longer than 11 months because of the proximity of the PHI. All major utilities are available, although a dedicated sewer will be needed to SWHSTW.	This site failed to meet the requirements in terms of access (the existing road needs upgrading), environmental impact (the close proximity of the PHI) and availability (rezoning will likely take a long time). **This site has been rejected.**

Table 2-2 Sheung Shui Site Search

Conclusion

2.2.5 Areas in Tuen Mun West, Man Kam To and Lok Ma Chau were examined but were rejected on various grounds. The part played by environmental factors in the rejection of these areas included transportation distance (Tuen Mun West), availability of sewage treatment infrastructure (all areas) and ecological impact (Lok Ma Chau), and is summarised in ***Table 2-3***.

2.2.6 Two sites, Site A and Site B, were subsequently identified in Sheung Shui. Upon closer examination, Site A was found to meet all requirements for siting the PSC, however, the close proximity of Hung Kiu San Tsuen is a concern that will need to be addressed by the design of the PSC and of mitigation measures, especially those relating to noise and odour.

2.2.7 Upon closer examination, Site B was rejected on various grounds. The part played by environmental factors in the rejection of Site B was primarily the hazard to life risk posed by the close proximity of SSWTW, which is a PHI by virtue of chlorine storage, and is summarised in ***Table 2-3***. The preferred site, Site A, is described in more detail in the following sections.

	Potential Site / Area				
Environmental Factors	**Tuen Mun West**	**Man Kam To CBA**	**Lok Ma Chau**	**Sheung Shui Site "A"**	**Sheung Shui Site "B"**
Air	✘				
Noise	✘				
Water/Sewage	✘	✘	✘		
Waste					
Ecology			✘		
Landscape & Visual					
Hazard					✘
Other*	✘	✘	✘		✘
Overall	✘	✘	✘	✓	✘

Note: "✓" indicates acceptance and "✘" indicates rejection on environmental grounds for each site / area

* See explanation in ***Tables 2-1 and 2-2***.

Table 2-3 Summary of Environmental Factors in Site Selection

2.3 Consideration of Alternative Construction Methods and Sequences of Works

Alternative Construction Methods

2.3.1 The method by which the PSC will be constructed has not been examined in detail, since the detailed design and construction of the PSC will be carried out under separate arrangement at a later stage.

2.3.2 However, for the purpose of this EIA, it is reasonable to assume that conventional construction methods and plant will be used for the construction works. Construction involves standard site formation/earthworks; utilities laying and connections; building foundations; asphalt laying; and superstructure construction.

2.3.3 These standard construction methods, including excavation by backhoe, piling and/or laying of foundation slabs, reinforced concrete frame building using formwork, external cladding, etc. are all well established in Hong Kong.

2.3.4 With the implementation of appropriate mitigation measures and good site management practices, as described in ***Sections 3.7, 4.8 and 5.7****,* the proposed standard construction methods will not cause adverse environmental impacts. For this reason, it is unlikely that alternative construction methods will achieve any significant reduction in environmental impacts.

2.3.5 Notwithstanding, the following alternative construction methods have been considered:

- **Off-site Fabrication** can reduce on-site environmental impacts (dust, noise, waste generation, etc.) by pre-fabricating repetitive elements of the building – it is often used in the construction of tower blocks. Considering the environmental benefits and dis-benefits of off-site fabrication, and the lack of significant repetition within the simple design of the PSC, it is unlikely that off-site fabrication will offer any environmental advantage and so is not recommended for further consideration.
- **Piling** is unlikely, given the current design direction of the PSC. However, if piling is required, then percussive piles and socketted H-piles can be considered. Percussive piles would cause substantial noise and vibration impacts, particularly at the adjacent Hung Kiu San Tsuen, whereas the noise and vibration impacts from the use of socketted H-piles would be significantly lower. Considering the environmental benefits and dis-benefits of the alternative piling methods, in the unlikely event that piling is required then socketted H-piles are recommended.
- **Quality Powered Mechanical Equipment (QPME)** are Powered Mechanical Equipment (e.g. backhoes, bulldozers, generators, etc.) that are relatively quiet and environmentally friendly, often meeting EU Directive 2000/14/EC or other equivalent standards. Although for reasons of worst case assessment the EIA has not assumed QPME will be used, it is recommended that the Works Contractor should support EPD's QPME initiative and use QPME for this Project, particularly given the proximity of Hung Kiu San Tsuen.

Sequence of Works

2.3.6 The following alternative sequences of construction were considered.

- **Concurrent Construction** involves various construction activities occurring at the same time. The environmental benefit of this construction sequence would be the reduction of the construction period and hence the duration of impact due to the construction. However, the magnitude of the overall environmental impact could be significant.
- **Phased Construction** involves construction activities being carried out sequentially, one followed by another. This construction sequence would help reduce the magnitude of the overall impacts, but the construction period would be longer.

2.3.7 As the two approaches have their environmental benefits and disbenefits, a balanced approach involving both concurrent and phased construction in different stages of construction is recommended. This will enable the short timeframe for construction to be met (see ***Section 2.7***), yet will also minimise the impact at sensitive receivers, such as Hung Kiu San Tsuen.

2.3.8 It will be the responsibility of the future Designer / Works Contractor to sequence the construction works appropriately to meet the target completion date, while also minimising the duration and magnitude of environmental impacts.

2.4 Preferred Scenario – Project Description

Location – Planning Context

2.4.1 The location of this site is shown in ***Figure 2-2***. The site is bounded by Man Kam To Road to the southwest, Hung Kiu San Tsuen to the south and vegetated areas to the east and north. The total area is about 12,791m^2.

2.4.2 The site comprises three small areas i.e. two former Short-term Tenancies (STTs) and a site zoned for a Petrol Fuel Station. STT 1118, a fee-paying public vehicle park, has expired, while STT 1363 for car-repairing and open-storage, was terminated on 27 February 2009. Basic infrastructure, such as water and electricity supply is readily available.

2.4.3 The Site is Government land, which currently falls partly in an area zoned "Open Storage" and partly in an area zoned "Other Specified Uses" annotated "Petrol Filling Station" on the Fu Tei Au and Sha Ling Outline Zoning Plan No. S/NE-FTA/10 (hereafter called the "OZP").

2.4.4 The Site is situated adjacent to Man Kam To Road, which is the main access road to/from the border area and so provides direct vehicular access to/from the border crossing, which is approximately 2km from the Site. The site is about 1,800m from Tsung Pak Long and 950m from Sheung Shui Wan Shan. The travelling distance to/from Fanling Highway is about 2.2km.

2.4.5 While the Site is more than 900m from major residential areas, to the immediate south of the site there are dwellings – the small village of Hung Kiu San Tsuen.

2.4.6 Government will initiate a re-zoning of the OZP to make it permissible for the site to be used for developing the PSC.

Location – Physical Environment

2.4.7 The surroundings of the site are mostly open carparks, open storage yards and vehicle-repair workshops.

2.4.8 The small village of Hung Kiu San Tsuen, which has 16 permitted structures and a few tens of residents, is located to the south of the Site, as shown in ***Photograph 2-1.*** The site is open to Man Kam To Road on the south, as shown in ***Photograph 2-2***. The site itself is located within a "bowl" formed by low hills to the east, as shown in ***Photograph 2-3***, which also shows the former use of the Site as a lorry park. An abandoned concrete batching plant lies to the north, as shown in ***Photograph 2-4***.

Photograph 2-1 View to the South – Hung Kiu San Tsuen

Photograph 2-2 View to the West – Site Entrance and Man Kam To Road

Photograph 2-3 View to the East – Hills Surrounding the Site Creating a "Bowl" Effect

Photograph 2-4 View to the North – Concrete Batching Plant

(Note Sign Indicating that Operation of the Plant Has Ceased)

Site History

2.4.9 Prior to its recent use as a fee-paying public vehicle park, the site was used for light industry and storage. ***Section 8*** discusses the previous uses of the Site.

Scope of Project

2.4.10 The PSC will be a single-storey building with part of the supporting mechanical plant on the rooftop. As shown in ***Figure 2-3***, two “stalls” (the main building) will each comprise loading/unloading areas; crate cleaning and storage areas; holding, killing, scalding, evisceration, packing and storage areas; isolation and inspection areas; changing rooms; and offices. At one end of the building will be a shared truck disinfection area. In addition to the main building, separate ancillary buildings will also be constructed, including an office, wastewater treatment facilities (WTFs), E&M plant rooms; fuel storage tanks and generators. As shown in ***Figure 2-4***, the related supporting mechanical plant, such as boiler rooms, odour removal system and air handling units for each stall will be placed on the centre area of the rooftop.

2.4.11 As shown in ***Figure 2-5***, which shows Section A-A from ***Figure 2-3***, the PSC site will be formed into a series of flat platforms, rising from 13.7mPD at the boundary with Man Kam To Road to a maximum elevation of 22.1mPD. The maximum external elevation of the main building will be 10m, with an exhaust point 3m above this (i.e. at 13m). The maximum external elevation of the WTF building will be 6m, with an exhaust point 7m above this (i.e. at 13m). As shown in ***Figure 2-6***, the main building will cover an area of approximately 5,545m^2 and together with the ancillary buildings, the total site coverage will be some 7,095m^2.

2.4.12 Under normal circumstances, the estimated daily throughput of the PSC will be about 20,000 chickens, however, to respond to market demands during festive periods (which occur only a few times annually, each lasting for not more than seven days), the daily maximum slaughtering capacity of the PSC will be increased to 30,000 chickens – this is considered to be the “worst case” scenario and will be used as the basis for assessment. Manual slaughtering of minor poultry will also take place, with a maximum slaughtering capacity of 3,000 minor poultry per day, in addition to the chickens. The PSC is anticipated to operate all year around.

Construction of the PSC Infrastructure by Government

2.4.13 The detailed design and construction of the PSC will be carried out under separate design and construction contracts. The poultry slaughtering machines will be provided by the Operators according to their needs. The anticipated construction activities will comprise:

- Clearance of all vegetation within the Site;
- Site formation and piling and drainage provisions;
- Construction of the PSC main building and ancillary buildings, as detailed in ***Figures 2-3 and 2-4***;
- Provision of air-conditioning and ventilation system (with negative pressure maintained inside the PSC);
- Provision of odour removal system;
- Provision of the WTFs; and
- Provision of fuel tanks and emergency generators.

Fit-out and Operation of the PSC by Operators

2.4.14 Upon completion of building construction, the two stalls will be ready for occupation by the Operators, who will be responsible for fit-out. While it is possible that the Operators will choose to fit a fully automated slaughtering line, it is also possible that the Operators will opt for manual slaughtering, or semi-automated slaughtering. Each will have different environmental impacts in terms of air, noise, water and waste.

2.4.15 For the purpose of assessment, therefore, this EIA has assumed the worst-case impacts in each case, whether this is from manual, semi-automated or fully automated processes. Details and justifications are provided in the relevant sections of this report.

2.5 Poultry Slaughtering

2.5.1 Daily operation of the stalls will be the responsibility of the Operators, and will be in accordance with the Operators' own procedures. However, based on the best available information the following is anticipated (see ***Figure 2-7***):

Reception / Holding

2.5.2 Vehicles with crates of live poultry coming from the Mainland, and with crates of live poultry from local farms will enter the PSC site through a dedicated "dirty" access route on the western side of the site. Crates will be unloaded at the unloading platform and moved into the holding area. After unloading, vehicles will pass through a disinfection area where they will be thoroughly cleaned before leaving the PSC through a dedicated "clean" route on the eastern side of the site.

2.5.3 Poultry shall not have access to any type of food for about 6 to 10 hours prior to slaughter. This will prevent the presence of food in the digestive tract when this part is removed, thus risking to soil the product. However, access to drinking water during transport and/or holding in the PSC is advisable to ensure that the chickens do not suffer unnecessarily.

2.5.4 Cages of live poultry will be stacked column by column. Each column will contain 10 layers of cages. The height of each cage is about 25cm, so each column will be around 2.5m high. The holding area will be air-conditioned and maintained at 23^{O}C. Wall/ceiling mounted fans will improve air circulation.

2.5.5 Swab tests and blood tests of Mainland poultry will be carried out prior to slaughter. For each batch, blood test result takes 1.5 hours and swab test results takes 4 hours, therefore slaughtering cannot start for minimum of 4 hours after delivery. Any diseased poultry that are identified will be placed in an isolation area and will be destroyed and disposed of appropriately.

Killing / Bleeding

2.5.6 Poultry will be removed from the crates in the holding area and brought into the killing room, which will be maintained at 25^{O}C. Empty crates will be taken to the crate cleaning area and disinfected using crate cleaning machine. Clean crates will be stored in the crate store and loaded back onto disinfected vehicles.

2.5.7 The head of the poultry is positioned downward so that the blood can flow down easily, preferably in such a way that the rest of the body is well secured. For example, the poultry can be placed head-first into an appropriately sized cone or funnel with a hole in the bottom to get access to the head to apply the bleeding cut. This would prevent the wings from flapping thus preventing blood from splashing on the wing tips afterwards. It is important to try to drain as much of the blood as possible, without causing damage to the body.

2.5.8 The best method and most humane way to kill poultry is to render the poultry unconscious prior to neck cutting. The carotid arteries and jugular veins will then be cut with a sharp knife so that blood is drained from the head quickly. Approximately two minutes of draining should be allowed to get the best possible bleeding out.

Scalding and De-feathering

2.5.9 Scalding involves passing the poultry through hot water after slaughter. This is done to prepare the epidermis (upper skin) such that the feathers come off more easily when plucked – specifically, scalding opens up the follicle in which the shaft of the feather is held.

2.5.10 The bled poultry is taken to the scalding room, which will be air-conditioned and maintained at $25^{O}C$. It is immersed in scalding tanks (maintained at about $60^{O}C$) for approximately one minute to loosen the feathers.

2.5.11 Plucking is started immediately after the scalding, otherwise the effect of scalding is lost as the poultry begins to stiffen. A de-feathering machine will be used to remove the feathers prior to evisceration. Typical de-feathering machines will operate at a rate of 100 birds/hour. Some manual plucking may be needed as de-feathering machines are rarely able to remove 100% of feathers. Each plucked poultry will be thoroughly washed by water jet or spray before evisceration.

Evisceration and Cleaning

2.5.12 Evisceration basically means removing everything inside the body cavity. During evisceration, the plucked poultry can be put on a table, however, this presents a risk of cross-contamination. It is therefore of the utmost importance that this table is cleaned thoroughly and preferably after each evisceration. Alternatively, suspended shackles could be used for evisceration.

2.5.13 The plucked poultry is taken to the evisceration room and laid on the table or shackled, as appropriate. The evisceration room will be air-conditioned and maintained at $23^{O}C$.

2.5.14 The neck skin is cut and split down the back and a second cut made at the base of the neck. The oesophagus, trachea and crop are separated from the neck skin. They can be cut off or left attached and be pulled from the body with the viscera.

2.5.15 The body cavity is opened by making a cut near the vent and extending the cut around the vent. Care must be taken not to cut the intestine to avoid the carcass being soiled with faecal material. All knives must be disinfected in $82^{O}C$ hot water when used between carcasses.

2.5.16 When the abdomen is opened the viscera are removed through the opening. It is very important to remove all the viscera, including the lungs, which are attached to the back. For this, the incision in the skin around the vent should be big enough to allow the entrance of a worker's gloved hand to remove the lungs properly – this may take some force to remove.

2.5.17 When all the contents of the cavity have been removed the carcass should be thoroughly washed using a water jet.

2.5.18 After the viscera have been inspected, the heart, liver and gizzard (stomach) are separated and saved, if required – they should be handled and washed at a separate area where the carcasses are rinsed. The ends of any parts of the vascular system that may still be attached to the heart are removed by trimming off the top to expose the chambers. The heart is washed and squeezed to force out any remaining blood. The green gall bladder is carefully trimmed away from the liver, avoiding any damage that could cause leakage of the green liquid within – this will not only spoil the way the product looks, but it also has a bitter taste.

2.5.19 Next the gizzard is split lengthwise and the contents washed away. The lining is then peeled away from the rest of the gizzard. Edible offal is further cleaned and the remains are discarded.

2.5.20 A post-mortem inspection area is located adjacent to the evisceration area to allow inspection of carcasses and viscera as needed.

Packing and Collection

2.5.21 The packing room will be air-conditioned and maintained at 15^{O}C. The carcass is packaged (e.g. placed in an unsealed plastic bag) and labelled. The product is stored on shelves in the cold store below 7^{O}C, awaiting collection. Edible viscera after thorough washing, should be packed and labelled in separate area and stored immediately under –18^{O}C.

2.5.22 Collection vehicles will enter and leave the PSC site through the dedicated "clean" route on the eastern side of the site. Poultry products will be loaded onto refrigerated vehicles, which will then distribute the poultry products throughout Hong Kong.

2.6 Operation Pattern

2.6.1 Two operation patterns have been prepared – one representing the normal throughput of 20,000 chickens plus 3,000 minor poultry (i.e. 23,000 poultry), and one representing the "worst case" throughput of 30,000 chickens plus 3,000 minor poultry (i.e. 33,000 poultry). ***Table 2-4***, below, shows the operation pattern for the "worst case" throughput of 33,000 poultry – this has been prepared based on best available information, however, the actual operation pattern may vary, subject to requirements of future Operators. All assessments in this EIA are based on this "worst case" throughput, however, for comparison purposes only, ***Table 2-5***, below, shows the operation pattern for the normal throughput of 23,000 poultry.

Worst Case Throughput of 33,000 Poultry

2.6.2 Vehicles with crates of live poultry coming from the Mainland will arrive at the PSC between 10am and 6pm to unload 15,000 chickens plus 3,000 minor poultry. An average of 1,600 poultry per vehicle has been assumed, which represents about 80% capacity of each vehicle. A total of 12 no. vehicles has been calculated to arrive between 10am and 4pm but this could be up to 14 or more, depending on the packing capacity. Notwithstanding, a maximum of three vehicles per hour will arrive during the peak hours of midday to 2pm.

2.6.3 Vehicles with crates of live poultry from local farms will arrive at the PSC between 7pm and midnight to unload 15,000 chickens. An average of 800 poultry per vehicle has been assumed, which represents about 80% capacity of each vehicle. A total of 19 no. vehicles will arrive between 7pm and midnight. A maximum of nine vehicles will arrive during the 9pm peak hour. Sufficient unloading bays will be provided for delivery vehicles and off-site queuing is not anticipated.

Time	Mainland Poultry Arrival	Local Poultry Arrival	No. Delivery Vehicles	Poultry in Holding Area	Poultry Slaughtered	Poultry in Cold Store	Poultry Collected	No. Collection Vehicles	Remarks
10:00 - 11:00	3,000		2	3,000					First batch from Mainland arrives
11:00 - 12:00	3,000		2	6,000					
12:00 - 13:00	**4,500**		3	10,500					
13:00 - 14:00	**4,500**		3	15,000					
14:00 - 15:00	1,500		1	16,500					Swab results available from first batch
15:00 - 16:00	1,500		1	18,000					Last batch from Mainland arrives
16:00 - 17:00				18,000					
17:00 - 18:00				18,000					
18:00 - 19:00				18,000					
19:00 - 20:00		750	1	18,750					First batch of Local Chickens arrives
20:00 - 21:00		**7,200**	**9**	23,450	2,500				Slaughtering commences
21:00 - 22:00		4,800	6	**25,350**	**2,900**	2,500			
22:00 - 23:00		1,500	2	23,950	**2,900**	5,400			
23:00 - 00:00		750	1	21,800	**2,900**	8,300			Last batch of Local Chickens arrives
00:00 - 01:00				18,900	**2,900**	11,200			
01:00 - 02:00				16,000	**2,900**	14,100			
02:00 - 03:00				13,100	**2,900**	17,000			
03:00 - 04:00				10,200	**2,900**	**19,900**			
04:00 - 05:00				7,300	**2,900**	18,800	4,000	2	First morning collection truck arrives
05:00 - 06:00				4,400	**2,900**	9,700	**12,000**	**6**	
06:00 - 07:00				1,500	**2,900**	4,600	8,000	4	
07:00 - 08:00					1,500	3,500	4,000	2	Slaughtering complete
08:00 - 09:00						1,000	4,000	2	
09:00 - 10:00							1,000	1	Last morning collection truck leaves
Total	**18,000**	**15,000**	**31**		**33,000**		**33,000**	**17**	
Maximum	**4,500**	**7,200**	**9**	**25,350**	**2,900**	**19,900**	**12,000**	**6**	

Note: [yellow] Indicates 3-hour Cleansing Period; [red box] indicates Mainland delivery vehicle arrival window; [green box] indicates local delivery vehicle arrival window

Table 2-4 Operation Pattern for "Worst Case" Throughput of 30,000 Chickens plus 3,000 Minor Poultry per Day

Time	Mainland Poultry Arrival	Local Poultry Arrival	No. Delivery Vehicles	Poultry in Holding Area	Poultry Slaughtered	Poultry in Cold Store	Poultry Collected	No. Collection Vehicles	Remarks
10:00 - 11:00	1,600		1	1,600					First batch from Mainland arrives
11:00 - 12:00	**3,300**		3	4,900					
12:00 - 13:00	**3,300**		3	8,200					
13:00 - 14:00	3,200		2	11,400					
14:00 - 15:00	1,600		1	13,000					Last batch from Mainland arrives
15:00 - 16:00				13,000					
16:00 - 17:00				13,000					
17:00 - 18:00				13,000					
18:00 - 19:00				13,000					
19:00 - 20:00		750	1	13,750					First batch of Local Chickens arrives
20:00 - 21:00		**6,250**	**8**	20,000					
21:00 - 22:00		1,500	2	**21,500**					
22:00 - 23:00		750	1	19,350	**2,900**				Slaughtering commences
23:00 - 00:00		750	1	17,200	**2,900**	2,900			Last batch of Local Chickens arrives
00:00 - 01:00				14,300	**2,900**	5,800			
01:00 - 02:00				11,400	**2,900**	8,700			
02:00 - 03:00				8,500	**2,900**	11,600			
03:00 - 04:00				5,600	**2,900**	**14,500**			
04:00 - 05:00				2,700	**2,900**	13,400	4,000	2	First morning collection truck arrives
05:00 - 06:00					2,700	8,300	**8,000**	**4**	Slaughtering complete
06:00 - 07:00						3,000	**8,000**	**4**	
07:00 - 08:00							3,000	2	Last morning collection truck leaves
08:00 - 09:00									
09:00 - 10:00									
Total	**13,000**	**10,000**	**23**		**23,000**		**23,000**	**12**	
Maximum	**3,300**	**6,250**	**8**	**21,500**	**2,900**	**14,500**	**8,000**	**4**	

Note: [yellow box] Indicates 3-hour Cleansing Period; [red box] indicates Mainland delivery vehicle arrival window; [green box] indicates local delivery vehicle arrival window

Table 2-5 Operation Pattern for "Normal Case" Throughput of 20,000 Chickens plus 3,000 Minor Poultry per Day

2.6.4 Crates of live poultry will be kept in the holding area from 10am to 7am (next day). The maximum number of poultry at any one time will be 25,350, between 9pm and 10pm.

2.6.5 Slaughtering will commence at 8pm and will be completed by 8am. During this twelve hour period, the maximum slaughtering rate will be 2,900 poultry per hour. By drawing reference to a semi-automated poultry plant in Shenzhen, which has a production rate of 16 chickens/man hour, approximately 180 workers will be involved in the slaughtering operations.

2.6.6 Dressed poultry will be kept in the cold store from 9pm to 9am (next day). The maximum number stored at any one time will be 19,900 between 3am and 4am. However, each cold store will be sized to accommodate 11,500 dressed poultry (i.e. 23,000 in total) to allow flexibility.

2.6.7 Dressed poultry will be collected from the PSC in refrigerated vehicles between 4am and 10am. An average of 2,000 dressed poultry per vehicle has been assumed, which represents about 80% capacity of each vehicle. A total of 17 no. vehicles will arrive between 4am and 10am. A maximum of six vehicles per hour will arrive during the peak hour of 5am to 6am. Sufficient loading bays will be provided for collection vehicles and off-site queuing is not anticipated.

2.6.8 Cleaning and disinfection of the holding area can be carried out between 7am and 10am; of the poultry slaughtering area between 8am and 11am; and of the packing area and cold store from 9am to noon. Thorough cleansing can be carried out within three hours.

Normal Throughput of 23,000 Poultry

2.6.9 Vehicles with crates of live poultry coming from the Mainland will arrive at the PSC between 10am and 3pm to unload 10,000 chickens and 3,000 minor poultry. An average of 1,600 poultry per vehicle has been assumed, which represents about 80% capacity of each vehicle. A total of 10 no. vehicles has been calculated to arrive between 10am and 3pm but this could be up to 11 or more, depending on the packing capacity. Notwithstanding, a maximum of three vehicles per hour will arrive during the peak hours of 11am to 1pm.

2.6.10 Vehicles with crates of live poultry from local farms will arrive at the PSC between 7pm and midnight to unload 10,000 chickens. An average of 800 poultry per vehicle has been assumed, which represents about 80% capacity of each vehicle. A total of 13 no. vehicles will arrive between 7pm and midnight. A maximum of eight vehicles will arrive during the 8pm peak hour.

2.6.11 Sufficient unloading bays will be provided for delivery vehicles and off-site queuing is not anticipated.

2.6.12 Crates of live poultry will be kept in the holding area from 10am to 5am (next day). The maximum number of poultry at any one time will be 21,500, between 9pm and 10pm.

2.6.13 Slaughtering will commence at 10pm and will be completed by 6am (next day). During this eight hour period, the maximum slaughtering rate will be 2,900 poultry per hour. By drawing reference to a semi-automated poultry plant in Shenzhen, which has a production rate of 16 chickens/man hour, approximately 180 workers will be involved in the slaughtering and processing operations.

2.6.14 Dressed poultry will be stored in the cold store from 11pm to 7am (next day). The maximum number stored at any one time will be 14,500 between 3am and 4am. However, each cold store will be sized to accommodate 11,500 dressed poultry (i.e. 23,000 in total) to allow flexibility.

2.6.15 Dressed poultry (20,000 chickens and 3,000 minor poultry) will be collected from the PSC in refrigerated vehicles between 4am and 8am. An average of 2,000 dressed poultry per vehicle has been assumed, which represents about 80% capacity of each vehicle. A total of 12 no. vehicles will arrive between 4am and 8am. A maximum of four vehicles per hour will arrive during the peak hour of 5am to 7am. Sufficient unloading bays will be provided for collection vehicles and off-site queuing is not anticipated.

2.6.16 Cleaning and disinfection of the holding area can be carried out between 5am and 8am; of the poultry slaughtering areas between 6am and 9am; and of the packing area and cold store from 7am to 10am. Thorough cleansing can be carried out within three hours.

2.7 Implementation and Programme

Implementation

2.7.1 The Government intends to provide the infrastructure and buildings comprising the PSC and will tender out each stall to a private Operator who will be responsible for fitting out the buildings and operating their stall. Under this arrangement, an EP will be applied for, prior to commencement of site formation and construction, and may reference this EIA Report. The two Operators will each be required to meet the operational requirements of the EP.

Programme

2.7.2 Key programme dates for the Project are:

- 2009 Appointment of the Consultant for the Design
- 2010 Site Available
- 2010 Invite Open Tender for Construction
- 2010 Commence Construction
- 2011 Invite Open Tenders for Operation of the Stalls
- 2012 Completion of Construction

2.8 Benefits of the Project

2.8.1 The major benefits of the Project include:

- Minimise the contact between live poultry and humans so as to reduce the risk of an outbreak of avian influenza within the community;
- Improved environmental protection and hygiene through provision of centralised wastewater treatment, odour control and waste management at the PSC; and
- Reduction in environmental impact at existing facilities (such as Cheung Sha Wan Temporary Wholesale Market and poultry stalls in wet markets).

2.9 Interaction with Other Projects

2.9.1 No other projects are known to be ongoing or planned in the vicinity of the proposed PSC in Sheung Shui at this time.

2.9.2 A dedicated foul sewer may need to be constructed, in parallel with construction of the PSC. A dedicated foul sewer from the PSC will be provided to the nearby SWHSTW or the existing rising main DN250 may be used if possible. This will be implemented by the time the PSC becomes operational. Details can be referred to ***Section 6***.

3 AIR QUALITY ASSESSMENT

3.1 Introduction

3.1.1 This section provides an assessment for the potential air quality impacts associated with the construction and operation of the PSC, in accordance with the ESB and Appendices 4 and 12 of the EIAO-TM.

3.2 Legislation, Policies, Plans, Standards and Criteria

3.2.1 The Air Pollution Control Ordinance (APCO) provides the statutory authority for controlling air pollutants from a variety of sources. Hong Kong SAR is required to meet the Hong Kong Air Quality Objectives (AQOs). The AQOs stipulate the maximum allowable concentrations for typical pollutants, of which total suspended particulates (TSP) and nitrogen dioxide (NO_2) are relevant to this EIA Study. The relevant AQOs are listed in ***Table 3-1***.

Pollutant	Concentration[1] (µg/m^3) and Averaging Time		
	1 Hour[2]	24 Hours[3]	1 Year[4]
NO_2	300	150	80
TSP	-	260	80

Notes: 1. Measured at 298K (25∘C) and 101.325 kPa (one atmosphere)
2. Not to be exceeded more than three times per year.
3. Not to be exceeded more than once per year
4. Arithmetic means

Table 3-1 Hong Kong Air Quality Objectives of NO_2 & TSP

3.2.2 The EIAO-TM stipulates that for construction dust impact assessment, hourly TSP level should not exceed 500µg/m^3 (measured at 25^{o}C and one atmosphere). Mitigation measures for construction sites have been specified in the Air Pollution Control (Construction Dust) Regulation.

3.2.3 Air Pollution Control (Construction Dust) Regulation under section 43 of the APCO defines notifiable and regulatory works for achieving a purpose of dust control for a number of designated activities. It requires a contractor to give an advance notice to EPD for undertaking any notifiable work. The contractor shall also ensure that the notifiable and regulatory works are being carried out in accordance with the Schedule of the Regulation. Dust control and suppression measures are provided in the Schedule. Notifiable works are site formation; reclamation; demolition of a building; foundation and superstructure construction for a building; and road construction. Regulatory works are building renovation; road opening and surfacing; slope stabilisation work; and activities which are potential source of dust arising.

3.2.4 In accordance with the EIAO-TM, odour level at Air Sensitive Receivers (ASRs) should not exceed 5 Odour Units (OU) based on an average time of 5 seconds for odour prediction assessment.

3.3 Air Sensitive Receivers and Baseline Conditions

Description of the Existing Environment

3.3.1 At present, air quality in the Study Area is mainly affected by exhaust emissions from vehicles using Man Kam To Road.

3.3.2 The nearest air quality monitoring station to the PSC site is the Tai Po air monitoring station. The available monitoring results of different air pollutants over the past five years are summarised in ***Table 3-2***.

Pollutants	2007	2006	2005	2004	2003	Average
Total Suspended Particulates, TSP (µg/m^3)	73	66	61	N/A	71	68
Nitrogen dioxide, NO_2 (µg/m^3)	53	57	49	N/A	52	53

Note: N/A – Data from Tai Po air monitoring station is not available.

Source: Air Quality in Hong Kong, EPD, HKSAR

Table 3-2 Background Air Pollutant Concentrations

Identification of Representative Air Sensitive Receivers

3.3.3 According to the ESB, the Study Area of the air quality impact assessment is 500m from the site boundary of the Project, as shown in ***Figures 3-1a to 3-1d***. With reference to the Approved Fu Tei Au and Sha Ling OZP No. S/NE-FTA/10 (gazetted on 27 October 2006). Land uses within the study area include Village Type Development (V), Open Storage (OS), Other Specified Uses (OU), Agriculture (AGR), Government/Institution/Community (G/IC) and Green Belt (GB).

3.3.4 A number of site visits were carried out in February to May 2007 to identify and verify the existing ASRs within the Study Area. ***Table 3-3***, below, lists the identified ASRs within the Study Area. The abandoned concrete batching plant mentioned in ***paragraph 2.4.8*** is not regarded as an ASR. As concluded during a recent revisit to the Site, conducted on 17 April 2009, there are no other ASRs within the Study Area than those identified in ***Table 3-3***.

3.3.5 In addition to the ASRs identified above, there are two G/IC zones found within the Study Area according to the Approved Fu Tei Au and Sha Ling OZP No. S/NE-FTA/10. However, there is currently no information of any planned development in this zone. A portion of one of the G/IC zone is occupied by the existing Man Kam To Road. The G/IC zones identified within the Study Area is shown in ***Figures 3-1a to 3-1d***.

ID	Name of ASR	Zoning	Type of Development	OZP	No. of Stories	Local Ground Level, mPD	Approximate Distance from the Site Boundary, m
A1a	Hung Kiu San Tsuen	OS	Village house	S/NE-FTA/10	2	18.5	8
A1b						12.0	84
A2	Tin Hau Temple	"OU" annotated "Port Back-up Uses"	Place of Worship	S/NE-FTA/10	1	4.1	271
A3	Border District Police Headquarters	G/IC	Office	S/NE-FTA/10	5	28.1	417
A4	Sha Ling Police Post	Future Man Kam To Road	Office	S/NE-FTA/10	1	10.6	376
A5a	Lee Ka Yuen	AGR	Village house	S/NE-FTA/10	2	12.3	150
A5b					2	12.3	258
A5c					2	17.0	235
A6a	Village Houses 1 & 2	Future Man Kam To Road	Village house	S/NE-FTA/10	1	13.8	263
A6b		OS			1	13.8	313
A7	Village House 3	OS	Village house	S/NE-FTA/10	1	19.0	228
A8	Village House 4	OS	Village house	S/NE-FTA/10	1	14.1	145
A9	Village House 5	OS	Village house	S/NE-FTA/10	1	14.2	99
A10	Village House 6	"OU" annotated "Port Back-up Uses"	Village house	S/NE-FTA/10	1	10.5	143
A11	Village House 7	"OU" annotated "Port Back-up Uses"	Village house	S/NE-FTA/10	2	10.5	182

Table 3-3 Air Sensitive Receivers within the Study Area

3.4 Air Pollution Sources and Potential Impacts

Construction Phase

3.4.1 Fugitive dust emission is anticipated when the following activities are undertaken during the construction phase of the Project:

- Removal of existing hardstanding;
- Site clearance;
- Excavation;
- Foundation works;
- Superstructure works;
- Vehicle movement on unpaved haul roads;
- Material handling; and
- Wind erosion from the site.

3.4.2 Considering the scale of the Project and the proposed formed site platforms, deep foundation and/or extensive excavation are not anticipated. The number of construction vehicles approaching and leaving the construction site should be minimal. The existing roads will provide direct access to the site during the construction phase, therefore, vehicle movements on unpaved haul roads are unlikely. Fugitive dust emission arising from vehicle movements within the construction site is therefore minimal.

3.4.3 Implementing the statutory dust control measures as detailed in ***Section 3.7*** will further minimise the dust emissions during the construction phase. Accordingly, the overall construction dust impact should be insignificant.

3.4.4 Other gaseous pollutant emissions from the construction vehicles and Powered Mechanical Equipment (PME) to be used on site also should be limited. Good practice such as shutting down the PME not in use and a regular maintenance of the PME will further minimise the gaseous emissions.

Operational Phase – Exhaust Emissions

3.4.5 Exhaust emissions from delivery and collection vehicles approaching and leaving the site will be one of the air pollution sources from the operation of the PSC. According to ***Table 2-4***, it is estimated that there will be no more than 9 vehicles leaving or approaching the PSC within any given hour. The operation pattern shown in ***Table 2-4*** has been agreed by the Project Proponent. Given that this number of vehicles is small, it is anticipated that exhaust emissions from delivery or collection vehicles associated with the PSC operation would be insignificant.

3.4.6 A Towngas and/or electric boiler will be required to provide scalding water for de-feathering and other cleaning operations. While no adverse gaseous emissions are anticipated from an electric boiler, nitrogen dioxide (NO_2) emissions have been assessed in the event that Towngas boilers are to be used. To avoid the occurrence of condensation in stack, a flue gas temperature higher than 200^{o}C is required.

3.4.7 To ensure that cumulative air impacts are fully addressed, it is necessary to identify chimneys within the 500m of the Site. The existing EPD chimney data, which has not been updated since 2007, identified four chimneys at the abandoned concrete batching plant adjacent to the Site. This information was validated during two site visits, which confirmed that no other chimneys are located within the Study Area. As shown in ***Photograph 2-4***, taken on 17 April 2009, the sign outside the plant confirms that operations have ceased. Although the concrete batching plant is currently abandoned, the cumulative impacts of these chimneys was assessed, to provide for the worst case. As such, the adopted chimney data summarised in ***Appendix 1-1*** are considered the best available information.

Operational Phase – Major Odour Emissions

3.4.8 Odour arising from the operation of the PSC will be the major air pollution source. Potential odour sources within the PSC will include the poultry and their faeces in the holding area, and odour from poultry during slaughtering, evisceration and packing. Odour will also arise from waste storage and from the on-site WTF.

3.4.9 There are no existing poultry slaughtering plants operating in Hong Kong from which to obtain real-world operational data and so it was necessary to identify overseas plants that are similar to that proposed in Hong Kong. Four poultry processing plants, two in Singapore and two in Malaysia, were identified to be similar to the PSC. It should be noted that the Singapore and Malaysia plants are of greater capacity, compared to that of the PSC.

3.4.10 Based on the processes detailed in ***Section 2.5***, and with reference to observations made at poultry plants in Singapore and Malaysia, the areas in ***Table 3-4***, below, have been identified as potential sources of odour emissions. These areas are also illustrated in ***Figure 3-2***.

Area	Odour Sources and Characteristics
Area 1 Reception / Holding	Live poultry will be kept in the holding area for a minimum of 4 hours (for Mainland poultry) prior to slaughter. Odour will be emitted from the live poultry and their faeces. Faeces on ground also emit a strong odour. Based on the preliminary estimate, a maximum of 25,350 poultry will be kept in the holding area at any one time.
Area 2 Slaughtering	Killing, bleeding, scalding and de-feathering activities will be carried out within the slaughtering area. Odour will be emitted during bleeding and de-feathering. Odour may also be emitted from the scalding process.
Area 3 Evisceration	Odour will be emitted during the evisceration process. The main sources will be from offal removal and from removed offal that is collected prior to disposal. Odours include blood, raw meat and offal.
Area 4 Packing	Odour will continue be emitted from the eviscerated carcasses. However, compared with the odour emitted from Areas 1 to 3, odour emitted from packing will be significantly less.
Area 5 Waste Collection	Poultry waste (such as feathers and offal) collected from slaughtering processes will be transferred to the solid waste disposal area. Odour will be emitted from poultry waste such as feathers and offal. There will be no blood recovery and processing, and hence no odour emissions related to this process are anticipated.
Area 6 Wastewater Treatment Facility	All process wastewater will be treated in the on-site WTF. The raw effluent screenings, equalisation tanks, treatment processes and sludge handling and storage will emit odour (hydrogen sulphide, sulphides, amines, etc.). However, little odour will be emitted during normal operation of the treatment process. Thus, odour will be emitted mainly from raw effluent screening and sludge handling/ dewatering units.

Note: Areas 1 to 5 are located within the main building. Area 6 is located within the WTF building.

Table 3-4 Major Odour Emission Sources and their Characteristics

3.4.11 Areas 1 to 5 (main building) and Area 6 (WTF building) will be enclosed and maintained at negative pressure by mechanical ventilation. Areas 1 to 4 (main building) will also be air-conditioned. Air drawn from Areas 1 to 5 (main building) will be ducted to exhausts located on the roof of the main building. An odour removal system will treat the air prior to discharge. Air drawn from Area 6 (WTF building) will be ducted to the exhaust located on the roof of the WTF building. An odour removal system will treat the air prior to discharge.

3.4.12 The site layout already maximises the buffer distance between the PSC and the ASRs as far as practicable. Exhaust outlets will be located on the roofs of the PSC and WTF buildings, furthest from Hung Kiu San Tsuen, which is located to the south of the Site.

Operation Phase – Minor Odour Emissions

3.4.13 To unload live poultry, trucks will reverse into the semi-enclosed vehicle bays, which afford access to the holding area. Since the holding area is maintained at negative pressure, when the loading doors are opened, outside air surrounding the delivery vehicles will be drawn in, thus preventing the fugitive emission of any odours from the vehicle. Unloading is carried out quickly, in a matter of minutes. As such, odour impact from poultry unloading will be insignificant overall.

3.4.14 After unloading live poultry to the holding area, empty delivery vehicles will drive to the covered area located at the northern side of the PSC. Here, vehicles will be washed and disinfected by water spraying with high-pressure jets. With the crates of live poultry removed, only residual odour from faeces will remain on the vehicle. During the first flush of water spraying, in the first minute or so of washing, faeces will be washed into the drains, leading to the WTF. As such, any odour impact from vehicle washing will be insignificant overall.

3.4.15 Fugitive odours, dust, feathers, etc. may be generated from vehicles delivering live poultry. On-site queuing of vehicles is not anticipated under normal operations, as adequate on-site parking is provided. The site layout has been designed such that any waiting vehicles will be located at the northwest side of the PSC building, furthest away from nearest ASR in Hung Kiu San Tsuen. As the PSC building itself will act as a barrier, fugitive odour and dust impact at Hung Kiu San Tsuen is considered to be insignificant from this source.

3.4.16 Packaged poultry awaiting collection will be kept in a cold store maintained below $7^{O}C$. An odour concentration of 376 OU/m^3 was measured from the odour sample collected in the "Chiller Room" (Cold Store) of Plant B in Singapore (see ***paragraphs 3.5.10 to 3.5.19***). However, apart from some chilled chickens awaiting collection, the chiller room was being cleaned during the sampling. Odours of frozen chicken and detergent were noted within the Cold Store in Singapore. Based on observations at other poultry plants in Singapore and Malaysia, the doors of the Cold Store were kept closed most of the time except when chilled/ frozen chickens were being transferred to refrigerated vehicles.

3.4.17 By design, there will be no exhaust from the cold store in the PSC. Although air from the cold store will escape when the door is opened (for a short time), odour will be suppressed by the low temperature (below $7^{O}C$) at which the cold store is maintained. Based on observations at poultry plants in Singapore and Malaysia, there was no noticeable odour outside the cold store. Therefore, odour emission from the cold store in the PSC is considered negligible.

3.4.18 In order to avoid the temperature of the dressed poultry from rising, refrigerated vehicles will be used for collection. Thus, odour emission in the collection area will be negligible.

3.5 Operation Phase Assessment Methodology

Nitrogen Dioxide Emission

3.5.1 Concentrations of nitrogen dioxide (NO_2) at the ASRs within the study area are estimated by the ISCST3 model with the following assumptions, which are detailed and justified in ***Appendix 1-1***.

- Scalding water of 8 ℓ/bird (see ***paragraph 5.6.32***) for de-feathering will be heated from 20^{O}C to about 60^{O}C.
- The maximum slaughtering rate of 1,450 birds/hour at each stall is assumed to occur between 8pm and 8am (the next day) to allow for operational flexibility (***Table 2-4*** refers).
- One Towngas boiler of 80% efficiency is assumed for each stall. Heat input per boiler will be ~2,425MJ/hr.
- According to information provided by Towngas on 20 April 2009, the maximum NO_x emission rate is 220mg/kWh. The emission factor and rate of NO_x is estimated to be 0.04g/s per boiler.
- A flue gas temperature of 202^{O}C is assumed to avoid the occurrence of condensation in stack (for hygiene purposes).
- $[NO_2] = [NO_x] \times 20\%$ + Background $[NO_2]$ (53 µg/m^3) (***Table 3-2*** refers).

3.5.2 Modelling assumptions and input parameters for ISCST3 are given in ***Table 3-5***, below.

Model Input	Operation Phase
Meteorological data	Meteorological data monitored at King's Park (for the information of mixing height only) and Ta Kwu Ling weather stations of Hong Kong Observatory for the year 2007
Dispersion option	Rural
Elevation of emission point	~32.6mPD (13m above ground), which is 3m above the roof of the main building
Diameter of the exhaust and number of outlets	2 outlets, each with a diameter of 0.2m (see ***Figure 2-3***).
Gas characteristics	For the worst-case assessment, minimum efflux velocity of ~6m/s has been adopted (as per Section 2.5(i) of EPD's *"Guidelines on Estimating Height Restriction and Position of Fresh Air Intake Using Gaussian Plume Models"* and "*Chimney Heights, the 1956 Clean Air Act Memorandum*"*). See also ***Appendix 1-1*** for derivation of this value. Exit temperature ~ 475K NO_x emission rate ~ 0.04 g/s per boiler
Building downwash	Figure B-2 of the *User's Guide for the Industrial Source Complex (ISC3) Dispersion Models* states that when determining the downwash of structure, "Disregard any tier with a height less than 40% of stack height" In addition to Clause 1.1.5.3.1 of Volume II of the *User Guide*, a plume is assumed to be unaffected by the building wake if the plume height is greater than 2.5x building height. As the outlet height will be 13m above ground, which is less than 2.5x the building height (~10m), building downwash effect was considered in the model
Emission factors for hour of day	For emission from the Project and other emissions, all hours: 1

Model Input	Operation Phase
Elevation of discrete receptors	1.4m above local ground with interval of 3m inclement to the top floor of the highest building of the representative ASR.
Uniform Cartesian grid	50m (distance between points)
Elevation of contours of the concentration of pollutant	Representative elevations selected at the worst-hit level

Note: * *"Chimney Heights, the 1956 Clean Air Act Memorandum"* is usually referred to when applying for a permit for a boiler/furnace/chimney under the APCO.

Table 3-5 ISCST3 Modelling Assumptions for NO_2 Assessment

Odour Emissions

3.5.3 It is assumed that all air within Areas 1 to 6, where major odour emissions are identified, will be expelled through exhausts located on the building roof. For Areas 1 to 5, the exhaust outlets will be located at the centre of the main building, and for Area 6 on the northern part of the WTF building. ***Figure 3-2*** shows these locations. ***Figure 3-3*** shows the possible arrangement of individual exhaust points within the exhaust outlets.

3.5.4 In order to assess whether there will be adverse odour impact on nearby ASRs, air quality modelling has been carried out to predict the odour concentration levels at the representative ASRs shown in ***Table 3-3***. The predicted odour concentration levels at the ASRs were compared against the EIAO-TM assessment criteria of 5OU, based on an averaging time of 5 seconds.

3.5.5 The ISCST3 air quality dispersion model was used for the simulation of the odour levels at the identified ASRs due to the emission from the exhausts on the roof of the main building and on the roof of the WTF building. Air quality modelling was carried out separately for different stability classes (A&B, C, D and E&F) of the meteorological data. Conversion factors for different stability classes shown in ***Table 3-6***, below, were applied to hourly odour levels to get the 5-second average odour concentration.

Stability Class	1-hour to 5-sec Conversion Factor
A, B	45
C	27
D	9
E, F	8

Table 3-6 Conversion Factor for Odour Concentration

3.5.6 Modelling assumptions and input parameters for ISCST3 are given in ***Table 3-7***, below.

Model Input	Operation Phase
Meteorological data	Meteorological data monitored at King's Park (for the information of mixing height only) and Ta Kwu Ling weather stations of Hong Kong Observatory for the year 2007
Dispersion Option	Rural
Elevation of emission point	~32.6mPD (13m above ground), which is 3m above the roof of the main building and 7m above the room of the WTF building.
Diameter of the Exhaust and Number of Outlets	2 no. outlets each with diameter of 0.58m on the main building; 2 no. outlets with diameters of 0.54m and 0.46m on the WTF building (see ***Figure 3-3***).
Gas characteristics	Efflux velocities of ~16m/s at the main building and ~16m/s at the WTF building (Release of air from outlets vertically upwards with an efflux velocity not less than 15m/s with reference to the Best Practice Means of rendering works for odour exhausts) Exit temperature ~ 298K
Building Downwash	Figure B-2 of the *User's Guide for the Industrial Source Complex (ISC3) Dispersion Models* states that when determining the downwash of structure, "Disregard any tier with a height less than 40% of stack height" In addition to Clause 1.1.5.3.1 of Volume II of the *User Guide*, a plume is assumed to be unaffected by the building wake if the plume height is greater than 2.5x building height. As the outlet heights will be +13m, which is less than 2.5x the building height (10m for the PSC building and 6m for the WTF building), building downwash effect was considered in the model
Elevation of discrete receptors	1.4m above local ground with interval of 3m inclement to the top floor of the highest building of the representative ASR.
Uniform Cartesian grid	50m (distance between points)
Elevation of contours of the concentration of pollutant	The maximum concentration of stability classes A to F at each elevation.

Table 3-7 ISCST3 Modelling Assumptions for Odour Assessment

3.5.7 As no detailed design of the PSC is available at present, the minimum elevation of emission point, approximate diameter of outlet and minimum efflux velocity were assumed based on the airflow rate of Areas 1 to 6, as estimated in ***Table 3-9***. As there are no guidelines or best practice means for the design and operation of poultry slaughtering plants in Hong Kong, the aforesaid assumptions are made with reference to relevant overseas guidelines for poultry farm such as *Environment Protection Manual for Authorised Officers, New South Wales, Environmental Protection Authority,* and relevant EPD guidelines for odour exhaust and control.

Odour Sampling

3.5.8 In order to estimate the odour emission rates of Areas 1 to 6 during the operation of the PSC, direct measurements of odour levels at source were carried out at two poultry slaughtering/ processing plants in Singapore and at the Cheung Sha Wan Poultry Wholesale Market (CSWPWM) in Hong Kong.

3.5.9 Odour sampling was carried out at the two Singapore plants (designated as "Plant A" and "Plant B") on 7 February 2007. The handling capacity of each plant was approximately 4,000 poultry per hour. During sampling, temperature, humidity and wind speed were recorded. However, airflow rate within the areas where odour samples collected could not be obtained as different areas were not physically separated, or the use of ventilation by electrical fans. Some detailed design information were provided by the plant operators.

3.5.10 Sampling works at Plant A and Plant B were carried out at 1200 to 1530 and 1700 to 2000, respectively, which were the periods of maximum numbers of chickens in the holding areas and peak operations of the slaughtering line of the plants, as advised by the operators.

3.5.11 Temperature and humidity in Singapore are similar to those in Hong Kong during summer. The temperature in Singapore is around 30^{O}C or above throughout the year. The temperature and humidity during sampling at live chicken holding areas, slaughtering area, evisceration area and offal treatment area ranged from 26^{O}C to 32^{O}C and 55% to 93% respectively. It should be noted that Areas 1 to 4 in the PSC will be air-conditioned to maintain the required temperature and humidity and are expected to be lower than those in the Singapore plants. Odour concentrations measured in the Singapore plants are therefore considered to be higher than those in the PSC and so there is no need to increase the odour concentrations measured at the Singapore plants when estimating the odour impacts arising from the PSC, in terms of temperature and humidity.

3.5.12 The operation details of the two Singapore plants and the odour sampling locations at these plants are provided in ***Appendix 1-2***. As the airflow rates of two Singapore plants could not be obtained, it should be noted that odour samples were collected at the places nearest to the odour sources where the strongest odour was identified in order to represent a worst-case odour concentration within the sampling areas.

3.5.13 Odour sampling was also carried out at two chicken sheds (designated “Shed A” and “Shed B”) at the CSWPWM on 15 February 2007, three days before Chinese New Year and, consequently, the busiest time of the year. The peak operation period for the wholesale market was from 4pm to 6pm, and so sampling was carried out within this period which was considered at a worst-case scenario for odour emission from the chicken sheds.

3.5.14 During sampling at CSWPWM, there were 3,200 chickens in Shed A and 8,600 chickens in Shed B. Temperature, humidity and wind speed were also recorded. However, airflow rate of the sampling areas could not be obtained since the sheds were semi-enclosed and airflows inside the sheds were maintained by natural ventilation/electrical fans installed on the roof. Sampling locations in Shed A and Shed B are shown in ***Appendix 1-3***.

3.5.15 Within limited time periods of the peak operations and allowing for odour sampling by the plants’ operators and chicken sheds’ owners, attempts were made to collect adequate odour samples from various areas of the Singapore plants and from the chicken sheds of CSWPWM. As mentioned above, the samples were collected during the peak operation of Plants A and B, and peak chickens arrival period of CSWPWM and, thus, the sampling period could be considered be representative of the general conditions for the worst anticipated conditions.

3.5.16 Odour sampling and assessment at Plant A and Plant B in Singapore was carried out by Aromatrix Technologies Pte Ltd (Aromatrix), a Singapore-based laboratory. Odour sampling and assessment at Shed A and Shed B in Hong Kong was carried out by Hong Kong Polytechnic University (PolyU). All sampling conducted by Aromatrix and PolyU was supervised on-site by Hyder staff.

3.5.17 Odour samples were collected using an odour sampling system including a battery-operated air pump, a sampling vessel and an odour bag. During air sampling, an empty sample bag was placed within a rigid plastic container and the container was then evacuated at a controlled rate.

As air pressure within the container decreased, the bag filled with air through the attached air intake tube. The air intake tube was positioned at the appropriate sampling height at the designated sampling location. About 60ℓ of air was collected for each sample. The air sample bag was then sealed and sent to the laboratory for olfactometry testing within 24 hours of sampling.

3.5.18 Sampling locations (ID), elevation, slaughtering process/associated facilities (Singapore plants only), time, duration of sampling, temperature, humidity, wind speed and other site observations were recorded during sampling.

3.5.19 The olfactometry tests were carried out by Aromatrix in Singapore and by the Odour Research Laboratory of PolyU in Hong Kong. In both cases, the analysis of odour samples was carried out in accordance with the European Standard Method (EN13725) for dynamic olfactometry. A summary of the odour sampling and laboratory results is given in ***Appendix 1-4***.

Estimation of Odour Emission Rates

3.5.20 Areas 1 to 6 represent major odour sources anticipated during the operation of the PSC. Odour emission rates of Areas 1 to 6 made reference to the best available information from the direct measurement of odour levels at Plant A and Plant B in Singapore and at Shed A and Shed B in Hong Kong.

3.5.21 The odour samples were collected from different plants and different places. Odour emissions and concentrations are affected due to various factors, identified in *"Influence of Temperature, Humidity and Ventilation Rate on the Release of Odour and Ammonia in a Floor Housing System for Laying Hens"* by Gustafsson and Nimmermark. In general, decreasing temperature and humidity will decrease odour emissions and concentrations. Airflow will affect concentration of odour but has limited effects on emissions.

3.5.22 Odour sampling works at Sheds A and B in Hong Kong were conducted in early spring and temperature was about 20^{O}C, which is lower than the 23 to 25^{O}C range for Areas 1 to 3 of the PSC. As mentioned above, odour concentrations are affected by temperature. As such, the measured odour concentrations at Sheds A and B are considered to be inapplicable to this assessment. The abovementioned factors have been taken into account in selecting the most applicable odour concentrations of Areas 1 to 6 for subsequent calculation of the odour emission rates.

3.5.23 Moreover, density of the odour emission source is another factor affecting the odour emission and concentration. A *"Code of Good Agricultural Practice for the Protection of Air" by Welsh Office, Agriculture Department* indicates that increasing poultry stocking density increases odour production. Furthermore, *"Overview of Methods to Reduce Odorant Emissions from Confinement Swine Buildings" by Gerald L. Riskowski* states that fewer pigs per unit floor area would reduce odour levels.

3.5.24 The fit-out for operation of each stall within the PSC will be carried out by the Operators. While it is possible that the Operators will choose to fit a fully automated slaughtering line, it is also possible that the Operators will opt for manual slaughtering, or semi-automated slaughtering.

3.5.25 In Singapore, the process included chilling of poultry products. Within the one hour processing time, chilling took approximately 40 minutes. Thus, the slaughtering and evisceration, which generate odour, took place within 20 minutes. As indicated in ***Table 2-4***, manual slaughtering and evisceration at the PSC will take one hour, some three times longer than automated slaughtering and evisceration at the Singapore plants. The exposure time of carcasses during these processes at the PSC is therefore three times longer than at the Singapore plants.

3.5.26 The odour concentrations obtained from sampling at Plants A & B in Singapore were a function of the volume of the rooms in which the samples were taken and the number of chickens in each room, which in turn was dependent on the hourly throughput. The slaughtering and evisceration time for each bird in the Singapore plants was 20 minutes and so the odour concentration for the proposed PSC will need to be increased by a factor of three to take account of the difference in exposure time.

3.5.27 Based on the above, the Singapore odour concentrations can be applied to the PSC in Hong Kong, normalising for room volume, process throughput rates and exposure time. Details of this are given in ***Appendix 1-5***. The comparison of odour concentrations measured at various areas of the Singapore plants, and justifications for selecting the most applicable odour results, are given in ***Table 3-8***, below.

3.5.28 Should the Operators choose fully automated or semi-automated slaughtering and evisceration, then the exposure time for each bird would be less than that for the manual process, and so the odour generation would also be less. Therefore, manual operation of the PSC, as assessed in this report, represents the worst-case.

Area	Factors Affecting Odour Emission	Singapore Plant A	Singapore Plant B	Justification for Adopting Measured Odour Concentration
Area 1 Reception / Holding	Odour concentration	397 OU/m^3	481 OU/m^3	Average measured in Plants A & B in Singapore (see ***Appendix 1-4***).
	Temperature	31.3 – 31.8 ^OC	31.5 – 32.3 ^OC	The Holding Area of the PSC will be air-conditioned to 23^{O}C, which is below that at Plants A & B. As higher temperatures increase odour emissions, measured odour concentrations do not need to be adjusted.
	Humidity	59 – 60%	70 – 76%	The Holding Area of the PSC will be air-conditioned to control humidity below that at Plants A & B. As higher humidity increases odour emissions, measured odour concentrations do not need to be adjusted.
	Airflow	Wind speed not detected	Wind speed not detected	There will be forced ventilation in the Holding Area of the PSC to maintain negative pressure and to provide airflow. Wall/ceiling fans will also improve air circulation. As airflow will decrease odour, measured odour concentrations do not need to be adjusted.
	Holding capacity	3,000 poultry	17,000 poultry	The maximum number of live poultry within the Holding Area of the PSC will be 25,350, which is greater than that at Plants A & B. However, the room volume of the PSC (1,561m^3) is much greater than that of Plants A & B. Therefore, the measured odour concentrations need to be adjusted.
	Room volume	~180m^3	~560m^3	
	Odour emission factor	23.8 OU/bird	15.8 OU/bird	The odour emission factor of Plant A is higher than that of Plant B. Therefore, the odour emission factor of Plant A is adopted as the basis for assessment, but will first need to be normalised (see ***Table 3-10***).
Area 2 Slaughtering	Odour concentration	519 OU/m^3	541 OU/m^3	Average measured in Plants A & B in Singapore (see ***Appendix 1-4***).
	Temperature	28.3 – 30.7^{O}C	27.1 – 28.7^{O}C	The Slaughtering Area of the PSC will be air-conditioned to 25^{O}C, which is below that at Plants A & B. As higher temperatures increase odour emissions, measured odour concentrations do not need to be adjusted.
	Humidity	78 – 93%	87 – 91%	The Slaughtering Area of the PSC will be air-conditioned to control humidity below that at Plants A & B. As higher humidity increases odour emissions, measured odour concentrations do not need to be adjusted.
	Airflow	Wind speed not detected	Wind speed not detected	There will be forced ventilation in the Slaughtering Area of the PSC to maintain negative pressure and to provide airflow. Wall/ceiling fans will also improve air circulation. As airflow will decrease odour, measured odour concentrations do not need to be adjusted.
	Slaughtering rate	4,000 birds/hr	4,000 birds/hr	The maximum slaughtering rate at the PSC will be 2,900 birds/hour which is less than Plants A & B. Furthermore, the room volume of the PSC(1,474m^3) is greater than those of Plants A & B. Therefore, the measured odour concentrations need to be adjusted.
	Room volume	~200m^3	~224m^3	
	Odour emission factor	25.9 OU/bird	30.3 OU/bird	The odour emission factor of Plant B is higher than that of Plant A. Therefore, the odour emission factor of Plant B is adopted as the basis for assessment, but will first need to be normalised (see ***Table 3-10***).

Area	Factors Affecting Odour Emission	Singapore Plant A	Singapore Plant B	Justification for Adopting Measured Odour Concentration
Area 3 Evisceration	Odour concentration	537 OU/m^3	730 OU/m^3	Average measured in Plants A & B in Singapore (see ***Appendix 1-4***).
	Temperature	28.3 – 29.0 ^{O}C	27.4 – 27.7 ^{O}C	The Evisceration Area of the PSC will be air-conditioned to 23^{O}C, which is below that at Plants A & B. As higher temperatures increase odour emissions, measured odour concentrations do not need to be adjusted.
	Humidity	93%	80 – 90%	The Evisceration Area of the PSC will be air-conditioned to control humidity below that at Plants A & B. As higher humidity increases odour emissions, measured odour concentrations do not need to be adjusted.
	Airflow	Wind speed not detected	Wind speed not detected	There will be forced ventilation in the Evisceration Area of the PSC to maintain negative pressure and to provide airflow. Wall/ceiling fans will also improve air circulation. As airflow will decrease odour, measured odour concentrations do not need to be adjusted.
	Evisceration rate	4,000	4,000	The maximum evisceration rate at the PSC will be 2,900 birds/hour which is less than Plants A & B. Furthermore, the room volume of the PSC(1,761m^3) is greater than those of Plants A & B. Therefore, measured odour concentrations need to be adjusted.
	Room volume	~176	~343	
	Odour emission factor	23.7 OU/bird	62.6 OU/bird	The odour emission factor of Plant B is higher than that of Plant A. Therefore, the odour emission factor of Plant B is adopted as the basis for assessment, but will first need to be normalised (see ***Table 3-10***).
Area 4 Packing / Collection	Odour concentration	51 OU/m^3	44 OU/m^3	Average measured in Plants A & B in Singapore (see ***Appendix 1-4***).
	Temperature	27.4 ^{O}C	22.3 – 22.8 ^{O}C	The Packing Area of the PSC will be air-conditioned to 15^{O}C, which is below that measured at Plants A & B. As higher temperatures increase odour emissions, measured odour concentrations do not need to be adjusted.
	Humidity	40%	85 – 92%	The Packing Area of the PSC will be air-conditioned to control humidity below that at Plants A & B. As higher humidity increases odour emissions, measured odour concentrations do not need to be adjusted.
	Airflow	Wind speed not detected	Wind speed not detected	There will be forced ventilation in the Packing Area of the PSC to maintain negative pressure and to provide airflow. As airflow will decrease odour, measured odour concentrations do not need to be adjusted.
	Packing rate	4,000	4,000	The maximum packing rate at the PSC will be 2,900 birds/hour which is less than Plants A & B. The volume of the packing room was not measured, although in both Plants A & B they were of similar size to the evisceration rooms. The room volume of the PSC (1,918m^3) is therefore likely to be greater than those assumed for Plants A & B. Therefore, measured odour concentrations need to be adjusted.
	Room volume	~176	~343	
	Odour emission factor	2.2 OU/bird	3.8 OU/bird	The odour emission factor of Plant B is higher than that of Plant A. Therefore, the odour emission factor of Plant B is adopted as the basis of this assessment, but will first need to be normalised (see ***Table 3-10***).

Area	Factors Affecting Odour Emission	Singapore Plant A	Singapore Plant B	Justification for Adopting Measured Odour Concentration
Area 5 Waste Collection	Odour concentration	604 OU/m^3	150 OU/m^3	Average measured in Plants A & B in Singapore (see ***Appendix 1-4***). As indicated below, the measured odour concentration at Plant A are more applicable to the PSC. As such, the odour concentration measured at Plant A is adopted as the basis of this assessment. Normalisation is not required (see ***Table 3-10***).
	Temperature	31.9 ^{O}C	25.6 ^{O}C	The Waste Collection Area of the PSC will be provided with mechanical ventilation. Although higher temperature will increase odour emissions, wastes (offal/feathers, etc) will be disposed into an enclosed waste container and temperature of the working area will have limited effect on fugitive odour emission. As such, the measured odour concentrations do not need to be adjusted.
	Humidity	55%	90%	The Waste Collection Area of the PSC will not be air-conditioned, but will draw in cooled air from adjoining Areas. Although higher humidity will increase odour emissions, wastes (offal/feathers, etc) will be disposed into an enclosed waste container and humidity of the working area will have limited effect on fugitive odour emission. As such, the measured odour concentrations do not need to be adjusted.
	Airflow	Wind speed not detected	2m/s	There will be forced ventilation in the Waste Collection Area of the PSC to maintain negative pressure and to provide airflow. Airflow will affect concentration of odour but has limited effects on emissions. Since the wind speed at Plant B was 2m/s, odour concentration measured at Plant B might be affected, whereas those at Plant A would not.
	Storage Capacity	N/A	N/A	N/A
	Room volume	N/A	N/A	N/A
	Odour emission factor	604 OU/m^3	150 OU/m^3	Based on the above justifications the measured odour concentration in OU/m^3 at Plant A should be more applicable to the PSC. Therefore, odour concentration measured at Plant A was directly adopted for estimating the odour emission rate for Area 5 of the PSC.
Area 6 Wastewater Treatment Plant	Odour concentration	N/A	N/A	Neither Plant A nor Plant B in Singapore used an on-site WTF – wastewater was discharged straight to foul sewer without pre-treatment. As such, it not possible to refer to the Singapore plants. Reference is therefore made to the *Supplementary EIA for Sheung Shui Slaughter House* for the odour emission from wastewater treatment plant using biological treatment (see ***Table 3-10*** for further details).
	Airflow			There will be forced ventilation in the WTF building to maintain negative pressure and to provide airflow.

Table 3-8 Comparison of Plants A and B in Singapore with the PSC and Justification for Adopting Odour Concentrations

3.5.29 Taking into consideration room volume, process throughput rates and exposure time, odour emission rates (ER) for Areas 1 to 6 were derived using the odour concentrations (C) from the odour samplings and the airflow rates (Q) where:

ER (OU/s) = C (OU/m^3) x Q (m^3/s) for Areas 1, 4, 5 and 6

ER (OU/s) = 3 x C (OU/m^3) x Q (m^3/s) for Areas 2 and 3

3.5.30 Room volume is based on the footprint of each area and an assumed minimum headroom of 3.5m (Areas 1 to 5) or 4.5m (Area 6), which represents a worst case in terms of odour concentration – increased headroom would result in greater room volume and therefore a reduced odour concentration.

3.5.31 Air exchange rates typically adopted in Hong Kong range from 10 to 15 per hour for dirty rooms (toilet, refuse collection room, etc), subject to the detailed design, although there is no standard for air exchange rate for the rooms similar to Areas 2 to 4. Although the PSC is fully air-conditioned (except for Areas 5 and 6), a value of 5 to 10 air changes per hour has been adopted in Areas 2, 3 and 4. The air exchange rate for Area 1 has been estimated based on the guidelines for animal holding areas (CIBSE Section B2, Table B2.6).

3.5.32 The estimated airflow rates of the Areas 1 to 6 are shown in ***Table 3-9***. Detailed calculations are given in ***Appendix 1-5***.

Area	Air Change Rate per hour		Room Volume (m^3)		Airflow Rate, m^3/s	
	Stall 1	Stall 2	Stall 1	Stall 2	Stall 1	Stall 2
Area 1 – Reception / Holding	12*	12*	777	784	2.59	2.61
Area 2 – Slaughtering	10	10	704	770	1.95	2.14
Area 3 – Evisceration	8	8	886	875	1.97	1.94
Area 4 – Packing / Collection	5	5	966	952	1.34	1.32
Area 5 – Waste Collection	15	15	146	140	0.61	0.58
Area 6 – WTF	15	15	860	635	3.58	2.64

Note: * Based on 8 to 12 air change/hour for animal holding area, as per CIBSE Section B2, Table B2.6

Table 3-9 Estimated Airflow Rates

3.5.33 Giving consideration to energy saving, both in terms or air cooling and air handling, it has been proposed that air is drawn from clean areas into less clean areas, supplemented as necessary by fresh air intakes. Thus, Area 1 (the least clean) will draw in air from Area 2, Area 2 will draw in air from Area 3 and Area 3 will draw in air from Area 4 (the cleanest). Area 5 will draw in cool are from adjacent Areas and 6 will draw in fresh air only.

3.5.34 The estimated odour emission rates of Areas 1 to 6 and the rationale of using the odour concentration or odour emission data are given in ***Table 3-10***, below. Details of the calculations of the odour emission rates are provided in ***Appendix 1-5***.

3.5.35 From ***Table 3-10***, the total odour emission rates from the PSC are estimated to be 2,709 OU/s from Stall 1 and 2,600 OU/s from Stall 2.

Area	Normalised Odour Emission from Singapore Plant (OU/bird)	Adjusted Odour Concentration for PSC (OU/m^3)		Odour Emission Rate Assumed for PSC (OU/s)		Rationale for Using the Odour Concentration / Odour Emission Rate
		Stall 1	Stall 2	Stall 1	Stall 2	
Area 1 Reception / Holding	23.8	388.2	384.8	1005.6	1005.6	The most applicable odour concentration measured in Plant A, from ***Table 3-8*** and ***Appendix 1-5***.
Area 2 Slaughtering	30.3	187.2	171.0	365.7	365.7	The most applicable odour concentration measured in Plant B, from ***Table 3-8*** and ***Appendix 1-5***.
Area 3 Evisceration	62.6	307.5	311.2	605.1	605.1	The most applicable odour concentration measured in Plant B, from ***Table 3-8*** and ***Appendix 1-5***.
Area 4 Packing / Collection	3.8	5.7	5.7	7.6	7.5	The most applicable odour concentration measured in Plant B, from ***Table 3-8*** and ***Appendix 1-5***.
Area 5 Waste Collection	604 OU/m^3	604	604	366.6	352.3	The most applicable odour concentration measured in Plant A, from ***Table 3-8*** and ***Appendix 1-5***.
Area 6 Wastewater Treatment Facility	100 OU/m^3	100	100	358.1	264.4	Reference is made to the *Supplementary EIA for Sheung Shui Slaughter House* for the odour emission from wastewater treatment plant. In the Sheung Shui Slaughterhouse EIA, it stated that biological treatment process emits little odour and most of the odour would be emitted during the raw sewage screening and the sludge (screenings, DAF and biological sludge) handling/dewatering units and 100 OU/m^3 was adopted for estimating the odour emission from wastewater treatment process. As a comparatively smaller volume of wastewater will be generated from the PSC as compared to the Sheung Shui Slaughterhouse, it is considered that the application of the 100 OU/m^3 is reasonable for the purpose of assessment.
		Total for PSC		**2,709**	**2,600**	

Table 3-10 Assumed Odour Emission Rates for PSC

3.6 Assessment Results

Operation Phase – Nitrogen Dioxide Emission

3.6.1 Cumulative concentrations of NO_2 at ASRs (including NO_2 concentrations from the Towngas boilers, the four chimneys at the abandoned concrete batching plant and the background concentration) are shown in ***Table 3-11***. Contour plots of the "worst-hit" elevations, based on grid receptor values, are shown in ***Figures 3-4 to 3-9***.

	Assessment Height		Predicted NO_2 Concentrations (µg/m^3)		
ASR ID	Floor Level	mAG	1-hr *300(µg/m^3)	24-hr *150(µg/m^3)	Annual *80(µg/m^3)
A1a	G/F	1.4	82	57	53
A1a	1/F	4.4	85	58	54
A1b	G/F	1.4	64	55	53
A1b	1/F	4.4	65	55	53
A2	G/F	1.4	58	54	53
A3	G/F	1.4	76	57	53
A3	1/F	4.4	77	57	53
A3	2/F	7.4	77	58	54
A3	3/F	10.4	83	59	54
A3	4/F	13.4	96	60	54
A4	G/F	1.4	61	55	53
A5a	G/F	1.4	62	56	53
A5a	1/F	4.4	63	56	53
A5b	G/F	1.4	62	55	53
A5b	1/F	4.4	62	55	53
A5c	G/F	1.4	64	56	53
A5c	1/F	4.4	65	56	53
A6a	G/F	1.4	64	56	53
A6b	1/F	4.4	64	56	53
A7	G/F	1.4	77	60	54
A8	G/F	1.4	64	56	53
A9	G/F	1.4	65	58	53
A10	G/F	1.4	63	54	53
A10	1/F	4.4	64	54	53
A11	G/F	1.4	64	54	53

Notes: **Bold underlined values** denote exceedance of criteria (no exceedance indicated)

* denotes AQO criteria

Table 3-11 Predicted NO_2 Concentrations at Representative ASRs

3.6.2 The results in ***Table 3-11*** show that there is no NO_2 exceedance at representative ASRs. As such, no significant air quality impact due to the use of towngas boiler is anticipated. The exceedances in AQOs above the abandoned concrete batching plant, shown in ***Figures 3-5 and 3-7***, are considered to be due to the emissions from the chimneys of the concrete batching plant which, for the purpose of cumulative assessment, is assumed to be operating.

Operation Phase – Odour Emissions

3.6.3 Air quality modelling of odour was carried out at different stability classes (A&B, C, D and E&F) of the meteorological data. presents The predicted 5-second average odour concentrations at the representative ASRs are shown in ***Table 3-12***. Contour plots of "worst-hit" concentrations based on grid receptor values are shown in ***Figures 3-10, 3-12, 3-14, 3-16 and 3-18***.

	Assessment Height		Predicted Unmitigated 5-Second Average Odour Concentrations (OU)			
ASR ID	Floor Level	mAG	Class A&B	Class C	Class D	Class E&F
A1a	G/F	1.4	**29.1**	**7.5**	3.5	3.3
A1a	1/F	4.4	**33.2**	**16.0**	**7.6**	**7.6**
A1b	G/F	1.4	**19.4**	**9.1**	2.0	1.2
A1b	1/F	4.4	**20.0**	**10.1**	2.6	2.1
A2	G/F	1.4	**12.2**	3.7	0.2	0.2
A3	G/F	1.4	**15.4**	**9.2**	**6.8**	**11.8**
A3	1/F	4.4	**15.3**	**9.1**	**6.8**	**15.2**
A3	2/F	7.4	**15.3**	**9.0**	**6.9**	**21.3**
A3	3/F	10.4	**15.2**	**8.8**	**7.0**	**28.6**
A3	4/F	13.4	**15.0**	**8.6**	**7.2**	**35.0**
A4	G/F	1.4	**12.4**	**7.0**	1.8	0.4
A5a	G/F	1.4	**21.0**	**11.4**	3.0	2.3
A5a	1/F	4.4	**21.2**	**11.8**	3.5	2.8
A5b	G/F	1.4	**15.9**	**9.5**	4.0	2.7
A5b	1/F	4.4	**15.9**	**9.5**	4.4	3.1
A5c	G/F	1.4	**20.8**	**15.1**	**5.5**	4.7
A5c	1/F	4.4	**20.8**	**15.2**	**5.7**	**5.0**
A6a	G/F	1.4	**14.5**	**8.3**	2.3	0.3
A6b	1/F	4.4	**14.8**	**8.5**	1.8	0.5
A7	G/F	1.4	**18.8**	**12.0**	2.7	0.7
A8	G/F	1.4	**13.9**	**5.1**	0.3	0.0
A9	G/F	1.4	**23.6**	**11.8**	2.1	1.3
A10	G/F	1.4	**18.2**	**9.1**	2.0	1.2
A10	1/F	4.4	**18.4**	**9.6**	2.3	1.7
A11	G/F	1.4	**18.2**	**8.9**	2.2	1.2

Note: **Bold underlined values** denote exceedance of the 5 OU assessment criterion

Table 3-12 Predicted Unmitigated 5-Second Average Odour Concentration at Representative ASRs

3.6.4 The unmitigated results in ***Table 3-12*** show that most representative ASRs exceed the 5 OU limit. This indicates that there will be odour impacts at these ASRs due to the operation of the PSC. Mitigation measures to minimise the odour impact must therefore be implemented during the operation of the PSC. Recommended mitigation measures are described in ***paragraphs 3.7.11 and 3.7.12***.

3.7 Mitigation Measures

Construction Phase

3.7.1 The dust arising from the construction phase of the Project is controlled under the Air Pollution Control (Construction Dust) Regulation. This regulation defines several major dust emitting activities as ‘notifiable works’, such as:

- Construction of the foundation of a building; and
- Construction of the superstructure of a building.

3.7.2 It should be noted that the Works Contractor has a responsibility to notify EPD when undertaking any notifiable works prior to the commencement of such works. In addition, the Works Contractor is also required to fulfil specific dust control requirements given in the Regulation’s Schedule for specific jobs.

3.7.3 The following good site management/practices are recommended to avoid/ minimise incidences of dust emission:

Site Boundary and Entrance

- Vehicle washing facilities including a high pressure water jet should be provided at every discernible or designated vehicle exit point; and
- The area at which vehicle washing takes place and the section of the road between the washing facilities and the exit point should be paved with concrete, bituminous or hardcore material.

Haul Roads and Unpaved Areas

- Each and every main haul road should be paved with concrete, bituminous hardcore materials or metal plates, and kept clear of dusty materials; or
- Unpaved haul roads and areas should be sprayed with water so as to keep the entire road surface wet.

Excavated Materials

- Any stockpile of dusty material should be either: (a) covered entirely by impervious sheeting; (b) placed in an area sheltered on the top and the three sides; or (c) sprayed with water or a dust suppression chemical so as to maintain the entire surface wet.

Exposed Earth

- Exposed earth should be properly treated by compaction, hydroseeding, vegetation planting or seating with latex, vinyl, bitumen within six months after the last construction activity on the site or part of the site where the exposed earth lies.

Loading, Unloading or Transfer of Dusty Materials

- All dusty materials should be sprayed with water immediately prior to any loading or transfer operation so as to keep the dusty material wet.

Debris Handling

- Any debris should be covered entirely by impervious sheeting or stored in a debris collection area sheltered on the top and the three sides; and
- Before debris is dumped into a chute, water should be sprayed so that it remains wet when it is dumped.

Transport of Dusty Materials

- Vehicles used for transporting dusty materials/spoils should be covered with tarpaulin or similar material. The cover should extend over the edges of the sides and tailboards.

Site Clearance

- The working area for the uprooting of trees, shrubs, or vegetation or the removal of boulders, pole, pillars should be sprayed with water immediately before, during and immediately after the operation so as to maintain the entire surface wet; and
- All demolished items should be covered by impervious sheeting or placed in a spot with shelters on top and three sides within a day of the demolition.

3.7.4 Workers at all levels should be co-operative to avoid dust generation and dispersion to the surrounding environment.

3.7.5 With the implementation of the above mitigation measures and adequate water spraying to the unpaved haul roads and areas and general construction activities such as site clearance, excavation, dusty materials loading/unloading and debris handling, the dust emission from the construction sites would be reduced significantly and the construction dust impact imposed on the nearby ASRs would be insignificant.

Operation Phase – Odour Emissions

Odour Control Technologies

Scrubbers

3.7.6 Scrubbers are commonly used for controlling agricultural and industrial odours. Scrubbers remove odorous gases on the basis of absorption. In wet scrubbers odorous compounds are removed when air passes through a film of liquid through chemical absorption or chemical/biological reaction with sodium hypochlorite. In dry scrubbers, air passes over different filter media, such as catalytic iron filters, activated carbon, impregnated alumina, etc.

3.7.7 The air/liquid contact (wet) or surface area of filter media (dry) determines the removal efficiency of odour treatment equipment. Special design and use of packing materials can increase the removal efficiency. Scrubbers with high odour removal efficiencies of up to 99%[Ref.1] are currently available and are used in fish processing and rendering industries. In addition, removal efficiency of 95% for ammonia which would be the dominant odour source at the Reception / Holding Area (Area 1) with an airflow rate of $5m^3/s$ is achievable in accordance with a specification of a water scrubber.

1. Eugene McGahan, Chaim Kolominskas, Kelsey Bawden and Robin Ormerod, "*Strategies to Reduce Odour Emissions from Meat Chicken Farms*", Proceedings 2002 Poultry Information Exchange – concluding an odour removal efficiency of 86 to 99%

Biofilters

3.7.8 Biofilters are beds of biological material (such as soil, peat, shells, etc.) that remove odour from biodegradable gases through absorption and microbial oxidation. The efficiency of removal odorous compounds can exceed 99% when the design is optimised. Biofilters have widespread application and are currently used in Hong Kong, for example, at the Western Wholesale Market and at NorthPoint Sewage Pumping Station. Capital and operation costs for biofilters vary with the technology used.

Activated Carbon Filters

3.7.9 Activated carbon can absorb 90-95% of a large variety of degradable gases and volatile organic compounds (VOCs), which are the dominant odour sources for areas other than Area 1, even at very low concentrations. However, the absorption capacity of the carbon filter is sensitive to temperature and moisture. Higher temperature and moisture reduce the absorption capacity of the activated carbon. Since the carbon filters are expensive to purchase and replace, activated carbon is not considered to be cost-effective for treating high odour concentrations.

Ionisers

3.7.10 An air ioniser is a device that uses high voltage to ionise (electrically charge) air molecules. Most commercial air purifiers are designed to generate negative ions. Particles are attracted to the electrode and these ions are de-ionized by seeking earthed conductors, such as walls and ceilings. Some commercial ionisers provide such surfaces, which then are triggered to warn the end-user to clean and/ or replace the "dirt" trap. Heavier combined particles may precipitate out of the air. Ionisers can be used to remove odour particles.

Recommendation

3.7.11 Dry or wet scrubbers are widely used for removing industrial odours and are one of the most cost-effective means to remove odour. Ionizers may also remove 90% ammonia and volatile organic compounds (VOCs) which are considered to be the major odour contributors in poultry odour. Biofilters can also remove odours to a very high level of efficiency.

3.7.12 Therefore, it is recommended that an odour removal system comprising scrubbers and/or ionizers and/or biofilters should be installed with a minimum combined odour removal efficiency of 95%. This is an efficiency level readily available in commercial equipment, with devices used singly or in series. All air ducted from Areas 1 to 5 and Area 6 should be passed through the odour removal systems for the main building and WTF building, respectively, prior to being expelled into the surrounding air. The exact configuration of the odour removal systems to achieve a minimum 95% odour removal will be prepared during the detailed design of the PSC.

Good Management and Operational Practice

3.7.13 Good management and operation practice should be implemented in order to eliminate odorous emission from the operation of the PSC. The following measures are recommended:

Live Poultry Unloading and Holding Areas

- Vehicles should be immediately driven to washing area after unloading;
- All cages and poultry should be sprayed with water immediately prior to unloading and to dampen dusty material; and

- High pressure water jets should be used to keep the floor surface free from feathers, faeces and other odorous materials from poultry.

Washing Area

- After unloading poultry, vehicles shall be thoroughly washed by high pressure water jets at designated points before exiting the Site; and
- Used crates shall be washed and disinfected using an automatic crate washing machine. Clean crates shall then be loaded onto clean vehicles.

Slaughtering Plant

- Floors and equipment in the slaughtering and evisceration areas should be cleaned frequently by water spraying;
- Offal and feathers should be collected and transferred to designated temporary storage area immediately after slaughtering and evisceration processes; and
- Regular maintenance of plant and equipment should be undertaken to ensure ventilation systems and associated equipment are operating properly and achieving expected performance.

Waste Management and WTF

- Offal, feathers, dead poultry and other odorous materials shall be stored in refuse bins with close-fitted lids. All refuse should be collected by waste collectors and disposed of frequently (e.g. daily);
- Equipment such as bar screens, containers and tanks should be frequently cleaned to prevent odours from accumulation of organic debris;
- Screened materials and sludge should be stored in the enclosed containers in order to minimise odour escape; and
- Sludge, greases and floating solids should be regularly removed in order to prevent putrefaction of accumulated organics in the tanks.

3.7.14 To ensure that these recommendations are implemented during operation of the PSC, audits will be carried out as part of the EM&A programme. These audits will confirm that the recommendations are properly implemented. Please see ***Section 12.2*** and the Implementation Schedule in ***Appendix 5*** for further details.

Operation Phase – Mitigated Scenario

3.7.15 With provision of an odour removal system achieving 95% odour removal efficiency, the predicted 5-second average odour concentrations at the representative ASRs are shown in ***Table 3-13***. Contour plots of "worst-hit" concentrations based on grid receptor values are shown in ***Figures 3-11, 3-13, 3-15, 3-17 and 3-19***.

ASR ID	Assessment Height		Predicted Mitigated 5-Second Average Odour Concentrations (OU)			
	Floor Level	mAG	Class A&B	Class C	Class D	Class E&F
A1a	G/F	1.4	1.5	0.4	0.2	0.2
A1a	1/F	4.4	1.7	0.8	0.4	0.4
A1b	G/F	1.4	1.0	0.5	0.1	0.1
A1b	1/F	4.4	1.0	0.5	0.1	0.1
A2	G/F	1.4	0.6	0.2	0.0	0.0
A3	G/F	1.4	0.8	0.5	0.3	0.6
A3	1/F	4.4	0.8	0.5	0.3	0.8
A3	2/F	7.4	0.8	0.4	0.3	1.1
A3	3/F	10.4	0.8	0.4	0.3	1.4
A3	4/F	13.4	0.8	0.4	0.4	1.7
A4	G/F	1.4	0.6	0.3	0.1	0.0
A5a	G/F	1.4	1.0	0.6	0.2	0.1
A5a	1/F	4.4	1.1	0.6	0.2	0.1
A5b	G/F	1.4	0.8	0.5	0.2	0.1
A5b	1/F	4.4	0.8	0.5	0.2	0.2
A5c	G/F	1.4	1.0	0.8	0.3	0.2
A5c	1/F	4.4	1.0	0.8	0.3	0.3
A6a	G/F	1.4	0.7	0.4	0.1	0.0
A6b	1/F	4.4	0.7	0.4	0.1	0.0
A7	G/F	1.4	0.9	0.6	0.1	0.0
A8	G/F	1.4	0.7	0.3	0.0	0.0
A9	G/F	1.4	1.2	0.6	0.1	0.1
A10	G/F	1.4	0.9	0.5	0.1	0.1
A10	1/F	4.4	0.9	0.5	0.1	0.1
A11	G/F	1.4	0.9	0.4	0.1	0.1

Note: **Bold underlined values** denote exceedance of the 5 OU assessment criterion (no exceedances)

Table 3-13 Predicted Mitigated 5-Second Average Odour Concentration at Representative ASRs

3.7.16 The mitigated results in ***Table 3-13*** show that no representative ASRs will exceed the 5 OU limit. This indicates that there will be no unacceptable odour impact due to the operation of the PSC.

3.7.17 ***Figures 3-15, 3-17 and 3-19*** show areas (no ASRs) at elevations of 7.4mAG, 10.4mAG and 14.4mAG, respectively, where the 5 OU limit will be exceeded. The ground under these areas is either the PSC Site, or is open ground designated as either "GB" or "OS" on the OZP. PlanD have been consulted on future development at these locations and have confirmed no objection, in terms of planning, to the exceedance of the odour limit at elevation above these locations.

3.8 Key Assumptions and Parameters

Nitrogen Dioxide Emission

3.8.1 ***Table 3-14*** summarises the key assumptions and parameters adopted in the NO_2 assessment:

Item	Key Assumptions and Parameters	Ref
1	NO_x emission rate of a Towngas boiler is estimated to be 0.04g/s (Towngas information refers).	Para. 3.5.1
2	Exhaust will be diverted to two outlets, each with a diameter of 0.2m with an efflux velocity of not less than 6m/s to avoid downwash effect. Exit temperature is ~475K.	***Table 3-5***
3	Minimum height of exhaust stacks will be about 13m above ground.	***Table 3-5***
4	Towngas boiler will be used to provide hot water for scald tanks.	Para 3.4.6

Table 3-14 Key Assumptions and Parameters for NO_2 Assessment

Odour Emission

Table 3-15 summarises the key assumptions and parameters adopted in the odour assessment:

Item	Key Assumptions and Parameters	Ref
1	To control odour emissions from the PSC, the unloading area will be semi-enclosed and the holding area, slaughtering area, evisceration area, packing/collection area and solid waste disposal area (Areas 1 to 5), and the WTF (Area 6) will be enclosed. Negative pressure will be maintained in Areas 1 to 6 by mechanical ventilation. Areas 1 to 4 will be air-conditioned.	Para. 3.4.11
2	Air drawn from Areas 1 to 5 will be ducted to a single location on the roof of the main building. An odour removal system will treat the air prior to discharge. Air drawn from Area 6 will be ducted to a single location on the roof of the WTF building. An odour removal system will treat the air prior to discharge.	Para. 3.4.11
3	Odour removal systems will achieve an odour removal efficiency of at least 95%.	Para 3.7.12
4	Minimum height of exhaust outlets for air from Areas 1 to 5 is ~32.6mPD (13m above ground), which is 3m above the roof of the main building. Minimum height of exhaust outlets for air from Area 6 is ~32.6mPD (13m above ground), which is 7m above the roof of the WTFbuilding.	***Table 3-7***
5	Assumed number of outlet and diameter of the exhaust outlets from odour removal system: 2 outlets with diameter of 0.58m at PSC Building; 2 outlets with diameters of 0.54m and 0.46m at WTF Building	***Table 3-7***
6	Efflux velocity of the exhaust outlets ~16m/s. Exit temperature of exhaust air 298K.	***Table 3-7***
7a	The assumed airflow rates of Areas 1 to 6 of PSC Stall 1 are as follows:	Para. 3.5.32, ***Table 3-9*** and ***Appendix 1-5***

Area	Floor Area (m^2)	Clear Headroom (m)	Air Change Rate (m^3/s)	Estimated Emission Rate (OU/s)
Area 1	222	3.5	2.59	1,005.6
Area 2	201	3.5	1.95	365.7
Area 3	253	3.5	1.97	605.1
Area 4	276	3.5	1.34	7.6
Area 5	42	3.5	0.61	366.6
Area 6	191	4.5	3.58	358.1

Item	Key Assumptions and Parameters	Ref
7b	The assumed airflow rates of Areas 1 to 6 of PSC Stall 2 are as follows:	Para. 3.5.32 ***Table 3-9*** and ***Appendix 1-5***
8	Implementation of good management and operation practice in order to eliminate odorous emission from the operation of the PSC.	Para.3.7.13

Area	Floor Area (m^2)	Clear Headroom (m)	Air Change Rate (m^3/s)	Estimated Emission Rate (OU/s)
Area 1	224	3.5	2.61	1,005.6
Area 2	220	3.5	2.14	365.7
Area 3	250	3.5	1.94	605.1
Area 4	272	3.5	1.32	7.6
Area 5	40	3.5	0.58	352.3
Area 6	141	4.5	2.64	264.4

Table 3-15 Key Assumptions and Parameters for Odour Assessment

3.9 Residual Impacts

Operation Phase – Nitrogen Dioxide Emission

3.9.1 There will be no residual impact on the nearby ASRs due to the operation of the towngas boiler of the PSC in terms of nitrogen dioxide concentrations.

Operation Phase – Odour Emissions

3.9.2 There will be no residual impact on the nearby ASRs due to the operation of the PSC with the implementation of recommended mitigation measures and good management and operation practices.

3.10 Conclusions

3.10.1 By implementing good site management, dust generation from site clearance, wind erosion and construction activities will be eliminated and no adverse impacts will be contributed to the surrounding ASRs during construction phase.

3.10.2 The use of a towngas boiler will give minimal rise in concentrations of nitrogen dioxide within the Study Area. As such, the boiler would not cause significant air quality impact on the nearby ASRs.

3.10.3 By implementing suitable odour removal equipment and adopting good operation practices, odour arising from the PSC will be controlled and the residual odour levels outside the PSC will not cause significant air quality impacts on nearby ASRs.

3.10.4 In case there is any material change to the assumptions in ***Tables 3-13 and 3-14*** (e.g. outlet height, outlet location, building massing, etc) then a revised Industrial Emission Impact Assessment should be prepared by a qualified environmental consultant and submitted to EPD for approval.

3.11 References

1 A Concise Guide to the Air Pollution Control Ordinance, Environmental Protection Department of HKSAR, May 2005.

2 A Guidance Note on the Best Practicable Means for Rendering Works (Feather Factory), Environmental Protection Department of HKSAR, June 1995.

3 A Guidance Note on the Best Practicable Means for Rendering Works (Fish Meal Factory), Environmental Protection Department of HKSAR, June 1995.

4 A Guidance Note on the Best Practicable Means for Rendering Works (Lard/ Bone Boiling Factory), Environmental Protection Department of HKSAR, March 1995.

5 Air Quality in Hong Kong, EPD, HKSAR, 2000 to 2005.

6 Air quality: Determination of odour concentration by dynamic olfactometry, EN 13725, British Standard, April 2003.

7 Approved Fu Tei Au and Sha Ling OZP No. S/NE-FTA/10

8 Environmental code of practice for poultry farms in Western Australia, Department of Environment of Western Australia, May 2004.

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4 NOISE ASSESSMENT

4.1 Introduction

4.1.1 This section provides an assessment for the potential noise impact associated with the construction and operation of the PSC in accordance with the ESB and Appendices 5 & 13 of the EIAO-TM, respectively. The noise impact assessment has also been carried out in accordance with the criteria and methodology stipulated in the relevant Technical Memoranda issued under the Noise Control Ordinance (NCO).

4.2 Legislation, Policies, Plans, Standards and Criteria

General Criteria

4.2.1 The NCO provides the statutory framework for noise control. It defines statutory limits applicable to equipment used during the construction and operation phases of the Project. The NCO invokes four Technical Memoranda, which stipulate the control approaches and technical means for noise assessment:

- 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); and
- Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites (IND-TM).

Construction Noise Criteria

Construction Works During Non-restricted Hours

4.2.2 The noise standards for the assessment of construction activities during non-restricted hours are provided in Table 1B of Appendix 5 of EIAO-TM and are summarised in ***Table 4-1***. Non-restricted hours are the time period between 0700 and 1900 on any day not being a Sunday or a general holiday.

Uses	$L_{eq(30\ mins)}$, dB(A)
All domestic premises including temporary housing accommodation	75
Hotels and hostels	75
Educational institutions including kindergartens, nurseries and all other where unaided voice communication is required	70 65 (during examinations)

Table 4-1 EIAO-TM Noise Standards for Construction Activities within Non-Restricted Hours

Construction Works During Restricted Hours

4.2.3 The NCO provides statutory controls on general construction works during the restricted hours (i.e. 1900 to 0700 hours from Monday to Saturday or any time on Sundays and public holidays).

4.2.4 No construction activities within the restricted hours for the Project is anticipated. If there is any use of any Powered Mechanical Equipment (PME) for the carrying out of construction works during the restricted hours and/or any Prescribed Construction Work (PCW) to be undertaken within a Designated Area (DA), a Construction Noise Permit (CNP) must be obtained from EPD.

4.2.5 Although minor piling might be needed for this Project, if percussive piling is to be used, a CNP must also be obtained from EPD.

4.2.6 The Acceptable Noise Levels (ANLs) of PP-TM are shown in ***Table 4-2***.

NSR Window Type or Means of Ventilation	ANL, dB(A)
NSR (or part of NSR) with no windows or other openings	100
NSR with central air conditioning system	90
NSR with windows or other openings but without central air conditioning system	85

Note: 10 dB(A) shall be subtracted from the ANLs shown above for NSRs which are hospital, medical clinics, educational institutions, courts of law or other NSRs which are considered by the Authority to be particularly sensitive to noise

Table 4-2 Basic Noise Levels (BNLs) in GW-TM

Operation Noise Criteria

Road Traffic Noise

4.2.7 The noise standards for the assessment of road traffic noise caused by the Project are provided in Table 1A of Appendix 5 of EIAO-TM and are summarised in ***Table 4-3***.

Common Uses	Road Traffic Noise $L_{10\ (1\ hour)}$, dB(A)
Domestic premises including temporary housing accommodation	70
Hotel and hostels	70
Offices	70
Educational institutions including kindergartens, nurseries and all other where unaided voice communication is required	65
Hospital and clinics, convalescences and homes for the aged, diagnostic rooms, wards	55
Places of public worship and courts of law	65

Note: The above standards apply to noise sensitive uses which rely on opened windows for ventilation

Table 4-3 EIAO-TM Road Traffic Noise Planning Criteria

4.2.8 In situations where the predicted noise levels at the NSRs are higher than the abovementioned noise standards (e.g., $L_{10(1\text{-}hr)}$ 70 dB(A) at domestic premises) but the noise contribution attributed to the PSC operation will be less than 1.0 dB(A), the noise contribution attributed to the PSC operation is considered to be insignificant. This has been adopted in a number of similar EIA studies which have been approved by EPD under EIAO, including:

- South East New Territories (SENT) Landfill Extension (EIA-143/2007);
- Repositioning and Long Term Operation Plan of Ocean Park (EIA-121/2006);
- Cement Silos addition work in Tai Po Cement Depot (EIA-087/2002);
- Fill Bank at Tseung Kwan O Area 137 (EIA-076/2002);
- Proposed Headquarters and Bus Maintenance Depot in Chai Wan (EIA-060/2001); and
- New World First Bus Permanent Depot at Chai Wan (EIA-034/1999).

Industrial Noise Sources

4.2.9 Operation noise emitted from the PSC is controlled under the IND-TM. According to the Table 1A of EIAO-TM, the level of the intruding noise at the façade of the nearest sensitive use should be at least 5 dB(A) below the appropriate ANL shown in Table 2 of the IND-TM or, in the case of the background being 5 dB(A) lower than the Acceptable Noise Level (ANL), the predicted noise level should not exceed the background. The operation noise criteria for different ASRs are summarised in ***Table 4-4***.

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

Table 4-4 Operation Noise Criteria

4.2.10 The ASR assumed is for indicative assessment only. Industrial noise sources are controlled under Section 13 of the NCO and the Authority shall assess the noise impacts based on the contemporary conditions/situations. Nothing in this report shall bind the Noise Control Authority in the context of law enforcement against all the industrial noise sources being assessed.

4.3 Noise Sensitive Receivers and Baseline Conditions

Description of the Existing Environment

4.3.1 The PSC will be located within a site that is surrounded by hills on three sides that form a “bowl”. The noise environment in the Study Area is mainly affected by vehicles on Man Kam To Road to the southwest of the Site.

Identification of Representative Noise Sensitive Receivers

4.3.2 The spatial scope of the noise assessment for both construction and operation phases is 300m from the boundary of the Project, in accordance with the ESB.

4.3.3 Noise Sensitive Receivers (NSRs) were selected to represent both the existing and future land uses which are potentially affected by the Project. A thorough review of the latest Outline Zoning Plans and Outline Development Plans was conducted to identify committed land uses. Site visits were conducted to identify existing NSRs as well as any noise sensitive structures that no longer exist.

4.3.4 The closest NSR is the small village of Hung Kiu San Tsuen, with a few tens of residents, located to the south of the Site. The NSRs identified within the Study Area are summarised in ***Table 4-5***, below, and shown in ***Figure 4-1***.

NSR ID	Description	Type of Development	Assessment Point	No. of Storey	Local Ground Level, mPD	Distance to Notional Source*, m
N1	Hung Kiu San Tsuen	Village House	N1a N1b N1c	2 2 2	21.0 17.0 12.0	49.4 52.4 136.0
N2	Tin Hau Temple	Place of Worship	N2	1	8.1	313.7
N3	Lee Ka Yuen	Village House	N3	1	12.3	225.1
N4	Village House	Village House	N4	1	13.8	280.0
N18	Village House	Village House	N18	2	10.5	209.3
N19	Village House	Village House	N19	2	10.5	238.9
N20	Village House	Village House	N20	1	14.2	162.3
N21	Village House	Village House	N21	2	14.1	167.7
N22	Village House	Village House	N22	1	26.0	185.8
N23	Village House	Village House	N23	2	7.3	344.2
N24	Village House	Village House	N24	2	7.3	361.5

Note: * Slant distance is measured from the whole Site area to the NSRs

Table 4-5 NSRs within Study Area

4.3.5 The representative NSRs for the operation (traffic) phase identified within the Study Area (300m from the boundary of the Project and areas affected by the Project along both sides of Man Kam To Road and Jockey Club Road from Man Kam To Road to Po Shek Wu Road) are summarised in ***Table 4-6***, below, and are indicated on ***Figures 4-2a and 4-2b***.

NSR ID	Description	Type of Development	Assessment Point	No. of Storey	Local Ground Level, mPD
N1	Hung Kiu San Tsuen	Village House	N1a	2	21.0
			N1b	2	17.0
			N1c	2	12.0
			N1d	1	12.0
N2	Tin Hau Temple	Place of Worship	N2	1	8.1
N3	Lee Ka Yuen	Village House	N3	1	12.3
N4	Village House	Village House	N4	1	13.8
N5	San Uk Ling	Village House	N5a	3	12.2
			N5b	1	9.9
			N5c	1	16.3
			N5d	1	13.1
			N5e	2	15.1
			N5f	2	13.1
			N5g	2	23.4
			N5h	2	14.6
		Temple	N5i	1	13.0

NSR ID	Description	Type of Development	Assessment Point	No. of Storey	Local Ground Level, mPD
		Village House	N5j	1	16.2
			N5k	2	13.0
			N5l	2	13.6
N6	Sha Ling	Village House	N6a	2	14.0
			N6b	1	12.1
			N6c	2	10.9
			N6d	1	10.9
			N6e	2	14.0
			N6f	2	11.9
			N6g	1	11.9
			N6h	2	11.9
			N6i	2	7.1
			N6j	1	7.1
			N6k	2	6.0
			N6l	1	11.7
N7	Man Kok Tsuen	Village House	N7a	3	6.8
			N7b	3	6.8
N8	Ha Pak Tsuen	Village House	N8a	3	7.4
			N8b	3	7.4
			N8c	3	7.4
N9	Sheung Pak Tsuen	Village House	N9a	2	7.4
			N9b	2	7.4
			N9c	2	7.4
N10	Tai Yuen Tsuen	Village House	N10a	2	7.4
			N10b	3	7.4
			N10c	1	7.4
			N10d	3	7.4
N11	Sheung Shui Seventh-day Adventist Church	Place of Worship	N11	2	7.5
N12	Hing Yan Tsuen	Village House	N12a	3	7.8
			N12b	2	7.8
			N12c	3	7.8
			N12d	3	7.8
		Open Area	N12e	3	7.8
N13	Fung Kai No. 1 Secondary School, No. 1, No. 2 Primary School & Kindergarten	School	N13a	3	7.7
			N13b	2	7.7
			N13c	3	7.7
			N13d	2	7.7

NSR ID	Description	Type of Development	Assessment Point	No. of Storey	Local Ground Level, mPD
N14	Sheung Shui Church	Place of Worship	N14	5	7.0
N15	Fung Kai Liu Man Shek Tong Secondary School	School	N15	8	7.0
N16	Tsui Lai Garden	Residential House	N16	29	10.1
N17	Shing Fat Building	Residential House	N17	3	7.0
N18	Village House	Village House	N18	1	10.5
N19	Village House	Village House	N19	2	10.5
N20	Village House	Village House	N20	1	14.2
N21	Village House	Village House	N21	2	14.1
N22	Village House	Village House	N22	1	26.0
N23	Village House	Village House	N23	2	7.3
N24	Village House	Village House	N24	2	7.3
N25	Village House (Po Sheung Tsuen)	Village House	N25	3	6.1

Notes: * Slant distance is measured from the whole Site area to the NSRs
( ) indicates the NSR IDs for Construction and Industrial Noise Impact Assessments (***Table 4-5*** refers)

Table 4-6 NSRs for Operation (Traffic) Phase

4.3.6 ***Table 4-6*** proposed assessment points that were chosen for a worst-case scenario where locations are closest to and directly facing the road. Additional assessment points for NSRs further from the road would be required if any significant noise impact from the Project is forecast.

4.3.7 Photographs taken at ground level of the NSRs are provided in ***Appendix 2-15.***

4.3.8 Assessment on any planned receivers, in particular, any new houses would be built within the village zone along Jockey Club Road from Man Kam To Road to Po Shek Wu Road, including NSRs 7 to 10, and 12, was also undertaken. Only the area in between NSRs 11 and 12 that is along the boundary of Jockey Club Road from Man Kam To Road to Po Shek Wu Road was an open area, while others are already occupied by park or planted with trees. Therefore, one more assessment point, N12e, was added for assessment on planned receiver. No other possible noise sensitive receiver was found from the latest OZPs.

4.4 Potential Sources of Impact and Emission Inventory

Construction Phase

4.4.1 Construction noise will be arising from the use of PME. The number of PME to be used during construction is limited given the relatively small size of the PSC and nature of the construction works. Most works will be undertaken within the “bowl” that will screen the noise generated on the Site from the NSRs such that adverse construction noise impact is not envisaged.

4.4.2 A summary of key construction activities is provided as below:

- Site clearance and formation/foundation, including removal of existing hard-standing and percussive piling; and
- Construction of the PSC.

4.4.3 The plant inventory of the PME summarised in ***Appendices 2-1*** to ***2-3*** to be used during construction, which has been reviewed by the Project Proponent, and the inventory is considered to be reasonable.

4.4.4 The noise assessment was undertaken based on the assumption that all PME are located on a notional noise source point and will be operated simultaneously during each type of the construction activity, namely site formation/foundation and superstructure, to represent the worst-case scenario. It should be noted that in practice, site formation/foundation and superstructure works will not be carried out concurrently.

Operation Phase

Road Traffic Noise

4.4.5 Existing traffic noise sources comprise the traffic on Man Kam To Road from the boundary to the PSC and on Jockey Club Road from Man Kam To Road to Po Shek Wu Road.

4.4.6 Potential traffic noise sources due to operation of the PSC include vehicles delivering live poultry to the PSC, either from the Mainland or from local farms, and refrigerated vehicles collecting dressed poultry from the PSC, travelling along Man Kam to Road and Jockey Club Road from Man Kam To Road to Po Shek Wu Road. Based on ***Table 2-4***, traffic flow due to operation of the PSC is shown in ***Appendix 2-4***.

Industrial Noise Sources

4.4.7 The process of operational activities of the PSC is described in ***Sections 2.5 and 2.6***. Potential noise sources during the operation of the PSC have been identified as follows:

- On-site movement of delivery vehicles / refrigerated collection vehicles;
- Unloading of live poultry;
- Loading of dressed poultry;
- Fixed plant or equipment which will be located inside the stall (i.e., fully enclosed) for slaughtering;
- Pump and noisy equipment of the WTF will be fully enclosed;
- Exhaust fans for the main building;
- Exhaust fans for the odour removal system; and
- Air-cooled chillers.

4.4.8 Based on the estimated traffic generation shown in ***Table 2-4***, the vehicle parking area will be sufficient that there will be no off-site queuing of vehicles as provision will be made within the site for queuing. Delivery vehicles will unload live poultry at the northwest and southwest portion of the Site, within the semi-enclosed unloading area. As a result, on-site noise will mainly be screened by the PSC building itself, the 5m fence walls and structure, and also contained by the surrounding hillsides.

4.4.9 Unloading of poultry will be semi-enclosed at the northwest and southwest portions of the Site within the PSC building area, in accordance with the latest conceptual layout plan. Also, based on current market practice, polymer cages are assumed to be used. As such, unloading of poultry due to impacting noise should be minimal compared with other noise sources.

4.4.10 Loading of dressed poultry packaged in polymer containers will also be semi-enclosed within the PSC building areas as indicated in the conceptual layout plan (***Figure 2-3*** refers). Although there will be opening at the loading area facing Hung Kiu San Tsuen, the fence wall along the site boundary will further fully screen off the noise generating from the loading activity within the semi-enclosed area. As such, it is not anticipated that unloading and loading within the Site will have significant noise impact on the identified NSRs.

4.4.11 Given that any mechanical plant or equipment for slaughtering and evisceration will be located inside the PSC building, which is either fully enclosed or provided with acoustic treatment facility (isolator, noise enclosure, etc), adverse noise impact from operations within the main building to the NSRs is not anticipated. The requirements of acoustic treatment will be studied by a qualified acoustic consultant during the detailed design stage.

4.4.12 ***Figure 4-4*** shows the routing of vehicles inside the PSC.

4.4.13 Air-cooled chillers will be placed at the roof of the main PSC building. The design specification of the air conditioning unit will meet the relevant noise criteria stipulated under the NCO and the EIAO-TM. Exhaust fans for the odour removal system and the PSC building are assumed to be placed at the centre of the PSC and WTF buildings.

4.4.14 The assumed sound power levels (SWLs) of the air-cooled chillers and the exhaust fan of the odour removal system (to be placed on the roof of the PSC building) have made reference to *Good Practices on Ventilation System Noise Control* (GP-VS). ***Appendices 2-10*** and ***2-11*** show the SWLs of fixed plant assumed to be in operation during the operation phase. The assumed SWLs are summarized below for the ease of reference:

- Exhaust fan with a SWL of 99dB(A) for odour removal system and PSC, assuming the flowrate of each fan = 8,600m^3/hr at static pressure 750Pa; and
- Air-cooled chiller with a SWL of 105dB(A) assuming the cooling capacity of each chiller = 200 tonnes.

4.4.15 From the proposed operation schedule provided in ***Table 2-4*** and described in ***Section 2.5***, it can be seen that plant and equipment within the PSC operates less than 24 hours per day. However, for the purpose of providing a worst case assessment, the fixed plant are assumed to be operated for 24 hours each day.

4.5 Construction Phase Assessment Methodology

4.5.1 The Construction noise assessment has been conducted based on standard acoustic principles and the methodology stated in the GW-TM. The assessment procedures are as below:

- Identify locations of representative NSRs likely to be affected by construction works;
- Identify the plant inventory of Powered Mechanical Equipments (PME) and Sound Power Levels (SWL) of the various PME to be used with reference to GW-TM and “Sound power levels of other commonly used PME” (Other PME) published by EPD during the works;
- Apply corrections for distance attenuation, barrier corrections, facade reflection and directivity where appropriate to determine the Predicted Noise Level (PNL) at the NSR;
- Apply reasonable percentage on time for some PMEs including dump trucks, lorries, mobile crane and bulldozer; and
- Compare the PNL with the corresponding criteria.

4.6 Operation Phase Assessment Methodology

Road Traffic Noise

Calculation of Noise Levels

4.6.1 Potential noise impact from the road traffic noise generated from the Project has been assessed using road traffic noise calculation procedures prescribed in the "Calculation of Road Traffic Noise (1988)" (CRTN) published by the Department of Transport, UK. The road traffic noise levels at the representative assessment points were predicted using the RoadNoise software, which implements the CRTN procedures. Road sections of concern include:

- Man Kam To Road; and
- Jockey Club Road – Section from Man Kam To Road to Po Shek Wu Road.

4.6.2 The commissioning year of the Project is tentatively scheduled in 2011 and so background traffic forecasts for 2011 (the first full year of operation) and the maximum projection for 2026 (+15 years) were prepared by a traffic specialist and are shown in ***Appendix 2-5***. The traffic data from 2011 to 2026 were forecasted based on the "Comprehensive Traffic Study – 3" (CTS3) traffic model. Transport Department (TD) has no in-principle objection to adoption of this traffic data for traffic noise impact assessment – see ***Appendix 2-5***. For the ease of comparison, the traffic forecasts with the maximum hourly traffic generation of the operation of the PSC are also presented in ***Appendix 2-5***.

4.6.3 Traffic flow due to the operation of the PSC (PSC traffic) relates to live poultry arrivals and dressed poultry collections. Approximate maximum hourly off-site traffic flow estimates were made with reference to ***Table 2-4***.

4.6.4 It should be noted that the predicted background traffic along Man Kam To Road and Jockey Club Road from Man Kam To Road to Po Shek Wu Road between 2011 and 2026 shows an increase over time and so the maximum background traffic flows will occur in 2026. As advised by the traffic specialist, in the absence of information to the contrary any further projection of background traffic data beyond 2026 would be based on extrapolation of the 2011 to 2026 traffic forecast data and so would continue to show an increase.

4.6.5 PSC traffic will remain constant throughout the operational life of the PSC as the traffic has been estimated based on ***Tables 2-3***. As the background (without operation of the PSC) traffic forecast will increase over time and traffic flow generated by the PSC is constant, the contribution of PSC traffic to the total traffic (i.e. background plus PSC traffic) will decrease over time. Therefore, the maximum traffic noise contribution from vehicles going to/from the PSC would be when there is the least traffic flow on Man Kam To Road and Jockey Club Road without operation of the PSC.

4.6.6 Since only Basic Noise Level (BNL) of total hourly flow and correction for percentage heavy vehicle (p) will be increased based on CRTN, hourly off-site noise contributions due to the PSC were calculated by comparing the BNLs and corrections with and without the PSC. According to the results, the noise contributions arising from the PSC operation will range from 0.0 to 0.2 in Year 2011 and from 0.0 to 0.1 in 2026, respectively. The results are tabulated in ***Appendix 2-6***.

4.6.7 With reference to ***Appendix 2-6***, NSRs along Man Kam Road, Po Shek Wo Road and Jockey Club Road will be subject to a maximum contribution of 0.2 dB(A) between the hours of 0500 and 0600 in Year 2011. As such, traffic noise impact was assessed using the traffic forecast of

0500 to 0600 in Year 2011as the worst-case scenario in terms of maximum noise contribution (Scenario A).

4.6.8 Similarly, ***Appendix 2-6*** shows the noise contribution of the PSC arising from Man Kam To Road will be the highest (0.1 dB(A)) compared with the contributions arising from the other roads at a number of hours, including between 0500 and 0600, in Year 2026. Since 0500 to 0600 in Year 2011 was considered (Scenario A), off-site traffic noise levels were also calculated based on the hourly flow between 0500 and 0600 in Year 2026 (Scenario B).

4.6.9 ***Table 4-7*** summarises the abovementioned scenarios for ease of reference.

Scenario	Year	Time Period of Consideration	Potential Maximum Hourly Traffic Flow due to the Project
A	2011	0500 to 0600	6
B	2026	0500 to 0600	6

Table4-7 Scenarios for Traffic Noise Assessment

Identification of Number of Exceedances

4.6.10 Representative assessment points of the identified NSRs were agreed with EPD and are shown in ***Figures 4-2a and 2b***. In accordance with Clause 3.4.2.2 (vi) (a2) of the ESB, the potential noise impact from the PSC was quantified by estimating the total number of dwellings, classrooms and other noise sensitive elements that are exposed to noise levels exceeding the criteria set in Table 1A of Appendix 5 of the TM (summarised in ***Table 4-3)***.

4.6.11 Should there be any predicted noise levels at the NSRs exceeding the noise criteria with noise contribution due to the Project of more than or equal to 1.0 dB(A) as mentioned in Sections 4.2.7 and 4.2.8, additional assessment points located further away from the noise source (i.e. Man Kam To Road or Jockey Club Road from Man Kam To Road to Po Shek Wu Road) should be identified in order to estimate the total number of dwellings, classrooms or noise sensitive uses subject to unacceptable noise levels..

4.6.12 Direct technical remedies should be recommended to mitigate the traffic noise impact due to the PSC (if any) in accordance with Clause 3.4.2.2 (vi) (a3) of the ESB.

Industrial Noise

Fixed Plant Outside the PSC Building

4.6.13 The exhaust fans for the odour removal system, PSC building and air-cooled chillers are to be placed at the roof of the buildings (approximately 10mAG) at the middle of the PSC and WTF buildings. It is also assumed that all fixed plant will be operated simultaneously to represent the worst-case scenario. No other major noise sources are expected to be located at the outside of the PSC building. The assumed locations of the fixed plant used outside the PSC building are shown in ***Figure 4-4***.

4.6.14 According to the IND-TM, a correction factor for tonality, impulsiveness and intermittency shall be applied in assessing the fixed plant noise, if necessary. It is anticipated that the operation of the fixed plant will not involve any rapid changes in operating mode. Therefore, the factor for impulsiveness and intermittency was not applied in the calculations. Moreover, no tonal effect of the fixed plant is anticipated. Therefore, no correction factor for tonality was calculated.

Fixed Plant Inside the PSC Building and the WTFs

4.6.15 Mechanical plant or equipment placed inside the PSC building for the operation line and the WTFs will be fully enclosed within the PSC building area. For some equipment with considerable vibration, such as pumps, isolators (springs, floating slabs, etc) will be provided to minimize vibration.

4.6.16 Unloading of the live poultry will be semi-enclosed at the northwest and southwest portion within the PSC building.

4.6.17 Loading of dressed poultry will be semi-enclosed within the PSC building. Although there will be opening at the loading area facing Hung Kiu San Tsuen, fence wall along the site boundary will further screen off the noise generating from the loading activity within the semi-enclosed area.

4.6.18 It is not anticipated that any mechanical plant or equipments installed inside the PSC building will have any discernable noise impact on the identified NSRs due to significant transmission loss of the building structure and provision of acoustic treatment facilities as mentioned in the preceding paragraphs. Nevertheless, major noise sources from the assumed mechanical plant or equipment placed inside the PSC building are summarised in ***Table 4-8*** below.

Major Noise Generating Activity	Typical Plant Noise Level at 7m*, dB(A)	Sound Power Levels, dB(A)
Forklift for unloading cages of live poultry from vehicles and stacking them in the holding area	51 to 73	76 to 98
Boiler for scalding	68 to 75	93 to 100
Plant/equipment for slaughtering and evisceration	55 to 65	80 to 90
Forklift for loading dressed poultry into refrigerated vehicles at collection area	51 to 73	76 to 98

Note: * Typical plant noise levels are made reference to *Environment Protection Manual for Authorised Officers*, New South Wales, Environmental Protection Authority

Table 4-8 Major Noise Source from Fixed Plant Inside Main Building

Vehicle Movement within the Site

4.6.19 Delivery vehicles and collection vehicles will be a noise source within the Site, as they enter the site, unload/load and then exit the site. The level of noise will depend on the number of vehicles within the site at any one time, and the level of impact will depend on timing – whether the standards for daytime/evening or night-time are applicable.

4.6.20 In recognition of this, the conceptual design for the PSC has already provided 5m high fence walls/structure, as shown in ***Figure 4-3***. From this illustration, it can be seen that at the southeast corner of the site, closest to the NSRs in Hung Kiu San Tsuen, a 5m high structure has been designed, to provide an acoustic shield to the NSRs from loading activities in the collection area. Furthermore, a 5m high wall has been proposed between the “dirty” and “clean” areas of the Site to provide an acoustic shield to the NSRs from unloading activities in the delivery area.

4.6.21 These are not considered to be mitigation measures, but rather a pro-active commitment to design-out potential impacts at the outset, rather than relying on mitigation.

Prevailing Noise Levels and ASR

4.6.22 Noise measurements were undertaken in the vicinity of NSR N1 (Hung Kiu San Tsuen) on 28 February 2007 to determine existing background noise levels. The measurement results are summarised in ***Table 4-9,*** below, and shown in ***Appendix 2-9***.

NSR	ASR [Note 1]	Time Period	ANL – 5 $L_{eq\ (30min)}$ dB(A)	Prevailing Noise Level $L_{Aeq\ (30min)}$ dB(A) [Note 2]
N1a – Hung Kiu San Tsuen	A	Day (0700 to 1900)	55	66.5
		Evening (1900 to 2300)		60.7
		Night (2300-0700)	45	60.9
N1b – Hung Kiu San Tsuen	A	Day (0700 to 1900)	55	69.9
		Evening (1900 to 2300)		65.2
		Night (2300-0700)	45	60.9

Notes: 1. The suggested ASR is determined based on the following factors as stipulated in IND-TM: (i) The representative NSR is located in rural area

2. Average of the measured prevailing noise levels as shown in ***Appendix 2-9***

Table 4-9 Prevailing Noise Levels

4.6.23 It was found that the prevailing noise level was higher than the "ANL-5 dB(A)" criterion during daytime/evening periods (7am to 11pm) and during night time (11pm to 7am). Therefore, according to the EIAO-TM, "ANL-5 dB(A)" was adopted as the noise criterion for all periods at all NSRs. The assessment of ASR for other identified NSRs are summarised in ***Table 4-10***.

4.6.24 Fixed plant noise is assessed based on standard acoustic principles with reference to the IND-TM. Prediction of fixed plant noise is carried out for the fixed plant placed outside the PSC. In addition, noise generating from the movements of vehicles delivering live poultry or collecting dressed poultry along the access roads within the PSC was assessed based on GW-TM and percentage on time.

NSR ID	Description	ASR	Description (based on conservative assessment)	Time Period	ANL – 5 Leq $_{(30min)}$ dB(A)
N1c	Hung Kiu San Tsuen	A	N1c is located within a rural area with village type development nearby. It is not affected by any IF and so the indicative ASR for N1c is "A" .	Day (0700 to 1900) & Evening (1900 to 2300)	55
				Night (2300-0700)	45
N2	Tin Hau Temple	A	N2 is located within a rural area with village type development nearby. It is not affected by any IF and so the indicative ASR for N2 is "A".	Day (0700 to 1900) & Evening (1900 to 2300)	55
				Night (2300-0700)	45
N3	Lee Ka Yuen	A	N3 is located within a rural area with village type development nearby. It is not affected by any IF and so the indicative ASR for N3 is "A".	Day (0700 to 1900) & Evening (1900 to 2300)	55
				Night (2300-0700)	45
N4	Village House	A	N4 is located within a rural area with village type development nearby. It is not affected by any IF and so the indicative ASR for N4 is "A".	Day (0700 to 1900) & Evening (1900 to 2300)	55
				Night (2300-0700)	45
N18	Village House	A	N5 is located within a rural area with village type development nearby. It is not affected by any IF and so the indicative ASR for N5 is "A".	Day (0700 to 1900) & Evening (1900 to 2300)	55
				Night (2300-0700)	45
N19	Village House	A	N6 is located within a rural area with village type development nearby. It is not affected by any IF and so the indicative ASR for N6 is "A".	Day (0700 to 1900) & Evening (1900 to 2300)	55
				Night (2300-0700)	45
N20	Village House	A	N7 is located within a rural area with village type development nearby. It is not affected by any IF and so the indicative ASR for N7 "A".	Day (0700 to 1900) & Evening (1900 to 2300)	55
				Night (2300-0700)	45
N21	Village House	A	N8 is located within a rural area with village type development nearby. It is not affected by any IF and so the indicative ASR for N8 is "A".	Day (0700 to 1900) & Evening (1900 to 2300)	55
				Night (2300-0700)	45
N22	Village House	A	N9 is located within a rural area with village type development nearby. It is not affected by any IF and so the indicative ASR for N9 is "A".	Day (0700 to 1900) & Evening (1900 to 2300)	55
				Night (2300-0700)	45
N23	Village House	A	N10 is located within a rural area with village type development nearby. It is not affected by any IF and so the indicative ASR for N10 is "A".	Day (0700 to 1900) & Evening (1900 to 2300)	55
				Night (2300-0700)	45
N24	Village House	A	N11 is located within a rural area with village type development nearby. It is not affected by any IF and so the indicative ASR for N11 is "A".	Day (0700 to 1900) & Evening (1900 to 2300)	55
				Night (2300-0700)	45

Note: ( ) indicates NSR ID for Operation (Traffic) Noise

Table 4-10 ASR of Identified NSRs

4.7 Assessment Results

Construction Phase

4.7.1 The PNLs at the identified NSRs at each construction stage are summarised in ***Table 4-11***, below. Detailed calculations are shown in ***Appendix 2-1***.

NSR ID	Assessment Point	Predicted Construction Noise Levels, dB(A)		Daytime Noise Standard (EIAO-TM), dB(A)
		Site Formation /Foundation	Superstructure	
N1	N1a	**<u>85</u>**	**<u>83</u>**	75
	N1b	**<u>83</u>**	**<u>81</u>**	
	N1c	73	71	
N2	N2	62	60	
N3	N3	65	63	
N4	N4	67	65	
N18	N18	71	69	
N19	N19	70	68	
N20	N20	72	71	
N21	N21	72	70	
N22	N22	66	64	
N23	N23	66	64	
N24	N24	66	64	

Note: **<u>Bold underlined values</u>** denote exceedance of daytime noise standard

Table 4-11 Predicted Construction Noise Levels (Unmitigated Scenario)

4.7.2 The assessment results indicate that the PNLs at N1a and N1b will exceed the daytime noise standard for both site formation/foundation and superstructure works. There will be no exceedance of daytime noise standard of 75dB(A) for any construction activities at other NSRs.

4.7.3 As any percussive piling and construction works during restricted hours shall be governed by NCO, application of CNP shall be required during the construction phase. Assessment according relevant TM shall be carried out by Noise Control Authority during the course of processing of CNP application and granting the CNP. Thus, noise impact due to the percussive piling or construction works during restricted hours is considered to be insignificant under the control of NCO and no assessment for percussive piling and construction works during restricted hours is included in this report.

4.7.4 In order to alleviate the construction noise impacts on the affected NSRs, mitigation measures illustrated in ***Section 4.8*** shall be implemented during the construction phase of the Project.

Operation Phase

Road Traffic Noise

4.7.5 Details of predicted noise levels and estimated numbers of dwellings, classrooms and other noise sensitive elements that will be exposed to noise levels exceeding the criteria for Scenarios A and B are presented in ***Appendices 2-7 and 2-8***, respectively. As shown in ***Appendix 2-6***, although the predicted overall traffic noise levels at the NSRs, will exceed the traffic noise standards, noise contributions due to the operation of PSC will be less than 1.0 dB(A). The predicted noise levels and noise contribution of the PSC summarised in ***Table 4-12*** and detailed in ***Appendices 2-7 and 2-8***, respectively.

4.7.6 Since the noise contributions will be less than 1.0 dB(A), no unacceptable off-site traffic noise impact arising from the operation of the PSC is anticipated. As such, no direct technical remedies are required in accordance with clause 3.4.2.2(vi)(a3) of the ESB.

ID	Description	Road Traffic Noise Criteria $L_{10\ (1\ hour)}$, dB(A)	Predicted Noise Level, $L_{10(1hour)}$, dB(A)			Acceptable Noise Impact?
			Without Project	With Project	Project Contribution	
Scenario A –0500 to 0600 in Year 2011 (Maximum Noise Contribution due to the PSC)						
N1	Hung Kiu San Tsuen	70	60 - 72	60 - 72	0.1 - 0.2	Y
N2	Tin Hau Temple	65	57	57	0.1	Y
N3	Lee Ka Yuen	70	53 - 61	53 - 62	0.2 - 0.2	Y
N4	Village House	70	50 - 61	50 - 62	0.1 - 0.2	Y
N5	San Uk Ling	70	51 - 73	51 - 73	0.1 - 0.2	Y
N6	Sha Ling	70	49 - 74	49 - 74	0.1 - 0.2	Y
N7	Man Kok Tsuen	70	53 - 72	53 - 72	0.1 - 0.2	Y
N8	Ha Pak Tsuen	70	49 - 74	49 - 74	0.1 - 0.2	Y
N9	Sheung Pak Tsuen	70	49 - 72	49 - 73	0.1 - 0.3	Y
N10	Tai Yuen Tsuen	70	43 - 70	43 - 70	0.1 - 0.2	Y
N11	Sheung Shui Seventh-day Adventist Church	65	69 - 70	70 - 70	0.2 - 0.2	Y
N12	Hing Yan Tsuen	70	46 - 75	46 - 76	0.1 - 0.2	Y
N13	Fung Kai No. 1 Secondary School, No. 1, No. 2 Primary School & Kindergarten	65	57 - 70	57 - 70	0.1 - 0.2	Y
N14	Sheung Shui Church	65	72 - 73	72 - 73	0.1 - 0.2	Y
N15	Fung Kai Liu Man Shek Tong Sec School	65	59 - 70	60 - 70	0.1 - 0.2	Y
N16	Tsui Lai Garden	70	61 - 63	61 - 63	0.1 - 0.1	Y
N17	Shing Fat Building	70	72 - 72	72 - 72	0.1 - 0.1	Y
N18	Village House	70	72	72	0.2	Y
N19	Village House	70	69	69	0.1	Y
N20	Village House	70	57	57	0.1	Y
N21	Village House	70	68	68	0.1	Y

ID	Description	Road Traffic Noise Criteria $L_{10\ (1\ hour)}$, dB(A)	Predicted Noise Level, $L_{10(1hour)}$, dB(A) Without Project	With Project	Project Contribution	Acceptable Noise Impact?
N22	Village House	70	66	66	0.1	Y
N23	Village House	70	72 - 73	73 - 73	0.1 - 0.2	Y
N24	Village House	70	70 - 70	70 - 70	0.2 - 0.2	Y
N25	Village House	70	69 - 69	69 - 69	0.2 - 0.2	Y
Scenario B – 0500 to 0600 in Year 2026 (Peak Hour Traffic Flow)						
N1	Hung Kiu San Tsuen	70	62 - 74	62 - 74	0 - 0.1	Y
N2	Tin Hau Temple	65	59	59	0.0	Y
N3	Lee Ka Yuen	70	54 - 63	55 - 63	0.1 - 0.1	Y
N4	Village House	70	52 - 63	52 - 63	0.1 - 0.1	Y
N5	San Uk Ling	70	52 - 75	53 - 75	0 - 0.1	Y
N6	Sha Ling	70	50 - 76	50 - 76	0 - 0.1	Y
N7	Man Kok Tsuen	70	55 - 74	55 - 74	0 - 0.1	Y
N8	Ha Pak Tsuen	70	51 - 75	51 - 76	0 - 0.1	Y
N9	Sheung Pak Tsuen	70	51 - 74	51 - 74	0 - 0.2	Y
N10	Tai Yuen Tsuen	70	45 - 72	45 - 72	0 - 0.2	Y
N11	Sheung Shui Seventh-day Adventist Church	65	71 - 72	71 - 72	0.1 - 0.1	Y
N12	Hing Yan Tsuen	70	47 - 77	48 - 77	0 - 0.2	Y
N13	Fung Kai No. 1 Secondary School, No. 1, No. 2 Primary School & Kindergarten	65	58 - 71	58 - 71	0 - 0.1	Y
N14	Sheung Shui Church	65	74 - 75	74 - 75	0.1 - 0.2	Y
N15	Fung Kai Liu Man Shek Tong Sec School	65	61 - 72	61 - 72	0 - 0.2	Y
N16	Tsui Lai Garden	70	63 - 65	63 - 65	0 - 0.1	Y
N17	Shing Fat Building	70	74 - 74	74 - 74	0.1 - 0.1	Y
N18	Village House	70	74	74	0.0	Y
N19	Village House	70	71	71	0.0	Y
N20	Village House	70	58	58	0.0	Y
N21	Village House	70	69	69	0.0	Y
N22	Village House	70	68	68	0.0	Y
N23	Village House	70	74 - 74	74 - 74	0 - 0.1	Y
N24	Village House	70	72 - 72	72 - 72	0.1 - 0.1	Y
N25	Village House	70	71 - 71	71 - 71	0.1 - 0.1	Y

Note: **Bold underlined values** denote unacceptable noise impact with predicted noise levels exceeding noise criteria and contribution ≥ 1.0 dB(A) in presence of Project

Table 4-12 Summary of Predicted Traffic Noise Levels

Industrial Noise

4.7.7 The assessment results presented in ***Table 4-13***, below, show that the predicted operation noise levels at all NSRs, exceed the night-time noise standard, and at N1a, N1b, N1c, N8 and N9 the day and evening time noise standard is also exceeded. The plant inventory and detailed noise calculations are provided in ***Appendices 2-10 to 2-11***. Measures to mitigate industrial noise sources to acceptable levels are recommended in ***Section 4.8***.

NSR	Description	Assessment Point	Predicted Operation Noise Level $L_{Aeq\ (30min)}$ dB(A)	ANL – 5 $L_{eq\ (30min)}$ dB(A)	
				Day & Evening (0700–2300)	Night (2300–0700)
N1	Hung Kiu San Tsuen	N1a	**63 (day & evening)** **63 (night-delivery)** **63 (night-collection)**	55	45
		N1b	**62 (day & evening)** **62 (night-delivery)** **62 (night-collection)**		
		N1c	**58 (day & evening)** **58 (night-delivery)** **58 (night-collection)**		
N2	Tin Hau Temple	N2	50 (day & evening) **50 (night-delivery)** **50 (night-collection)**		
N3	Lee Ka Yuen	N3	52 (day & evening) **52 (night-delivery)** **52 (night-collection)**		
N4	Village House	N4	54 (day & evening) **54 (night-delivery)** **54 (night-collection)**		
N18	Village House	N5	54 (day & evening) **54 (night-delivery)** **53 (night-collection)**		
N19	Village House	N6	52 (day & evening) **52 (night-delivery)** **52 (night-collection)**		
N20	Village House	N7	56 (day & evening) **56 (night-delivery)** **56 (night-collection)**		
N21	Village House	N8	**60 (day & evening)** **60 (night-delivery)** **60 (night-collection)**		
N22	Village House	N9	**55 (day & evening)** **55 (night-delivery)** **55 (night-collection)**		
N23	Village House	N10	49 (day & evening) **49 (night-delivery)** **49 (night-collection)**		
N24	Village House	N11	49 (day & evening) **49 (night-delivery)** **49 (night-collection)**		

Note: Bold underlined values denote noise exceedance

Table 4-13 Predicted Operation Industrial Noise Levels (Unmitigated Scenario)

4.8 Mitigation Measures

Construction Phase

Good Site Practice

4.8.1 Good site practice as described below is recommended to adopt to minimise the noise nuisance:

- 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 orientated 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.

4.8.2 The following sections illustrate the recommended mitigation measures in order to reduce construction noise to the planning limit.

Adoption of Quiet PME

4.8.3 Sound power levels (SWLs) of possible quieter PME were referred to EPD's GW-TM, Other PME" and British Standard "*Noise Control on Construction and Open Sites, BS 5228: Part 1: 1997*" (BS 5228), respectively. The SWLs of those quiet PME are summarised in ***Table 4-14***.

4.8.4 The construction plant inventory for predicting the mitigated construction noise assessment is shown in ***Appendix 2-2***.

Quiet PME	CNP Reference/ Other PME / BS 5228	SWL, dB(A)
Breaker	Table C8/12	106
Bulldozer	Table C3/27	109
Concrete lorry mixer	Table C6/23	100
Concrete pump	Table C6/36	106
Crane, mobile	Table C7/114	101
Excavator/loader	Table C3/97	105
Generator (Super silenced)	CNP 103 of GW-TM	95
Poker, vibratory, hand-held (electric)	Other PME	102
Roller, vibratory	Table C3/115	102

Table 4-14 Possible Quiet PME

4.8.5 After adoption of quiet PME, mitigated construction noise levels were predicted and summarised in ***Table 4-15***, below Detailed calculations of the construction noise levels with adoption of quiet PME are presented in ***Appendix 2-2***. The results show that the PNL at N1a will still exceed the daytime noise standard for site formation/foundation.

NSR ID	Assessment Point	Predicted Construction Noise Levels, dB(A)		Daytime Noise Standard (EIAO-TM) dB(A)
		Site Formation/ Foundation	Superstructure	
N1	N1a	**79**	**78**	75
	N1b	**76**	**76**	
	N1c	66	65	
N2	N2	55	55	
N3	N3	59	58	
N4	N4	60	59	
N18	N18	64	64	
N19	N19	63	62	
N20	N20	66	65	
N21	N21	65	65	
N22	N22	59	58	
N23	N23	60	59	
N24	N24	59	58	

Note: Bold underlined values denote exceedance of assessment criterion

Table 4-15 Predicted Construction Noise Levels (Mitigated Scenario with Provision of Quiet PME)

Use of Temporary Noise Barriers

4.8.6 After adoption of quiet PME, the predicted construction noise levels at N1a and N1b for site formation/ foundation and superstructure works will still exceed the relevant noise standard of 1 to 4 dB(A). Therefore, it is proposed to enhance the noise mitigation by provision of a temporary noise barrier (~5m high) at the south-eastern boundary of the site.

4.8.7 With the provision of the proposed barrier, breaker, bulldozer, concrete lorry mixer, excavator/loader, generator, roller, dump truck/lorry and water pump can be partially shielded so that a screening effect of at least –5 dB(A) can be applied to N1a and N1b, respectively. For hand-held poker, only –5 dB(A) during site formation/foundation was applied because the poker may be used at the rooftop of the PSC during superstructure stage in which the poker will not be shielded.

4.8.8 The proposed noise barrier shall be free of gaps and made of materials having a surface mass density of at least 10 kg/m^2 recommended by EPD's "*Guidelines On Design of Noise Barriers*".

4.8.9 With the implementation of the above mitigation measures, the mitigated construction noise levels would comply with the daytime construction noise standard and are summarised in ***Table 4-16***, below. Detailed calculations of the mitigated construction noise levels are presented in ***Appendix 2-3***.

NSR ID	Assessment Point	Predicted Construction Noise Levels, dB(A)		Daytime Noise Standard (EIAO-TM) dB(A)
		Site Formation/ Foundation	Superstructure	
N1	N1a	74	74	75
	N1b	72	72	
	N1c	66	65	
N2	N2	55	55	
N3	N3	59	58	
N4	N4	60	59	
N18	N18	64	64	
N19	N19	63	62	
N20	N20	66	65	
N21	N21	65	65	
N22	N22	59	58	
N23	N23	60	59	
N24	N24	59	58	

Note: Screening effect of the proposed barrier was applied for N1a and N1b only

Table 4-16 Predicted Construction Noise Levels (Mitigated Scenario with Provision of Quiet PME and Temporary Noise Barriers)

Cumulative Impacts from Concurrent Projects

4.8.10 There will be one concurrent project, under preliminary planning, to be constructed in the vicinity of the Study Area of the Project – a dedicated sewer is planned to be constructed from the Site to Shek Wu Hui Sewage Treatment Works. A preferred option for the dedicated sewer is shown in ***Figure 6-2***. Details of the proposed sewerage are given in ***Section 6***.

4.8.11 It is anticipated that minimal scale of construction activities such as trench excavation by sections, manhole construction, laying of sewer, will be undertaken. Therefore, the construction of the dedicated sewer is expected to be section by section with shallow excavation within a short period of time for each section. In view of these, the construction noise contribution from this concurrent project is anticipated to be insignificant. Nevertheless, good site practice as mentioned in ***paragraph 4.8.1*** is recommended to minimize any noise nuisance due to the construction of the dedicated sewer.

Operation Phase

Road Traffic Noise

4.8.12 Since off-site road traffic noise impacts arising from the PSC under Scenarios A and B will be acceptable, there will be no need to provide direct mitigation measures.

Industrial Noise Sources

4.8.13 ***Table 4-13*** showed that predicted operation noise levels at all representative NSRs will mostly exceed the daytime/evening criterion and all exceed the night-time noise criterion. Therefore, direct mitigation measures will be required.

4.8.14 In terms of fixed plant outside the PSC building, partial or complete enclosures with silencers at condenser fan outlets and silencers/louvers at air inlets of the enclosures for the air-cooled chillers on the roof of the PSC building are recommended. A reduction in noise level of 25dB(A) is expected with reference to the *Good Practices on Ventilation System Noise Control* (GP-VS) issued by EPD in 1999. Installation of silencers at air discharge points and provision of complete enclosures with isolators for the exhaust fans of the odour removal system and the PSC building would also provide a noise reduction of at least 20dB(A) with reference to GP-VS.

4.8.15 Moreover, it is recommended to install enclosures with acoustic louvers/silencers at condenser fan outlets and at air inlets of the enclosure for the air-cooled chillers at the roof of the PSC building. Installation of acoustic louvers/silencers is also recommended for the exhaust fans of the odour removal system.

4.8.16 In terms of vehicle movements within the Site, the perimeter walls and the 5m high E&M room with 0.5m canopy already included in the conceptual design provide sufficient mitigation from vehicle movements to the NSRs in Hung Kiu San Tsuen. In addition, quieter truck/forklift for loading/unloading activities with a SWL of not higher than 83 dB(A) shall be used.

4.8.17 With the implementation of the recommended mitigation measures, predicted noise levels at all representative NSRs will comply with both daytime/evening and night time noise standards. The mitigated results are summarised in ***Table 4-17***, below, and detailed in ***Appendices 2-12*** to ***2-13***.

NSR	Description	Assessment Point	Predicted Operation Noise Level $L_{Aeq\ (30min)}$ dB(A)	ANL – 5 $L_{eq\ (30min)}$ dB(A)	
				Day & Evening (0700–2300)	Night (2300–0700)
N1	Hung Kiu San Tsuen	N1a	49 (day & evening) 45 (night-delivery) 44 (night-collection)	55	45
		N1b	48 (day & evening) 43 (night-delivery) 43 (night-collection)		
		N1c	42 (day & evening) 38 (night-delivery) 38 (night-collection)		
N2	Tin Hau Temple	N2	33 (day & evening) 29 (night-delivery) 29 (night-collection)		
N3	Lee Ka Yuen	N3	35 (day & evening) 32 (night-delivery) 32 (night-collection)		
N4	Village House	N4	34 (day & evening) 31 (night-delivery) 33 (night-collection)		
N18	Village House	N5	37 (day & evening) 33 (night-delivery) 33 (night-collection)		
N19	Village House	N6	35 (day & evening) 32 (night-delivery) 31 (night-collection)		

NSR	Description	Assessment Point	Predicted Operation Noise Level $L_{Aeq\ (30min)}$ dB(A)	ANL – 5 $L_{eq\ (30min)}$ dB(A)	
				Day & Evening (0700–2300)	Night (2300–0700)
N20	Village House	N7	47 (day & evening) 41 (night-delivery) 45 (night-collection)	55	45
N21	Village House	N8	39 (day & evening) 37 (night-delivery) 38 (night-collection)		
N22	Village House	N9	37 (day & evening) 34 (night-delivery) 36 (night-collection)		
N23	Village House	N10	32 (day & evening) 29 (night-delivery) 28 (night-collection)		
N24	Village House	N11	32 (day & evening) 28 (night-delivery) 28 (night-collection)		

Table 4-17 Predicted Operation Industrial Noise Levels (Mitigated Scenario)

4.9 Residual Impacts

Construction Phase

4.9.1 With the implementation of the mitigation measures recommended in ***Section 4.8***, the PNLs at the NSRs will comply with the noise standards. Therefore, there will be no residual noise impacts at the NSRs.

Operation Phase

Road Traffic Noise

4.9.2 As there will be no unacceptable off-site traffic noise impacts due to the PSC, there will be no residual noise impacts at the NSRs.

Industrial Noise Sources

4.9.3 With provision of the recommended mitigation measures, industrial noise sources will not result in any unacceptable residual noise impacts at the NSRs.

4.10 Conclusions

4.10.1 The use of PME during the construction phase of the Project is not expected to cause any adverse construction noise impact on the NSRs provided that the recommended mitigation measures are implemented properly.

4.10.2 Good site practice is recommended to minimise the noise levels during construction as far as possible. Furthermore, recommended quiet PMEs shall be used in order to reduce any potential construction noise generated from construction works. Construction of a 5m high temporary noise barrier at the south-eastern site boundary shall also be adopted, in particular during site formation/foundation works when construction noise levels were predicted to exceed the daytime noise standard. With the implementation of these mitigation measures any potential construction noise generated during the construction phase of the Project is mitigated to an acceptable level.

4.10.3 Although the predicted overall traffic noise levels at some of the identified assessment points exceed the criteria, the traffic noise contribution due to the Project is insignificant. As such, off-site traffic noise impact is considered to be acceptable.

4.10.4 Noise impact arising from the PSC operation will exceed both daytime/evening and night-time noise criteria of EIAO-TM. With the provision of the recommended noise mitigation measures, potential noise impacts at the NSRs will be mitigated to acceptable levels. However, it should be noted that the calculations were based on a conceptual design and the Designer and/or Works Contractor is responsible to engage an acoustic/noise specialist to review the mitigation measures. The Designer and/or Works Contractor should consider other possible mitigation measures, such as quieter plant, that are available in the market.

4.10.5 No adverse noise impact is expected during either construction or operation phases of the Project, provided that recommended noise mitigation measures are properly implemented. No residual noise impact is anticipated.

4.10.6 In case that any parameters in terms of sound power levels, use of construction or operation equipments, mitigation measures and location of the noise sources are changed that may increase the noise impact, a revised Noise Impact Assessment should be prepared and additional mitigation measures should be recommended by a qualified noise specialist.

5 WATER QUALITY ASSESSMENT

5.1 Introduction

5.1.1 This section provides an assessment for the potential water quality impact associated with the construction and operation of the PSC, in accordance with the ESB and Appendices 6 and 14 of the EIAO-TM.

5.1.2 Wastewater will be generated by PSC, both process wastewater and wastewater from cleaning, and this will require pre-treatment in a Wastewater Treatment Facility (WTF), one for each stall, which will be constructed on-site (see ***Section 6*** for details).

5.1.3 A foul sewer will be constructed into which sewage and the effluent from the WTF can be discharged, and will connect to Shek Wu Hui Sewage Treatment Works (SWHSTW). Drainage Services Department (DSD) and EPD have been consulted on this issue and asked to confirm whether the effluent from the PSC can be accepted at SWHSTW for final treatment. No objection in principle to this has been received.

5.2 Legislation, Policies, Plans, Standards and Criteria

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

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

5.2.2 The WPCO provides the major statutory framework for the protection and control of water quality in Hong Kong. According to the Ordinance and its subsidiary regulations, Hong Kong waters are divided into ten main Water Control Zones (WCZ). Each WCZ has a designed set of statutory Water Quality Objectives (WQOs). For this Study, the WQOs for Deep Bay WCZ are applicable.

5.2.3 All discharges during construction and operation phases 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. ***Table 5-1***, below, shows the discharge standards for Deep Bay WCZ.

5.2.4 Under the WPCO-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 standards are defined by EPD and specified in licence conditions (under the WPCO) for any new discharge within a WCZ.

Determinants \ Flow rate (m^3/day)	≤10	>10 ≤100	>100 ≤200	>200 ≤400	>400 ≤600	>600 ≤800	>800 ≤1,000	>1,000 ≤1,500	>1,500 ≤2,000	>2,000 ≤3,000	>3,000 ≤4,000	>4,000 ≤5,000	>5,000 ≤6,000
pH (pH units)	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10
Temperature (°C)	43	43	43	43	43	43	43	43	43	43	43	43	43
Suspended Solids	1,200	1,000	900	800	800	800	800	800	800	800	800	800	800
Settleable Solids	100	100	100	100	100	100	100	100	100	100	100	100	100
Biochemical Oxygen Demand	1,200	1,000	900	800	800	800	800	800	800	800	800	800	800
Chemical Oxygen Demand	3,000	2,500	2,200	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Oil & Grease	100	100	50	50	50	40	30	20	20	20	20	20	20
Iron	30	25	25	25	15	12.5	10	7.5	5	3.5	2.5	2	1.5
Boron	8	7	6	5	4	3	2.4	1.6	1.2	0.8	0.6	0.5	0.4
Mercury	0.2	0.15	0.1	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Cadmium	0.2	0.15	0.1	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Copper	1.5	1	1	1	0.8	0.6	0.5	0.4	0.3	0.2	0.15	0.1	0.05
Nickel	4	3	3	2	1.5	1.5	1	0.8	0.7	0.7	0.6	0.6	0.6
Chromium	2	2	2	2	1	0.7	0.6	0.4	0.3	0.2	0.1	0.1	0.1
Zinc	5	5	4	3	1.5	1.5	1	0.8	0.7	0.7	0.6	0.6	0.6
Silver	4	3	3	2	1.5	1.5	1	0.8	0.7	0.7	0.6	0.6	0.6
Other Toxic Metals Individually	2.5	2.2	2	1.5	1	0.7	0.6	0.4	0.3	0.2	0.15	0.12	0.1
Total Toxic Metals	10	10	8	7	3	2	2	1.6	1.4	1.2	1.2	1.2	1
Cyanide	2	2	2	1	0.7	0.5	0.4	0.27	0.2	0.13	0.1	0.08	0.06
Phenols	1	1	1	1	0.7	0.5	0.4	0.27	0.2	0.13	0.1	0.1	0.1
Sulphide	10	10	10	10	5	5	4	2	2	2	1	1	1
Sulphate	1,000	1,000	1,000	1,000	1,000	1,000	1,000	900	800	600	600	600	600
Total Nitrogen	200	200	200	200	200	200	200	100	100	100	100	100	100
Total Phosphorus	50	50	50	50	50	50	50	25	25	25	25	25	25
Surfactants (Total)	200	150	50	40	30	25	25	25	25	25	25	25	25

Note : All figures in mg/ℓ unless otherwise indicated and represent upper limits. Shade indicates the limits applicable to the discharge from the PSC (flowrate from ***paragraph 6.3.2***)

Source: *WPCO-TM – Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters*

Table 5-1 Standards for Effluents Discharged into Foul Sewers Leading into Government Sewage Treatment Plants with Microbial Treatment in Deep Bay WCZ

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

5.3 Water Sensitive Receivers and Baseline Conditions

5.3.1 The nearest Water Sensitive Receiver (WSR) is the open channel that has recently been constructed along the northwest boundary of the Site by DSD.

5.3.2 No water quality monitoring data for this open channel is available, as it has only just been constructed. Furthermore, there was no water in the channel during the site visits, and so it is believed to be ephemeral in nature. As such, no baseline conditions within the Study Area can be defined.

5.3.3 No other WSRs, such as significant water courses, have been identified within 300m of the Site. The Ng Tung River (River Indus) is >300m from the Site at its closest point and is therefore outside of the Study Area.

5.3.4 There is potential for the WSRs to be affected during the construction phase of the Project. During operation of the PSC, all process wastewater shall be treated in an on-site WTF prior to discharge into a foul sewer leading to SWHSTW. All sewage shall be discharged directly to the foul sewer. There will be no discharge of sewage to any local water systems.

5.4 Assessment Methodology

5.4.1 The evaluation criteria and guidelines presented in Appendices 6 and 14 of EIAO-TM were followed where applicable for the study.

5.4.2 Potential sources of water quality impact that may arise during construction and operation phases of the Project are described. All the identified sources of potential water quality impact are then be evaluated and their impact significance determined. Mitigation measures are proposed to reduce any identified impact to acceptable level.

5.4.3 At this time the exact level of automation or mechanisation of operations within the PSC cannot be determined. Therefore, to allow for a worst case calculation of wastewater, full automation has been assumed because a highly automated poultry plant will use more process water on a per bird basis than a manual poultry plant.

5.5 Impact Prediction and Evaluation During Construction Phase

5.5.1 Potential sources of water quality impacts associated with the construction phase of the Project include:

- Construction runoff and drainage;
- General construction activities; and
- Sewage generated from the on-site construction workers.

Construction Runoff and Drainage

5.5.2 Runoff and drainage from the Site may contain suspended solids and other contaminants. Potential sources of water pollution from Site runoff comprise:

- Runoff from exposed bare soil and earth, drainage channels and stockpiles;
- Release of grouting and cement materials with rain wash;
- Waste from any concrete batching plant;
- Wash water from dust suppression sprays and vehicle wheel washing; and
- Fuel, oil and lubricant from maintenance of construction vehicles and mechanical equipment.

5.5.3 The topography of the Site is generally flat, although it slopes down towards Man Kam To Road at the southwest. As such, any construction runoff likely to be generated from the Project is considered to have minimal impact on the WSR.

5.5.4 Nevertheless, mitigation measures shall be implemented to control construction runoff, and to minimise the chance of introducing silt and pollutants into the storm water drainage system along Man Kam To Road. With the implementation of adequate site drainage and the provision of silt removal facilities, no unacceptable water quality impacts are anticipated.

General Construction Activities

5.5.5 General construction activities have the potential to cause water pollution as a result of stockpiling, accumulation of debris and rubbish, concrete dust, etc. Spillage of chemicals, such as oil and diesel from construction plant and equipment, could also result in water quality impacts.

5.5.6 However, it is considered that the impact of these activities upon the WSR will be minimal provided that the site boundaries are well maintained. Good construction and site management practices, such as sediment barriers, site drainage and waste disposal, will also limit the sediment and pollutants to acceptable levels.

Sewage Generated from On-site Workforce

5.5.7 Sewage is characterised by high levels of Biochemical Oxygen Demand (BOD), ammonia and *E. coli* bacteria. Water quality impacts from sewage generated by the on-site workforce will be avoided if adequate sewage collection and disposal facilities, such as portable chemical toilets, are properly installed and maintained.

Cumulative Impacts

5.5.8 The only concurrent project will be the construction of the foul sewer to take effluent from the PSC WTFs to SWHSTW. In terms of water quality, there will be no significant cumulative impacts due to the minor nature of the construction works for the foul sewer within the vicinity of the PSC.

5.6 Impact Prediction and Evaluation During Operation Phase

5.6.1 The following potential sources of wastewater from the operation of the PSC have been identified and are assessed in the subsequent sections:

- Air pollution control/odour scrubbing system;
- Workers and visitors;
- Cleaning and disinfection of the PSC; and
- Poultry slaughtering and evisceration.

5.6.2 With the exception of sewage from workers and visitors, it is proposed that all of this wastewater shall be treated in the on-site WTFs (one for each stall) so as to meet the relevant discharge standards shown in ***Table 5-1***. Sewage from workers and visitors will be discharged directly to foul sewer.

5.6.3 Each of these effluents will have different characteristics and each will contribute to the total flow and loading to the WTF. Therefore, each are discussed separately, below.

5.6.4 Reference has been made to assumptions contained in the *Draft EIA for Proposed Cheung Sha Wan Wholesale Market Complex*[Ref.1] (the CSWWM EIA). Where necessary, this has been supplemented – principal references include US EPA Development Document[Ref.2], *EU BATBREF Document*[Ref.3] and the *IFC Environmental, Health and Safety Guidelines for Poultry Processing*[Ref.4], as well information obtained from a visits to poultry plants in Singapore and Malaysia in February 2007.

Wastewater from Air Pollution Control/Scrubbing System

5.6.5 If a dry scrubbing system is used for air pollution control, there will be no effluent discharged and therefore no water quality impact from this source. If a wet scrubbing system is used, there will be some wastewater generated. The choice of scrubber will be made at the design stage and it is not possible to determine the system to be used at this time. However, if a wet scrubber is used, the quantity of wastewater will be small and will easily be accommodated within the 20% "degree of safety" in WTF design capacity adopted in ***Section 6***.

Wastewater from Workers and Visitors

5.6.6 At any one time, it has been assumed that there will be a maximum of 180 no. workers plus 20 no. management/administration staff at work within the PSC. In addition, delivery vehicles will visit the PSC each day, but only for a short period to unload crates of live poultry and pick-up clean empty crates. Collection vehicles will also visit the PSC to collect dressed poultry but, again, only for a short period. Therefore, it has been assumed that 50% of the vehicle drivers will use the toilet facilities within the PSC.

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1 EHS Consultants Ltd., 1999, *Draft EIA for Proposed Cheung Sha Wan Wholesale Market Complex*, for ArchSD. See ***Appendix 3***
2 US EPA, Jan 2002, *Development Document for the Proposed Effluent Limitations Guidelines and Standards for the Meat and Poultry Products Industry*.
3 EU, May 2005, Reference Document on Best Available Techniques [BATBREF] in Slaughterhouse and Animal By-products Industries.
4 International Finance Corporation, *Environmental, Health and Safety Guidelines for Poultry Processing*, Draft, September 13, 2006.

5.6.7 Based on the assumptions used in the EPD's *Guidelines for the Design of Small Sewage Treatment Plants*, the estimates of domestic effluent flow rates and pollutant loads from sewage generated by PSC workers and vehicle drivers are presented in ***Table 5-2***, below. The unit rates are based on workers with shifts of around 8 hours/day and the total number of workers assumes several shifts of 8 hours/day. Therefore, the unit rates are considered applicable.

Parameter	Biochemical Oxygen Demand (BOD) [Note 1]	Suspended Solids (SS) [Note 1]	Sewage Flow Rate [Note 1]
Total for 200 no. Workers	4,600g	4,600g	$10.00m^3$
Total for 48 x 50% = 24 no. Drivers [Note 2]	552g	552g	$1.20m^3$
Concentration	460mg/ℓ	460mg/ℓ	Total Flow $11.20m^3$
Discharge Standard [Note 3]	1,200mg/ℓ	1,200mg/ℓ	

Notes: 1. Unit Rate for BOD and SS is 23g/head/day and for sewage flow is $0.05m^3$/head/day, based on *Guidelines for the Design of Small Sewage Treatment Plants* for normal working hours

2. From "No. Delivery Vehicles in PSC" and "No. Collection Vehicles in PSC" from ***Table 2-4***

3. Standard from ***Table 5-1*** for $\leq 10m^3$/day (sewage only)

Table 5-2 Estimated Pollutant Loading and Flow from Sewage

5.6.8 As the estimated concentrations of BOD and SS are well within the relevant discharge standards, the sewage generated by workers and visitors can be disposed of directly to the foul sewer that will connect to SWHSTW. To optimise the design capacity of the on-site WTFs it has therefore been assumed that all sewage will be diverted directly to the foul sewer and will not treated on-site. This also benefits the design and efficiency of the WTF as no saltwater (flushing water) will need to be accommodated and treated.

5.6.9 It should be noted that wastewater from hand basins, showers and other personal hygiene facilities, or emergency cleaning operations, throughout the PSC (excluding toilets) will be connected to the WTF. This is because such wastewater could contain washed-off material from poultry slaughtering and evisceration.

Wastewater from Cleaning and Disinfection

Floor Washing

5.6.10 The CSWWM EIA estimates use of water for floor washing at a rate of $10ℓ/m^2$/day ($0.01m^3/m^2$/day) per wash. Given the need to ensure the highest possible standards of hygiene in the PSC, it is proposed to double this rate to $20ℓ/m^2$/day ($0.02m^3/m^2$/day) per wash, to allow for the use of high-pressure water sprays and disinfectant sprays.

5.6.11 For the PSC, the floor washing will be dictated by the operational pattern, shown in ***Table 2-4***. Given this operational pattern, the floors of the various areas within the PSC that are used for poultry holding, slaughtering, evisceration and packing can be washed once per day for a period of three hours.

5.6.12 From ***Figure 2-6***, the gross floor area of the two stalls (i.e. Areas 1A and 1B) is $5,153m^3$. The volume of floor washing water generated is therefore $5,153m^3 \times 0.02m^3/m^2 = 103m^3$. This is a conservative estimation, since some of areas within the two stalls are actually offices, changing rooms, etc. that would not be subjected to this type of floor cleaning.

5.6.13 The 103m^3 of water consumed for floor washing is irrespective of the throughput of the PSC, as it is based on floor area. A typical range for cleaning water consumption within Danish and Norwegian slaughterhouses is 1,973 to 2,600ℓ/tonne of poultry (BATBREF), equivalent to 2.6 to 3.4ℓ/bird. 103m^3 represents 3.1ℓ/bird for 33,000 birds, which is a good correlation to Danish and Norwegian slaughterhouses, given the relatively compact design of the PSC and the consequential smaller floor areas.

5.6.14 The estimated pollution loading and flow from floor washing is given in ***Table 5-3***, below, and is calculated from sampled floor washings from CSWWM:

Parameter	Concentration (mg/ℓ)*	Loading (kg/day)	Loading per Bird (g)
Total Nitrogen	350	36.05	1.09
Total Phosphorus	78	8.03	0.24
COD	3,400	350.20	10.61
BOD	1,450	149.35	4.53
Suspended Solids	2,000	206.00	6.24
Oil & Grease	240	24.72	0.75
Flow	103m^3/day (33,000 poultry @ 3.12ℓ/bird)		

Source: *CSWWM EIA, Table 6-5, Cheung Sha Wan Temporary Poultry Market (see ***Appendix 3***)

Table 5-3 Estimated Pollution Loading and Flow from Floor Washing

5.6.15 It has been assumed that entirely wet cleaning techniques will be utilised at the PSC. However, effluent volumes and pollutant loadings from floor cleaning could be reduced by using dry clean-up techniques, where appropriate.

Delivery Vehicle/Crate Washing

5.6.16 The water consumption rate for vehicle washing is estimated at 144ℓ (0.144m^3) per vehicle, based on use of a water hose with a flow rate of 0.3ℓ/sec for eight minutes per vehicle. There will be 31 no. vehicles delivering live poultry (from ***Table 2-4***), hence a flow of 4.46m^3/day is expected. The vehicle washing area will be bunded to ensure that all wash water is collected and drained to the WTF. The vehicle washing area will also be provided with a roof so that rain does not enter the bunded area.

5.6.17 It has been assumed that an automatic crate washing machine would be installed to provide rapid and hygienic washing of crates. A typical crate washer with a capacity of 1,000 crates/hour requires 1,600ℓ of water for start-up and would use 3ℓ per crate for rinsing.

5.6.18 It has been assumed that one crate will contain ten chickens. Although minor poultry will not be delivered in chicken crates, it has been assumed that their crates would also be washed. 33,000 poultry will be delivered in 3,300 crates, which would generate 11.50m^3/day of wastewater.

5.6.19 Wastewater from vehicle washing and crate washing is expected to be similar in pollutant characteristics and so the estimated flow is based on their combined effluent volumes of 15.96m^3/day, or 0.48ℓ/bird. The estimated pollution loading and flow from vehicle washing and crate washing is given in ***Table 5-4***, below.

Parameter	Concentration (mg/ℓ)*	Loading (kg/day)	Loading per Bird (g)
Total Nitrogen	130	1.93	0.06
Total Phosphorus	20	0.30	0.01
COD	810	12.00	0.36
BOD	300	4.44	0.13
Suspended Solids	2,000	29.62	0.90
Oil & Grease	N/A	N/A	N/A
Flow	15.96m^3/day (33,000 poultry @ 0.48ℓ/bird)		

Source: * CSWWM EIA, Table 6-5, Cheung Sha Wan Temporary Poultry Market analysis of Temporary Market Crate Washing (see ***Appendix 3***). Except Suspended solids figure which is uplifted from 400mg/ℓ to more closely represent the dry solids waste from chickens 2,000mg/ℓ (see below)

Table 5-4 Estimated Pollution Loading and Flow from Delivery Vehicle and Crate Washing

5.6.20 The principal contaminants associated with crate and vehicle washing will be excreta from poultry. Wet muck out operations for 4,000 broiler chickens would be expected to generate an effluent of 3.6m^3/day with an effluent strength 3,800mg/ℓ BOD and 22,000 mg/ℓ SS*[Ref.5]*. This equates to 3.4g BOD/day and 20g SS/day on a per bird basis. However, these loadings assume that birds are excreting over a 24 hour period, which is not the case for deliveries to the PSC.

5.6.21 If a travel period of two hours is assumed then the BOD and suspended solids load associated with excreta on a per bird basis would be 0.29g BOD/day and 1.67g SS/day. The BOD loading figures are in broad agreement with the calculated loadings based on the CSSWWM EIA analysis, however, the suspended solids estimate has been increased to give better agreement.

5.6.22 The WTFs have been sized on effluent treatment plant loadings from crate cleaning and vehicle washing that assume entirely wet cleaning techniques, however, WTF loading and size could be reduced if some dry techniques were utilised.

5.6.23 The withdrawal of feed prior to loading poultry for transportation to slaughter can help reduce the level of faecal contamination during transportation and, therefore, can reduce the amount of effluent produced during cleaning operations and also reduce the intestinal tract contents.

Wastewater from Poultry Slaughtering and Evisceration

5.6.24 Wastewater will be generated from poultry slaughtering and evisceration, which comprises:

- Stunning and killing;
- Scalding and de-feathering; and
- Evisceration and carcass cleaning.

5.6.25 The flow rate will depend upon the actual mode of operation to be adopted (manual, semi-automated or automated) and on the specific plant and equipment that will be installed, which cannot be confirmed at present. Therefore, typical effluent volumes have been assessed for each likely activity based on available data sources.

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5 ERL Ltd [for Environmental Protection Agency], May 1983, *Final Disposal of Agricultural Wastes Economic and Environmental Aspects*

5.6.26 As stated in ***paragraph 5.4.3***, an automated slaughtering and processing system has been assumed because this will use more water per bird than a manual or semi-automated system and therefore represents the worst case in terms of wastewater generation. The descriptions below, therefore, represent a fully automated system as opposed to the semi-automated system described in ***Section 2.5***.

Stunning and Killing

5.6.27 It is typical practice overseas to collect blood in order to reduce BOD and total nitrogen concentrations*[Ref.2]* in wastewater. The blood collected can be processed with recovered feathers in the production of feather meal, a by-product feedstuff used in livestock and poultry feeds as a source of protein. However, it is assumed that all drained blood will be routed to the WTFs, as this is the worst case scenario.

5.6.28 Blood typically represents 6-8% of a chicken's body weight, of which no more than 70% will drain out*[Ref.6]*. The average chicken weight is taken as 1.7kg*[Ref.7]* and it is therefore estimated that 80mℓ of blood is drained from each chicken. To be conservative, the same volume of blood is assumed for minor poultry as for chickens. Therefore, the total volume of blood for 33,000 poultry is estimated at 2.64m^3. The estimated pollution loading and flow from stunning and killing is given in ***Table 5-5***, below, which takes into consideration the composition of chicken blood:

Parameter	Concentration * (mg/ℓ)	Total Loading (kg/day)	Loading per Bird (g)
Total Nitrogen	16,500	43.56	1.32
Total Phosphorus	183	0.48	0.01
COD	150,000	396.00	12.00
BOD	92,000**	242.88	7.36
Suspended Solids	N/A	N/A	N/A
Oil & Grease	620	1.64	0.05
Flow	2.64m^3/day (33,000 poultry @ 80mℓ/bird)		

Source: * US EPA, Jan 2002, *Development Document for the Proposed Effluent Limitations Guidelines and Standards for the Meat and Poultry Products Industry*

** Struzeski W.H., 1962, *Wastes from the poultry processing industry. Technical Report W. 62-3 US Department of H.E.W, Ohio, USA*

Table 5-5 Estimated Pollution Loading and Flow from Stunning and Killing

Scalding and De-feathering

5.6.29 The United States Department of Agriculture (USDA) requires that all scald tanks have a minimum overflow of 1ℓ/bird to reduce the potential for microbial contamination*[Ref.8]*. Data from Danish and Norwegian slaughterhouses*[Ref.3]* quotes a range of water use for scalding (up to 1.3ℓ/bird) and de-feathering (up to 1.9ℓ/bird).

6 Nielsen V.C. (1996) Treatment and Disposal of Processing Wastes. In *Processing of Poultry*, edited by G.C. Mead, Chapman and Hall Publishing Company, New York, New York, pp.368

7 As advised by Veterinary Public Health Section, FEHD via email on 12 February 2007

8 Sams, A.R., ed. 2001. Poultry meat processing. Boca Raton, FL: CRC Press.

5.6.30 Nielsen quotes Hamza et al (1978)[Ref.6] giving scald tank overflow rates of 5ℓ/bird with an effluent composition of 978mg/ℓ BOD, 1,330mg/ℓ COD and 1,556mg/ℓ total solids. The same author quotes a water use for feather flumes of 4ℓ/bird and an effluent strength of 937mg/ℓ BOD. The Food and Agriculture Organisation (FAO) [Ref.9] refers to water use within scald tanks of 8ℓ/bird with effluent loading of 1 to 5g BOD/bird.

5.6.31 Based on the highest figures quoted above, a conservative estimate of effluent composition would be 978mg/ℓ BOD, 1,330mg/ℓ COD 1,556mg/ℓ of total solids, with a flow rate of 8ℓ/bird, or 264m^3/day. On this basis, the estimated pollutant loading and flow from scalding and de-feathering is given in ***Table 5-6***, below.

Parameter	Concentration (mg/ℓ)	Total Loading (kg/day)	Loading per Bird (g)
Total Nitrogen	NA	NA	NA
Total Phosphorus	NA	NA	NA
COD	1,330	351.12	10.64
BOD	978	258.19	7.82
Suspended Solids	1,556	410.78	12.45
Oil & Grease	NA	NA	NA
Flow	264m^3/day (33,000 poultry @ 8ℓ/bird)		

Table 5-6 Estimated Pollution Loading and Flow from Scalding and De-feathering

Evisceration and Carcass Cleaning

5.6.32 A review of data from Danish and Norwegian slaughterhouses[Ref.3] quotes a range of water use for evisceration between 1.7 and 2.4ℓ/bird. Nielsen quotes Hamza et al (1978)[Ref.6] and a water use figure of 2.0ℓ/bird and a mean pollution load of 6g BOD/bird, a value that is in agreement with data provided by Barnes for medium-to-high capacity poultry plants[Ref.10].

5.6.33 A conservative usage of 2.4ℓ/bird (the higher end of the range quoted above), or 79.20m^3/day has been assumed. The estimated pollutant loading and flow from evisceration and cleaning is given in ***Table 5-7***, below.

5.6.34 It should be noted that vacuum transport systems would eliminate the water associated with offal flumes and their associated pollutant load. For the purposes of the generating a waste effluent profile into the WTF, however, we have assumed that no vacuum transport system is installed – a worst case scenario.

9 L.A.H.M. Verheijen ,D. Wiersema, L.W. Hulshoff Pol, J. De Wit International Agriculture Centre, Wageningen, The Netherlands (1996), *Management of Waste from Animal Product Processing. FAO Corporate Document Repository.*

10 Barnes, D., Forster, C.F. and Hrudey, S.E. (1984). Surveys in Industrial Wastewater Treatment: Food and Allied Industries. Pittman Publishing Limited, London, England

Parameter	Concentration (mg/ℓ)	Total Loading (kg/day)	Loading per Bird (g)
Total Nitrogen	NA	NA	NA
Total Phosphorus	NA	NA	NA
COD [Note 1]	4,800	380.16	11.52
BOD	2,400 [Note 2]	190.08	5.76
Suspended Solids	NA	NA	NA
Oil & Grease	NA	NA	NA
Flow	79.20m^3/day (33,000 poultry @ 2.4ℓ/bird)		

Notes: 1. COD loading is estimated based on the presumption of twice the BOD loading.

2. Nielsen [Ref.6] quotes a range of pollutant BOD concentration within offal flumes of 1,678 to 2,640mg/ℓ and edible offal flumes ranges from 78 to 1,156mg/ℓ. Hence the assumed concentration of 2,400mg/ℓ – calculated from the 6g BOD/bird pollutant load within 2.4ℓ is in agreement – albeit a conservative estimate.

Table 5-7 Estimated Pollution Loading and Flow from Evisceration and Carcass Cleaning

Overall Effluent Composition Arriving at WTF

5.6.35 ***Table 5-8***, below, estimates the total loading, flow, cumulative concentration and loading per bird of the combined effluent arriving at the WTFs.

5.6.36 The total wastewater flow of ~465m^3 per day is equivalent to around 14ℓ/bird slaughtered. The UK Environmental Technology Best Practice Programme quotes good practice figures for overall water consumption at 8 to 15ℓ/bird[Ref.11]. Whilst other references such as Nielsen[Ref.6] and Hrudley[Ref.10] indicate higher water consumption rates at ~33ℓ/bird, these are considered unrepresentative of modern slaughterhouse facilities, which practice more energy and water efficient production and cleaning techniques. The rate of 14ℓ/bird slaughtered is at the higher end of the UK Environmental Technology Best Practice Programme range, which is not surprising since no water efficient features have been assumed in the assessment.

5.6.37 ***Table 5-9***, below, sets out the typical overall effluent characteristics (flows, concentrations and pollutant loadings) from poultry slaughterhouses around the world and compares these with the calculated loadings set out in ***Table 5-8***. It can be seen that the calculated loadings are broadly in agreement with the other data sources.

11 Envirowise : Environmental Technology Best Practice Programme (2000), Guide GG233 : *Reducing Water and Effluent Costs in the Poultry Meat Industry*. http://www.envirowise.gov.uk. UK

Parameter	Wastewater Loading (kg/day)*					Minimum Combined Flow*		Loading per Bird (g)*
	Floor Washing	Delivery Vehicle / Crate Washing	Stunning & Killing	Scalding & De-Feathering	Evisceration & Cleaning	Total Load (kg/day)	Cumulative Concentration (mg/ℓ)	
Table Ref. (this report)	*Table 5-3*	*Table 5-4*	*Table 5-5*	*Table 5-6*	*Table 5-7*			
Total Nitrogen	36.05	1.93	43.56	NA	NA	81.54	175.43	2.47
Total Phosphorus	8.03	0.30	0.48	NA	NA	8.81	18.95	0.27
COD	350.20	12.00	396.00	351.12	380.16	1,489.48	3,204.56	45.14
BOD	149.35	4.44	242.88	258.19	190.08	844.94	1,820.68	25.60
Suspended Solids	206.00	29.62	N/A	410.78	NA	646.40	1,390.71	19.59
Oil & Grease	24.72	N/A	1.64	NA	NA	26.36	56.71	0.80

Parameter	Anticipated Flow (m^3/day)					Combined Flow (m^3/day)	Flow Per Bird (ℓ)
Anticipated Flow	103.00	15.96	2.64	264.00	79.20	464.80	14.08

Note: * Figures are shown as a minimum value in recognition that unavailable (NA) parameter data for individual effluent flows will still contribute to the combined stream.

Table 5-8 Estimated Pollution Loading and Flow from All Individually Identified Sources of Wastewater

	PSC for 33,000 Poultry (from *Table 5-8*)		Malaysian Poultry Plant [Ref.12]		US EPA [Ref.2]		Danish Poultry Slaughterhouses [Ref.13]		Nielsen[Ref.6]	
	approx. 14ℓ/bird		15ℓ/bird / 23ℓ/bird *		15ℓ/bird		16ℓ/bird		~33ℓ/bird	
Parameter	**mg/ℓ**	**g/bird**	**mg/ℓ**	**g/bird**	**mg/ℓ**	**g/bird**	**mg/ℓ**	**g/bird**	**mg/ℓ**	**g/bird**
Total Nitrogen	175.43	2.47	170	3.9	54	0.8	N/A	4	N/A	N/A
Total Phosphorus	18.95	0.27	N/A	N/A	12	0.2	N/A	0.55	N/A	N/A
COD	3,204.56	45.14	2,410	54.9	N/A	N/A	N/A	N/A	N/A	N/A
BOD	1,820.68	25.60	1,736	39.5	1,662	24.2	N/A	37	N/A	10 - 29
Suspended Solids	1,390.71	19.59	965	22.0	760	11.1	N/A	N/A	N/A	15
Oil & Grease	56.71	0.80	236	5.4	665	9.7	N/A	N/A	N/A	12

Note: * The metered water flow for the Malaysian Poultry Plant primary processing area indicates a water use of 15ℓ/ bird. However the 23ℓ/ bird figure was measured during site effluent characterisation studies when effluents were measured.

Table 5-9 Comparisons of Calculated PSC Loading against Measured Plant Data in Malaysia and that From Literature Research

12 CETEC Laboratory Kuala Lumpur, March 2003, Wastewater Characterisation Study for the plant operator.

13 Danish EPA. 2000. Miljøprojekt Nr. 573 Renere teknologi på fjerkræslagterier –Projektrapport. Ole Pontoppidan and Poul-Ivar Hansen, Slagteriernes Forskningsinstitut. P. 9. Data derived from a survey of 10 poultry slaughterhouses with an average capacity of 12 million chickens per year.

Basis for Design of WTFs

5.6.38 ***Table 5-10***, below, sets out the final considered design basis for the WTFs for treating wastewater arising from the PSC. This excludes sewage generated by workers and visitors, which will be discharged directly to foul sewer.

Parameter	Concentration from *Table 5-8* (mg/ℓ)	WPCO Discharge Standard (mg/ℓ)*	Exceedance of WPCO Standard (mg/ℓ)	WTF Removal Efficiency Required to Meet Standard
Total Nitrogen	175.43	200	Nil	Nil
Total Phosphorus	18.95	50	Nil	Nil
COD	3,204.56	2,000	1,204.56	38%
BOD	1,820.68	800	1,020.68	56%
Suspended Solids	1,390.71	800	590.71	42%
Oil & Grease	56.71	50	6.71	12%

Source: *Shaded Column from ***Table 5.1***

Table 5-10 Design Requirement for WTFs

5.6.39 All parameters exceed the discharge standard, except for total nitrogen and total phosphorus. To meet the discharge standard, wastewater will require treatment prior to discharge to foul sewer. The necessary treatment can be achieved by the on-site WTF, the concept design of which is described in ***Section 6.3***.

5.7 Mitigation Measures

Construction Phase

Construction Runoff and Drainage

5.7.1 Any effluent discharge from the Site is subject to control under a WPCO discharge licence. Wastewater shall properly be treated to meet the discharge standards set out in the relevant discharge licence. No direct discharge of site runoff into the adjacent open channel will be allowed.

5.7.2 Runoff and drainage shall be prevented or minimised in accordance with the following guidelines in ProPECC PN 1/94:

- Provision of perimeter channels to intercept stormwater from outside the Site. To be constructed in advance of site formation works and earthworks;
- Sand/silt removal facilities such as sand traps, silt traps and sediment basins shall be provided to remove sand/silt particles from runoff to meet the requirements of the TM standard under the WPCO. These facilities shall be properly and regularly maintained;
- Programming of works to minimise soil excavation during rainy seasons;
- Exposed soil surface shall be protected by paving as soon as possible to reduce the potential of soil erosion;

- Temporary access roads shall be protected by crushed gravel and exposed slope surfaces shall be protected when rainstorms are likely to occur;
- Trench excavation shall be avoided in the wet season as far as practicable, and, if necessary, these trenches shall be excavated and backfilled in short sections; and
- Open stockpiles of construction materials on Site shall be covered with tarpaulin or similar fabric during rainstorms.

5.7.3 The wheel washing facility ensures no earth, mud or debris is tracked off the Site and deposited on to Man Kam To Road. Sand and silt in the wash water from the wheel washing facility, shall be settled out and removed before discharging into the storm drain. Any section of the road between the wheel washing bay and Man Kam To Road shall be paved with a back-fall to prevent wash water or other site runoff from entering the public area.

5.7.4 Oil receptors shall be provided and shall be regularly emptied to prevent release of oil and grease into the storm drainage system after accidental spillage. The interceptor shall have a bypass to prevent flushing during periods of heavy rain.

General Construction Activities

5.7.5 Debris and rubbish generated on Site shall be collected, handled and disposed of properly to avoid them entering the open channel. All fuel tanks and storage areas shall be provided with locks and be sited on sealed areas, within bunds of a capacity equal to 110% of the storage capacity of the largest tank. Open storm water drains and culverts near the works area shall be covered to block the entrance of large debris and refuse.

Sewage Generated from On-site Workforce

5.7.6 The sewage from construction work force is expected to be handled by portable chemical toilets. Appropriate and adequate toilets shall be provided by licensed contractors who shall be responsible for appropriate disposal of collected sewage and maintenance of the toilets.

Operation Phase

5.7.7 Sewage will be generated by workers and visitors and will be discharged directly to foul sewer. Process wastewater arising from the use of personal hygiene facilities, from floor washing, from delivery vehicle / crate washing and from the various slaughtering processes will require treatment in the on-site WTF. The WTF will treat this process wastewater to meet the relevant discharge standards shown in ***Table 5-1*** and the conditions specified in the future WPCO discharge licence for the WTF. Treated effluent from the WTF will be discharged to foul sewer.

5.7.8 The foul sewer will be connected to SWHSTW for further treatment of the wastewater and there will be no discharge of liquids within the Site. Therefore, no adverse water quality impact to the WSR is expected from these sources.

5.7.9 The conceptual design for a WTF to achieve the necessary level of treatment, and the required sewerage, is described in ***Section 6***, but has not taken into consideration any water saving features adopted in overseas poultry slaughtering facilities. As such, the impacts resulting from the generation of wastewater could be mitigated by reducing the quantity, discussed below.

5.7.10 Planned maintenance shutdown of the WTF will be scheduled for non-operational hours. Regular maintenance will minimise emergency shutdown.

5.7.11 Two pumping stations and twin rising mains are proposed in ***paragraph 6.2.29***. In the event that one of the rising mains bursts, it will be immediately closed to prevent leakage of sewage and to avoid pollution – this would be considered an emergency situation.

5.7.12 Based on the WTF and sewerage design provided in ***Section 6***, during emergency shutdown of one of the WTFs, the other WTF will likely be able to handle the total flow from the normal throughput operation of the PSC. During emergency shutdown of one of the pumping stations or rising mains, flow in the other pump or main will be increased and/or tankering of surplus effluent directly to SWHSTW will be carried out until the pump or main is repaired.

5.7.13 However, given that regular and preventive maintenance will be adopted, periods for emergency shutdown will likely be brief, and so the periods for tankering and volumes of wastewater to be tankered are not likely to be extensive. At no time will discharge of untreated effluent purely due to shutdown of the WTF, pumps or rising mains occur.

Wastewater Reduction Measures

5.7.14 In ***Section 5.6*** the effluent characteristics from different poultry slaughterhouse processing steps were set out. In addition a number of alternative working practices were also described, e.g. blood recovery. ***Table 5-11***, below, summarises these options and attempts to quantify indicative available reduction in biological load (as BOD) and volume at the WTF, should these alternative working practices be adopted by Operators.

	Wastewater Reduction Measures			
Impact on WTF	**Dry Collection of Excreta**	**Blood Recovery**	**Vacuum Transport Evisceration***	**Total Wastewater Reduction**
Volume Reduction (ℓ/bird)		0.08	1.58	1.66
BOD Reduction (g BOD/bird)		7.36	3.80	11.16
Volume Reduction (m^3/day)	14.81	2.64	52.14	69.59
BOD Reduction (kg BOD/day)	4.44	242.88	125.40	372.72

Note: *Previously identified pollutant load and effluent volume for non-vacuum system would have included for water used to give a final clean to the carcass. In the absence of better data, the volumes and pollutant loadings associated with evisceration fluming are assumed to represent 66% of the totals identified in ***Table 5-8*** for the "Worst Case" scenario

Table 5-11 Wastewater Reduction Measures and Impact on WTF

5.7.15 Based on ***Table 5-11*** a total wastewater reduction of 69.59m^3/day (15% of 464.80m^3/day) is achievable, representing both potable water supply and effluent disposal.

5.7.16 For potable water supply, the current non-domestic charge rate is \$4.58/m^3 and this translates into cost savings of \$319/day, or \$116,435/year.

5.7.17 For effluent disposal, trade sewage charges are \$1.20/m^3 supplied and this translates into cost savings of \$83/day, or \$30,295/year. The Trade Effluent Surcharge (TES) for "slaughtering, preparing and preserving meat" (under Schedule B) applies only to BOD >3,870mg/ℓ and COD >2,823mg/ℓ. As the WTF will produce an effluent with considerably lower BOD and COD, the TES will not apply to the effluent from the PSC.

5.7.18 In summary, if the water reduction measures described above are implemented these could reduce consumption by 69.59m^3/day with a corresponding operational cost saving of $402/day, or $146,730/year. This would also be a more elegant and environmentally sustainable design solution. As such, adoption of water-saving designs are strongly recommended.

5.8 Residual Impacts

Construction

5.8.1 After the implementation of proposed construction phase mitigation measures, no residual impact is expected.

Operation

5.8.2 No residual impact is expected after the construction and operation of the on-site WTFs to meet the standards for effluents discharged into foul sewers leading into government sewage treatment plants with microbial treatment in Deep Bay WCZ.

5.8.3 Based on ***Tables 5-2 and 6-3***, wastewater strength and loading discharging to foul sewer leading to SWHSTW are summarised in ***Table 5-12***:

Parameter	Wastewater Strength (mg/ℓ)			Wastewater Loading (kg/day)		
	Sewage from Toilets	Treated Effluent from WTFs	Total	Sewage from Toilets	Treated Effluent from WTFs	Total
Total Nitrogen	-	78.94	77.08	-	36.69	36.69
Total Phosphorus	-	8.52	8.32	-	36.69	36.69
COD	-	1,281.85	1,251.69	-	595.80	595.80
BOD	460.00	637.23	633.06	5.15	296.18	301.34
Suspended Solids	460.00	139.07	146.62	5.15	64.64	69.79
Oil & Grease	-	5.67	5.54	-	2.64	2.64
Flow (m^3/day)	11.20	464.80	476.00	11.20	464.80	476.00

Table 5-12 Wastewater Strength and Loading Discharged to Foul Sewer Leading to SWHSTW

5.8.4 The above loadings and flows are well within the operational parameters of SWHSTW and so will not cause any adverse impact. A retention tank will be used to control the release of treated effluent from the WTPs to SWHSTW in order to avoid the diurnal peak flow at SWHSTW.

5.9 Conclusions

5.9.1 This assessment has considered the water quality impacts from the construction and operation of the PSC. No significant residual impact related to water quality is anticipated, provided that the recommended mitigation measures are properly implemented.

5.9.2 The use of environmentally sound designs to achieve significant water-savings are strongly recommended. If the recommended water reduction are implemented these could reduce consumption by 69.59m^3/day, with a corresponding operational cost saving of $402/day, or $146,730/year – this would also be a more environmentally sustainable design solution.

6 SEWERAGE AND SEWAGE TREATMENT IMPLICATIONS

6.1 Introduction

6.1.1 The detailed design of the WTF and sewerage will be carried out during the detailed design stage and so these details are not presently available.

6.1.2 The suggested configuration, estimated loading and flow rates and conceptual designs contained in this EIA shall not pre-empt or constrain the future detailed design of the sewerage and/or WTF, nor shall they supplant specifications provided in any future contract documents.

6.1.3 The sewerage and effluent treatment implications discussed in this section have been provided to demonstrate that, in the absence of a detailed design, the required sewerage and effluent treatment can be achieved in practice using commercially available plant and equipment. As such, the WTFs can be designed to meet the effluent discharges assumed in this EIA and thereby achieve acceptable environmental operation.

6.1.4 Notwithstanding, the designer is recommended to carry out his own calculations of loading and flow rates, based on the configuration, plant and equipment to be installed in the PSC.

6.2 Sewerage

6.2.1 The Designer/Works Contractor will ensure that any sewerage required to service the PSC will be designed and constructed to meet current standards, prior to the operation of the PSC. Twin rising mains for each pumping station shall be provided.

Existing Sewerage Systems

6.2.2 There is no local gravity sewerage system in the vicinity of the Site. However, there is a single 250mm diameter rising main running along Man Kam To Road, which continues under pressure all the way to SWHSTW. This pumping main originates at a DSD Sewage Pumping Station (SPS) approximately 600m north of the PSC along Man Kam To Road (referenced as XPS1000182 on DSD's Drainage Record Plan 3-NW-21A). Records of the flows passing through the SPS, as well as details of the SPS and downstream rising main, are kept by DSD.

6.2.3 This SPS receives flow from an upstream 250mm diameter rising main and a local 300mm diameter gravity sewer, which collects flow from village houses and other buildings upstream, and adds flows from the Police Dog Unit and Force Search Unit Training School.

6.2.4 The upstream 250mm diameter rising main originates at a SPS in Ta Kwu Ling Village on Lin Ma Hang Road (referenced as XPS1000181 on DSD's Drainage Record Plan 3-NW-13C). This SPS receives flows from two rising mains and one gravity sewer. One of the rising mains is an upstream 150mm diameter rising main, which collects flow (treated leachate) from the NENT Landfill Leachate Treatment Plant, while the other is a 200mm diameter rising main from Tong Fong SPS. The 225mm diameter gravity sewer collects flow from village houses and other buildings in the immediate surroundings of the SPS.

Contributing Catchments

6.2.5 It is considered likely that the treated leachate flows from NENT Landfill will be fairly consistent, since the leachate treatment plant at NENT Landfill has a fixed maximum throughput. As such, there will be a significant base flow from this source at all times.

6.2.6 The series of NENT Village SPS receive considerable additional flow to Pak Hok Shan SPS with the discharge from a laundry. In the rainy season, the SPS in Sha Ling and its upstream SPS are often overloaded due to high infiltration of stormwater. The existing NENT leachate rising main is already overloaded in wet weather and does not have spare capacity, yet will need to accommodate further flow from villages to be sewered in the future.

Off-site Sewage Treatment

6.2.7 The nearest Government sewage treatment plant is SWHSTW, which provides secondary treatment to sewage collected from Sheung Shui and Fanling areas, and discharges treated effluent into Shek Sheung River.

6.2.8 SWHSTW has a design capacity of 80,000m^3/day serving a population of 195,000. A plan to upgrade to the treatment works will be completed in 2009, expanding the capacity to 93,000m^3/day serving a population of 230,000. This upgrade is planned to be completed before the operation of the PSC.

6.2.9 The projected effluent discharge from the PSC is ~476m^3/day, comprising ~11m^3/day of sewage from toilets and ~465m^3/day of effluent from the on-site WTFs. This effluent will meet the required *Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters.* This discharge is considered fairly minor (just 0.5%) with respect to the expanded treatment capacity of 93,000m^3/d at SWHSTW.

6.2.10 DSD and EPD have been consulted on this issue and asked to confirm whether the effluent from the PSC can be accepted at SWHSTW for final treatment. No objection in principle has been received from DSD and EPD. In earlier consultations with DSD on effluent flows, they advised that high flows should ideally arrive at SWHSTW during off-peak hours, say, after 2am, in order to reduce the hydraulic impact to SWHSTW.

6.2.11 It is proposed that slaughtering and evisceration operations at the PSC shall be carried out as shown in ***Table 2-4***. The wastewater generated by these operations, plus vehicle, crate and floor washing, and the subsequent effluent from the PSC that arrives at SWHSTW is shown in ***Table 6-1***, below, and in ***Figure 6-1***.

6.2.12 ***Figure 6-1*** shows (in red) the generation of wastewater within the PSC and (in blue), the arrival of sewage and treated effluent from the WTFs at SWHSTW. These flows have been achieved through the use of an equalisation tank to balance the flow of wastewater into the WTFs, and the use of a retention tank to control the release of treated effluent from the WTFs to SWHSTW in order to avoid the diurnal peak flow at SWHSTW. A one hour period has been allowed between the sewage and treated effluent from the WTF leaving the PSC site and arriving at SWHSTW. The actual design and sizing of the equalisation tank and retention tank will be carried out during the detailed design stage.

Time	Sewage from Toilets	Process Wastewater into WTFs (excludes Sewage)					WTF			Discharge to SWHSTW*	Retention Tank
		Vehicle Washing	Crate Washing	Floor Washing	Slaughtering Evisceration	Total Wastewater*	Cumulative Flow	Equalisation Tank	Total WTF Flow		
10:00 - 11:00	0.47	0.29	-		-	**0.29**	0.29	126.32	19.37	0.44	56.72
11:00 - 12:00	0.47	0.29	-		-	**0.29**	0.58	107.24	19.37	0.47	75.62
12:00 - 13:00	0.49	0.43	-		-	**0.43**	1.01	88.30	19.37	0.47	94.52
13:00 - 14:00	0.49	0.43	-		-	**0.43**	1.44	69.37	19.37	0.49	113.40
14:00 - 15:00	0.44	0.14	-		-	**0.14**	1.58	50.14	19.37	0.49	132.27
15:00 - 16:00	0.44	0.14	-		-	**0.14**	1.73	30.92	19.37	0.44	151.20
16:00 - 17:00	0.42	-	-		-	**-**	1.73	11.56	19.37	0.44	170.12
17:00 - 18:00	0.42	-	-		-	**-**	1.73	-	19.37	0.42	189.07
18:00 - 19:00	0.42	-	-		-	**-**	1.73	-	19.37	0.42	208.02
19:00 - 20:00	0.44	0.14	-		-	**0.14**	1.87	-	19.37	0.42	226.97
20:00 - 21:00	0.64	1.29	0.87		26.20	**28.36**	30.23	-	19.37	0.44	245.90
21:00 - 22:00	0.57	0.86	1.01		30.39	**32.26**	62.50	-	19.37	0.64	264.62
22:00 - 23:00	0.47	0.29	1.01		30.39	**31.69**	94.19	-	19.37	0.57	283.42
23:00 - 00:00	0.44	0.14	1.01		30.39	**31.55**	125.73	-	19.37	0.47	302.32
00:00 - 01:00	0.42	-	1.01		30.39	**31.40**	157.14	12.04	19.37	0.44	321.25
01:00 - 02:00	0.42	-	1.01		30.39	**31.40**	188.54	24.07	19.37	0.42	340.20
02:00 - 03:00	0.42	-	1.01		30.39	**31.40**	219.94	36.11	19.37	116.62	242.95
03:00 - 04:00	0.42	-	1.01		30.39	**31.40**	251.34	48.14	19.37	116.62	145.70
04:00 - 05:00	0.47	-	1.01		30.39	**31.40**	282.75	60.18	19.37	116.62	48.45
05:00 - 06:00	0.57	-	1.01	34.33	30.39	**65.74**	348.48	106.55	19.37	116.67	-
06:00 - 07:00	0.52	-	1.01	34.33	30.39	**65.74**	414.22	152.92	19.37	0.57	-
07:00 - 08:00	0.47	-	0.52	34.33	15.72	**50.58**	464.80	184.13	19.37	0.52	-
08:00 - 09:00	0.47	-	-		-	**-**	-	164.76	19.37	0.47	18.90
09:00 - 10:00	0.44	-	-		-	**-**	-	145.40	19.37	0.47	37.80
Total	**11.20**	**4.46**	**11.50**	**103.00**	**345.84**	**464.80**			**464.80**	**476.00**	

Note: All figures in m^3. "Sewage from Toilets" volumes are from ***Table 5-2***. Totals for each component of wastewater are those shown in ***Table 5-8***
Equalisation tank size = 184.13m^3, say, 200m^3. Retention tank size = 19.37 x 20 = 387.4,or 390m^3

Table 6-1 Estimated Timing and Volumes of Wastewater Generation and Arrival of Sewage and Treated WTF at SWHSTW

Potential Options for Effluent Discharge to SWHSTW

6.2.13 A number of options for delivering the sewage and treated effluent from the WTFs to SWHSTW have been examined and evaluated in terms of technical achievability.

Option 1 – Connection to the Existing 250mm Diameter Rising Main

6.2.14 Assuming a current velocity of approximately 1.5m/s in the existing main (the *DSD Sewerage Manual, Part 2*, recommends velocities in the range of 1m/s to 2m/s) and a pipe roughness (k_s) of 0.6mm, the existing rising main would have a capacity in the order of 75ℓ/s. The addition of a further 10ℓ/s to the flow would increase the velocity to approximately 1.7m/s and, in very simplistic terms, it might be possible to pass the flow from the PSC through the existing main, which would eliminate the need to construct and maintain long lengths of pipelines in public roads. However, the actual situation is far more complex than this simplified scenario and various factors would need to be carefully considered and analysed before the feasibility of this option could be confirmed.

6.2.15 The interconnection of multiple pumped systems is notoriously difficult, due to the interaction between the various pumping systems under different pumping conditions, and this would be even worse with the connection of a new system to an existing arrangement. Back-flow within pumping systems can fairly easily be prevented by the common practice of including non-return valves in the pipework arrangements at the SPS. However, of greater concern would be the potential effect on pressures within the rising main under various pump operating conditions, and it would be necessary to carry out a comprehensive surge analysis of the pumping systems and rising main under all combinations of pump operating configurations, including emergency pump or power failure.

6.2.16 Potentially adverse pump interaction could be minimised by the inclusion of interconnected pump controls at the two SPS (XPS1000182 and the pumping station at the PSC), although this would require development of a complex operating control regime and connections, which might not be workable.

6.2.17 A related issue would be the expected increases in maximum operating and surge pressures as a result of the additional flows. It would be essential to thoroughly review the design capacities of all fittings and thrust blocks, with upgrading and/or remedial measures developed, as appropriate. This is a significant piece of work in itself and not something that could, or should, be carried out as part of an EIA Study.

6.2.18 From notes on DSD's Drainage Record Plans and information on NENT Landfill, it is understood that the existing rising main would have been constructed in the early 1990s and is therefore approaching 15 years of age. As the PSC is unlikely to be in operation for several more years, it is quite likely that the existing main will be closer to 20 years old by the time effluent is discharged from the PSC, and this is close to DSD's recommended design life for rising mains of 25 years.

6.2.19 Careful consideration should therefore be given to any overall plans for replacement/upgrading of the existing main before the option of direct connection is pursued further. For this reason, and the other reasons given above, **this is not a preferred option at this time.**

Option 2 – Connection to the Upstream Pumping Station XPS1000182

6.2.20 Whilst direct connection from the PSC to the existing rising main would involve numerous complications and potentially serious adverse impacts, the utilisation of any spare capacity in the existing system would overall be most efficient and would minimise disruption. An alternative option, therefore, might be to discharge from the PSC towards the upstream SPS XPS1000182, which is only 600m away from the PSC site, compared with 2.1km for SWHSTW.

6.2.21 Based on the topography between the Site and the upstream SPS, it is likely that pumping the entire way would be necessary.

6.2.22 As with other options, the available spare capacity in the existing 250mm diameter rising main will need to be carefully evaluated before the practicality of this option can be determined, although this approach would minimise disruption to the existing facilities. As stated in ***paragraph 6.2.6***, indications are that there is no spare capacity. It might be necessary to upgrade the existing SPS to cater for the additional flows. For this reason, and the other reasons given above, **this is not a preferred option at this time.**

Option 3 – Connection from the Existing Rising Main to the PSC

6.2.23 An alternative option to avoid the complications of connecting two pumping systems would be to provide a new pumping station at the PSC to receive the flows from the existing rising main and then to pump all flows onwards to SWHSTW through the remainder of the existing main. This arrangement would provide a break in the existing pressure system at the new pumping station sump, thus avoiding the surge and pressure interfaces.

6.2.24 Although technically feasible, this option would require public sewage flows to be discharged to the PSC, which is not a practical arrangement. Furthermore, it would also result in all flows passing through the single existing rising main rather than twin mains, as currently required by EPD and DSD. For this reason, and the other reasons given above, **this is not a preferred option at this time.**

Option 4 – Dedicated Twin Rising Mains Directly to SWHSTW

6.2.25 The remaining option is to provide twin rising mains from the PSC to SWHSTW, which would provide a robust arrangement for the transfer of effluent to the public treatment facilities. However, this would require the construction of twin pumping mains (150mm diameter or greater) all the way from the PSC to the SWHSTW inlet, a distance of approximately 2.1km.

6.2.26 In addition to the initial construction cost, there would need to be long-term maintenance of the mains and a suitable maintenance agent would need to be identified – DSD have advised that the rising main, by its nature, is not under the purview of DSD.

6.2.27 Notwithstanding, it is considered that this option will provide the most robust and least technically complex solution and so **this is the preferred option at this time**, and is discussed in detail below.

Preferred Sewerage Option

6.2.28 The preferred option is to construct dedicated twin rising mains from the PSC directly to SWHSTW. Twin pipes of at least 150mm diameter are proposed but this should be confirmed by the Designer when maximum hourly flows have been established, based on the operations of the PSC, and maximum pumping rates have been agreed after discussions with DSD.

6.2.29 Two pumps (one duty, one standby) plus a sump of adequate capacity will need to be constructed within the Site. Twin rising mains should also be provided to ensure that the rising mains are maintainable without shutting down. In the event that one of the rising mains bursts, it will be immediately closed to prevent leakage of sewage and to avoid pollution. To compensate, flow in the other main will be increased and/or tankering of surplus effluent to SWHSTW will be carried out until the main is repaired.

6.2.30 There are three possible alignments for the dedicated twin rising mains from the PSC to SWHSTW.

- **Alignment A** would be to construct the rising mains across Ng Tung River via Tung Yin Bridge. Thereafter they would connect into the existing sewer system in the Sheung Shui Wai village area. This would involve the upgrading of the existing sewer and the downstream trunk sewer system and would involve construction under carriageways through populated areas and so would likely cause significant disruption.
- **Alignment B** would follow the route of Alignment A but would the rising mains would continue directly to SWHSTW. This would involve construction under carriageways through populated areas and so would likely cause significant disruption.
- **Alignment C** would be to construct new twin rising mains along Fu Tei Au Road, following the existing DN250 rising main. This alignment goes through less populated areas with less traffic flow, and so would have less impact than Alignments A and B. DSD have been consulted on this issue and no objection has been received.

6.2.31 Alignment C is therefore considered to be the preferred alignment option for the purposes of this EIA. ***Figure 6-2*** shows the indicative routes for Alignment C, as well as Alignments A and B.

6.2.32 The design and construction of the twin rising mains will be the responsibility of the Designer/ Works Contractor and it is their decision as to which alignment is adopted. The Designer shall be required to carry out a land ownership survey to confirm whether the adopted alignment encroaches on private land – this confirmation shall be included in a Sewerage Impact Assessment (SIA) prepared by the Designer, based on his detailed design.

6.2.33 Responsibilities for design, construction, operation and maintenance of the sewage infrastructure are discussed in ***Section 6.5.***

6.3 Sewage Treatment

Sizing of the WTF

6.3.1 As described in ***Section 5.6***, wastewater from the PSC will not meet the *Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters* issued under Section 21 of the WPCO. As such, on-site WTFs will be required to pre-treat the wastewater prior to discharge to foul sewer.

6.3.2 As the calculations in ***Table 5-8*** are based on a conceptual design for the PSC and for assumed operation patterns, it would be prudent to add a contingency allowance, say around 20%, to the overall design basis for the WTFs to allow for future flexibility. Thus, rather than sizing the two WTFs for 462.07m^3 per day combined capacity, they will be sized for 20% more than this, i.e. for ~555m^3/day combined capacity, or 280m^3/day per WTF.

6.3.3 This will allow wastewater generation of around 16.7ℓ/bird using both WTFs, or around 8.3ℓ/bird using just one WTF (e.g. if one WTF needed to be taken out of service) for the worst case PSC throughput of 33,000 birds/day. If the normal throughput of 23,000 birds/day is considered, ~555m^3/day combined capacity would allow wastewater generation of around 24ℓ/bird using both WTFs, or around 12ℓ/bird using just one WTF.

6.3.4 This provision is still within the *UK Environmental Technology Best Practice Programme* range, with the wastewater generation rate based on fully automated processing. If manual or semi-automated processing is to be used, the wastewater generation rate per bird would be reduced.

6.3.5 Given the above, it is likely that just one of the two WTFs could treat all of the wastewater generated during normal operational throughput of the PSC, allowing configuration of duty and standby WTFs, if desired – this is discussed further in ***paragraph 5.7.12*** .

Design of the WTF

6.3.6 The two proposed WTFs will be located within the PSC as shown in ***Figure 2-3****,* with a combined footprint of approximately 523m^2, as indicated in ***Figure 2-6***. A schematic flow diagram for the WTF is provided in ***Figure 6-3*** and the following text should be read in conjunction with this schematic.

6.3.7 Both of the WTFs will be identical in terms of design, although their actual layout may vary to meet the dimensions of the area allocated. The following discussion refers to one WTF with a capacity of 280m^3/day, but is applicable to both. The two WTFs together will provide a combined capacity of 555m^3/day.

6.3.8 The principal constituents of poultry slaughtering wastewaters are a variety of readily bio-degradable organic compounds, primarily fats and proteins, present in both particulate and dissolved forms. The effluent flow and composition were estimated in ***Section 5.6*** and form the basis of the conceptual design.

Stage 1 – Screening Effluent

6.3.9 To reduce wastewater treatment requirements, the effluent arriving at WTF will be screened to reduce the content of particulate matter before treatment.

6.3.10 As good operating practice it is suggested that bar screens (or catch pots) are installed within floor drains from each individual production area to remove any large size objects prior to discharge to WTF. An added benefit of screening is increased collection of materials and subsequent increased production of rendered by-products. Furthermore the shorter the organic particles are in contact with wastewater, the less organic nitrogen will be converted to ammonia nitrogen. This is significant because organic nitrogen can be removed from the wastewater by physical pre-treatment; such as fine screening, settling or flotation; but ammonia cannot because it is in solution and will therefore pass through the WTF primary treatment stages.

6.3.11 Depending on the available space and plant arrangement, wastewater arriving at WTF can either be collected within an agitated underground sump and pumped to an effluent screen; or alternatively can be screened within a gravity effluent channel. Numerous screening systems are available (e.g. brushed bar, static wedgewire, rotary drum screens).

6.3.12 Subject to a more detailed evaluation of effluent generation volume profile by the designer it is suggested that the capability of the screening system and subsequent transfer to an effluent balance tank should be based on the maximum flow plus 20% safety margin. The maximum slaughtering rate is 1,450 birds/hour per stall. Assuming the maximum of 14ℓ per bird, the maximum possible hourly flow will be 20m^3. The peak flow capacity should therefore be, say, 24m^3/hour.

6.3.13 One possible screening system would be to utilise a self cleaning continuous belt cleaning system in combination with a screw compactor system to remove fine and solids from the poultry slaughterhouse effluent. A large number of screening elements are attached to the drive chains forming a 1mm to 3mm opening size; hooks protruding from the belt elements are provided to capture larger solids.

6.3.14 The screw compactor system enables a degree of dewatering of retained screenings to take place (reduction in wastewater by 50% and up to 40% reduction in volume). Collected screening materials will be stored at designated areas for possible export to a rendering or reclamation facility. Any waste material requiring off-site disposal will require dewatering at the WTF solids dewatering facility, prior to transport to an off-site facility, such as a landfill.

6.3.15 A standby coarse screen system in the form of an automatic bar screen (<25mm bar spacing), or a manually raked system will maintain effluent flows in the event of a blockage at the belt cleaning system. Both duty and standby screens must be capable of handling the identified peak flow of 24m^3/hour.

6.3.16 Screened effluent is pumped (in the case of the screens fitted to gravity drain channels) via an effluent sump into a flow equalisation tank. The capacity of the equalisation tank is designed to provide residence time to accommodate peak flow periods and thus balance pollution loadings and flows to subsequent treatment stages within the WTF.

6.3.17 The volume of the equalisation tanks have been calculated in ***Table 6-1*** and are minimised to avoid odour generation. To prevent septic conditions within the equalisation tank stirring and aeration is included in the form of submerged jet aerators, chosen to minimise aerosols.

Stage 2 – Removal of Fats, Greases and Fine Solids

6.3.18 After the removal of coarse solids, the effluent stream still contains finely suspended solids, fats and grease. These have a high organic pollutant loadings and form a floating scum that adheres to the sides of tanks and pipes. If not removed these fats can cause serious problems with the operation of downstream biological treatment processes.

6.3.19 Dissolved Air Flotation (DAF) is used extensively world-wide in the primary treatment of poultry slaughterhouse wastewaters. DAF plants are able to remove very small or light particles (including grease) more completely and in a shorter period of time compared with gravity settlement techniques.

6.3.20 In DAF systems, air is dissolved in the wastewater under a pressure of several atmospheres followed by release of the pressure to the atmospheric level, creating numerous fine air bubbles in contact with particulate matter. The heavy materials settled at the bottom will be removed by a bottom scraper and combined with the other collected solids. Typically, the sludge recovered would be in the region of 3-4% dry solids content.

6.3.21 Chemicals (e.g. polymers and flocculants) are often added prior to the DAF to improve the DAF performance. Typical removal rates of suspended solids by DAF vary between 40% and 65%

(without chemical addition); and between 80% and 93% (with chemical addition). Oil and grease removal by DAF ranges from 60% to 80% (without chemical addition) and 85% to 95% (with chemical addition).

6.3.22 The choice of chemicals used for coagulation and flocculation will depend upon the intended disposal route of the sludge. Should the sludge be recoverable as a by-product for possible animal feed (if high fat content) or sent for land spreading (if high nutrient content) then the chemicals used must be of low toxicity. In such instances the use of organic polymers is preferred to avoid high aluminium or iron concentrations in the rendered product that are associated with other common coagulants such as aluminium and iron salts. pH control of incoming and outgoing effluent may be necessary to produce optimal conditions for precipitation.

6.3.23 Experience at a similar facility in Malaysia using organic coagulants and anionic polymer solution would suggest a maximum dry sludge production from DAF flotation of 0.07kg dry solids/bird[Ref.1]; a coagulant dose rate of 80ppm and polymer dose rate of 4ppm. On this basis, the maximum dry solids production from the DAF plant using organic polymers is estimated to be 2.31 tonnes/day for a throughput of 33,000 poultry. These maximum figures are conservative, since a dry solids production rate of 0.015 to 0.03kg/chicken is quoted for flocculation sludge dry matter within Danish Poultry slaughterhouses[Ref.2], which would equate to less than a quarter or less than a half of the figures quoted above.

Stage 3 – Primary Treatment by DAF

6.3.24 A DAF plant design based on a maximum solids loading rate of 5kg/hr/m^2, an air:solids ratio of 0.02kg air/kg solids and an effluent temperature of 25^{O}C would equate to the following design:

- Recycle rate @ 50% of incoming;
- DAF tank area ~3m^2;and
- Compressed air use of 0.28kg/hr.

6.3.25 The solids collected from the proposed DAF plant will be removed from the DAF at a typical 4% solids. These solids could be recoverable as a by-product, as is generally the practice elsewhere. However, any non-recovered material will require off-site disposal (e.g. to landfill) and so would require further dewatering at the WTF solids dewatering facility.

6.3.26 Typical quoted performance for chemically assisted DAF plants treating poultry slaughterhouse effluents are shown in the ***Table 6-2***, below.

6.3.27 The typical effluent treatment for poultry slaughterhouses when discharging to sewer is: coarse screening (at source) → fine screening → removal of fats oil and grease (usually DAF)[Ref.3]. One would therefore anticipate an effluent treatment plant discharging to sewer to not require further processing.

1 Hyder Site Visit - Ayamas Food Corporation BHD, Malaysia (2007); DAF plant performance parameters provided by Stork Aqua. 8400 kg/day dry solids generated based on 120,000 birds/day

2 Danish EPA. 2000. Miljøprojekt Nr. 573 Renere teknologi på fjerkræslagterier –Projektrapport. Ole Pontoppidan and Poul-Ivar Hansen, Slagteriernes Forskningsinstitut. P. 9. Data derived from a survey of 10 poultry slaughterhouses with an average capacity of 12 million chickens per year.

3 Guidance for Poultry Processing IPPC S6.11 | Issue 3 | Modified on 1 October, 2003

	Influent (Table 5-8)	US EPA [Ref.4]	BATBREF [Ref.5]	Ayamas Plant [Ref.1]	Assumed DAF Performance	
Parameter	**(mg/ℓ)**		**%age removal**			**(mg/ℓ)**
Total Nitrogen	175.43	57%	55%	40% - 60%	55%	78.94
Total Phosphorus	18.95	57%	70%	-	55%	8.52
COD	3,204.56	-		65% - 75%	60%	1,281.85
BOD	1,820.68	-	70%	65% - 75%	65%	637.23
Suspended Solids	1,390.71	-		85% - 97%	90%	139.07
Oil & Grease	56.71	87%	85%	>95% (non-emulsified)	90%	5.67

Table 6-2 DAF Performance with Chemical Precipitation

6.3.28 Applying the anticipated performance to the incoming effluent gives the likely outlet effluent concentrations as shown in ***Table 6-3***. Comparing this anticipated DAF outlet effluent characterisation with the required discharge standards it is apparent that the effluent leaving the DAF treatment stage would fully meet the required discharge standard to sewer.

Parameter	WPCO Discharge Standard (mg/ℓ)	Treated Effluent from DAF Plant (mg/ℓ)	Meets WPCO Discharge Standard
Total Nitrogen	200	78.94	✓
Total Phosphorus	200	8.52	✓
COD	2,000	1,281.85	✓
BOD	800	637.23	✓
Suspended Solids	800	139.07	✓
Oil & Grease	50	5.67	✓
Flow*	>400 & ≤600 m^3/day	465.80m^3/day	

Note: * In addition to the 464.80m^3/day of effluent from the WTFs, there will be 11.20m^3/day of sewage from toilets within the PSC, to give a total flow to SWHSTW of 475m^3/day – see ***Table 5-12***

Table 6-3 Effluent from DAF Treatment Discharged to Sewer

Sludge De-watering

6.3.29 Waste sludge materials not recovered as by-product materials will require dewatering in order to achieve the 30% dry solids requirement for off-site disposal (e.g. to landfill). It is proposed that waste sludge materials are first thickened mechanically using a rotary drum thickener to create a ~5-6% solids thickened material which is then subsequently dewatered further using a filter press. The addition of lime to enhance moisture content reduction may be required before the filter press.

4 US EPA, Jan 2002, *Development Document for the Proposed Effluent Limitations Guidelines and Standards for the Meat and Poultry Products Industry.* Table 5-12 Removal Efficiencies for Poultry Pollutants of Concern [removal efficiencies taken from the 50-POTW study (Docket No. W-01-06, Record No.00180)[.

5 European Union, May 2005, Reference document on Best Available Techniques [BATBREF] in the Slaughterhouses and Animal By-products Industries. Data specifically quoted is taken from Nordic States (2001). "Best Available Techniques (BAT) in Nordic Slaughterhouses".

6.3.30 Filtrate recovered from both the rotary drum thickener and the filter press is returned to the equalisation tank upstream of the DAF floatation unit process. The flocculated DAF sludge is processed through the sludge dewatering stages to produce a filter cake at 30% dry solids (or 70% moisture).

6.3.31 The dry weight of the solids was estimated at 2.31 tonnes/day in ***paragraph 6.3.24***. Using the following equation, the weight of the filter cake can be calculated. At 30% dry solids (70% moisture) a total of 7.7 tonnes/day of filter cake would require off-site disposal.

$$W = \frac{100xD}{100-M}$$

where W = Wet weight
D = Dry Solids
M = Moisture %age

6.4 Final Effluent Discharge

6.4.1 Final effluent will be discharged into a foul sewer connecting the PSC with SWHSTW. The discharge of treated effluent from each WTF shall be subject to standards and monitoring requirements specified in the Discharge Licenses, one for each WTF, issued under the WPCO. shall be applied for the operation of each of the on-site WTFs. Effluent monitoring requirements, if any, specified in the Discharge License are additional to any monitoring recommended in the EM&A for this Project.

6.5 Responsibilities for Sewerage and Sewage Treatment Infrastructure

6.5.1 The proposed responsibilities for design, construction operation and maintenance of the sewerage and sewage treatment infrastructure are shown in ***Table 6-4***, below:

Sewerage and Sewage Treatment Infrastructure	Responsible Party			
	Design	Construction	Operation	Maintenance
On-site WTF	Designer	Works Contractor	Operator	Operator or Government Agent or Term Contractor
On-site SPS	Designer	Works Contractor	Operator	Operator or Government Agent or Term Contractor
On-site Twin Rising Mains	Designer	Works Contractor	n/a	Operator or Government Agent or Term Contractor
Off-site Rising Mains Connecting to SWHSTW	Designer	Works Contractor	n/a	Operator or Government Agent or Term Contractor

Table 6-4 Responsibilities for Sewerage and Sewage Treatment Infrastructure

6.6 Conclusions

6.6.1 Although there is an existing DN250 rising main along the southeast side of Man Kam To Road, connection to this could prove technically challenging and so has not been considered as a valid option at this time. Instead, dedicated twin rising mains will be constructed directly from the WTF to SWHSTW.

6.6.2 Effluent from the PSC can be conveyed to SWHSTW for treatment and will not cause any adverse impacts to WSRs within the Study Area. Furthermore, it has also been shown that the composition and flow rate of the effluent from the WTF are well within the operational parameters of SWHSTW and so is unlikely to cause any significant adverse impact to SWHSTW. Nevertheless, the Designer shall be required to carry out a SIA, based on his detailed design, to confirm the impact on SHWSTW and to agree design parameters with DSD.

6.6.3 As process wastewater from the PSC will not meet the required standards for discharge to Government sewer, an on-site WTF will be required to pre-treat the wastewater prior to discharge. A conceptual design of a suitable WTF based on DAF technology has been prepared to demonstrate that the required level of treatment can be achieved using commercially available plant and equipment.

6.6.4 The suggested configuration, estimated loading and flow rates and conceptual designs contained in this EIA shall not pre-empt or constrain the future detailed design of the sewerage and/or WTF by the Designer, nor shall they supplant specifications provided in any future contract documents.

6.6.5 The sewerage and effluent treatment implications discussed in this section have been provided to demonstrate that, in the absence of a detailed design, the required sewerage and effluent treatment can be achieved in practice using commercially available plant and equipment. As such, the designer will be able to design a WTF that will, as a minimum, be able to meet the effluent discharges assumed in this EIA and thereby achieve acceptable environmental operation.

6.6.6 The performance of the proposed DAF treatment process estimated in this EIA was based on performance data collected from other DAF systems that were used for treating wastewaters from poultry slaughter houses that have similar wastewater characteristics (in terms of constituent concentrations, loading rates, flow rates, etc.) to the PSC. Based on the collected performance data within the poultry industry, the proposed wastewater treatment process utilising DAF will be able to treat and reduce the concentrations of relevant parameters in the wastewater from the PSC to levels that will meet the WPCO discharge standard. From the EIA perspective, this demonstrates that it is feasible to treat the PSC wastewater using the currently available technologies to meet the effluent discharge standards. During the detailed design of the WTF, however, secondary biological treatment processes, such as Sequential Batch Reactor (SBR), or Membrane Bioreactor (MBR) processes, may be included following the DAF unit to further improve the effluent quality.

6.6.7 The Designer is recommended to carry out his own calculations of loading and flow rates, based on the configuration, plant and equipment comprising his detailed design. The Designer should carry out a SIA, based on his detailed design, to confirm the acceptability of his design, and seek the approval of the relevant authority.

7 WASTE MANAGEMENT IMPLICATIONS

7.1 Introduction

7.1.1 This section primarily provides an assessment of solid waste management implications associated with the construction (predominantly construction waste) and operation (predominantly poultry remains and sludge) of the new PSC, in accordance with the ESB and Appendices 7 and 15 of the EIAO-TM.

7.1.2 This section identifies the waste arising from the construction and operation of the PSC, evaluates the potential environmental impacts associated with the handling, collection, treatment, transportation and disposal of wastes and recommends appropriate mitigation measures and good site practice to minimise the identified environmental impacts.

7.1.3 ***Section 8*** considers the potential for existing contamination of lots within the site, together with possible remediation options, and ***Section 7.9*** provides a summary of the suitable design and control methods, recommended elsewhere in the report, to address human health risk.

7.2 Legislation, Policies, Plans, Standards and Criteria

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

- Waste Disposal Ordinance (Cap. 354);
- Waste Disposal (Chemical Waste) (General) Regulation;
- Waste Disposal (Charges for Disposal of Construction Waste) Regulation;
- Land (Miscellaneous Provisions) Ordinance (Cap. 28); and
- Public Health and Municipal Services Ordinance (Cap. 132) – Public Cleansing and Prevention of Nuisances Regulation.

7.2.2 Other ‘guideline’ documents that detail how the Works Contractor and Operators should comply with the regulations are as follows:

- A Guide to the Registration of Chemical Waste Producers, Environmental Protection Department, Hong Kong;
- A Guide to the Chemical Waste Control Scheme, Environmental Protection Department, Hong Kong;
- 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 32/92, The Use of Tropical Hard Wood on Construction Sites; 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. 19/2001, Metallic Site Hoardings and Signboards;
- Works Bureau Technical Circular No. 33/2002, Management of Construction/Demolition Materials including Rock;
- Environment, Transport and Works Bureau Technical Circular (Works) No. 31/2004, Trip-ticket System for Disposal of Construction and Demolition Material; and
- Environment, Transport and Works Bureau Technical Circular (Works) No. 19/2005, Environmental Management on Construction Sites.

7.3 Sensitive Receivers and Baseline Conditions

Sensitive Receivers

7.3.1 In terms of solid waste management, there are no "sensitive receivers" as such. Waste disposal facilities, such as public fill reception facilities (to which inert construction waste arising from construction works would be taken) or landfills (to which operational wastes would be taken) are not considered to be sensitive receivers as they are designed to accept waste material. Any secondary impacts at the location of the waste disposal facility is deemed to be addressed by the operator of that facility.

Baseline Conditions

7.3.2 The closest public fill reception facility, the Tuen Mun Area 38 Fill Bank, currently (February 2009) handles around 2,500 tonnes of inert construction waste per day[Ref.1].

7.3.3 The closest landfill to the Site is the North East New Territories (NENT) Landfill. In 2007, the average daily waste intake of this facility was 2,250 tonnes[Ref.2].

7.4 Assessment Methodology

7.4.1 The assessment of waste management impacts arising from this Project during construction and operation has been assessed in accordance with the EIA ESB and with the criteria given in Appendices 7 and 15 of the EIAO TM.

7.4.2 The waste management hierarchy has been applied in the assessment and development of mitigation measures for waste. The waste management hierarchy, shown in ***Figure 7-1***, is a concept that shows the desirability of various waste management methods.

7.4.3 All opportunities for reducing waste generation have been assessed based upon the following factors:

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1 http://www.cedd.gov.hk/eng/services/tripticket/index.html
2 Monitoring of Solid Waste in Hong Kong – Statistics for 2007, EPD, June 2008.

- Avoiding or minimising waste generation through changes in the design;
- Adopting better management practices to promote segregation of waste materials;
- Reuse and recycling; and
- Diverting waste to public filling areas or other construction sites.

7.4.4 The types and quantities of waste have been estimated and disposal options for each category of waste identified, taking into account the existing or future spare capacities of the waste disposal facilities and the environmental implications of the handling, collection and disposal of waste material.

7.4.5 The assessment comprises :

- Analysis of activities and waste generation during the Construction Phase for:
  - Waste from site preparation
  - Waste from maintenance of plant and equipment
  - Waste from daily activities
- Analysis of activities and waste generation during the Operation Phase for:
  - Waste from poultry slaughtering
  - Waste from maintenance of plant and equipment
  - Sewage sludge from the WTFs
  - Waste from daily activities
- Proposals for Waste Management during Construction Phase and Operation Phases for their respective sources of waste, in terms of :
  - Reduction, reuse and recycling
  - Disposal options
  - Impacts and mitigation

7.5 Analysis of Activities and Waste Generation During the Construction Phase

7.5.1 There are three main sources of waste generation during the proposed 17-month construction phase, which have been categorised in accordance with those shown in ***Figure 7-2***:

- Waste from site preparation (C&D Materials);
- Waste from maintenance of plant and equipment (Chemical Waste); and
- Waste from daily activities (Municipal Solid Waste – MSW).

Waste from Site Preparation

7.5.2 Some earthworks will be required to form the platforms on which the buildings will be constructed, although this will not be extensive. The quantity of excavated materials generated from site preparation (e.g. utility trenches, foundation works, etc.) will be dependent on the detailed design of the PSC, which will be prepared by the Designer. As such, it is not possible to accurately determine the likely quantities of excavated C&D Materials at this time, although an estimate has been made, below.

7.5.3 At present the Site is entirely covered in hardstanding (asphalt), which is in poor condition, as shown in ***Photograph 7-1***:

Photograph 7-1 Existing Poor Condition of the Hardstanding within the Site

7.5.4 To give a worst-case assessment, it has been assumed that the old asphalt would not be reused on site. Given the poor quality of the asphalt, it is not considered suitable for recycling and so would need to be excavated and disposed of at a public fill reception facility. It is also assumed that no significant quantity of the material excavated for platform formation or foundation construction would be reused on site, and so all would need to be disposed of at a public fill reception facility.

7.5.5 The Site is about 12,791m^2 in area. Assuming that 0.25m depth of hardstanding will be removed, this results in some 3,198m^3 of old asphalt and underlying material to be disposed of.

7.5.6 To provide the 5,545m^2 platform areas for construction of the main buildings (Areas 1A, 1B and 1C from ***Figure 2-6***) it is assumed that, on average, 1m depth of material will be removed from these areas – this is based on the site profile in ***Figure 2-5*** – and equates to 5,545m^3 requiring disposal. Furthermore, it is assumed that a further 0.25m depth of material would need to be removed for foundation works for all of the built areas. These areas, shown as Areas 1 to 5 in ***Figure 2-6***, cover some 7,095m^2 and so would result in 1,774m^3 of material requiring disposal.

7.5.7 Taken together, some 10,517m^3 of C&D Material would be excavated and disposed of. Assuming a density of 1.8tonnes/m^3, in total this is equivalent to 18,931 tonnes.

Waste from Maintenance of Plant and Equipment

7.5.8 Servicing of the Works Contractor's plant and equipment will likely be the primary source of chemical waste during the construction phase. The majority of chemical waste produced is therefore expected to consist of solid wastes and liquid wastes.

7.5.9 The volume of chemical waste arising will depend upon the total number of plant/equipment and the level of on-site maintenance. Based on experience, this is expected to be less than 50ℓ/ month or, conservatively, 850kg during the 17-month construction phase.

Waste from Daily Activities

7.5.10 To determine the quantities of waste generated during the construction phase, reference has been made to Government statistics[Ref.2] which show that between 2003 and 2007, the average per capita disposal rate for MSW was 1.37kg/person/day. This MSW rate, rather than the domestic waste rate, has been applied to the construction phase since this will take into account the wider variety of wastes that will arise during construction, e.g., packaging of equipment and construction materials, etc.

7.5.11 The total volume of MSW generated depends on the number of workers to be employed on site. Based on the 17-month construction programme it has been assumed that an average of 40 no. workers would be present on site for 6 days per week during this period. The total general waste arising would therefore be:

Waste = 17 months x 4.3 wks/month x 6 days/wk x 1.37kg/worker/day x 40 workers
= 24 tonnes (approximately)

7.5.12 Thus 24 tonnes of MSW is expected, which is around 1.4tonnes/month (~320kg/week) on average throughout the 17-month construction phase. This figure does not take into consideration recyclable materials collected by the Works Contractor (see ***paragraph 7.7.10***) and so represents a conservative estimation.

7.5.13 Portable toilets will be provided for the workforce and will be maintained off-site by a specialist contractor. There will be no impacts from toilet facilities during the construction phase.

7.6 Analysis of Activities and Waste Generation During the Operation Phase

7.6.1 There are four main sources of waste generation during the operation phase, which have been categorised in accordance with those shown in ***Figure 7-2***:

- Waste from poultry slaughtering (Special Waste);
- Waste from maintenance of plant and equipment (Chemical Waste);
- Sewage sludge from the WTFs (Special Waste); and
- Waste from daily activities (MSW).

Waste from Poultry Slaughtering

7.6.2 The maximum daily slaughtering capacity of the PSC is 33,000, comprising 30,000 chickens plus 3,000 minor poultry. For the purpose of this assessment, it has been assumed that the waste generated by the minor poultry will be the same as that from chickens.

7.6.3 The average weight of live chickens slaughtered in Hong Kong is 1.7kg[Ref.3]. It has been assumed that processed chickens will retain their heads and feet. Some of the offal (e.g., liver, gizzard and heart) may be sold as product, which will reduce the quantity of waste requiring disposal, however for the purpose of assessment it has been assumed that these will become waste. It has also been assumed that blood will be treated by the on-site WTFs, and will not be sold as product, or considered as solid waste.

3 As advised by Veterinary Public Health Section, FEHD via email on 12 February 2007.

7.6.4 On this basis, ***Table 7-1***, below, estimates the solid waste arising from the slaughtering process as 9,818 kg/day.

Waste Type	% of Live Weight [Ref.4]	Estimated Waste Arisings (kg/day)*
Feathers	5.5%	3,086
Intestine	6.0 %	3,366
Gizzard	1.5 %	842
Liver	2.0 %	1,122
Heart	0.5 %	280
Other Offal	2.0 %	1,122
Total	**17.5%**	**9,818**

Note: * Total waste arisings are based on 33,000 poultry assumed @ 1.7 kg[Ref.20]

Table 7-1 Estimated Solid Waste Arisings from the Slaughter of 33,000 poultry/day

Waste from Maintenance of Plant and Equipment

7.6.5 The volume of chemical waste arising will depend upon the type of equipment installed in the PSC, which is not known at this time. It is likely, however, that chemical waste will be generated at a lower rate than during the construction phase, since no heavy plant will be used. Therefore, the quantity of chemical waste will be less than 50ℓ/month or, conservatively, less than 600kg/year.

Sewage Sludge from the WTFs

7.6.6 Bio-solids produced by the WTFs, together with any other waste sludge materials not recovered as by-product materials, will require dewatering in order to achieve the 30% dry solids requirement for off-site disposal (e.g. to landfill). It is proposed that waste sludge materials are first thickened mechanically using a rotary drum thickener to create a ~5-6% solids thickened material which is then subsequently dewatered further using a filter press. The addition of lime to enhance moisture content reduction may be required before the filter press processing step.

7.6.7 Filtrate recovered from both the rotary drum thickener and the filter press is returned to the equalisation tank upstream of the DAF floatation unit process. Assuming the flocculated DAF sludge is processed through the sludge dewatering stages then a total of 7,700 kg/day of filter cake (at 30% dry solids) would be generated.

Waste from Daily Activities

7.6.8 To determine the quantities of general waste generated during the operation phase, reference has again been made to Government statistics[Ref.2] which show that between 2003 and 2007, the average per capita disposal of domestic waste was 1.0kg/person/day. This domestic rate, rather than the MSW rate, has been applied to the operation phase, since this is more representative of the wastes that will arise during operation, e.g., paper, food, etc.

4 IFC International Finance Corporation. 2006. Environmental Health & Safety Guidelines in Poultry Processing [Draft].

7.6.9 At any one time, it has been assumed that there will be 180 no. process line workers plus 20 no. management/administration staff at work within the PSC. In addition, delivery vehicles will visit the PSC each day, but only for a short period to drop off poultry and clean up. It is unlikely that drivers will generate domestic waste during their brief stop at the PSC.

7.6.10 The total daily MSW arising would therefore be 1.0kg/person/day x 200 persons = 200kg/day. This figure does not take into consideration recyclable materials collected by the Operators (see ***paragraph 7.8.12***) and so represents a conservative estimation.

7.6.11 All toilets would be connected directly to foul sewer and so would not contribute to solid waste generation within the Site.

7.7 Proposal for Waste Management During the Construction Phase

7.7.1 Proposals for waste management during the construction phase comprise:

- Reduction, reuse and recycling;
- Disposal options; and
- Impacts and mitigation.

7.7.2 These three proposals will be examined in terms of the three major sources of waste generation during the construction phase, namely :

- Waste from site preparation (C&D Materials);
- Waste from maintenance of plant and equipment (Chemical Waste); and
- Waste from daily activities (MSW).

7.7.3 To enhance waste management during construction, the Works Contractor shall prepare and implement a Waste Management Plan (WMP), which becomes a part of the Environmental Management Plan (EMP), in accordance with the requirements of ETWB TC(W) No. 19/2005.

Reduction, Reuse and Recycling

Waste from Site Preparation

7.7.4 Given the condition of the old asphalt on the Site, it is unlikely that it can be reused or recycled on-site and so will need to be taken off-site. Similarly, given the compact nature of the Site, there is little opportunity for excavated material to be reused or recycled in any significant quantity on-site. The Designer may be able to reduce the amount of waste generated through his detailed design, and this should be encouraged.

7.7.5 This type of inert C&D Material is termed “public fill” and should be sent to a public fill reception facility, for subsequent off-site reuse. The closest such facility to the Site is the Fill Bank at Tuen Mun Area 38.

7.7.6 The trip-ticket system should be put in place in accordance with ETWB TC(W) No.31/2004 and the Construction Waste Disposal Charging Scheme. Copies/counterfoils from trip tickets (showing the quantities of public fill taken off-site) shall be kept for record purposes.

7.7.7 Relevant WBTCs, such as WBTC No. 19/2001 – Metallic Site Hoardings and Signboards, that relate to environmentally-responsible construction methods, waste reduction, reuse and recycling will be followed.

Waste from Maintenance of Plant and Equipment

7.7.8 Plant/equipment maintenance schedules should be designed to optimise maintenance and thereby minimise the generation of chemical wastes – contractors will generally adopt this approach as a matter of course because of the corresponding cost savings.

7.7.9 Chemical waste that is collected will be transported off-site for treatment by a licensed collector. The Works Contractor will need to register with EPD as a chemical waste producer. Where possible, chemical wastes (e.g. waste lubricants) should be recycled at an appropriate facility, e.g. at Dunwell's oil re-refinery.

Waste from Daily Activities

7.7.10 The Works Contractor should implement an education programme for workers relating to avoiding, reducing, reusing and recycling MSW. This should include provision of three-colour recycling bins throughout the PSC (to allow paper, plastic and aluminium to be collected separately) and posters and leaflets advising on the correct use of recycling bins.

Disposal Options

Waste from Site Preparation

7.7.11 Non-inert C&D Materials, such as vegetation, are termed construction waste and should be disposed of at NENT landfill, which is the nearest landfill to the PSC.

7.7.12 The trip-ticket system should be put in place in accordance with ETWB TC(W) No.31/2004 and the Construction Waste Disposal Charging Scheme. Copies/counterfoils from trip tickets (showing the quantities of construction waste taken off-site) shall be kept for record purposes.

Waste from Maintenance of Plant and Equipment

7.7.13 Solid and liquid chemical wastes liquid that cannot be recycled (or re-refined in the case of waste lubricants) should be disposed of at an appropriate facility, such as EPD's Chemical Waste Treatment Centre (CWTC) on Tsing Yi. Landfilling of chemical waste should be avoided.

7.7.14 Copies/counterfoils from collection receipts issued by the licensed chemical waste collector (showing the quantities and types of chemical waste taken off-site, and details of the treatment facility) shall be kept for record purposes.

Waste from Daily Activities

7.7.15 Residual, non-recyclable, MSW should be stored in appropriate containers prior to collection and off-site disposal at NENT landfill, which is the nearest landfill to the PSC.

7.7.16 Copies/counterfoils from collection receipts issued by the nominated MSW collector (showing the quantities and types waste taken off-site, and details of the disposal facility) shall be kept for record purposes.

Impacts and Mitigation

Waste from Site Preparation

7.7.17 Inert C&D Materials that will need to be sent for off-site reuse may first have to be stockpiled on site. Any stockpiled material shall be covered (e.g. by a tarpaulin) until removed in order to prevent wind-blown dust during dry weather, and to reduce muddy runoff during wet weather. Any stockpiled topsoil should be hydroseeded to prevent dust and improve its appearance.

7.7.18 Public fill will not generate odour during transportation off-site and the truck containing this waste will be covered to prevent dust during transport. Similarly, construction waste (predominantly vegetation from this Site) is also unlikely to generate odour. As such, the environmental impacts caused by the handling, collection, transportation and disposal of public fill and construction waste will not be significant.

Waste from Maintenance of Plant and Equipment

7.7.19 Plant/equipment maintenance schedules should be designed to optimise maintenance and thereby minimise the generation of chemical wastes – contractors will generally adopt this approach as a matter of course because of the corresponding cost savings.

7.7.20 Chemical waste that is collected will be transported off-site for treatment by a licensed collector. The Works Contractor will need to register with EPD as a chemical waste producer. Where possible, chemical wastes (e.g. waste lubricants) should be recycled at an appropriate facility.

Waste from Daily Activities

7.7.21 All recyclable materials (separated from the MSW) should be stored on-site in appropriate containers (such as 1,100ℓ or 2,400ℓ covered bins) prior to collection by a local recycler for subsequent reuse and recycling. Residual, non-recyclable, MSW should be stored in appropriate containers (that contain odours, in the case of putrescible waste).

7.7.22 Regular collection will be made by an approved waste collection contractor in purpose-built Refuse Collection Vehicles (RCVs) that minimise environmental impacts during transportation.

7.8 Proposal for Waste Management During the Operation Phase

7.8.1 Proposals for waste management during the operation phase comprise:

- Reduction, reuse and recycling;
- Disposal options; and
- Impacts and mitigation.

7.8.2 These proposals will be examined in terms of the four main sources of waste generation during the operation phase, namely :

- Waste from poultry slaughtering (Special Waste);
- Waste from maintenance of plant and equipment (Chemical Waste);
- Sewage sludge from the WTFs (Special Waste); and
- Waste from daily activities (MSW).

Reduction, Reuse and Recycling

Waste from Poultry Slaughtering

7.8.3 In overseas countries, it is typical practice to collect blood and process it, together with recovered feathers, to produce feather meal, a by-product feedstuff used in livestock and poultry feeds as a source of protein. Since blood has the highest COD strength of any liquid effluent arising from poultry slaughterhouses, its recovery therefore represents an opportunity for the Operators to reduce final effluent strengths, reduce WTF costs and reduce the quantity of sludge that is generated by the WTF. However, it is not considered that this could be implemented in Hong Kong in the near future.

7.8.4 During the evisceration and cleaning process, the viscera are separated from the carcass, and edible components (hearts, livers, and gizzards) are harvested. The inedible viscera, known as offal, are collected. In overseas countries, the offal is collected for subsequent rendering and so reduces the quantity of poultry waste. Again, it is not considered that there would be opportunities for animal by-product rendering in the near future.

7.8.5 During wastewater treatment, after the removal of coarse solids, the effluent stream still contains finely suspended solids, fats and grease, which will be removed by coagulation and flocculation in the DAF plant. In overseas countries, coagulants and flocculants of low toxicity are used to enable the sludge to be recovered as a by-product for animal feed (if high fat content) or sent for land spreading (if high nutrient content), thereby reducing the quantity of sewage sludge generated. However, such uses of by-products are not applicable to Hong Kong.

7.8.6 Many of the waste reduction, reuse and recycling opportunities described above are tried and tested practices in the poultry industry overseas, but are not applicable to Hong Kong for a variety of reasons. It should be noted, however, that EPD is now carrying out engineering feasibility and EIA studies for developing the first phase of the Organic Waste Treatment Facility (OWTF) at Siu Ho Wan. Following tendering and construction, it is expected that the first phase OWTF would be commissioned before the middle of the 2010's, and could be available to accept some of the organic waste generated by the PSC. Furthermore, the second phase OWTF is planned to be located in Shaling, North District, and so would be much closer to the PSC than Siu Ho Wan. Therefore, there is potential for waste recycling in the future.

Waste from Maintenance of Plant and Equipment

7.8.7 It is suggested that the Operators should register with EPD as a chemical waste producer and provide on-site collection and storage.

7.8.8 Where possible, it is recommended that waste lubricants are recycled into new products at an appropriate facility, e.g. at an oil re-refinery. Solid chemical wastes that cannot be recycled should be disposed at an appropriate facility, such as the CWTC.

Sewage Sludge from the WTFs

7.8.9 There are currently no opportunities for the reuse or recycling of sludge in Hong Kong, although a sludge treatment facility is planned for Nim Wan, which will be a waste-to-energy facility, and could accept sewage sludge from the WTFs in the future.

7.8.10 For the present, it is possible to reduce the quantity of sludge generated by optimising the technology used and the throughput. Since the throughput of the WTF will depend upon the quantities of wastewater being treated the only means to reduce the quantities of sludge for a given volume of wastewater would be to use a technology that results in low sludge yield, such as DAF.

7.8.11 The choice of treatment technology will be made during the detailed design of the PSC by the Designer, and will need to take into consideration the capital and operating costs of the WTFs, efficiency and ability to treat the expected quality and quantity of wastewater and the future cost of disposing of the sludge.

Waste from Daily Activities

7.8.12 The Operators should implement an education programme for staff relating to avoiding, reducing, reusing and recycling MSW waste. This should include provision of three colour recycling bins throughout the PSC (to allow paper, plastic and aluminium to be collected separately) and posters/leaflets showing the correct use of recycling bins. Collected materials should be sold to recyclers.

7.8.13 The Operators should also provide on-site collection and storage of residual, non-recyclable, MSW, prior to off-site disposal at NENT landfill.

Disposal Options

Waste from Poultry Slaughtering

7.8.14 Poultry waste is considered to be Special Waste (abattoir wastes, animal carcasses) under the Hong Kong classification. Any poultry waste that is not reused or recycled will need to be stored in hygienic conditions prior to collection and transportation to an off-site disposal facility.

7.8.15 Poultry waste should be stored in sealed containers in a waste storage room that should be well ventilated and extracted air treated to remove odour prior to release.

7.8.16 According to EPD Guidance[Ref.5] the most appropriate disposal method for animal carcasses is cremation, however, no animal carcass cremation facilities exist in Hong Kong at this time and so landfill is the only option. However, no infectious carcasses are allowed for disposal at landfills except under special circumstances. In such cases, landfill is only acceptable in emergencies and as a short-term back-up method.

7.8.17 At present, animal carcasses and abattoir waste are mainly disposed of at landfills. To minimise the associated potential environmental impact, the disposal of these wastes is controlled by EPD through an Admission Ticket system, which will be considered on a case-by-case basis.

Waste from Maintenance of Plant and Equipment

7.8.18 Waste from maintenance of plant and equipment within the PSC would be considered to be Chemical Waste under the Hong Kong classification.

7.8.19 Any dust collected by the air pollution control equipment must be tested to ensure compliance for landfill disposal. If compliant, then the Practice Note for disposal of dusty waste at landfill sites and the Admission Ticket system shall be followed. If not acceptable for direct landfill disposal, then the dust shall be considered as chemical waste and treated and disposed of accordingly.

5 EPD Practice Note for the Disposal of Animal Carcasses at Landfill Sites.

7.8.20 Solid and liquid chemical wastes liquid that cannot be recycled (or re-refined in the case of waste lubricants) should be disposed of at an appropriate facility, such as the CWTC. Copies/ counterfoils from collection receipts issued by the licensed chemical waste collector (showing the quantities and types of chemical waste taken off-site, and details of the treatment facility) shall be kept for record purposes.

Sewage Sludge from the WTFs

7.8.21 At present, sludge is mainly disposed of at landfills. To minimise the associated potential environmental impact, the disposal of these wastes is controlled by EPD through an Admission Ticket system, which will be considered on a case-by-case basis.

7.8.22 Sludge should be disposed of at NENT landfill, or at any future dedicated sludge treatment facility. Copies/counterfoils from collection receipts issued by the licensed sludge collector (showing the quantities of sludge waste taken off-site, and details of the treatment/disposal facility) shall be kept for record purposes.

Waste from Daily Activities

7.8.23 Residual, non-recyclable, MSW should be stored in appropriate containers prior to collection and off-site disposal at NENT landfill, which is the nearest landfill to the PSC. Copies/ counterfoils from collection receipts issued by the nominated general waste collector (showing the quantities and types of waste taken off-site, and details of the disposal facility) shall be kept for record purposes.

Impacts and Mitigation

Waste from Poultry Slaughtering

7.8.24 Poultry waste should be stored within the PSC in sealed containers. The sealed containers should be collected by a licensed contractor and delivered to an appropriate disposal facility. The nearest such facility is NENT Landfill.

7.8.25 There is no practice note for abattoir waste disposal, however, the following conditions would be included in the Admission Ticket:

- Waste shall be de-watered such that all free liquid is removed;
- The load compartment of the delivery vehicles shall be adequately covered and sealed to avoid leaking fluids/odour during transportation; and
- The load compartment outer bodies shall be kept clean at all times.

7.8.26 The following environmental/hygiene mitigation measures, as recommended by EPD[Ref5], should be followed at the landfill by the landfill operator:

- Animal carcasses should be preferably sealed in plastic bags and transported in enclosed compartments;
- Decaying and offensive carcasses must be deposited into pre-excavated trenches. Fresh carcasses should be deposited at the base of the tipping face;
- Inform the landfill staff of the trench requirements three days before the actual deposition date;
- Slightly offensive decaying carcasses should be generously sprinkled with lime;

- Allow at least 0.5m clear at the top of the trench for immediate backfilling with soil. Carcasses at the tipping face should be immediately covered with domestic refuse or soil;
- No person should be allowed to enter and/or work inside the trenches;
- Avoid direct skin contact or accidental ingestion of animal tissue, fluid or blood;
- No smoking or sources of ignition; and
- Disposal operations should be supervised by trained personnel. All persons handling carcasses should wear suitable protective clothing and should be equipped with hand-hooks. The equipment should be cleaned afterwards.

Waste from Maintenance of Plant and Equipment

7.8.27 Chemical wastes should be stored in appropriate containers in a covered area. "No Smoking" signs will be clearly displayed to prevent accidental ignition of any flammable materials. Drip trays capable of storing 110% of the volume of the largest container will be used to mitigate possible leakage. Whenever the drip trays contain the maximum number of containers, a registered chemical waste collector will transport the containers to the appropriate treatment or disposal facility.

Sewage Sludge from the WTFs

7.8.28 Sludge should be collected by a licensed collector at regular intervals, as determined by the operation of the WTFs. Purpose-built sludge tankers will minimise the potential for environmental impacts during transportation.

7.8.29 There is no practice note for sludge disposal, however, the following conditions would be included in the Admission Ticket:

- Sludge shall be de-watered such that all free liquid is removed; and
- Moisture content <85% (15% dry solids) for acceptance at NENT Landfill.

Waste from Daily Activities

7.8.30 Residual, non-recyclable, domestic waste should be stored in appropriate containers (that contain odours, in the case of putrescible waste). Regular collection should be made by an approved waste collection contractor in purpose-built RCVs that will minimise the potential for environmental impacts during transportation.

7.9 Conclusions

7.9.1 This waste management assessment has looked at the construction phase of the PSC and has estimated waste arisings in terms of C&D materials (i.e. public fill and construction waste), chemical waste and MSW. It has also looked at the operation phase of the PSC and has estimated waste arisings in terms of special waste, chemical waste and MSW. These different waste categories are defined in ***Figure 7-2***.

7.9.2 ***Table 7-2***, below, summarises the overall waste arisings from the construction and operation phases of the PSC. It should be noted that these estimates represent gross waste arisings, and do not take into account reuse and recycling, which cannot be estimated at this time.

Waste Type	Waste Classification	Waste Arisings
Construction Phase		
Waste from site preparation	C&D Material	18,931 tonnes
Waste from maintenance of plant and equipment	Chemical Waste	0.85 tonnes
Waste from daily activities	MSW	24 tonnes
	Total	**say 18,956 tonnes**
Operation Phase		
Waste from poultry slaughtering	Special Waste	9,818 kg/day
Waste from maintenance of plant and equipment	Chemical Waste	1.64 kg/day
Waste from the WTFs	Special Waste	7,700 kg/day
Waste from daily activities	MSW	200 kg/day
	Total	**17,720 kg/day**

Table 7-2 Estimated Overall Waste Arisings

Construction Phase

7.9.3 From ***Table 7-2***, it can be seen that the construction phase will generate 18,956 tonnes of waste (averaging 1,115 tonnes/month throughout the 17-month construction period) that will require transfer to public filling facilities (public fill), treatment (chemical waste) or disposal at landfill (MSW and construction waste).

7.9.4 There is sufficient capacity at the Tuen Mun Area 38 Fill Bank to accommodate the public fill and there is sufficient capacity within facilities in Hong Kong (e.g. Dunwell's oil re-refinery and at the CWTC) for treating chemical wastes. The disposal of 24 tonnes of MSW at NENT Landfill will not significantly affect the total disposal capacity of this facility, which is $35Mm^3$.

7.9.5 In conclusion, the waste management impacts resulting from the construction phase of the PSC are not considered to be significant.

Operation Phase

7.9.6 On a daily basis, it has been estimated that the PSC will generate 17.7 tonnes of waste that will require landfill disposal (special waste and MSW) or treatment (chemical waste).

7.9.7 The daily landfill disposal of these quantities of special waste and MSW from the PSC represents 0.78% of the daily waste intake at NENT Landfill, which averaged 2,250 tonnes/day in 2007. There is also sufficient capacity within facilities in Hong Kong for the treatment of 600kg/year of chemical wastes (e.g. Dunwell's oil re-refinery and EPD's CWTC, which has a throughput capacity of 100,000tonnes/year and currently operates below this).

7.9.8 In conclusion, the waste management impacts resulting from the operation phase of the PSC are not considered to be significant.

8 ASSESSMENT OF POTENTIAL LAND CONTAMINATION

8.1 Pollutant Linkage

8.1.1 This section assesses the likelihood that one or more pollutant linkages (source– pathway–receptor) exist within the site. The assessment has been completed by means of reviewing the historical information on the Site that could be obtained; assessing the current use of the site and the likely contamination that may have occurred; and assessment of potential receptors in the surrounding environment.

8.1.2 If a pollutant linkage is deemed to be potentially present, a professional view is taken on the likelihood of the impact or harm to a given receptor being significant or likely to be significant at some time in the future.

8.1.3 For the purposes of this report a pollutant linkage is assumed to be in place at the site if there is reasonable evidence to indicate that a source of contamination is present at the site, a receptor is present on, under or near the site and a pathway exists between the source and the receptor.

Source

8.1.4 A source of pollution or contamination source could be present under the site due to a historical use at the site or the current use of the site. The contamination could be due to accidental spillage (e.g. petrol, diesel or chemicals) long term leakage (e.g. leaking fuel tank or pipe) or other reason such as storage of materials (e.g. chemical drums, waste) or illegal deposit of waste.

Receptor

8.1.5 A receptor is defined as a living person, animal or plant. Receptors would also include surface or groundwater, crops and buildings.

Pathway

8.1.6 For the purposes of this report a pathway is assumed means by which the receptors can be impacted by the source, such as:

- The ingestion, inhalation or skin contact with contaminated soils;
- The mobility of contaminants in the soil by infiltrating rainwater mobilising the contamination and impacting groundwater through the movement of contamination in the soil pore water;
- The off site migration of contaminated groundwater into surface water; or
- Off-site migration of landfill gas.

8.1.7 It is noted that the above pathways may or may not be present at any site and additional pathways may be identified during the review process.

8.2 Site Description and Surrounding Environment

8.2.1 The site is currently covered with a poor quality hardstanding surface and was until recently used as a lorry park. The hills surrounding the Site contain a number of electricity pylons and also a visible above-ground pipeline. A number of grave are also located in the hills behind the Site. To the northeast of the Site is a K-Wah concrete batching plant that is abandoned and to the southeast of the Site lies the small village of Hung Kiu San Tsuen. To the northwest of the site is an abandoned construction yard and refuse sorting yard.

8.2.2 Further descriptions of the Site, including photographs, are provided in ***Section 10***.

8.2.3 No petrol or diesel tanks were seen at the site. No storage of hazardous materials, such as chemicals or waste materials, was evident at the site.

8.3 Geology, Hydrology and Hydrogeology

Geology

8.3.1 The north western region of the New Territories consists of low lying alluvial plains. The alluvium sands and clay deposits being of the Quaternary Age. The low lying hills are predominantly of the Mesozoic age and consist of decomposed slightly metamorphosed coarse ash crystal tuff.

Hydrology

8.3.2 The surface water flow in the area would be influenced and controlled by the River Indus (Ng Tung River), which flows from the southeast to the northwest, about 300m from the site at its closest point. The rivers in this region are influenced by tidal flow.

8.3.3 The nearest surface water feature to the site is an open channel that is currently being constructed along the northwest boundary of the site. No other water courses, have been identified within 300m of the Site. The historical maps show a stream did once flow from the west and along the northern boundary before flowing across the site and off to the south towards the River Indus.

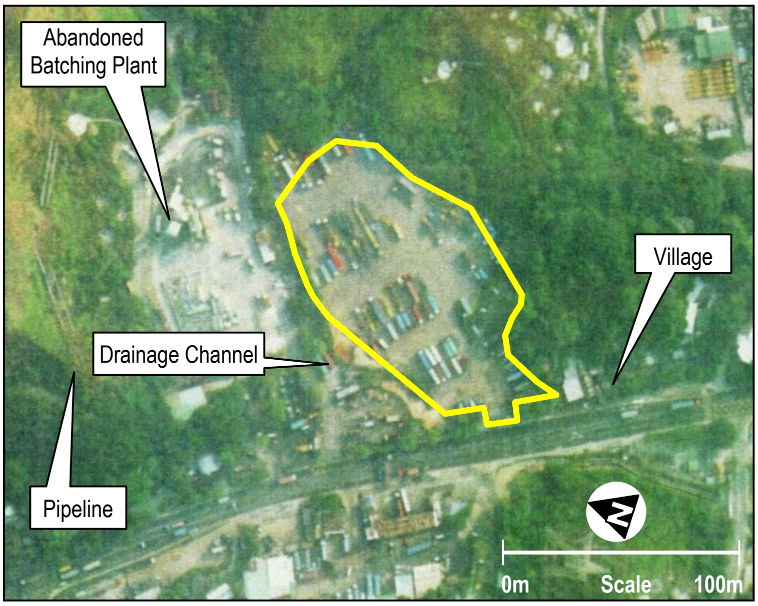
Hydrogeology

8.3.4 The overall groundwater flow in the region is from south to north, generally in the direction of the river flow. However, it is considered that some localised groundwater flow in the vicinity of the Site is likely to be in a southerly direction towards the River Indus (Ng Tung River). The main aquifer is composed of the alluvial sands and gravels. In the area it is possible that the aquifer could be confined by an alluvial clay/silt layer. It is understood that in some areas of Sheung Shui a layer of clay/silts is present above the alluvium.

8.4 Current Use of the Site

8.4.1 By means of assessment of the latest aerial photographs (February 2006) and the site visits carried out in December 2006 and February 2009, current use of the site has been assessed.

February 2006



Photograph 8-1 Aerial Photograph – February 2006

8.4.2 The photograph confirms that the site was until recently used as a Fee-paying Public Vehicle Park. Ongoing excavation being carried out by DSD is shown by sandy colour to the north of the Site. An abandoned concrete batching plant is evident to the north. The above-ground pipeline can be also seen to the north of the batching plant. A wood is evident to the south of the Site. The hills to the east site are dotted with small white areas, assumed to be graves, rock outcrops or localised slope failures.

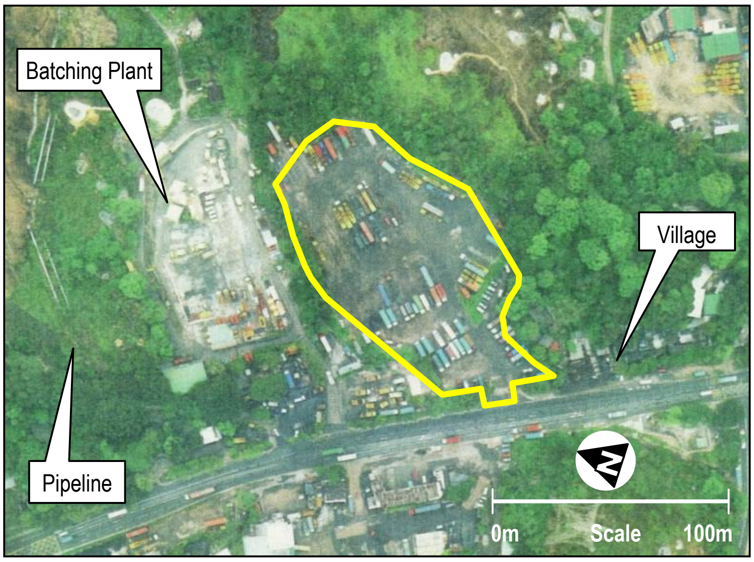
8.4.3 The pipeline has been identified from the historical maps[Ref.1] to lead to the Table Hill Covered Fresh Water Service Reservoir.

8.5 Historical Use of the Site

8.5.1 By means of assessment of aerial photographs of the Site (every five years, where possible) an understanding of the Site's history and potential to be contaminated can be assessed. The following sections provide an assessment of aerial photographs from April 2005 to November 1945. Also provided is a review of the maps covering these periods, providing additional information on land use.

1 Map Reference Sheet No. 3-NW-21D from 1999, Survey and Mapping Office, Lands

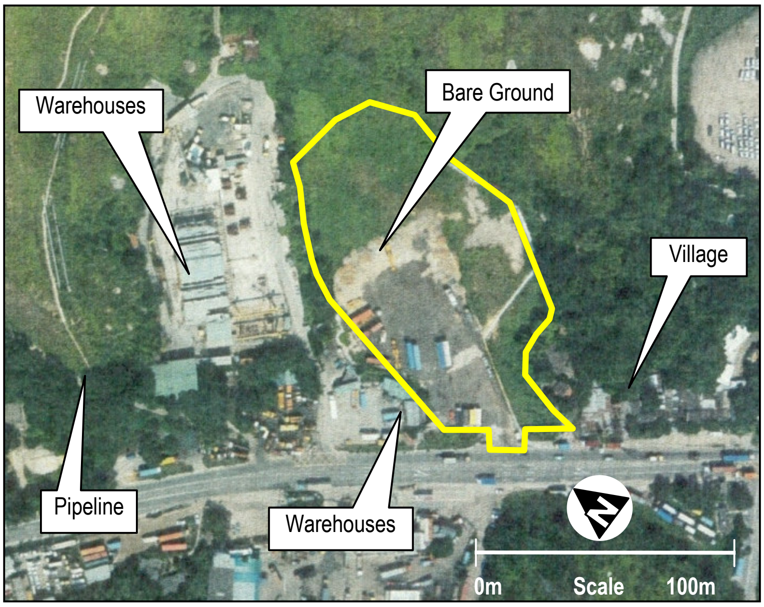
April 2005



Photograph 8-2 Aerial Photograph – April 2005

8.5.2 Very little difference in site use and surroundings compared to 2006. The Site was until recently used for lorry parking/storage. The concrete batching plant and pipeline to the north can clearly be seen. The small excavations to the east of the Site can be seen, as can the village to the south.

August 2000



Photograph 8-3 Aerial Photograph – August 2000

8.5.3 The area used for lorry parking is smaller than that seen in 2005 and 2006. The Site can be split into two uses. The top half appears to be covered in vegetation whereas the lower half is covered in hardstanding, and some lorries appear to be parked. The hardstanding is not complete and some natural ground can be seen in the centre of the Site. In the immediate northwest corner of the Site are some green-roofed buildings. The concrete batching plant site appears to be being used for a different purpose and there are some large warehouses present.

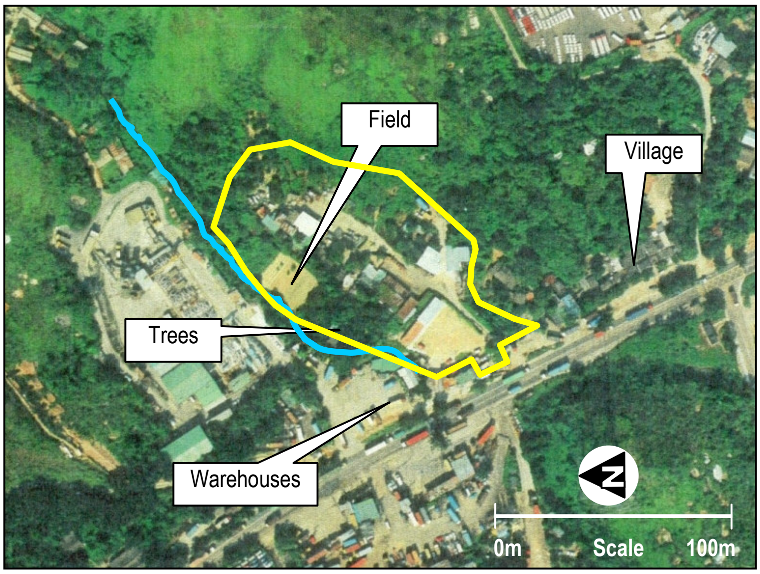
Historical Maps from 1998 and 1999

8.5.4 These two maps show a major change on the site. In 1998, the historical map[Ref.2] shows that the site is being used for some cultivation with open structures shown on the site. Only one of the structures, in the lorry park near the main road, is shown as permanent. The 1998 historical map also shows a stream (shown in blue on the photographs below) to be flowing from the west, along the northern boundary and on to the site. Later maps, as described below, show the stream to flow off to the south.

8.5.5 By 1999, the historical map[Ref.3] shows that the site has been completely cleared and only the permanent structure remains. The stream (shown in blue on the photographs below) is shown flowing from the west and along the northern boundary, where is disappears.

8.5.6 The large warehouses on the concrete batching plant site are shown as large open sided structures.

July 1995



Photograph 8-4 Aerial Photograph – July 1995

8.5.7 The use of the Site is less obvious in this photograph – it appears to be occupied by commercial uses.

8.5.8 There are various buildings on the Site and also some large trees and more vegetation. The ground surface would appear to be natural ground, rather than hardstanding. There are several warehouses on the Site.

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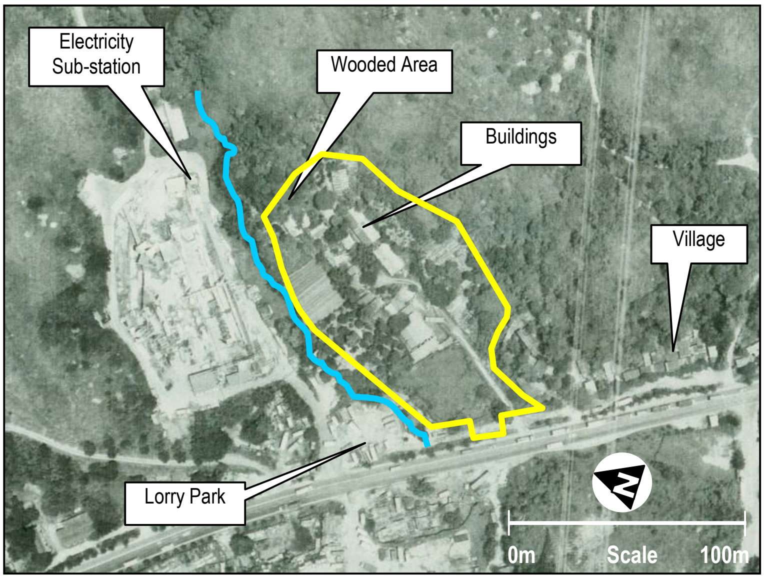
2 Map Reference Sheet No. 3-NW-21D from 1998, Survey and Mapping Office, LandsD
3 Map Reference Sheet No. 3-NW-21D from 1999, Survey and Mapping Office, LandsD

8.5.9 The historical map[Ref.4] shows the stream (shown in blue on the photographs) flowing from the east, along the northern boundary and then onto the site. The stream is not shown to flow off the site in this map. Later maps do show the stream to flow off to the south.

September 1990



Photograph 8-5 Aerial Photograph – September 1990

8.5.10 The Site is covered in a mixture of buildings and vegetation. It is not clear what the Site is being used for, a lorry can be seen parked outside a large building. There are some other buildings on the land and a lorry park by the main road. The Site to the north is being used for some manufacturing activity. The wooded area is smaller and the village more prominent.

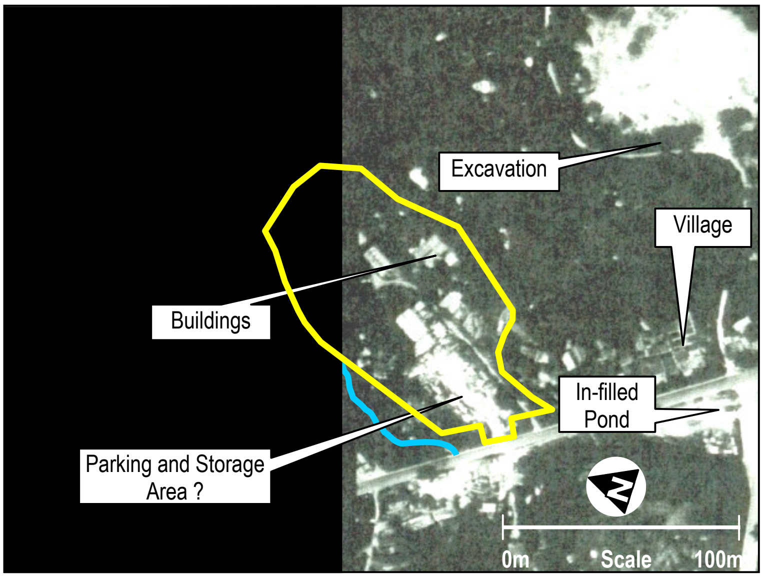
8.5.11 The historical map[Ref.5] indicates the site use is cultivated fields with several temporary structures. A stream flows along the northern perimeter from the east.

8.5.12 It is noted that the site to the north is bare except for an electricity sub-station (presumably used by the future concrete batching plant). It should be noted that this electricity sub-station is not within the Site.

4 Map Reference Sheet No. 3-NW-21D from 1992, Survey and Mapping Office, LandsD

5 Map Reference Sheet No. 3-NW-21D from 1989 (partial revision), Survey and Mapping Office, LandsD

September 1985



Photograph 8-6 Aerial Photograph (partial) – September 1985

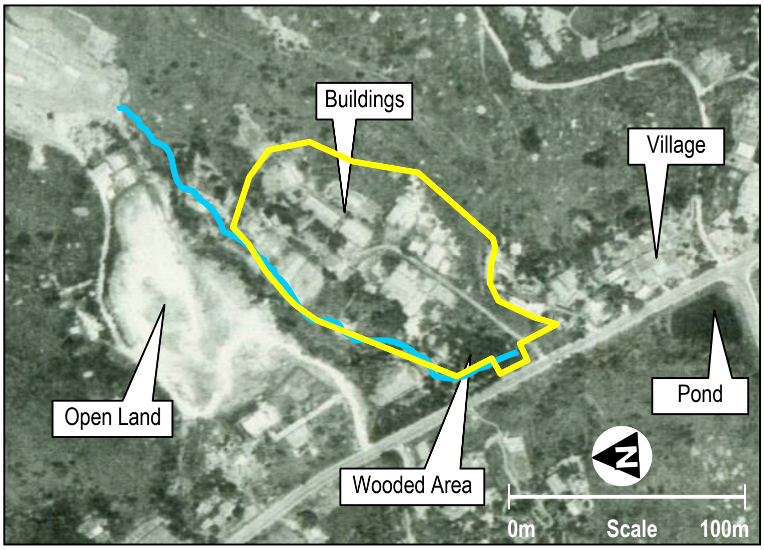
8.5.13 The service road can be seen leading to some buildings, there is a warehouse in the northeast corner of the Site. An area is being used for parking and general storage. There are fewer buildings than in 1979 (see below). There is a large excavation to the southeast of the Site beyond the woods. The area used as a lorry park in 1990 is vegetated in 1985.

8.5.14 The historical map[*Ref.6*] shows the site to be covered with temporary structures with some cultivation occurring along the northern perimeter. The north western corner of the site appears to have been cleared, presumably for use as a lorry park as described in ***paragraph 8.6.10***, above. A stream is shown flowing, from the east, along the northern boundary of the site before flowing through the site and out of the western side.

8.5.15 An electricity substation is situated to the north of the Site.

6 Map Reference Sheet No. 3-NW-21D from 1986, Survey and Mapping Office, LandsD

September 1979

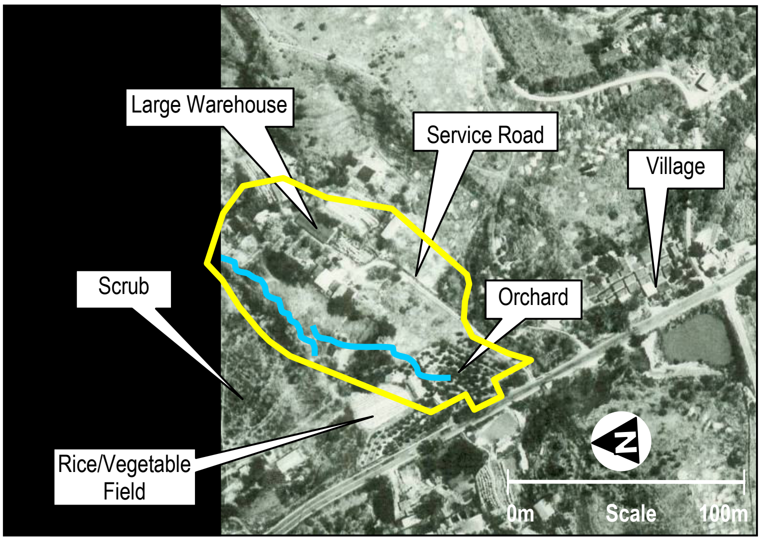


Photograph 8-7 Aerial Photograph – September 1979

8.5.16 There appear to be more buildings dotted around the Site. There is a large vegetated area along Man Kam To Road, where the current entrance to the Site is now located. Remnants of this wooded area remain today. The land to the north of the Site is just open ground. The wood to the south is non-existent and the pond near the village has not yet been filled.

8.5.17 The historical map[Ref.7] shows a stream running from the west of the site, along the northern boundary before flowing through the site and off to the south. Earlier maps show the stream to have flowed into a small pond.

December 1973



Photograph 8-8 Aerial Photograph (partial) – December 1973

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7 Map Reference Sheet No. 3-NW-21D from 1972, Survey and Mapping Office, LandsD

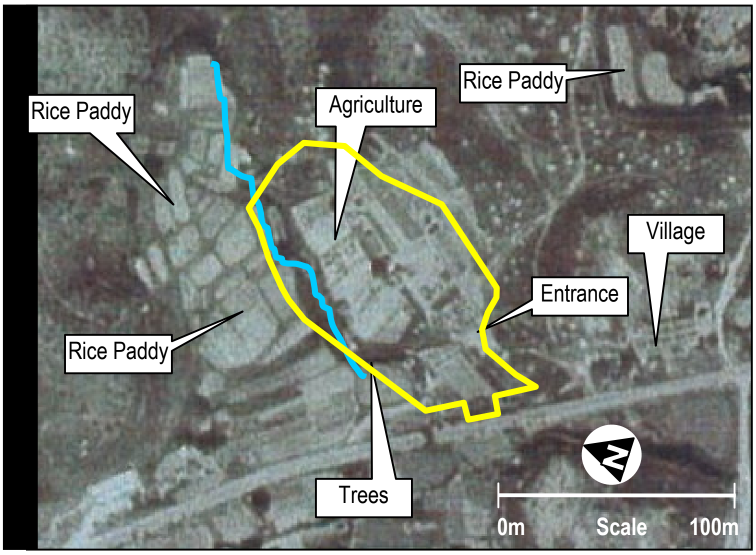
8.5.18 The Site is dominated by a large warehouse, which is situated at the end of the long service road. The vegetation on the site is very thin as the natural ground can be seen fairly clearly. Agricultural activity can be seen at the western part of the site – rice/vegetable fields and an orchard. The land where the current batching plant is located is covered with scrub vegetation. The village consists of many buildings.

8.5.19 The historical map[Ref.8] shows three small ponds to be present and various temporary structures, including a larger central one which corresponds with the aerial photograph. A stream flows from the east, down the northern perimeter of the site, before flowing through the site to a pond on the western boundary. The historical map[Ref.9] shows that the ponds have been filled by 1982.

December 1967

8.5.20 The historical map[Ref.10] shows the site to be covered with orchards and cultivated fields. The three small ponds are still evident on the site. A stream flows from the east, down the northern boundary of the Site before flowing though the Site to a pond on the western boundary.

October 1961



Photograph 8-9 Aerial Photograph– October 1961

8.5.21 The quality of the aerial photograph is not good (because of the high altitude at which it was taken) however, the Site and the adjacent land is clearly being used for agriculture – the land where the current batching plant is located is being used as rice paddy. A site entrance can be made out just to the north of the village. The area to the southeast of the Site is rice paddy.

8.5.22 The historical map[Ref.11] shows that the site is being used for orchards and cultivation. Three small ponds are shown on the map with the stream flowing down the northern boundary of the Site from the east and flowing through the Site and collecting in a pond on the western boundary.

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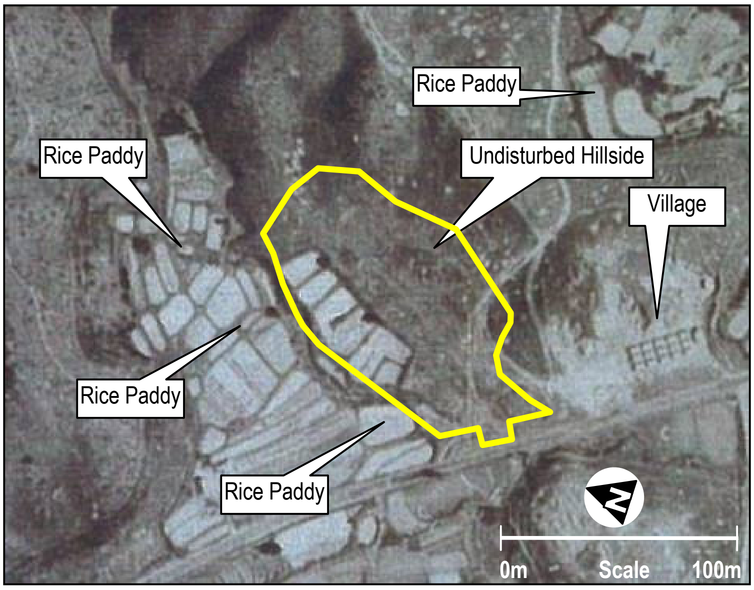
8 Map Reference Sheet No. C-510-SE-A from 1967 (partial revision), Survey and Mapping Office, LandsD
9 Map Reference Sheet No. 3-NW-21D from 1982, Survey and Mapping Office, LandsD
10 Map Reference Sheet No. C-510-NE-C from 1967, Survey and Mapping Office, LandsD

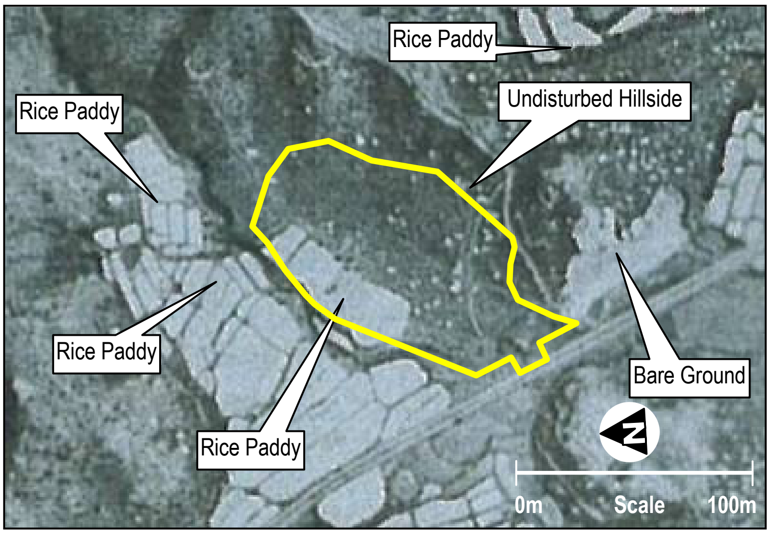
December 1956



Photograph 8-10 Aerial Photograph – December 1956

8.5.23 The village can be seen clearly the area around them is cleared of vegetation – the houses look to have been recently constructed. There is no evidence of the adjacent wood. The northern part of the Site is being used as rice paddy and the southern part appears to be undisturbed hillside. The land where the current batching plant is located is also being used as rice paddy.

November 1945



Photograph 8-11 Aerial Photograph – November 1945

8.5.24 The northern part of the Site is being used as rice paddy and the southern part of the Site appears to be undisturbed hillside. The land where the current batching plant is located is also

11 Map Reference Sheet No. C-510-NE-C from 1961, Survey and Mapping Office, LandsD

being used as rice paddy. The village has not yet been developed, although the land on which it will be sited appears to have been cleared.

8.6 Summary of Site History

1995 onwards

8.6.1 Site cleared of all buildings and used for lorry and car parking. There is no evidence to suggest that any above ground or below ground fuel tanks are or have ever been present on the Site. However, leakage of oil and/or fuel onto the hardstanding from parked vehicles is possible, albeit in relatively small amounts.

8.6.2 The stream crossing the Site is gradually filled in.

1970's onwards

8.6.3 The Site was being used for warehousing and storage, possibly linked to haulage of agricultural goods. It appears that areas of the Site have been cleared and then have naturally re-vegetated.

8.6.4 It is considered likely that hydrocarbon contamination may have occurred in the past. Fuel storage and storage of oil and chemicals is considered likely and leakage and spillage of such liquids is possible.

8.6.5 Buildings were spread extensively across the Site in the late 1970's and it is possible that when these were demolished, rubble could have been used for the road sub-surface. It is not known if the buildings contained hazardous materials.

Pre-1961

8.6.6 The Site appears to have been used solely for agricultural purposes.

8.7 Potential Pollutant Linkages at the Site

8.7.1 Based on the historical information and the site walkover, information a conceptual model has been formulated and is shown in ***Table 8-1***, below.

8.7.2 The conceptual model identifies all the linkages that could exist at the Site given the current use and presuming a future use as a poultry slaughtering plant. The model is based on the information available and gives an opinion on the likely significance of risk posed to the identified receptor. It is recommended that the model is reviewed should any new information be obtained at some future date.

Source	Pathway	Receptor	Linkage Present at the Site	Potential Significance
Contaminated soils due to historical leakage and spillage of fuels and chemicals. Possible hazardous materials in demolished buildings	Ingestion of soils, inhalation of dust and skin contact	Current site users	No. The site is covered with a hardstanding	Not applicable
		Construction workers	Yes , potentially present during construction work if hardstanding is to be removed	Not significant if appropriate PPE is worn in accordance with Health & Safety plan for the site
Contaminated soils due to historical leakage and spillage of fuels and chemicals. Possible hazardous materials in the demolished buildings	Ingestion of soils, inhalation of dust and skin contact	Future site workers	No. The Site will be hardstanding and buildings. Unknown contamination under the Site is unlikely to pose a risk	Not applicable
		Humans in adjacent sites, such as the batching plant and the village	Yes. A possible risk is posed by windblown dust	Not significant if adequate site management controls are in place and because adjacent sites are sparsely populated
	Migration via soil pore water	Underlying groundwater aquifer	Unknown. The underlying geology and potential contamination is unknown. However, presence of a confining clay layer is considered likely	Considered unlikely to be significant and the groundwater is not used for human consumption
	Migration via soil pore water and groundwater	Surface waters	Unknown no information on contamination	Considered unlikely to be significant due to the distance to the River and dilution effects
	Soil pore water	Trees / vegetation	No. Mature trees to the south and west of the Site have grown during the history of the site	Unlikely to be any significant impact as the trees would not have reached maturity
Biodegradable landfilled material	Generation of landfill gases	Humans.	No. No evidence that any void space existed for landfilling	Not applicable
		Trees / vegetation	No. Mature trees to the south and west of the site have grown during the history of the site	Unlikely to be present and significant as the trees would not have reached maturity

Table 8-1 Conceptual Model for the Site

8.8 Risk Assessment at the Site

Risk to Humans

8.8.1 Based on the information available, the risk to humans is not considered to be of significance at the Site. Assuming a worse case scenario of a considerable spillage or leakage of fuel or other liquid at some time in the past, the volatile elements of the liquid would have been expected to have vapourised soon after any incident and the liquid would be expected to have migrated into the underlying soil, where it is currently covered by hardstanding.

8.8.2 The redevelopment of the Site will result in the ground being covered by hardstanding and buildings and any long-term risk to humans coming into contact with any unknown contamination at depth is considered unlikely.

Risk to Groundwater and Surface Water

8.8.3 The risks posed to groundwater and surface water are not considered to be of significance at the Site. The groundwater is not known to be used for human consumption and the Ng Tung River is over 300m away and would not be expected to be impacted due to its distance from the Site, the volume of its flow and its potential to dilute and attenuate contaminants. The historical stream is not considered to be a potential receptor as it would appear to have been infilled and destroyed prior to the current site use.

8.8.4 Fuel oils and hydrocarbons (if any spillage has occurred) would be expected to remain perched above the aquifer on the confining clay layer, if present. If no layer is present the natural attenuation of contamination would be expected as the groundwater migrates off site. The significance of any contamination to the groundwater is considered low as the aquifer is not used for public water supply.

Risk to Trees and Vegetation

8.8.5 The site is surrounded by mature trees, which have grown over the last 30 years. There were no trees to the south of the site in 1940/1950. The wood to the south has grown in the last 10 to 20 years. If significant contamination is present at the Site it would be expected that these trees would have shown signs of distress and death. Yet the trees and vegetation have grown around the Site and at times in the past, for example 1988, vegetation has re-colonised the site indicating that widespread soil contamination is unlikely to be present.

8.9 Other Sources of Contamination in the Area

8.9.1 It is noted that there are several neighbouring land uses in proximity to the Site that could have resulted in contamination.

8.9.2 The most likely impact to the Site would be migration under the site of contaminants in groundwater.

8.9.3 Operations such as concrete batching (to the north of the Site), electricity sub-station and paint spraying (to the south of the Site) have the potential to cause contamination due to spillages of chemicals and fuel. In addition, previous uses of the concrete batching plant for unknown warehousing and storage could have resulted in that site becoming contaminated.

8.9.4 To the northwest of the site is an abandoned construction yard and refuse sorting yard. These activities could also have caused contamination of the underlying ground.

8.9.5 However, the likelihood of contamination being caused by these other locations at a level likely to impact the Site is considered low, based on the information available.

8.10 Conclusions and Recommendations

8.10.1 Based on the historical information on the Site and the lack of evidence to indicate any significant source of contamination has ever been present at the Site, it is concluded that the Site is not likely to be contaminated to a level likely to pose a significant risk to current or future users of the Site, waters or other receptors.

8.10.2 It is recommended that during construction a health and safety plan is prepared by the Works Contractor that covers aspects such as the discovery of large amounts of stained and odourous soils, underground tanks and other hazardous materials that may have been deposited at the Site. The plan should contain details of Personal Protective Equipment (PPE) that should be worn and details of how to deal with and dispose of any materials detected on Site.

8.10.3 If suspected contaminated materials are discovered during the construction works, the Project Proponent shall carry out a Land Contamination Assessment and submit the relevant reports to EPD for endorsement prior to the commencement of any construction works within the Site. Relevant reports would include a Contamination Assessment Plan (CAP), Contamination Assessment Report (CAR), Remediation Action Plan (RAP) and Remediation Report (RR).

8.10.4 It is recommended that the conceptual model should be reviewed if further information is obtained or the planned change of use is altered.

8.10.5 The proposed fuel tanks for the operation of the PSC (e.g. for back-up diesel generators) should be located above ground, with a bund beneath, to prevent undetected leakage (which would be a potential problem with underground tanks).

9 HUMAN HEALTH RISK

9.1 Introduction

9.1.1 Avian influenza can be caused by a number of influenza A viruses, e.g. H5N1, H7N2 etc.

9.1.2 There are also pathogens related to poultry slaughter and processing that can lead to human health risk, both in poultry plant workers and consumers. Examples of these pathogens are *Salmonella spp*., *Campylobacter spp*., *Staphylococcus aureus*, *Clostridium perfringens* and *Listeria monocytogenes*. *Salmonella spp*. and *Campylobacter spp*. are by far the most important pathogens associated with poultry products, causing food poisoning (gastroenteritis) in humans world-wide. Infection in humans is caused by ingestion of undercooked contaminated meat or substance cross-contaminated with these pathogens.

9.2 Pathways for Contamination

9.2.1 Horizontal transmission from environmental sources is the primary route of flock infections by *Campylobacter spp*., while horizontal and vertical transmission occurs with *Salmonella spp*. Horizontal transmission occurs from bird to bird, whereas vertical transmission occurs from bird to chick via infected eggs.

9.2.2 *Salmonella spp.* and *Campylobacter spp*. are commonly found in chickens, usually forming part of the gut flora as early as three days after birth, and contaminating chicken carcasses at slaughter. Bacterial counts on carcasses are likely to increase during slaughter and processing – transportation of poultry to the slaughter facility, de-feathering and evisceration have all been associated with increasing bacterial counts, with highest rates in the latter. Contamination can occur by faecal spillage, ingestion of contaminated water from dunking of inverted shackled poultry, and cross-contamination by processing plant workers.

9.2.3 There are two main routes of transmission for infection among PSC workers:

- Direct or indirect contact (i.e. through handling of infected poultry or their immediate contaminated environment during the slaughtering process).
- Droplet from infected poultry (i.e. inhalation of bioaerosols).

9.2.4 Workers in various operational areas of the PSC, including live poultry handling, inspection, slaughtering line, packaging, delivery, cleaning, WTF, solid waste management, condemned carcasses and parts disposal etc. could potentially be at risk.

9.2.5 It has been estimated in ***paragraph 2.6.5*** that approximately 180 slaughtering and processing workers would be required to achieve peak throughput. In addition to these workers, the Operators' office workers and government administrators would also be present on site. Thus, perhaps, some 200 workers could be present at the PSC and could potentially be at risk.

9.2.6 Having said that, however, in terms of potential risk there are three observations to be made:

- Firstly, health checks, sample testing and ante-mortem inspection on imported poultry will be carried out at the Man Kam To border and local poultry need to pass the sample testing before they are be released for delivery to the PSC. It is therefore unlikely that infected poultry will ever be delivered to the PSC.
- Secondly, in the unlikely event that infected poultry are detected at the PSC, the Operators will activate an "emergency response plan", which will include the measure to immediately stop all slaughtering activities at the PSC. As such, the risk to workers at the PSC will be immediately reduced, as the two main routes of transmission will have been eliminated. The implementation of the plan will not give rise to additional environmental impact to nearby sensitive receivers.
- Thirdly, despite evidence indicating that close contact with dead or sick poultry are the principal source of human infection, and that especially risky behaviours include slaughtering, de-feathering, butchering and preparation for consumption of infected poultry, there have been very few cases detected in presumed high-risk groups, such as commercial poultry workers, workers at live poultry markets, cullers, veterinarians, health staff caring for infected patients without adequate protective equipment [Ref.1].

9.2.7 Given the above, and provided that control and preventative measures, below, are put in place, the risk to human health from the operation of the PSC is not considered to be unacceptable.

9.3 Hierarchy of Control

9.3.1 There is a hierarchy of control and preventative measures that can reduce the risk of human infection with poultry-related pathogens. This hierarchy comprises:

- **Level 1 – Location and Physical Separation of the PSC from the General Public.** This provides initial segregation between poultry slaughtering and processing and the wider community.
- **Level 2 – Design and Layout of the PSC.** Appropriate design can reduce the risk to the local community and also to PSC workers.
- **Level 3 – Operational Procedures.** Sound operational practice (including appropriate training of workers) can reduce the risk to PSC workers, the local community and also to consumers of dressed poultry.
- **Level 4 – Personal Protection.** This will include vaccination of PSC workers against disease, on-going medical surveillance and follow-up treatment; personal hygiene; and use of Personal Protective Equipment (PPE) to reduce contact with potential infection.

9.4 Control and Preventative Measures

9.4.1 ***Table 9-1***, below, discusses the hierarchy of control. Preventative measures that have been incorporated to address human health risk that may be covered under the EP (except for *, which are covered under the WPCO) are listed under Levels 2a and 2b – these are also shown in the Implementation Schedule in ***Appendix 5***. Other preventative measures will be regulated under other relevant legislation, PSC licence conditions and contract terms for the PSC.

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1. World Health Organisation Avian Influenza ("Bird Flu") Fact Sheet – see http://www.who.int/mediacentre/factsheets/avian_influenza/en/

Identified Potential Hazards/Risks, Related Issues and Hierarchy of Control	Control and Preventative Measures to be Adopted
Level 1: Location of the PSC and Physical Separation of the PSC from the General Public	
While avian influenza is transmitted from infected poultry to humans, transmission between humans remains very inefficient. Therefore, the main pathway by which avian influenza is spread is thought to be via close contact between infected poultry and humans	▪ Segregating live poultry from the population removes this pathway and so will minimise the risk of an outbreak of avian influenza ▪ To achieve this, Government has proposed to develop a PSC in a relatively remote area ▪ After an extensive site search for a suitable location (see ***Section 2***) the site in Sheung Shui was selected – this is distant (almost 1km) from heavily populated areas but provides access to Mainland poultry farms by the most direct route avoiding population centres
Level 2a: Design and Layout of the PSC – External Environment	
Cross-contamination between transport of incoming live poultry and outgoing dressed poultry products	▪ The layout of the PSC shall be designed to separate vehicles bringing in live poultry and vehicles collecting dressed poultry products ▪ Provision of nine spaces for delivery vehicles and six spaces for collection vehicles, which is sufficient to avoid off-site queuing
Crate Washing: Pathogenic bacterial contamination of non-contaminated poultry	▪ Provision of a semi-enclosed "Lorry Unloading Area" within the PSC building
Vehicle Washing: Pathogenic bacterial contamination of non-contaminated poultry	▪ Provision of a "Vehicle Washing Area" within the PSC building
Odours, bioaerosols and other airborne contaminants escaping in an uncontrolled and untreated manner from the PSC	▪ Air drawn from within the PSC shall pass through an odour removal system before being exhausted, to avoid odour impacts ▪ Ventilation hood systems and devices must be sufficient in number and capacity to prevent grease or condensation from collecting on walls and ceilings ▪ Heating, ventilation, and air conditioning systems must be designed and installed so that make-up air intake and exhaust vents do not cause contamination of food, food-contact surfaces, equipment, or utensils
Wastewater generated from cleaning of crates and vehicles and from slaughtering activities escaping in an uncontrolled and untreated manner from the PSC	▪ WTFs shall be designed to meet the *Standards for Effluents Discharged into Foul Sewers Leading into Government Sewage Treatment Plants with Microbial Treatment in Deep Bay WCZ*, i.e., discharge to SWHSTW* ▪ A dedicated foul sewer shall be constructed from the PSC to SWHSTW to directly convey effluent from the PSC
Presence of wild animals/rodents/pests in close proximity to the PSC could act as disease vectors	▪ A boundary wall (minimum 2m) will enclose the site, thereby deterring wild animals from walking/crawling into the PSC site from the surrounding environment and so reducing the risk of transferring disease from the wild to the PSC and vice versa

Identified Potential Hazards/Risks, Related Issues and Hierarchy of Control	Control and Preventative Measures to be Adopted
Level 2b: Design and Layout of the PSC – Internal Environment	
Overall physical structures	▪ The premises should be painted with durable and light coloured paint that is easy to clean ▪ All ceilings must be constructed and finished as to prevent condensation, leakage, and formation of moulds can be easily cleaned ▪ Walls, floors, ceiling partitions and doors must be constructed with smooth and durable materials impervious to moisture ▪ Windows and all openings must be constructed and meshed to prevent the entrance of dust and pests, such as flies, rats and mice ▪ Floors must be made of non-slip materials, evenly graded to prevent water stagnation ▪ Proper signage should be provided for demarcation and instructions
Stressed poultry in the holding area and overcrowding will lead to more rapid spread of infection between poultry	▪ The holding areas shall be constructed such that waste and dirty water are drained into a manure sump ▪ Effective drainage should be ensured to enable proper cleaning of the area ▪ The holding areas shall be shall be provided with air-conditioning that meets operational needs – provision of wall/ceiling mounted fans will assist in improving air circulation ▪ The holding areas shall be designed to accommodate a maximum number of 25,350 poultry (approximately 13,000 per stall)
Cross-contamination between live and slaughtered poultry	▪ The slaughtering areas shall be physically separated from the holding area ▪ The packaging and storage areas are classified as clean areas and shall be physically separated from the slaughtering areas ▪ Offices and reception areas shall be physically separated from the rooms and areas in which poultry are processed, handled and stored ▪ A staff room shall be provided for the workers to take meals, rest and for recreational purposes. The room should be physically separated from poultry holding area and other processing areas
Cross-contamination between healthy and infected poultry	▪ Separate rooms shall be provided within the PSC building for pre-slaughter testing and post-mortem examination of poultry pending avian influenza testing results and requiring detailed inspection, respectively ▪ An Isolation Room will be provided to quarantine poultry suspected of being infected. The Isolation room will be fitted with a separate ventilation system

Identified Potential Hazards/Risks, Related Issues and Hierarchy of Control	Control and Preventative Measures to be Adopted
Bioaerosols and other airborne contaminants released during slaughtering into a confined environment	▪ The PSC shall be operated at negative pressure, with the ventilation system designed to draw air from the relatively clean areas (e.g. the packing areas) into dirty areas (e.g. the holding areas) ▪ The rate of air changes within the various operational rooms in the PSC shall prevent air from stagnating and shall draw in clean air into each room ▪ Indoor areas shall be provided with air-conditioning that meets operational needs
Design of manual, semi-automated or fully automated slaughtering machines and equipment	▪ The slaughtering machines and equipment shall be designed to meet industry best practice standards ▪ Any conveyors shall use materials that are microbe-resistant and easily cleaned and disinfected ▪ Materials that are used in the construction of utensils, equipment and any food-contact surfaces, should not allow the migration of deleterious substances or impart colour, odour, or taste to food and under normal use conditions must be safe and non-toxic, durable, corrosive resistant, and non-absorbent; sufficient in weight and thickness to withstand repeated washing; finished to have a smooth, light-coloured, easily cleanable surface; resistant to pitting, chipping, scratching distortion and decomposition ▪ All wastewater shall be treated by the on-site WTF* ▪ Equipment shall be provided to ensure all poultry are rendered unconscious prior to neck-cutting for animal welfare and to avoid struggling and consequential spraying of blood, which may splash on workers ▪ The neck-cutting process shall be designed such that contact between workers and poultry blood is minimised to the maximum possible extent. In an automated or semi-automated system, such protection is built-in and worker involvement is minimal. To achieve this protection in a manual system, suitable design is required, e.g. provision of screening at appropriate locations
Provision of personal hygiene facilities throughout the PSC	▪ Washrooms will be provided throughout the PSC, such that workers do not need to move between clean areas and dirty areas. Provision will be in accordance with Building Regulations and the exact number will be determined during detailed design ▪ Hand-washing basins equipped with non-hand operated taps, which supply both hot and cold water, will be provided at various working points – the exact number will be determined during detailed design ▪ Showers will also be provided for workers – the exact number will be determined during detailed design
Cold Storage	▪ Built-in cold stores will be provided to store a minimum of 19,900 dressed poultry
Storage rooms for non-food items	▪ A store room for clean items, such as wrapping or packing materials must be provided
Level 3a: Operational Procedures (pre-delivery)	
Poultry health checks	▪ Health checks, sample testing and ante-mortem inspection on imported poultry will be carried out at the Man Kam To border and local poultry need to pass the sample testing before they are be released for delivery to the PSC. It is therefore unlikely that infected poultry will ever be delivered to the PSC

Identified Potential Hazards/Risks, Related Issues and Hierarchy of Control	Control and Preventative Measures to be Adopted
Live poultry: Insufficient feed withdrawal will result in crop and digestive system full of food contents and will increase the risk of spread of disease (e.g. *E. coli sp.*)	▪ Although water should be provided at all times, feed should be withdrawn 6 to 10 hours prior to slaughter to avoid filling crop and digestive system with food materials and decrease the risk of spreading infective agents
Live poultry: Presence of non-sporulating bacteria (*Salmonella* sp., *E. coli* sp., *Campylobacter* sp., *Yersinia enterocolitica*, *Listeria monocytogenes*)	▪ Live poultry should be sourced from registered farms and each batch of poultry should be accompanied by a valid health certificate
Live poultry: Presence of sporulating bacteria (*Clostridium perfringens*)	
Level 3b: Operational Procedures (within the PSC)	
Reception of infected poultry and/or subsequent identification of infected poultry	▪ The Operators and/or relevant government officers shall inspect all incoming poultry to ensure that they are healthy ▪ Health certificates shall be checked and confirmed as valid ▪ Ante-mortem inspection of poultry will be carried out in the holding area of the PSC and post-mortem inspection will be carried out once the poultry are slaughtered and dressed ▪ Any poultry suspected to be infected shall be quarantined in the Isolation Room ▪ Quarantined poultry shall be killed in the designated area using the dedicated equipment and hygienically disposed of if confirmed to be infected ▪ Workers who are handling infected poultry should wear appropriate PPE according to the working protocol
Cross-contamination between transport of incoming live poultry and outgoing dressed poultry products	▪ Vehicles bringing in live poultry and vehicles collecting poultry products shall be separated through scheduling of vehicle arrivals/departure times ▪ Vehicle arrival times shall not normally require queuing within the Site
Crate Washing: Pathogenic bacterial contamination of non-contaminated poultry	▪ Removal of poultry crates shall be carried out within a semi-enclosed “Lorry Unloading Area” within the PSC building ▪ After poultry have been removed from transportation crates, crates shall be thoroughly washed and disinfected in the Crate Washing Area to prevent cross contamination during their return journey
Vehicle Washing: Pathogenic bacterial contamination of non-contaminated poultry	▪ After vehicles have been unloaded they shall be thoroughly washed and disinfected in the “Vehicle Washing Area” (also within the PSC building) to prevent cross contamination during their return journey

Identified Potential Hazards/Risks, Related Issues and Hierarchy of Control	Control and Preventative Measures to be Adopted
Presence of wild animals/rodents/pests in close proximity to the PSC could act as disease vectors	▪ All waste materials shall be securely stored prior to collection for off-site disposal to prevent foraging by and prevention of subsequent potential infection of domesticated/wild animals ▪ All vegetation will be removed within the PSC boundary to avoid attracting wild birds to the PSC site from the surrounding environment and so reducing the risk of transferring disease from the wild to the PSC and vice versa
Overall physical structures	▪ Walls, floors, ceiling partitions and doors must be cleaned and sanitized as necessary to prevent adulteration ▪ Windows and all openings must be maintained to prevent the entrance of dust and pests, such as flies, rats and mice ▪ Floors must be drained off to trapped outlets protected by grilles
Stressed poultry in the holding area and overcrowding will lead to more rapid spread of infection between poultry	▪ The holding areas shall be operated such that waste and dirty shall not affect other parts of the building ▪ The holding areas shall be maintained at 23^{o}C to reduce heat stress ▪ Overcrowding shall not be permitted ▪ All live poultry shall be given sufficient rest and water before slaughtering ▪ Live poultry shall normally be slaughtered within 12 hours of their arrival at the PSC ▪ If live poultry are unavoidably held for more than 24 hours, hygienic control for the holding area should be available, including washing facilities and dedicated cleansing team
Cross-contamination between live and slaughtered poultry	▪ Observing hand hygiene and wearing appropriate PPE (such as, gloves, gowns and footwear) is mandatory for workers entering into the clean areas
Cross-contamination between healthy and infected poultry	▪ If post-mortem examination of poultry shall be performed at the PSC, relevant safety required according to established international standards shall be followed ▪ Adequate inspection mirrors and knife sterilizers with hot water maintained at 82^{o}C shall be provided at the ante-mortem and post-mortem inspection areas
Cross-contamination between processed poultry (for human consumption) and waste/condemned material	▪ All waste and condemned material generated during slaughtering shall be stored in hygienic conditions in leak-proof sealed containers prior to disposal ▪ Trimmings and wastes must be regularly disposed of during and after processing and the receptacles must be regularly washed and disinfected according to the predefined schedules and policy ▪ Containers shall be stored in a separate area set aside for this purpose
Bioaerosols and other airborne contaminants released during slaughtering into a confined environment	▪ Indoor areas shall be maintained at 23^{O}C to 25^{O}C, as required ▪ If considered necessary, indoor air can be treated with pathogen removal devices – equipment using TiO_2 catalyst and UV disinfection achieves >99% pathogen destruction

Identified Potential Hazards/Risks, Related Issues and Hierarchy of Control	Control and Preventative Measures to be Adopted
Provision of cleaning equipment	▪ Installation of water spray equipment for washing both inside and outside surfaces of carcasses shall be provided and shall have sufficient water pressure at all spray outlets to enable carcasses to be thoroughly and efficiently washed/cleaned ▪ The viscera in the chickens are removed either manually or by venting gun. The whole of the viscera, including lungs and edible offal (i.e. heart, liver and gizzard) are drawn from the body cavity and left hanging from the carcass ▪ Edible offal is further cleaned and the remains are discarded ▪ Avoid forceful water jets to minimize the aerosol generation and splashing during the procedure. Appropriate training and PPE, including face and eye protection in addition to gloves, gown and boots should be provided for workers
Cleaning of the slaughtering areas	▪ Mobile pressurised water jets shall be provided for cleaning and disinfecting floors, walls, plant and equipment
Provision of personal hygiene facilities throughout the PSC	▪ Adequate lidded bins should be provided throughout the PSC, such that workers do not need to move between clean areas and dirty areas ▪ An adequate supply of liquid detergent and hand paper towels should be provided in washrooms ▪ Arrangements need to be in place to allow the laundering and disinfection of used PPE – not necessarily within the PSC
Cold Storage: Growth of bacterial pathogens due to time/temperature abuse	▪ Ensure good maintenance of the cold stores, such as keeping temperature record charts and avoid overloading beyond their designated capacity ▪ Dressed poultry shall be stored in a cold store below 7^{o}C prior to collection, whereas the edible viscera, after thorough washing, packed and labelled shall be stored in separate area and stored immediately under –18^{o}C
Storage rooms for non-food items	▪ Chemicals, detergent and any hazards materials must be properly labelled and stored in a separate store room ▪ Only approved chemicals must be used and stored in the environment
Pathogenic bacterial contamination of slaughtering and processing surfaces and operation areas	▪ A written policy on the hygiene procedures on regularly cleaning and disinfection of operational areas, plant and equipment shall be developed by the Operators and agreed with FEHD. The Department of Health would provide advice accordingly ▪ Adequate number of 82^{o}C water sterilisation points for disinfection of contaminated knives should be provided along the slaughter-line ▪ Floors, walls, surfaces, etc. of all areas all be regularly disinfected after each shift in accordance with hygiene procedures
Pest control	▪ Effective means must be provided to exclude vermin from entry and harbouring in the premises and any delivery vehicle ▪ PSC must have in place a pest management programme to prevent the harbouring and breeding of the pests on the grounds and within establishment facilities

Identified Potential Hazards/Risks, Related Issues and Hierarchy of Control	Control and Preventative Measures to be Adopted
Level 4: Personal Protection	
Infection of workers and medical surveillance and follow-up	▪ Workers shall be given appropriate vaccinations (e.g. influenza vaccinations) in order to maintain a healthy workforce ▪ Maintain a vaccination registry for all workers, including contract staff ▪ First aid facilities must be provided for workers ▪ Any cut or abrasion on an exposed part of the human body must at all times be covered by a waterproof dressing ▪ Workers who have or appeared to have an infectious disease, open lesions (including boils, sore) or infected wounds must be excluded from any operations which could result in product adulteration until their conditions are resolved ▪ Workers with symptoms of illness should seek immediate medical attention, informing their doctors that they work at the PSC ▪ Person in charge of the workforce should keep a record of sickness of the workers
Personal hygiene	▪ Workers shall attend regular occupational health education sessions to remind them of the importance of taking measures to prevent the spread of infection in the workplace ▪ Workers should at all times observe good personal and environmental hygiene ▪ Hands should be washed frequently with liquid soap, especially before eating and touching nose, mouth and eyes ▪ Workers shall cover mouth and nose with tissue paper when coughing or sneezing and dispose of the soiled tissues properly (into a bin with lid), then wash hands thoroughly ▪ Workers shall shower at the end of each shift and shall wash hands thoroughly with liquid soap whenever moving from their work location within the PSC (e.g. moving into a clean area)
Provision of PPE	▪ All the reusable PPE items should be thoroughly disinfected after each shift ▪ A written policy on disinfection of reusable PPE shall be developed by the Operators and agreed with FEHD. Department of Health would provide advice accordingly ▪ Workers shall be fully aware of how to correctly use PPE, both the gowning and de-gowning procedures ▪ Effective air handling/ventilation systems as proposed will obviate the need for workers to wear respirators, such as air-purifying respirators (N95), under normal circumstances. However, and only if needed, air-purifying respirators (N95) are the most practical and appropriate choices for poultry workers to wear in the unlikely event that they might be exposed to infected poultry ▪ Workers shall wear face protection, such as safety goggles (non-vented or indirectly vented) and surgical mask during procedures with anticipated splash hazards ▪ Protective clothing (which includes gloves, aprons, outer garments or coveralls, and boots) shall be used to prevent direct skin contact with contaminated materials and surfaces and reduce the likelihood of transferring contaminated material within the PSC

Table 9-1 Hierarchy of Control and Control and Prevention Measures to be Adopted

10 LANDSCAPE AND VISUAL IMPACT ASSESSMENT

10.1 Introduction

Study Aim

10.1.1 This Landscape and Visual Impact Assessment (LVIA) is necessitated due to the expected landscape and visual impacts that could result from the construction and operation phases of the PSC. Therefore, the assessment considers impacts during both phases. Since there are sensitive receivers that will be affected, this section also describes mitigation measures that would lessen the magnitude of impacts.

10.1.2 The aim of this LVIA is to identify and describe the expected landscape and visual impacts that might occur as a result of the construction and operation of the PSC and to define the significance and magnitude of these impacts before and after mitigation.

Study Area

10.1.3 ***Figure 2-1*** provides an aerial photograph showing the location of the PSC (identified as "Site A") and the surrounding environment.

10.1.4 In accordance with the ESB and *EIAO Guidance Note No. 8/2002*, the Landscape Impact Assessment (LIA) covers all areas that are within 500m from the Site. This extent is illustrated in ***Figure 10-1*** and ***Figure 10-2***.

10.1.5 The Study Area of the Visual Impact Assessment (VIA) covers all terrestrial and aquatic areas within the visual envelope of the Site. The visual envelope is defined as the visual zone of influence according to the *EIAO Guidance Note No. 8/2002,* and is illustrated in ***Figure 10-3***.

Purpose of this LVIA

10.1.6 The purpose of this LVIA is to:

- Define the existing landscape and visual quality in the LVIA Study Area;
- Evaluate the landscape and visual impacts associated with the PSC;
- Propose mitigation measures; and
- Establish if the levels of impacts resulting from the development are higher, lower or the same as the existing conditions.

10.1.7 To achieve this purpose, the following goals are set out for this LVIA as illustrated in the approved Method Statement.

- Carry out landscape and visual baseline studies and to describe the existing and future conditions;
- Identify and describe the landscape and visual impacts of the proposed development for both the construction and operation phases;

- Define the significance and magnitude of these impacts;
- Propose mitigation measures by taking local conditions and experience in consideration and to describe the maintenance and management of these mitigation measures; and
- Illustrate the residual impacts after mitigation.

10.2 Relevant Legislation and Guidelines

10.2.1 The methodology for undertaking the landscape and visual impact assessment is in accordance with Annexes 10 and 18 of the EIAO-TM, EIAO Guidance Note No. 8/2002 and the ESB. Legislation, standards and guidelines applicable to this assessment are as follows:

- Environmental Impact Assessment Ordinance (Cap. 499, Section 16);
- EIAO-TM – Annexes 10 and 18;
- EIAO Guidance Note No. 8/2002 – Preparation of Landscape and Visual Impact Assessment;
- Hong Kong Planning Standards and Guidelines;
- Approved Fu Tei Au and Sha Ling Outline Zoning Plan No. S/NE-FTA/10;
- Outline Zoning Plans No. S/FSS/13;
- ETWB TCW No. 3/2006 – Tree Preservation;
- ETWB TCW No. 2/2004 – Maintenance of Vegetation and Hard Landscape Features; and
- WBTC No. 7/2002 - Tree Planting in Public Works.

10.3 Assessment Methodology

LVIA Approach

10.3.1 The approach to this study has been set out to:

- Be in accordance with the standards and legislation as described in the EIAO and other legislation; and
- Follow a sound research ethic.

10.3.2 This LVIA is a professional study conducted by a team consisting of landscape architects assisted by field surveyors and production technicians. The landscape architects conducted the assessment in an independent and comprehensive manner, where the findings are authentic to their properties and are not according to preferred definitions. The landscape architects have relied on experience and professional judgement, evaluation of the study by relevant Government bodies and the other related impact assessments in this report. Furthermore, the findings of this LVIA study are presented in a structured and systematic manner to improve public comprehension. This is the “sound research ethic”.

Project Description

10.3.3 The layout of the PSC is described in ***paragraphs 2.4.10 to 2.4.12***. All plant and equipment will be housed within the building, except for air handling plant and stacks, which will be located on the roof. While external architectural details have yet to be determined, the dimensions in

paragraphs 2.4.10 to 2.4.12 provide for the maximum bulk of the PSC and therefore represent the worst case scenario for visual impact assessment.

Review of Planning and Development Control Framework

10.3.4 A review of the existing planning studies and documents was undertaken as part of the assessment to gain an insight into the planned role of the site, its context and to help determine whether the development fits into the wider existing and future landscape context.

10.3.5 This review considered the planning intentions described on OZPs and other documents. It identifies any issue of conflict with the neighbouring planned land uses. It in particular identifies future visually sensitive receivers (VSRs). It also describes the future landscape setting and visual context of the study area.

Landscape Impact Assessment

10.3.6 The assessment of the potential impacts comprises two distinct sections:

- Baseline survey; and
- Identification and definition of landscape impacts.

Baseline Survey

10.3.7 To conduct the landscape baseline study that describes the physical properties of the landscape, two surveys were carried out: The first was a desktop survey and the second a site survey. These two surveys collected data with respect to the landscape character areas (LCAs) and landscape resources (LRs). Landscape elements surveyed include:

- Vegetation;
- Rock features;
- Patterns of settlement;
- Land use; and
- Prominent watercourses and water bodies.

10.3.8 Landscape Resources are the individual landscape elements. These resources are described and illustrated herein. Part of the vegetation survey includes a specific survey on trees.

10.3.9 Landscape Character Areas broadly homogeneous units of similar character. These are areas where the topography and land use in particular defines landscape units and are further characterised by landscape element compositions.

10.3.10 Sensitivity to change of the individual LCAs and LRs are rated using low, medium or high depending on the following factors that influence sensitivity:

- Quality – the overall performance of a LCA or LR in the study area;
- Importance or rarity;
- Ability to accommodate change;
- Significance of potential change in the local context;
- Significance of potential change in the regional context;

- Maturity of landscape elements comprising; and
- Overall size within the study area.

10.3.11 The determined degree of sensitivity has the following meanings:

- **High.** A LR or LCA that is rare, protected or of particular value in its local context or in Hong Kong;
- **Medium.** A LR or LCA that is valuable to its local context and have a moderate ability to absorb change; and
- **Low.** A LR or LCA that is common, in poor condition (such as the eroded slopes on the site) and have the ability to absorb change.

Identification and Definition of Landscape Impacts

10.3.12 Identification is a systematic process during which any anticipated changes to the landscape are recorded. These changes will occur during the construction, operation and reinstatement phases of the venue. Such changes are described, measured and illustrated in this report.

10.3.13 Magnitude of change to LCAs and LRs are rated as negligible, small, intermediate or large. Factors affecting the magnitude of change are:

- Compatibility of the PSC features with the surrounding landscape;
- Duration of impacts under construction and operation phases;
- Scale of the facilities;
- Reversibility of change; and
- The relative size of the change in comparison to the size of the existing LCAs or LRs.

10.3.14 The measured magnitude of change has the following meanings:

- **Large.** the quantitative and qualitative loss is high and will lead to permanent alteration of the properties of the LR or LCA;
- **Intermediate.** The quantitative and qualitative loss is moderate and some portions of the LR or LCA will be permanently changed;
- **Small.** The quantitative and qualitative loss can be observed, but most portions of the LR or LCA will stay intact;
- **Negligible.** The effect of the impact on the LR or LCA is barely noticeable or non-existent.

10.3.15 The impact is a product of the sensitivity of a LCA or LR and the magnitude of change to such a LCA or LR. The significance threshold for impacts to landscape character and resources is a definition of the impact and is rated as significant, moderate/significant, moderate, slight/ moderate or negligible. Any such impacts are further defined as beneficial or adverse. The significance threshold is derived from the Significance Threshold Matrix as described in ***Table 10-1*** below.

Magnitude of Change Caused by PSC		Impact		
	Large	**Moderate**	**Moderate / Significant**	**Significant**
	Intermediate	Slight / Moderate	Moderate	Moderate / Significant
	Small	Slight	Slight / Moderate	Moderate
	Negligible	Negligible	Negligible	Negligible
		Low	**Medium**	**High**
		Sensitivity to Change		

Table 10-1 The Significance Threshold Matrix

10.3.16 ***Table 10-2***, below, describes the meanings of the above significance threshold definitions. Since impacts can be either beneficial or adverse, the definitions are also classified as such.

Adverse / Beneficial Impacts			
Significant	**Moderate**	**Slight**	**Negligible**
An impact where the proposal would cause significant deterioration or improvement in the existing environmental quality.	An impact that would cause noticeable deterioration or improvement in the existing environmental quality.	An impact that would barely cause a perceptible deterioration or improvement in the existing environmental quality.	An impact where the change might be noticeable.

Note: Moderate/Significant impacts can in part be classified as Moderate and in part as Significant
Slight/ Moderate impacts can in part be classified as Slight and in part as Moderate

Table 10-2 Impact Definitions

Tree Survey Methodology

10.3.17 Trees are landscape resources. The impact identification and definition process are therefore similar to the above statements. Broad brush and individual tree surveys were conducted.

10.3.18 Broad brush tree survey identifies the common species within the LIA study boundary and their species were recorded. The individual tree survey for this LIA was conducted by means of a field survey. Trees were identified and surveyed. Recorded data are: location of tree, species, size and condition. This report also describes the impact on trees in terms of felling and transplantation. Details of the Tree Survey are provided in ***Appendix 4***.

Visual Impact Assessment

10.3.19 Potential visual impacts are assessed under the following two topics:

- Baseline survey; and
- Identification and definition of visual impacts.

Baseline Survey

10.3.20 The baseline survey was carried out by means of both desktop and field surveys. Data was collected to describe the visual properties of existing and future VSR groups.

10.3.21 VSR groups are existing and future VSRs that are located within the visual envelope were identified. The visual envelope includes all areas from which the Main Arena can be seen and is defined as the view shed formed by natural and manmade features such as existing ridgelines, built developments and for example areas of woodland/or large trees.

10.3.22 Sensitivity to change of individual VSR groups are rated using low, medium or high depending on the following factors that influence sensitivity:

- Value of existing views;
- Quality of existing views;
- Availability of alternative views;
- Amenity of alternative views;
- Type of VSRs in the group;
- Number of VSRs in the group;
- Duration of views to the PSC;
- Frequency of views to the PSC; and
- Degree of visibility.

10.3.23 The determined degree of sensitivity has the following meanings:

- **High.** A VSR group with a large number of viewers that enjoy a unique or valuable view, which will be dramatically altered with the slightest change to it;
- **Medium.** A VSR group with a medium number of viewers who enjoy good views with some disturbances in the present sightlines. Change to their views will be noticeable, but will not alter the essential qualities thereof; and
- **Low.** A VSR group with only a few viewers, whose view will not be noticeably changed by the proposal.

Identification and Definition of Visual Impacts

10.3.24 Identification is a systematic process during which any anticipated changes to views are recorded. These changes will occur during the construction, operation and reinstatement phases of the PSC. Such changes are described illustrated in this report.

10.3.25 Magnitude of change of views from VSR groups is rated as negligible, small, intermediate or large. Factors affecting the magnitude of change are:

- Compatibility with the landscape and character of the surroundings;
- Duration of impacts;
- Scale of the Project;
- Reversibility of the change;
- Viewing distance; and
- Potential blockage of views.

10.3.26 The measured magnitude of change has the following meanings:

- **Large.** The qualitative change is dramatic and permanent;
- **Intermediate.** The qualitative change is noticeable, but viewers still have other views of good quality;
- **Small.** The qualitative change is noticeable, but viewers have a large number of high quality alternative views for enjoyment;
- **Negligible.** The effect of the impact on the VSR group is barely noticeable or non-existent.

10.3.27 Similar to the case of LCAs and LRs, the VSR groups impact is a product of the sensitivity of VSR group and the magnitude of change of its views. The significance threshold for impacts is a definition of the impact and is rated as significant, moderate/significant, moderate, slight/ moderate or negligible. Any such impacts are further defined as beneficial or adverse. The significance threshold is derived from the Significance Threshold Matrix as described in ***Table 10-1***, above, and the meanings of such impacts are clarified in ***Table 10-2***.

Landscape & Visual Impact Mitigation Measures

10.3.28 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 and associated activities in with the surrounding landscape.

10.3.29 The main constraint in doing this is the requirement that there shall be no vegetation within the PSC Site – this includes existing mature trees and planting inside the PSC for landscape and visual mitigation. This “no vegetation” requirement is for reasons of public health concern, since vegetation will attract wild birds and the spread of avian ‘flu’ between wild birds and poultry is a serious health concern. Hence, removing all vegetation within the PSC Site that attracts birds will minimise the risk of spreading avian ‘flu’.

10.3.30 However, outside the PSC Site existing vegetation (including mature trees) can be retained and additional planting can be carried out, subject to agreement with LandsD and/or the land owner, including planting for landscape and visual mitigation, compensatory planting for felled trees, and transplanted trees.

10.3.31 The remaining mitigation measures have considered factors including:

- Avoiding landscape and visual impacts as far as possible;
- Preserving sensitive landscape and visual elements as far as possible;
- Consideration of the contouring of new slopes in order to visually integrate them into the existing topography;
- Use of earth mounding or structural solutions for screening; and
- Feasibility of mitigation measures in respect of funding, implementation phasing and maintenance.

10.3.32 These objectives will result in the formation of landscape and visual mitigation proposals, which will alleviate the previously identified landscape and visual impacts as far as possible, both during its construction, operation and reinstatement phases, and to ensure that the residual impacts are acceptable.

Defining the Residual Impacts

10.3.33 The residual impacts are those, which remain after the proposed mitigation measures have been successfully implemented. This is assessed for the construction, operation and reinstatement phases.

10.3.34 As described above, the level of impact is a product of the sensitivity to change and the magnitude of change, which the proposals will cause to landscape character, landscape resource or visually sensitive receiver. It is a comparison of the future landscape modified by the proposals with the landscape, which would have existed during this period if the PSC had not been constructed. This assessment also considers the ability of the landscape character, landscape resource or visual amenity to tolerate change, i.e. its quality and sensitivity taking into account the beneficial effects of the proposed mitigation.

10.3.35 In accordance with Annex 10 of the EIAO-TM an overall assessment is also made of the residual landscape and visual impacts attributable to the proposed scheme

10.3.36 According to Annex 10 of the EIAO-TM, the ESB and the approved Method Statement, the two main elements were implemented when conducting the visual impact assessment for the PSC. They include:

- Desktop Survey; and
- Field Survey.

10.4 Review of Planning and Development Control Framework

10.4.1 A review of the existing and future development framework that encompasses or will be influenced by the PSC has been undertaken and the results of this review are described below. The aims of this review are:

- To gain insight into the planned functions of the study area and its context;
- To identify any issue of conflict with the neighbouring planned land uses;
- To describe how the PSC fits in the planning and development context; and
- To determine future sensitive receivers.

10.4.2 The OZP for Fanling and Sheung Shui (OZP No. S/FSS/13) illustrate the development intensions of nearby areas. The PSC site is situated in the Other Specified Uses (OU) and Open Storage Area (OS) and surrounded by Open Storage Area (OS) and greenbelt (GB).

10.4.3 Besides the development of the PSC, there is no currently known project in the vicinity of the study area.

10.5 Landscape Baseline Conditions

10.5.1 This section describes the landscape baseline conditions of all areas that are within the LIA Study Area. Descriptions relate to properties of the landscape resources and character areas.

Landscape Resources (LR)

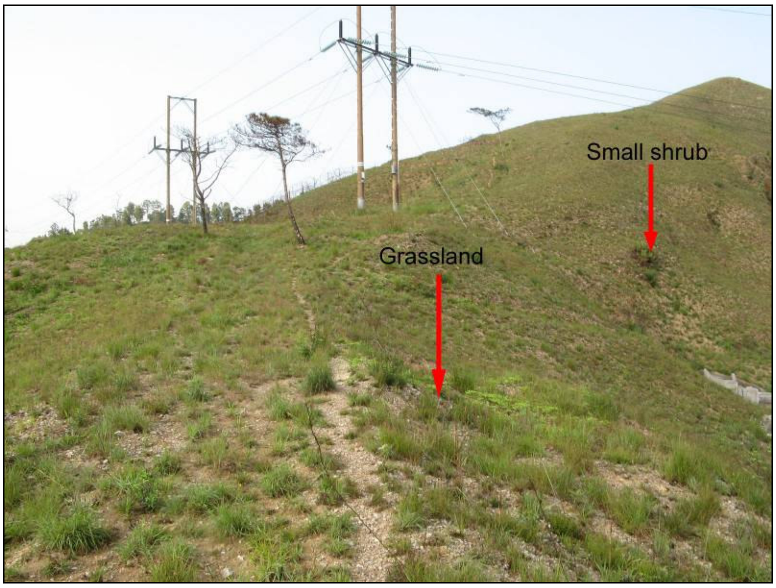
LR1 – Scrubland and Grassland

10.5.2 Scrubland and grassland are recorded within the Study Area. These are typically characterised by short grasses, small shrubs and herbaceous plants. Species include: *Alocasia odora*, *Polygonum chinense, Lantana camera, Ligustrum sinensis, Litsea rotundifolia var. oblongifolia* and *Solanum americanum*. ***Table 10-3***, below, shows the sensitivity to potential change of LR1.

Sensitivity Parameter	Rating
Quality of landscape resource	Low
Importance and rarity	Low
Ability to accommodate change	Medium
Local significance of potential change	Medium
Regional significance of potential change	Medium
Maturity	Low
Area	32 ha
Sensitivity Rating	**Medium**

Table 10-3 LR1 – Sensitivity to Potential Change

10.5.3 A typical image of this LR is shown in ***Photograph 10-1***, below:



Photograph 10-1 LR1 – Scrubland and Grassland

LR2 – Woodland

10.5.4 Trees within the LIA Study Area comprised of a mix of native and introduced tree species. Species include: *Ficus hispida, Schefflera heptaphylla, Macaranga tanarius* and *Melia azedarach*. ***Table 10-4***, below, shows the sensitivity to potential change of LR2.

Sensitivity Parameter	Rating
Quality of landscape resource	Medium
Importance and rarity	Medium
Ability to accommodate change	Medium
Local significance of potential change	Medium
Regional significance of potential change	Medium
Maturity	Medium
Area of woodland	36 ha
Individual trees within tree survey boundary	47
Sensitivity Rating	**Medium**

Table 10-4 LR2 – Sensitivity to Potential Change

10.5.5 A typical image of this LR is shown in ***Photograph 10-2,*** below:

Photograph 10-2 LR2 – Woodland

10.5.6 The initial individual tree survey has recorded a total number of 35 trees within the tree survey boundary. Eight trees will be removed as they will be inside the PSC Site and therefore subject to the “no vegetation” requirement. Of these eight trees, one can be transplanted and seven will need to be felled. Please refer to the preliminary tree survey report in ***Annex 4*** for tree details.

10.5.7 The transplanted tree shall be planted at a vacant area to the north the Site, adjacent to the PSC boundary wall. A total of 11 no. compensation trees (for the loss of the seven trees to be felled) shall be planted alongside the transplanted tree.

10.5.8 To prevent the risk of attracting birds to the Site, the proposed species for compensation shall be *Juniperus chinensis*. Based on the Hong Kong International Airport Approved Plant Species List, this species does not attract bird species found in Hong Kong. A detailed tree survey and tree compensation planting plans shall be prepared as part of a Tree Removal Application (TRA), to be submitted in due course to DLO in accordance with para. 17(d) of ETWB TC(W) 3/2006.

LR3 – Village and Roads

10.5.9 Road and rural features are located throughout the Study Area, in particular at Hung Kiu San Tsuen, the open storage areas on both sides of Man Kam To Road and the graveyards on hills. These are typical developments in this part of Hong Kong. Table 10-5, below, shows the sensitivity to potential change of LR3.

Sensitivity Parameter	Rating
Quality of landscape resource	Low
Importance and rarity	Low
Ability to accommodate change	High
Local significance of potential change	Low
Regional significance of potential change	Low
Area	25 ha
Sensitivity Rating	**Low**

Table 10-5 LR3 – Sensitivity to Potential Change

10.5.10 A typical image of this LR is shown in ***Photograph 10-3,*** below:

Photograph 10-3 LR3 – Urban / Developed Area

LR4 – River

10.5.11 The Ng Tung River is located at the South of the Study Area. ***Table 10-6***, below, shows the sensitivity to potential change of LR4.

Sensitivity Parameter	Rating
Quality of landscape resource	Medium
Importance and rarity	Medium
Ability to accommodate change	Low
Local significance of potential change	Medium
Regional significance of potential change	Low
Maturity	Low
Running length of the two streams	2 ha
Sensitivity Rating	**Medium**

Table 10-6 LR4 – Sensitivity to Potential Change

10.5.12 A typical image of this LR is shown in ***Photograph 10-4,*** below:

Photograph 10-4 LR4 – River

Landscape Character Areas (LCA)

LCA1 – Developed Areas

10.5.13 Developed areas comprise Hung Kiu San Tsuen, open storage areas and graveyards. This quality of the area is low and has high ability to accommodate change. The rating of this LCA's sensitivity to change and ratings of sensitivity parameters are recorded in ***Table 10-7***, below.

Sensitivity Parameter	Rating
Quality of landscape character	Low
Quality of landscape resources	Low
Importance and rarity	Low
Ability to accommodate change	High
Local significance of potential change	Low
Regional significance of potential change	Low
Area	26 ha
Sensitivity Rating	**Low**

Table 10-7 LCA1 – Sensitivity to Potential Change

10.5.14 A typical image of this LCA is shown in ***Photograph 10-5,*** below:

Photograph 10-5 LCA1 – Urban / Developed Area

LCA2 – Hillside

10.5.15 This character comprises of woodland, scrubland and grassland. ***Table 10-8***, below, shows the sensitivity to potential change of LCA2.

Sensitivity Parameter	Rating
Quality of landscape character	Medium
Quality of landscape resources	Medium
Importance and rarity	Low
Ability to accommodate change	Medium
Local significance of potential change	Medium
Regional significance of potential change	Low
Maturity of Landscape	Medium
Area	52 ha
Sensitivity Rating	**Medium**

Table 10-8 LCA2 – Sensitivity to Potential Change

10.5.16 A typical image of this LCA is shown in ***Photograph 10-6,*** below:

Photograph 10-6 LCA2 – Hillside

LCA3 – Woody Lowland

10.5.17 This character area includes wooded areas at low level mainly located adjacent to Man Kam To Road. ***Table 10-9***, below, shows the sensitivity to potential change of LCA3.

Sensitivity Parameter	Rating
Quality of landscape character	Medium
Quality of landscape resources	Medium
Importance and rarity	Medium
Ability to accommodate change	Medium
Local significance of potential change	Medium
Regional significance of potential change	Medium
Maturity of Landscape	Medium
Area	14.5 ha
Sensitivity Rating	**Medium**

Table 10-9 LCA3 – Sensitivity to Potential Change

10.5.18 A typical image of this LCA is shown in ***Photograph 10-7,*** below:

Photograph 10-7 LCA3 – Woody Lowland

LCA4 – River

10.5.19 This character area refers to the Ng Tung River located to the south of the Site. ***Table 10-10***, below, shows the sensitivity to potential change of LCA4.

Sensitivity Parameter	Rating
Quality of landscape character	Medium
Quality of landscape resources	Medium
Importance and rarity	Medium
Ability to accommodate change	Low
Local significance of potential change	Medium
Regional significance of potential change	Medium
Maturity	Medium
Running length of the two streams	2 ha
Sensitivity Rating	**Medium**

Table 10-10 LCA4 – Sensitivity to Potential Change

10.5.20 A typical image of this LCA was shown previously in ***Photograph 10-4***.

LCA5 – Farmland

10.5.21 This character refers to the farmland to the south of the Site. ***Table 10-11***, below, shows the sensitivity to potential change of LCA5.

Sensitivity Parameter	Rating
Quality of landscape character	Medium
Quality of landscape resources	Medium
Importance and rarity	Medium
Ability to accommodate change	Medium
Local significance of potential change	Medium
Regional significance of potential change	Medium
Maturity of Landscape	Medium
Area	1 ha
Sensitivity Rating	**Medium**

Table 10-11 LCA5 – Sensitivity to Potential Change

10.6 Landscape Impact Assessment

10.6.1 The largest impact on landscape resources will occur during the construction phase, when large areas of land will be used for site formation works. These impacts are described in ***Table 10-12***, below.

10.6.2 The impacts on landscape character areas are summarised in ***Table 10-13***, below.

LR Ref.	LR Notation	Sensitivity to Change	Impact Description	Source of Impact	Magnitude of Change	Significance Threshold
LR1	Scrubland and grassland	Medium	Construction: Loss of scrubland and grassland: less than 0.1 ha. Baseline cover is 32 ha.	Construction: Site formation works and building works at the edge of the site will remove a few shrubs.	Construction: Small	Construction: Slight
			Operation: Loss of scrubland and grassland same as for construction phase.	Operation: New building replacing scrubland and grassland.	Operation: Small	Operation: Slight
LR 2	Woodland	Medium	Construction: Removal of vegetation in woodland: less than 0.1 ha. Felling of existing trees: 0	Construction: Site formation works and building works at the edge of the site will remove a few plants in the woodland.	Construction: Small	Construction: Slight
			Operation: Removal of vegetation.	Operation: New building replacing plants in the woodland.	Operation: Small	Operation: Slight
LR 3	Village and Roads	Low	Construction: Loss of former open car park: 1.5 ha. Baseline cover of open storage area is 26ha. Loss of existing trees: 8 no.	Construction: Site formation works and building works; Tree removal	Construction: Large	Construction: Moderate Adverse
			Operation: Loss is same as for construction phase.	Operation: New building replacing former open car park and trees.	Operation: Large	Operation: Moderate Adverse
LR 4	River	Medium	Construction: No direct landscape or visual impact to this landscape resource will result from the operation.	Construction: Nil.	Construction: Negligible	Construction: Negligible
			Operation: No direct landscape or visual impact to this landscape resource will result from the operation.	Operation: Nil.	Operation: Negligible	Operation: Negligible

Table 10-12 Impacts on Landscape Resources

LCA Ref.	LCA Notation	Sensitivity to Change	Impact Description	Source of Impact	Magnitude of Change	Significance Threshold
LCA 1	Developed Areas	Low	Construction: Loss of 8 no. of trees	Construction: Site formation works and building works; removal of some existing trees, including screen trees, due to "no vegetation" requirement within the PSC boundary wall.	Construction: Intermediate	Construction: Moderate Adverse
			Operation: Loss of former open car park and trees	Operation: New building replacing former open car park and trees	Operation: Intermediate	Operation: Moderate Adverse
LCA 2	Hillside	Medium	Construction: No direct impacts	Construction: No direct impacts	Construction: Negligible	Construction: Negligible
			Operation: No direct impacts	Operation: No direct impacts	Operation: Negligible	Operation: Negligible
LCA 3	Woody Lowland	Medium	Construction: Loss of less than 0.1 ha of woody lowland	Construction: Site formation works and building works at the edge of the site will remove a few plants in the woody lowland	Construction: Small	Construction: Slight
			Operation: Loss of scrubland and grassland same as for construction phase	Operation: New building replacing plants in the woody lowland	Operation: Small	Operation: Slight
LCA 4	River	Low	Construction: No direct impacts	Construction: No direct impacts	Construction: Negligible	Construction: Negligible
			Operation: No direct impacts	Operation: No direct impacts	Operation: Negligible	Operation: Negligible
LCA 5	Farmland	Low	Construction: No direct impacts	Construction: No direct impacts	Construction: Negligible	Construction: Negligible
			Operation: No direct impacts	Operation: No direct impacts	Operation: Negligible	Operation: Negligible

Table 10-13 Impacts on Landscape Character Areas

10.7 Visual Baseline Conditions

Introduction

10.7.1 This section describes the visual baseline conditions of all VSR groups within the visual envelope, i.e. the visual properties enjoyed by these VSRs. ***Figure 10-3*** illustrates the Site boundaries, the visual envelope and the location of the VSRs.

Visual Baseline Conditions

VSR 1 – Open Storage Area

10.7.2 This VSR group consists of an open storage area directly opposite to the Site and will receive most of the visual impact compared with other VSRs. ***Table 10-14***, below, shows the sensitivity to potential change of VSR1.

Sensitivity Parameter	Rating
Value of existing views	Low
Quality of existing views	Low
Availability of alternative views	Medium
Amenity of alternative views	Medium
Number of VSRs in group	Low
Duration of views to new PSC	Short
Frequency of views to new PSC	Low
Degree of visibility	Medium
Sensitivity Rating	**Low**

Table 10-14 VSR1 – Sensitivity to Potential Change

10.7.3 A typical view from this VSR is shown in ***Photograph 10-8,*** below:

Photograph 10-8 VSR1 – View from Open Storage Area

10.7.4 The proposed PSC will only be evident to this VSR group at the ingress and egress point. The proposed boundary fence wall of the PSC is off-set from Man Kam To Road by 10m. The whole length of this wall is screened by lush foliage of the existing trees, thus only the gates to the PSC will be visible to this VSR. The magnitude of change during the construction and operation stage would be **intermediate** due to the high levels of screening and the indirect viewing distance.

VSR 2 – Graveyard 1

10.7.5 ***Table 10-15***, below, shows the sensitivity to potential change of VSR2. This VSR group represents the graveyard located southwest of the Site. The sensitivity rating of this VSR is considered to be low, as it is not frequently visited.

Sensitivity Parameter	Rating
Value of existing views	Medium
Quality of existing views	Medium
Availability of alternative views	High
Amenity of alternative views	Medium
Number of VSRs in group	Low
Duration of views to new PSC	Short
Frequency of views to new PSC	Low
Degree of visibility	Low
Sensitivity Rating	**Low**

Table 10-15 VSR2 – Sensitivity to Potential Change

10.7.6 A typical view from this VSR is shown in ***Photograph 10-9,*** below:

Photograph 10-9 VSR2 – View from Graveyard 1

10.7.7 The whole PSC development will be evident to this VSR group in a smaller scale due to the far viewing distance from the site. The existing boundary vegetation of the site would integrate the new building into the landscape. The magnitude of change during the construction and operation stage would be **small** due to the far view of the site to the VSR.

VSR 3 – Man Kam To Road 1

10.7.8 ***Table 10-16***, below, shows the sensitivity to potential change of VSR3. This VSR group represents vehicles. Most of the visual impacts of the PSC will be screened by the row of trees located at the Site boundary.

Sensitivity Parameter	Rating
Value of existing views	Low
Quality of existing views	Low
Availability of alternative views	Medium
Amenity of alternative views	Medium
Number of VSRs in group	Medium
Duration of views to new PSC	Short
Frequency of views to new PSC	Low
Degree of visibility	Low
Sensitivity Rating	**Low**

Table 10-16 VSR3 – Sensitivity to Potential Change

10.7.9 A typical view from this VSR is shown in ***Photograph 10-10,*** below:

Photograph 10-10 VSR3 – View from Man Kam To Road 1

10.7.10 The proposed PSC development will be fully screened by the existing trees along Man Kam To Road. The whole development is also off-set from the road by 10m, thus this VSR shall not have direct and full scale views to the site. The magnitude of change during the construction and operation stages would be **intermediate**.

VSR 4 – Man Kam To Road 2

10.7.11 ***Table 10-17***, below, shows the sensitivity to potential change of VSR4. This VSR group represents vehicles driving towards Man Kam To at the located to the west of the Site. The traffic rate is considered to be medium. Most of the visual impact from the PSC will be screened by the row of trees located at the Site boundary.

Sensitivity Parameter	Rating
Value of existing views	Low
Quality of existing views	Low
Availability of alternative views	Medium
Amenity of alternative views	Medium
Number of VSRs in group	Medium
Duration of views to new PSC	Short
Frequency of views to new PSC	Low
Degree of visibility	Low
Sensitivity Rating	**Low**

Table 10-17 VSR4 – Sensitivity to Potential Change

10.7.12 A typical view from this VSR is shown in ***Photograph 10-11,*** below:

Photograph 10-11 VSR4 – View from Man Kam To Road 2

10.7.13 Similar to VSR 3, the VSR 4 group shall not have direct and full-scale views to the site as the existing screen trees along Man Kam To Road will be retained and the development shall be off-set from the road by 10m. The magnitude of change would be **intermediate** during the construction and operation stages.

VSR 5 – Hung Kiu San Tsuen

10.7.14 ***Table 10-18***, below, shows the sensitivity to potential change of VSR5. This VSR represents the small village adjacent to the Site, which is occupied by two village houses, whose windows directly face the Site. Among the others, this VSR shall receive the most visual impact due to the proximity to the site and with only a few trees for screening in this area.

Sensitivity Parameter	Rating
Value of existing views	Low
Quality of existing views	Low
Availability of alternative views	Low
Amenity of alternative views	Medium
Number of VSRs in group	Low
Duration of views to new PSC	Long
Frequency of views to new PSC	High
Degree of visibility	High
Sensitivity Rating	**High**

Table 10-18 VSR5 – Sensitivity to Potential Change

10.7.15 A typical view from this VSR is shown in ***Photograph 10-12,*** below:

Photograph 10-12 VSR5 – View from Hung Kiu San Tsuen

10.7.16 The residents will have full-scale and directs views to the site as there is no existing planting along this area to help screen the impact. In the operation stage, the residents will face the 5m high boundary fence wall of the PSC, although a few trees provide some screening to the Site and soften the impact. The magnitude of change is **Large** during the construction and operation stages.

VSR 6 – Graveyard 2

10.7.17 ***Table 10-19***, below, shows the sensitivity to potential change of VSR6. This VSR group represents graveyards located at the small hill at the northeast of the Site.

Sensitivity Parameter	Rating
Value of existing views	Medium
Quality of existing views	Medium
Availability of alternative views	High
Amenity of alternative views	Medium
Number of VSRs in group	Low
Duration of views to new PSC	Medium
Frequency of views to new PSC	Medium
Degree of visibility	High
Sensitivity Rating	**Medium**

Table 10-19 VSR6 – Sensitivity to Potential Change

10.7.18 A typical view from this VSR is shown in ***Photograph 10-13,*** below:

Photograph 10-13 VSR6 – View from Graveyard 2

10.7.19 The whole PSC development can be fully viewed by the occasional users of this graveyard due to the open and wide views, although distant. Existing vegetation surrounding the Site would help integrate the new building with the landscape. The magnitude of change during the construction and operation stage is **intermediate**.

10.8 Visual Impact Assessment

10.8.1 The PSC will have a ***Slight/Moderate Adverse*** impact to VSR1 in the construction and operation stages due to the close proximity of the VSR group to the site and that there will be increased "moving in and out" of trucks/vehicles to the site; however, it is to be noted that most of the frontage of the PSC will be fully screened by the existing trees along Man Kam To Road with only the ingress and egress points exposed to their view.

10.8.2 The PSC will have a ***Slight Adverse*** impact to VSR2 in the construction as well as the operation stage. Users from this VSR are only few and the viewing distance to the PSC is quite distant. Existing boundary vegetation will also help blend the new building with the existing landscape.

10.8.3 The PSC will have a ***Slight/Moderate Adverse*** impact to VSR 3 in the construction as well as the operation stage due the heavy screening of existing trees along Man Kam To Road. Only the entry gates to the PSC will be exposed to the travellers along Man Kam To Road. The exposed entry way will also not be directly to full view to the VSR 3 as a 10m setback shall be provided from the road.

10.8.4 Similar to above, the PSC will have a ***Slight/Moderate Adverse*** impact to VSR 4 in the construction and the operation stages as most works and the future building will be set back by 10m from the road and screened by the existing tall trees with only the main gates exposed to travellers.

10.8.5 The PSC will have a ***Significant Adverse*** impact to VSR 5 due to the massing and scale imposed by the external wall of the plant room of the PSC and boundary wall; however, there are a few existing trees to partially screen views to the site. As VSR5 is located at a higher elevation than the PSC, the residents are fully exposed to the construction works and shall have a direct and close view to the 5m high fence wall during the operation stage in some areas, where no trees can provide screening.

10.8.6 The PSC will have a ***Moderate Adverse*** impact to VSR 6 in the construction and operation stages. Similar to VSR 2, the users from this VSR are few; however, viewing distance is closer. The existing boundary vegetation will also help integrate the new building with the landscape.

10.8.7 ***Table10-20***, below, describes the impact of the proposed PSC on the identified VSRs.

VSR Ref.	VSR Notation	Sensitivity to Change	Impact Description	Source of Impact	Magnitude of Change	Significance Threshold
VSR 1	Open Storage Area	Low	Construction: Vehicle movement will change the character of views when delivering materials/plant to site.	Construction: Vehicle movement; Site formation works; Clearance of vegetation and existing trees.	Construction: Intermediate	Construction: Slight/Moderate Adverse
			Operation: The architectural layout and finish of the new building.	Operation: New building.	Operation: Intermediate	Operation: Slight/Moderate Adverse
VSR 2	Graveyard	Low	Construction: Change of character of views. Change in the quality of views.	Construction: Vehicle movement; Site formation works; Clearance of vegetation.	Construction: Small	Construction: Slight Adverse
			Operation: The architectural layout and finish of the new building.	Operation: New building would have an improved appearance when compared to the present outlook of former car park.	Operation: Small	Operation: Slight Adverse
VSR 3	Man Kam To Road 1	Low	Construction: Change of character of views. Change in the quality of views.	Construction: Vehicle movement; Site formation works; Clearance of vegetation and trees.	Construction: Intermediate	Construction: Slight/Moderate Adverse
			Operation: The architectural layout and finish of the new building.	Operation: New building.	Operation: Intermediate	Operation: Slight/Moderate Adverse
VSR 4	Man Kam To Road 2	Low	Construction: Change of character of views. Change in the quality of views.	Construction: Vehicle movement; Site formation works; Clearance of vegetation and trees.	Construction: Intermediate	Construction: Slight/Moderate Adverse
			Operation: The architectural layout and finish of the new building.	Operation: New building.	Operation: Intermediate	Operation: Slight/Moderate Adverse
VSR 5	Hung Kiu San Tsuen	High	Construction: Change of character of views. Change in the quality of views.	Construction: Vehicle movement; Site formation works; Clearance of vegetation and trees.	Construction: Large	Construction: Significant Adverse
			Operation: The architectural layout and finish of the new building.	Operation: New building.	Operation: Large	Operation: Significant Adverse
VSR 6	Graveyard 2	Medium	Construction: Change of character of views. Change in the quality of views.	Construction: Vehicle movement; Site formation works; Clearance of vegetation.	Construction: Intermediate	Construction: Moderate Adverse
			Operation: The architectural layout and finish of the new building.	Operation: New building.	Operation: Intermediate	Operation: Moderate Adverse

Table10-20 Impacts on Visually Sensitive Receivers Before Mitigation

10.9 Recommended Landscape and Visual Impact Mitigation Measures

Introduction

10.9.1 In order to mitigate landscape and visual impacts, mitigation measures will be implemented. These can be categorised in the following groups:

- Construction areas;
- Tree planting/preservation;
- Reinstatement planting; and
- Building features.

Mitigation Measures for Construction (MC):

10.9.2 **MC1.** Site offices and construction yards:

- Site offices shall have olive green roof and façade coating, colour shall match with the existing environment; and
- Site offices and the construction yard shall be decommissioned after construction.

10.9.3 **MC2.** Height of site offices:

- The height of site offices, including the rooftop shall not exceed 10m; and
- Building services equipment such as antennas may exceed 10m and should be coated in black.

10.9.4 **MC3.** Hoarding and screening. Where practical, the site offices, construction yards and storage areas shall be screened with hoarding along the peripheries of the site using colour in harmony with the surrounding environment until the completion of relevant construction phases.

10.9.5 **MC4.** Construction equipment and building material:

- Shall be orderly and carefully stored in order to appear neat and avoid visibility from outside where practical;
- Excess materials shall be removed from site as soon as practical; and
- All construction equipment shall be removed from site upon completion of construction works.

Mitigation Measures for Tree Preservation and Planting (MT)

10.9.6 **MT1.** Compensation for losses is anticipated. The tree compensation:tree loss ratio shall be at least 1:1 in terms of quantity. Species for compensation planting shall be *Juniperus chinensis*. As per the Airport Authority study"Hong Kong International Airport Approved Plant Species List" (Revision 3: June 2007), *Juniperus chinenis* is not considered to attract bird species.

10.9.7 **MT2.** As transplantation on site is not permissible, trees that require removal shall be transplanted off site to the location identified.

10.9.8 **MT3.** Preservation:

- No tree shall be transplanted or felled without prior approval by relevant Government departments;
- Transplant preparation works shall be carried out as soon as possible after commencement of construction. Over-pruning such as hard pruning of tree crown, pollarding or topping shall be avoided. Rootball and crown pruning shall be carried out over at least 3 months, and
- Existing off-site shrub and ground cover planting areas that are disturbed by the works shall be reinstated. Recommended plant selection for shrubs shall include, but not be limited to, the following native species: *Rhodomyrtus tomentosa*, *Rhaphiolepis indica*, *Gardenia jasminoides*, *Ilex asprella*, *Melastoma candidum*, and *Psychotria asiatica*.

Mitigation Measures for the Proposed Building (MB)

10.9.9 **MB1.** External fence walls shall be finished with durable and easy to clean paint and shall be in a colour scheme, which shall blend the new structure with the “green” environment. The colour scheme of the building shall also be in harmony with the surrounding environment as much as possible.

10.9.10 **MB2.** The building shall be in stepped height to distribute the building mass and avoid a “wall effect”.

10.9.11 **MB3.** The building shall be composed of horizontal and vertical lines on the façade to reduce the apparent bulk of the building, materials such as glass and timber may be integrated into the design to add interest and variety to the design.

10.9.12 **MB4.** Flat roof areas shall be articulated to reflect horizontal and vertical lines of the façade to have an overall cohesive architectural design and so as to break the flatness. Colouring/finish shall allow blending with the surrounding environment.

10.9.13 **MB5.** Where possible, the roof profile shall be slightly pitched so as to add interest and so as to easily integrate with the surrounding hills.

10.9.14 **MB6.** Paving shall be designed to reflect the horizontal and vertical lines of the building and add interest to the PSC as seen from far and higher views.

10.10 Residual Landscape Impacts

10.10.1 This section describes the landscape impacts that will remain after the implementation of mitigation measures, in terms of residual landscape resource impacts and residual landscape character area impacts.

Residual Landscape Resource Impacts

10.10.2 The impacts on LR are summarised in ***Figure 10-4***. ***Table 10-21***, below, describes the residual impacts on LRs.

LR Ref.	LR Notation	Impact Before Mitigation	Proposed Mitigation Measures	Impact After Mitigation
LR 1	Scrubland and Grassland	Construction: Slight Adverse	Construction: MT1, MT3	Construction: Slight Adverse
		Operation: Slight Adverse	Operation: MT1,MT3	Operation: Negligible
LR 2	Woodland	Construction: Slight Adverse	Construction: MT1,MT3	Construction: Slight Adverse
		Operation: Slight Adverse	Operation: MT1,MT3	Operation: Negligible
LR 3	Village and Roads	Construction: Moderate Adverse	Construction: MT1-2, MC1-5	Construction: Moderate Adverse
		Operation: Moderate Adverse	Operation: MB1-3	Operation: Slight Adverse
LR 4	River	Construction: Negligible	Construction: Nil	Construction: Negligible
		Operation: Negligible	Operation: Nil	Operation: Negligible

Table10-21 Residual Impacts on Landscape Resources

Residual Landscape Character Area Impacts

10.10.3 The impacts on LCAs are summarised in ***Figure 10-5***. ***Table10-22***, below, describes the residual impacts on LCAs.

LCA Ref.	LCA Notation	Impact Before Mitigation	Proposed Mitigation Measures	Impact After Mitigation
LCA 1	Developed Areas	Construction: Moderate Adverse	Construction: MC1-4	Construction: Moderate Adverse
		Operation: Moderate Adverse	Operation: Nil.	Operation: Slight Adverse
LCA 2	Hillside	Construction: Negligible	Construction: Nil	Construction: Negligible
		Operation: Negligible	Operation: Nil	Operation: Negligible
LCA 3	Woody Lowland	Construction: Slight Adverse	Construction: MT1, MT3	Construction: Slight Adverse
		Operation: Slight Adverse	Operation: MT1, MT3	Operation: Negligible
LCA 4	River	Construction: Negligible	Construction: Nil	Construction: Negligible
		Operation: Negligible	Operation: Nil	Operation: Negligible
LCA 5	Farmland	Construction: Negligible	Construction: Nil	Construction: Negligible
		Operation: Negligible	Operation: Nil	Operation: Negligible

Table10-22 Residual Impacts on Landscape Character Areas

10.11 Residual Visual Impacts

10.11.1 The implementation of mitigation measures in the construction stage (MC1-4 and MT1-3) and operation stage (MB1-6) would reduce the impact of the PSC to VSR1 from a Slight/Moderate Adverse rating to ***Slight Adverse*** impact. Although most of the PSC will be screened from VSR 1 by the row of trees along Man Kam To Road, once mitigation measures are in place the viewers will only be slightly affected as the PSC shall provide a better outlook than the existing carpark.

10.11.2 The ***Slight Adverse*** impact rating to VSR2 during the construction and operation stages will remain even after the implementation of mitigation measures (MC1-4 and MT1-3 in the construction stage, and MB1-6 in the operation stage) due to the massing and visibility of the PSC even from the far distance. Although, it is to be noted that the PSC will provide a better outlook than an empty carpark.

10.11.3 For travellers in VSR3, the impact of the PSC will only be ***Slight Adverse*** upon implementation of the mitigation measures during the construction and operation stage. With implementation of mitigation measures MC1-4 and Mt1-3 in the construction stage, and MB1-6 in the operation stage, glimpse of the PSC from the row of trees along Man Kam To Road and the ingress/egress area will not provide an unpleasant view to the travellers.

10.11.4 Similar to travellers in VSR3, the impact of the PSC to VSR4 will only be ***Slight Adverse*** upon implementation of mitigation measures during construction and operation stage.

10.11.5 Impacts resulting from the blockage of views and the proximity of the structure of the PSC to the residents of VSR5, will be lessened from Significant to ***Moderate adverse*** upon implementation of mitigation measures (MC1-4 and MT1-3 in the construction stage and MB1-6 in the operation stage) as design measures will provide aesthetics and try to blend the external walls with the existing green environment. Reinstatement of shrub planting shall also soften the hard impact of the wall.

10.11.6 Impacts resulting from the PSC to VSR6 will be lessened from Moderate to ***Slight Adverse*** once mitigation measures are implemented in the construction (MC1-4 and MT1-3) and operation stages (MB1-6). Although the scale and massing of the structure will impede views, the PSC will provide a better outlook than the existing carpark to the few users of the graveyard.

10.11.7 The impacts on VSRs are summarised in ***Figure 10-6***. ***Table10-23***, below, describes the residual impacts on VSRs.

VSR Ref.	VSR Notation	Impact Before Mitigation	Proposed Mitigation Measures	Impact After Mitigation
VSR 1	Open Storage Area	Construction: Slight/Moderate Adverse	Construction: MC1-4, MT1-3	Construction: Slight Adverse
		Operation: Slight/Moderate Adverse	Operation: MB1-6	Operation: Slight Adverse
VSR 2	Graveyard	Construction: Slight Adverse	Construction: MC1-4, MT1-3	Construction: Slight Adverse
		Operation: Slight Adverse	Operation: MB1-6	Operation: Slight Adverse

VSR Ref.	VSR Notation	Impact Before Mitigation	Proposed Mitigation Measures	Impact After Mitigation
VSR 3	Man Kam To Road 1	Construction: Slight/Moderate Adverse	Construction: MC1-4, MT1-3	Construction: Slight Adverse
		Operation: Slight/Moderate Adverse	Operation: MB1-6	Operation: Slight Adverse
VSR 4	Man Kam To Road 2	Construction: Slight/Moderate Adverse	Construction: MC1-4, MT1-3	Construction: Slight Adverse
		Operation: Slight/Moderate Adverse	Operation: MB1-6	Operation: Slight Adverse
VSR 5	Hung Kiu San Tsuen	Construction: Significant Adverse	Construction: MC1-4, MT1-3	Construction: Moderate Adverse
		Operation: Significant Adverse	Operation: MB1-6	Operation: Moderate Adverse
VSR 6	Graveyard 2	Construction: Moderate Adverse	Construction: MC1-4, MT1-3	Construction: Slight Adverse
		Operation: Moderate Adverse	Operation: MB1-6	Operation: Slight Adverse

Table10-23 Residual Impact on Visual Sensitive Receivers

10.11.8 ***Figure 10-7*** shows photomontages illustrating the visual impact before and after mitigation measures for a close VSR at VSR1. ***Figure 10-8*** shows photomontages illustrating the visual impact before and after mitigation measures at VSR5. ***Figure 10-9*** shows photomontages illustrating the visual impact before and after mitigation measures for a distant VSR at VSR6.

10.12 Provisional Programme of Landscape Works

10.12.1 Tree transplantation shall commence prior to any construction works, upon approval of the TRA. Compensation tree planting and reinstatement of disturbed planting will commence at the later stage of construction. A detailed programme will be prepared during the detailed design stage.

10.12.2 Since no vegetation is permitted within the Site, there will be no on-site landscape works within the site boundary. However, tree relocation, off-site compensation planting and shrub reinstatement along the outside of the boundary wall is proposed. The programme for this will be identified during the detailed design stage.

10.13 Summary and Conclusions

10.13.1 Overall, impacts on landscape resources are acceptable. Impacts are mainly due to removal of trees along Man Kam To Road (the Landscape Resource “Village areas and Roads”) as there are few existing trees within the site. The impact within the site is considered only slight, since the removal of a few trees will not make a considerable change to the existing outlook of the Site, i.e. as a former car park. However, although only slight, there is doubt on the acceptability of the landscape impact as mitigation measure of compensatory and amenity planting, which is not allowed within the site boundary due to the “no vegetation” requirement. Transplantation and compensation of removed trees shall therefore be off-site. Only minimal reinstatement shrub planting is proposed outside the Site, along the outside of the boundary wall, as shown in ***Figure 10-10***.

10.13.2 The impact on the landscape character is acceptable. The landscape character will benefit from the PSC by receiving a new building with a better aesthetic outlook than the former car park.

10.13.3 Visual impacts will be acceptable after mitigation. Although amenity shrub and tree planting for screening is not possible within the Site, the visually-pleasing architectural design of the PSC will provide a better visual impact to visual receivers within the area than the former carpark. For the residents of Hang Kiu San Tsuen, who will be the most affected by the PSC, the hoarding, and eventually the external façade of the boundary wall shall be well-designed to lessen the impact. The surrounding woodland as well as reinstatement shrub planting along the boundary of the Site will help integrate the new development with the existing landscape, thus lessening the impact to the few users of the VSRs in the graveyards. Travellers along Man Kam To Road will not receive much visual impact as most of the existing trees along the road shall be retained and will screen the Site throughout construction and operation phases of the PSC.

10.13.4 Overall, the landscape and visual impact of the PSC to the environment is generally acceptable upon proper implementation of mitigation measures. In the TRA, justification will be provided in accordance with para.17(d) of ETWB TC(W) 3/2006.

11 SUMMARY OF ENVIRONMENTAL OUTCOMES

11.1 Population and Environmental Sensitive Areas Protected

11.1.1 Environmental impacts arising from the PSC, if not mitigated properly, could potentially affect the nearby population (although this is relatively small) and sensitive receivers during construction and operation periods.

11.1.2 During construction, for example, fugitive dust emission from site formation, noise from construction plant, etc. could affect nearby residents. During operation, odour could affect nearby residents and noise from vehicles (both those delivering live poultry to the PSC and those collecting dressed poultry (for subsequent distribution throughout Hong Kong) could affect sensitive receivers along proposed transport routes.

11.1.3 In addition to the nearby (relatively small) population there will also be workers within the Site during the construction phase and a resident workforce during the operation phase.

11.1.4 However, with proper implementation of the proposed environmental mitigation measures, the surrounding population and sensitive receivers will not be adversely impacted from construction and operation of the PSC. Construction workers and the operation workforce will be protected by implementation of relevant labour and health and safety legislation.

11.2 Adoption of Environmentally Friendly Designs

11.2.1 A number of environmentally friendly design features have been incorporated into the conceptual design on which this EIA is based. It is recommended that the future Designer and/or Works Contractor consider adoption of these features in his detailed design:

- **Odour.** The PSC will be operated at negative pressure, with air handling equipment providing induced flow from areas of low odour (e.g. the dressed poultry storage area) to high odour (e.g. live poultry holding area). An odour removal system will treat this air before discharge from exhaust points, located furthest from air sensitive receivers.
- **Noise from Fixed Plant.** Fixed plant and equipment (e.g. air conditioning units) should be located furthest from NSRs.
- **Noise from Vehicular Traffic.** The route between the Man Kam To border crossing and the PSC for delivery of live poultry from the Mainland follows Man Kam To Road, on which there are few noise sensitive receivers. Vehicles collecting dressed poultry for subsequent distribution throughout Hong Kong will likely use Jockey Club Road through Sheung Shui New Town. To further minimise vehicular noise impact along Jockey Club Road, signage at selected junctions could direct traffic for the PSC along Po Wan Road, thereby avoiding most of Jockey Club Road, although this is not essential to meet noise standards.

- **Freshwater Demand and Wastewater Treatment.** Dry collection of excreta, blood recovery and vacuum transport evisceration (for automated processing) were recommended. Together, these could reduce water demand and wastewater treatment volumes by up to 15%, or 69.59m^3/day. This translates to an operational cost saving of up to $319 per day, or $116,435/year, based on current charges for freshwater and sewage treatment.
- **Waste Minimisation.** In overseas countries, it is typical practice to collect blood and process it, together with recovered feathers, to produce feather meal, a by-product feedstuff used in livestock and poultry feeds as a source of protein. The inedible viscera, known as offal, are collected for subsequent rendering. These opportunities minimise waste generation. The Operators should implement an education programme for staff relating to avoiding, reducing, reusing and recycling general waste, including provision of three colour recycling bins. Collected materials should be sold to off-site recyclers.
- **Land Contamination.** Should fuel tanks be required for the operation of the PSC (e.g. for back-up diesel generators), these should be located above ground, with a bund beneath, to prevent undetected leakage (which would be a potential problem with underground tanks).
- **Visual Appearance.** Although amenity shrub and tree planting for screening is not possible within the Site, the existing stand of mature trees along Man Kam To Road will be retained, except at the ingress/egress point. A well-designed external façade will provide screening and less visual impact than the existing use.

11.3 Key Environmental Problems Avoided

11.3.1 The key environmental problems avoided relate predominantly to public health. By carrying out all poultry slaughtering at one location, live poultry is effectively segregated from the population and so will minimise the risk of an outbreak of avian influenza within the community.

11.3.2 Other environmental problems avoided relate to the treatment and disposal of waste from poultry slaughtering, which can now be carried out to high standards under one roof, as opposed to being spread throughout the community (in wet markets, etc.) where it is more difficult to enforce standards.

11.3.3 In order to avoid or minimise the environmental impacts of the PSC, a number of preventive measures have been recommended in this report. The key environmental measures and problems avoided are highlighted below:

- With the implementation of dust suppression measures during the construction and demolition works, the dust emission from the construction sites will be reduced by 90% and no adverse construction dust impact will affect the nearby sensitive receivers.
- During the construction phase, the surplus excavated materials will be reused on site as far as practical to minimise the amount of waste requiring disposal at public fill reception areas.

11.4 Compensation Areas

11.4.1 Transplantation and compensation of felled trees will need to be located off-site. An area to the north of the PSC boundary wall has been identified as an appropriate compensation area. Further details will be provided in the TRA, in accordance with ETWB TC(W) 3/2006.

11.5 Key Environmental Benefits of the Environmental Protection Measures Recommended

11.5.1 The key environmental benefits of implementing the recommended preventive and mitigation measures during construction and operation phases can be summarised as follows:

- The air, noise, water quality, and visual impacts at the sensitive receivers will all be minimised or mitigated to within the acceptable criteria and standards.
- The amount of waste materials requiring disposal will be minimised 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.

11.6 Key Environmental Impacts

11.6.1 A summary of the key environmental impacts arising from the PSC is provided in ***Table 11-1***. below. In terms of landscape and visual impacts, these are described as either adverse or beneficial, and the degree of impact is also specified, e.g., moderate, slight, etc.

Environmental Impact	Construction Phase	Operation Phase	Overall Impact
Air Quality	***TSP.*** Without dust control measures, exceedance of assessment criteria at some of the identified ASRs predicted. With dust control measures implemented, no exceedance of assessment criteria predicted at ASRs.	***NO_2.*** No exceedance of assessment criteria predicted at ASRs. ***Odour.*** Without odour control measures, exceedance of assessment criteria at the identified ASRs is predicted. With odour control measures implemented, no exceedance of assessment criteria predicted at ASRs.	No adverse environmental impacts predicted, provided that the mitigation measures recommended are properly implemented.
Noise	***Predicted Noise Level.*** PNLs at the identified NSRs comply with the relevant assessment criteria provided that recommended mitigation is in place.	***Predicted Noise Level from Industrial Sources.*** PNLs at the identified NSRs comply with the relevant assessment criteria provided that recommended mitigation is in place. ***Predicted Noise Level from Off-Site Road Traffic.*** Although the predicted overall traffic noise levels at the representative NSRs exceed the assessment criteria, the noise contribution due to the traffic from the PSC is insignificant. Unacceptable road traffic noise impact due to the PSC is not anticipated.	No adverse environmental impacts predicted, provided that the mitigation measures recommended are properly implemented.
Water Quality	***Water Quality.*** With the recommended mitigation measures, no adverse impact to WSRs is expected.	***Sewage and Process Wastewater.*** 11.20m^3/day of sewage from toilets and 464.80m^3/day of effluent from the on-site WTFs, giving a total of ~476m^3/day. Process wastewater will be treated at an on-site WTF to WPCO standards. Effluent from WTF and sewage will be diverted to a purpose-built sewer connected to SWHSTW for secondary treatment.	No adverse environmental impacts predicted, provided that the mitigation measures recommended are properly implemented.
Waste Management	***Public Fill.*** 18,931 tonnes from site preparation. ***Chemical Waste.*** 0.85 tonnes from maintenance of plant and equipment. ***MSW.*** 24 tonnes from daily activities.	***Special Waste.*** 9,818 kg/day from poultry slaughtering. ***Chemical Waste.*** 1.64 kg/day from maintenance of plant and equipment. ***Special Waste.*** 7,700 kg/day of sewage sludge from the WTFs. ***MSW.*** 200 kg/day from daily activities	No adverse environmental impacts predicted, provided that the mitigation measures recommended are properly implemented.
Landscape and Visual	***Scrubland.*** Loss of all vegetation within the Site ***Woodland.*** Loss of 7 no. trees within the Site. Transplantation of 1 no. tree and compensation planting of 11 no. trees. ***Woody Lowland.*** Loss of less than 0.1ha ***Visual Impact.*** Visual impact to passers by and to residents of Hung Kiu San Tsuen during the construction phase.	***Visual Impact.*** Majority of visual impact will be screened by natural topography and trees along Man Kam To Road. Change of visual character from the former car park to the new PSC. As there are no existing trees to block the view to the site, residents of Hung Kiu San Tsuen are fully exposed to the construction works and shall have a direct and close view to the 5m high fence wall during the operation stage.	Slight Adverse to Moderate Adverse (construction) and Slight Adverse to Moderate Adverse (operation) residual impacts, assuming that the mitigation measures recommended are properly implemented.

Table 11-1 Summary of Key Environmental Impacts

12 ENVIRONMENTAL MONITORING AND AUDIT

12.1 Need for EM&A During Construction Phase

12.1.1 The PSC will be a simple and functional building. Major earthworks will not be required as foundations will likely be spread footings or a raft – major piling works are not anticipated. Site formation work will be minimal. The Site is currently screened from the adjacent Man Kam To Road by a stand of mature trees and the remainder of the site is enclosed in a “bowl”, made up of natural hillsides. The nearest sensitive receivers are in the adjacent Hung Kiu San Tsuen.

Air Quality

12.1.2 The assessment has concluded that dust emissions from the construction phase will be reduced to the minimum achievable level by implementation of the recommended mitigation measures and good site practice. However, given the close proximity of the nearest ASRs (the adjacent Hung Kiu San Tsuen) it is recommended that quantitative monitoring of dust (i.e. 1-hour and 24-hour TSP) is carried out (including baseline monitoring prior to construction).

12.1.3 Full details of the air quality monitoring requirements are provided in the EM&A Manual.

12.1.4 Dust from the construction phase will be reduced to the minimum achievable level by implementation of the recommended mitigation measures and good site practice. Nevertheless, it is recommended that the Works Contractor’s Environmental Team (ET) should conduct weekly site audits during construction to ensure that appropriate dust mitigation is being implemented effectively and in accordance with recommendations in the EIA.

12.1.5 Full details of the air quality auditing requirements are provided in the EM&A Manual.

Noise

12.1.6 The assessment has concluded that with implementation of mitigation measures and good site practice, noise impacts will be reduced to the minimum achievable level. However, given the close proximity of the nearest NSRs (the adjacent Hung Kiu San Tsuen) it is recommended that construction noise monitoring is carried out. Full details of the noise monitoring requirements are provided in the EM&A Manual.

12.1.7 Noise from the construction phase will be reduced to the minimum achievable level by implementation of the recommended mitigation measures and good site practice. Nevertheless, it is recommended that the Works Contractor’s ET should conduct weekly site audits during construction to ensure that appropriate noise mitigation is being implemented effectively and in accordance with recommendations in the EIA.

12.1.8 Full details of the noise auditing requirements are provided in the EM&A Manual.

Water Quality

12.1.9 No WSRs have been identified in the vicinity of the Site. The assessment has concluded that with implementation of mitigation measures and good site practice, impacts from muddy run-off will be reduced to the minimum achievable level.

12.1.10 Nevertheless, it is recommended that the Works Contractor's ET should conduct weekly site audits during construction to ensure that appropriate water quality mitigation is being implemented effectively and in accordance with recommendations in the EIA.

12.1.11 Full details of the water quality auditing requirements are provided in the EM&A Manual.

Landscape & Visual

12.1.12 The assessment has concluded that impacts to landscape resources are acceptable and that impact to landscape character is also acceptable. Visual impacts will be acceptable after mitigation. Baseline review and construction EM&A is required.

12.1.13 The project landscape architect shall be responsible for inspection of the following:

- Retained trees are properly fenced off around the dripline of the trees and existing vegetation to be retained are properly maintained throughout construction period;
- Tree felling and transplanting operations are according to the approved permit by relevant Government departments;
- The new plantings provide screening effect and blend in with the existing environment;
- Compensatory tree planting is in the ratio of at least 1:1 in terms of quantity; and
- Site offices and hoarding are properly constructed and located.

12.1.14 Auditing shall be undertaken fortnightly to ensure all the implementation of landscape and visual mitigation measures are carried out properly.

12.1.15 Full details of the landscape planting auditing requirements are provided in the Project EM&A Manual.

12.2 Need for EM&A During Operation Phase

Odour

12.2.1 To prevent uncontrolled air emissions, all activities relating to slaughtering of poultry will be carried out within the PSC in a negative pressure environment, achieved through the use of appropriate air handling plant. To further reduce any potential impact on air quality, the exhaust vents shall be located at points furthest from the ASRs in Hung Kiu San Tsuen.

12.2.2 Modelling has demonstrated that with recommended mitigation (air scrubbers) there will be no odour impacts at any ASRs, even under worst-case conditions. Nevertheless, odour monitoring by means of odour patrols is recommended during the first year of operation, and thereafter in response to any complaint related to odour.

12.2.3 Full details of the odour monitoring requirements are provided in the EM&A Manual.

Noise

12.2.4 The main operations of the PSC shall be fully enclosed. The unloading of live poultry and the loading of dressed poultry will be semi-enclosed and shall be located within the PSC building at the furthest point from NSRs in Hung Kiu San Tsuen.

12.2.5 The design specification of the air conditioning units, which will be located on the roof of the PSC building at the furthest points from NSRs in Hung Kiu San Tsuen, shall comply with the noise criteria stipulated in the NCO and the EIAO-TM.

12.2.6 Modelling has demonstrated that with recommended mitigation there will be no noise impacts at any NSRs, even under worst-case conditions. For this reason, it is considered that operational noise monitoring is not necessary and so is not proposed.

12.2.7 Modelling has also demonstrated that there will be no unacceptable off-site traffic noise impacts at the noise sensitive receivers along the transport routes. For this reason, it is considered that operational (traffic noise) monitoring is not necessary and so is not proposed.

Effluent Quality

12.2.8 The Operators will be required to obtain a Discharge Licence under the WPCO for the operation of the WTFs. Licence conditions will stipulate permitted effluent composition and concentrations and monitoring of WTF effluent quality will be required if deemed necessary under the WPCO to demonstrate compliance with the Licence conditions.

12.2.9 Monitoring of WTF effluent quality will be required under the Discharge Licence For this reason, it is considered that additional operational effluent quality monitoring is not necessary and so is not proposed.

Landscape & Visual

12.2.10 Auditing shall be undertaken every six months for the first three years of operation to confirm successful vegetation growth.

12.2.11 Full details of the landscape planting auditing requirements are provided in the Project EM&A Manual.

12.3 Conclusion

Need for EM&A

12.3.1 The report has demonstrated that dust, noise and muddy run-off arising from construction, and odour, noise and WTF effluent arising during operation can be effectively controlled to acceptable levels by employing mitigation measures and good site practice.

12.3.2 Based upon consideration of the assessments carried out in this report, and on the summary above, monitoring for construction dust and noise and operational odour is proposed. Weekly construction audits are also recommended for dust, noise and water quality to ensure that appropriate mitigation is being implemented effectively and in accordance with recommendations in the EIA.

12.3.3 Full details of EM&A requirements are provided in the EM&A Manual.

Project Implementation Schedule

12.3.4 To ensure that the recommended mitigation measures and good site practice are implemented during construction and operation phases, a Project Implementation Schedule has been provided in ***Appendix 5***. This schedule lists the scope, location/duration, responsibility and timing for all recommended mitigation measures and good site practice, and has been agreed by all parties listed in the Implementation Schedule.

12.3.5 It is recommended that the Project Implementation Schedule should form part of the contract documents for the PSC, i.e., should be contractually enforceable. This will provide the necessary level of confidence that mitigation measures and good site practice will be fully implemented and so will ensure that environmental impacts will not exceed those assumed in this EIA report.

13 CONCLUSIONS AND RECOMMENDATIONS

13.1 Conclusions

Air Quality – Construction Phase

13.1.1 By implementing good site management, dust generation from site clearance, wind erosion and construction activities will be eliminated and no adverse impacts will be contributed to the surrounding ASRs during construction phase.

Air Quality – Operation Phase

13.1.2 The following processes have been identified where there will be a potential for odour emissions:

- **Area 1 – Reception / Holding.** Live poultry will be kept in the holding area for a minimum of 4 hours (for Mainland poultry) prior to slaughter. Odour will be emitted from the live poultry and their faeces. Faeces on ground also emit a strong odour. Based on the preliminary estimate, a maximum of 25,350 poultry will be kept in the holding area at any one time.
- **Area 2 – Slaughtering.** Killing, bleeding, scalding and de-feathering activities will be carried out within the slaughtering area. Odour will be emitted during bleeding and de-feathering. Odour may also be emitted from the scalding process.
- **Area 3 – Evisceration.** Odour will be emitted during the evisceration process. The main sources will be from offal removal and from removed offal that is collected prior to disposal. Odours include blood, raw meat and offal.
- **Area 4 – Packing.** Odour will continue to be emitted from the eviscerated carcasses. However, compared with the odour emitted from Areas 1 to 3, odour emitted from packing will be significantly less.
- **Area 5 – Waste Collection.** Poultry waste (such as feathers and offal) collected from slaughtering processes will be transferred to the solid waste disposal area. Odour will be emitted from poultry waste such as feathers and offal. There will be no blood recovery and processing, and hence no odour emissions related to this process are anticipated.
- **Area 6 – Wastewater Treatment Facility.** All process wastewater will be treated in the on-site WTF. The raw effluent screenings, equalisation tanks, treatment processes and sludge handling and storage will emit odour (hydrogen sulphide, sulphides, amines, etc.). However, little odour will be emitted during normal operation of the biological treatment process. Thus, odour will be emitted mainly from raw effluent screening and sludge handling/ dewatering units.

13.1.3 Areas 1 to 5 (main building) and Area 6 (WTF building) will be enclosed and maintained at negative pressure by mechanical ventilation. Areas 1 to 4 (main building) will also be air-conditioned. Air drawn from Areas 1 to 5 (main building) will be ducted to exhausts located on the roof of the main building. An odour removal system will treat the air prior to discharge. Air drawn from Area 6 (WTF building) will be ducted to the exhaust located on the roof of the WTF building. An odour removal system will treat the air prior to discharge.

13.1.4 By implementing an odour removal system and adopting good operation practices, odour arising from the PSC will be controlled and the residual odour levels outside the PSC will not cause significant air quality impacts on nearby ASRs.

Noise – Construction Phase

13.1.5 The use of PME during the construction phase of the PSC is not expected to cause any adverse construction noise impact on the NSRs provided that recommended mitigation measures, such as good site practice specific, silenced PME and movable barriers, are implemented properly.

No adverse noise impact is expected during construction of the PSC, provided that recommended noise mitigation measures are properly implemented. No residual noise impact is anticipated.

Noise – Operation Phase

13.1.6 Although the predicted overall traffic noise levels at the identified assessment points exceed the assessment criteria, the traffic noise contribution due to the PSC is insignificant. No direct technical remedies were therefore required.

13.1.7 With the provision of the recommended noise control measures for industrial noise sources, potential noise impacts at the NSRs will be mitigated to acceptable levels.

13.1.8 No adverse noise impact is expected during the operation phase of the PSC, provided that recommended noise mitigation measures are properly implemented. No residual noise impact is anticipated.

Water Quality – Construction Phase

13.1.9 Other than a drainage channel on the west side of the Site, no other WSRs, such as significant water courses, have been identified within 300m of the Site. Ng Tung River (River Indus) is more than 300m from the Site at its closest point and is therefore outside of the Study Area.

13.1.10 There is potential for the WSRs to be affected during the construction phase of the PSC, however, with the implementation of adequate site drainage and the provision of silt removal facilities, no unacceptable water quality impacts were anticipated.

Water Quality – Operation Phase

13.1.11 During operation of the PSC a thorough assessment of all likely wastewater sources was carried out. A total of ~476m^3/day of wastewater will be generated, comprising ~11m^3/day of sewage from toilets and ~465m^3/day of process wastewater, in which concentrations of some relevant parameters exceed the standards for discharge to Government sewer. As such, pre-treatment in on-site WTFs will be required.

13.1.12 All process wastewater shall therefore be treated in on-site WTFs (see below) prior to discharge into a foul sewer leading to SWHSTW. All sewage shall be discharged directly to the foul sewer. There will be no discharge of sewage to any local water systems.

13.1.13 Water-saving processes/measures were identified that could reduce water demand and wastewater treatment volumes by up to 15%, or 69.59m^3/day. This translates to an operational cost saving of up to $319 per day, or $116,435/year, based on current government charges.

13.1.14 Overall, no significant residual impact related to water quality was anticipated, provided that the recommended mitigation measures are properly implemented. The use of environmentally sound designs to achieve significant water-savings are strongly recommended.

Sewerage and Sewage Treatment Implications

13.1.15 Wastewater from the PSC will not meet the required standards for discharge and so an on-site WTF will be required to treat the wastewater prior to discharge to foul sewer. A conceptual design for a WTF based on DAF technology has been prepared to demonstrate that the required level of treatment can be achieved using commercially available plant and equipment.

13.1.16 The suggested configuration, estimated loading and flow rates and conceptual designs proposed were based on an assumed set of parameters that would be defined by the designer in his detailed design of the PSC. As such, the conceptual designs presented in this report are not intended to pre-empt or constrain the future detailed design of the sewerage and/or WTFs by the designer, nor shall they supplant specifications provided in any future tender/contract documents.

13.1.17 The projected effluent discharge from the PSC is ~476m^3/day, comprising ~11m^3/day of sewage from toilets and ~465m^3/day of effluent from the on-site WTFs. This effluent will meet the required *Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters.* This discharge is considered fairly minor (just 0.5%) with respect to the expanded treatment capacity of 93,000m^3/d at SWHSTW.

13.1.18 A number of options for conveying the sewage and WTF effluent from the PSC to SWHSTW were examined:

- **Option 1.** Connection to the Existing 250mm Diameter Rising Main
- **Option 2.** Connection to the Upstream Pumping Station XPS1000182
- **Option 3.** Connection from the Existing Rising Main to the PSC
- **Option 4.** Dedicated Twin Rising Mains Directly to SWHSTW

13.1.19 The preferred option was Option 4, dedicated twin rising mains from the WTFs at the PSC to SWHSTW to convey effluent from the WTF directly to SWHSTW for treatment. Three different alignments were examined for Option 4 and Alignment C, following the existing DN250 rising main beneath Fu Tei Au Road was preferred. This alignment goes through less populated areas with less traffic flow, and so would have less impact than the other two alignments which go through more built-up areas.

13.1.20 No adverse impacts to WSRs within the Study Area were identified. No impacts to the operation of SWHSTW were identified and DSD and EPD have not raised any objection in principle to this proposal.

Waste Management Implications – Construction Phase

13.1.21 Approximately 18,956 tonnes of waste is estimated to be generated during construction of the PSC. This comprises 18,931 tonnes of C&D Materials (from site preparation) that will require disposal as public fill at Tuen Mun Area 38 Fill Bank; 0.85 tonnes of chemical waste (from maintenance of plant and equipment) that will require treatment at the CWTC or at the Dunwell facilities; and 24 tonnes of MSW (from daily activities) that will require disposal at NENT Landfill.

13.1.22 There is sufficient capacity at the Tuen Mun Area 38 Fill Bank to accommodate the public fill. There is sufficient capacity within facilities in Hong Kong (e.g. Dunwell's oil re-refinery and CWTC) for the treatment of chemical wastes. The disposal of 24 tonnes of MSW at NENT Landfill will not significantly affect the total disposal capacity of this facility, which is $35Mm^3$.

13.1.23 Therefore, the waste management impacts resulting from the construction phase of the PSC are not considered to be significant.

Waste Management Implications – Operation Phase

13.1.24 Approximately 17,720 kg of waste per day will be generated during the operation of the PSC. This comprises 17,518 kg/day of Special Waste (9,818 kg/day from poultry slaughtering and 7,700 kg/day of sewage sludge) that will require disposal at NENT Landfill; 1.64 kg/day of Chemical Waste (from maintenance of plant and equipment) that will require treatment at the CWTC or at the Dunwell facilities; and 200 kg/day MSW (from daily activities) that will require disposal at NENT Landfill.

13.1.25 The daily landfill disposal of these quantities of special waste and MSW from the PSC represents 0.78% of the daily waste intake at NENT Landfill, which averaged 2,250 tonnes/day in 2007. There is also sufficient capacity within facilities in Hong Kong for the treatment of 600kg/year of chemical wastes (e.g. Dunwell's oil re-refinery and the CWTC, which has a throughput capacity of 100,000tonnes/year and currently operates below this).

13.1.26 Therefore, the waste management impacts resulting from the operation phase of the PSC are not considered to be significant.

Land Contamination

13.1.27 Based on the historical information and the lack of evidence to indicate any significant source of contamination has ever been present at the Site, it was concluded that the Site was not likely to be contaminated to a level likely to pose a significant risk to current or future users, waters or other receptors.

Human Health Risk

13.1.28 Implications to human health were examined by identifying the likely pathogens arising from operations within the PSC and the likely pathways that could lead to infection. A hierarchy of control was then developed to identify the necessary mitigations measures and operational practice to be employed that would minimise the effects on human health.

Landscape and Visual Impact

13.1.29 The site boundary has been configured to minimise the number of trees affected. Of the 35 no. trees identified within the Site boundary during the tree survey, only eight trees will be removed to ensure that no vegetation will remain within the Site. One will be transplanted and seven will be felled. Compensation planting of a further eleven trees will be carried out to compensate for those felled. Shrubs along the outside of the boundary wall will also be reinstated if needed. Shrubs along the outside of the boundary wall will also be reinstated if needed.

13.1.30 The largest impact on landscape resources will occur during the construction phase, when large areas of land will be used for site formation works. Landscape resources within the 500m Study Area comprise scrubland and grassland; woodland; villages and roads; and river. The mitigated adverse impacts during construction range from “negligible” to “moderate”, and during operation range from “negligible” to “slight”. Overall, the impact on the landscape character is considered to be acceptable and the landscape character will benefit from the PSC by receiving a new building with a better aesthetic outlook than the former car park.

13.1.31 Although planting is not possible within the Site, the visually-pleasing architectural design of the PSC will provide a better visual impact to visual receivers within the area than the former carpark. For the residents of Hang Kiu San Tsuen, who will be the most affected by the PSC, the hoarding, and eventually the external façade of the boundary wall shall be well-designed to lessen the impact.

13.1.32 The mitigated adverse impacts to Visual Sensitive Receivers (VSRs) during construction and operation range from “slight” to “moderate”. Visual impacts are considered to be acceptable after mitigation.

13.1.33 Overall, the landscape and visual impact of the PSC to the environment is generally acceptable upon proper implementation of mitigation measures. Although mitigation measures for the loss of trees within the Site as a landscape resource cannot be achieved, these trees will be compensated for at greater than 1:1 ratio. Justification will be provided in the tree felling application in accordance with paragraph 17(d) of ETWB TC(W) 3/2006.

13.2 Recommendations

Air Quality – Construction Phase

13.2.1 The Works Contractor should notify EPD when undertaking any notifiable works prior to the commencement of such works. In addition, the Works Contractor shall also fulfil specific dust control requirements for specific jobs, as indicated in the Regulation’s Schedule.

13.2.2 Good site management/practice was recommended to avoid/minimise incidences of dust emission. Details were described in ***paragraph 3.7.3*** and cover; Site boundary and entrance; haul roads and unpaved areas; excavated materials; exposed earth; loading, unloading or transfer of dusty materials; debris handling and transport of dusty materials; and site clearance.

Air Quality – Operation Phase

13.2.3 An odour removal system with an odour removal efficiency of at least 95% should be provided for the PSC. All air ducted from the concerned areas should pass through the odour removal system prior to discharge to the surrounding air. The design parameters for the Towngas boilers (if any) and odour removal system should follow the assumptions in ***Tables 3-14 and 3-15***.

13.2.4 Good operational management/practice was described in ***paragraph 3.7.13*** and covers: live poultry unloading and holding areas; washing area; slaughtering plant; and waste management and WTF.

Noise – Construction Phase

13.2.5 Good site management/practice was recommended to reduce noise levels. Details were described in ***paragraph 4.8.1*** and cover: use of well-maintained plant; turning off/throttling down plant; orientation of plant; use of silencers/ mufflers/enclosures; location of mobile plant away from NSRs; and the use of screening.

13.2.6 Specific "quiet" PME was also recommended to further reduce construction noise generated from construction works and the use of movable noise barriers was similarly recommended to prevent construction noise from exceeding the daytime noise standard.

Noise – Operation Phase

13.2.7 Although the predicted overall traffic noise levels at the identified assessment points exceed the assessment criteria, the traffic noise contribution due to the PSC was insignificant. As such, no unacceptable off-site traffic noise impact due to the PSC operation is anticipated. No direct technical remedies will therefore be required.

13.2.8 For industrial noise sources, it was recommended to install enclosures with acoustic silencers/louvers at condenser fan outlets and at air inlets of the enclosure for the air-cooled chillers at the roof of the PSC building. Installation of acoustic louvers is also recommended for the exhaust fans of the odour removal system. In terms of vehicle movements within the Site, the perimeter walls already included in the conceptual design provide sufficient mitigation from vehicle movements to the NSRs in Hung Kiu San Tsuen.

13.2.9 With the provision of the mentioned mitigation measures, noise impact arising from the on-site PSC operation will be mitigated to acceptable levels.

Water Quality – Construction Phase

Construction Runoff and Drainage

13.2.10 Wastewater shall properly be treated to meet the discharge standards set out in the relevant Discharge Licence. No direct discharge of site runoff into the adjacent open channel will be allowed. Runoff and drainage shall be prevented or minimised in accordance with the following guidelines in ProPECC PN 1/94.

13.2.11 The wheel washing facility ensures no earth, mud or debris is tracked off the Site and deposited on to Man Kam To Road. Sand and silt in the wash water from the wheel washing facility shall be settled out and removed before discharging into the storm drain. Any section of the road between the wheel washing bay and Man Kam To Road shall be paved with a back-fall to prevent wash water or other site runoff from entering the public area.

13.2.12 Oil receptors shall be provided in the drainage system and regularly emptied to prevent the release of oil and grease into the storm drainage system after accidental spillage. The interceptor shall have a bypass to prevent flushing during periods of heavy rainfall.

General Construction Activities

13.2.13 Debris and rubbish generated on Site shall be collected, handled and disposed of properly to avoid them entering the open channel. All fuel tanks and storage areas shall be provided with locks and be sited on sealed areas, within bunds of a capacity equal to 110% of the storage capacity of the largest tank. Open storm water drains and culverts near the works area shall be covered to block the entrance of large debris and refuse.

Sewage Generated from On-site Workforce

13.2.14 The sewage from work force is expected to be handled by portable chemical toilets. Appropriate and adequate portable toilets shall be provided by licensed contractors who shall be responsible for appropriate disposal of collected sewage and maintenance of the toilets.

Water Quality – Operation Phase

13.2.15 WTFs shall be required to pre-treat wastewater (excluding sewage) to meet the relevant discharge standards prior to discharge to foul sewer. Sewage generated by visitors and workers shall be discharged direct to foul sewer.

13.2.16 The use of environmentally sound designs to achieve significant water-savings was strongly recommended. Water-saving processes/measures were identified that could reduce water demand and wastewater treatment volumes by up to 15%, or $69.59m^3$/day. This translates to an operational cost saving of up to $319 per day, or $116,435/year, based on current charges for freshwater and sewage treatment.

Sewerage and Sewage Treatment Implications

13.2.17 Although a conceptual design for the WTF have been provided, the designer was recommended to carry out his own calculations of loading and flow rates, based on the configuration, plant and equipment comprising his detailed design.

13.2.18 WTF equalisation tank volumes should be minimised to avoid odour generation and it was recommended that recycling of the treated effluent is investigated by the designer, particularly for lower grade water use requirements.

13.2.19 It was further recommended that the designer should carry out a full SIA, once the detailed design of the PSC has been finalised and the volume of effluent is known, to confirm the acceptability of his design, and seek the approval of the relevant authority.

13.2.20 It was recommended to construct dedicated twin rising mains of at least 150mm diameter from the Site directly to SWHSTW. Two pumps plus a sump of adequate capacity will need to be constructed within the Site. Twin rising mains for each pump should also be provided to ensure that the rising mains are maintainable without shutting down.

Waste Management Implications

13.2.21 Proposals comprising reduction, reuse and recycling, disposal options, and impacts and mitigation for waste management during both construction and operation phases were recommended in ***Sections 7.7 and 7.8***.

13.2.22 Specifically, it was recommended that the Operators consider the adoption of some or all of the following waste reduction, reuse and recycling opportunities: collection of blood for processing (together with recovered feathers) into feather meal, a by-product feedstuff for livestock and poultry; offal collection for rendering; and use of low toxicity coagulants and flocculants to enable sludge to be recovered as a by-product for animal feed or sent for land spreading.

13.2.23 It was recommended that waste lubricants from plant/equipment (generated during both construction and operation/maintenance) are recycled into new products at an appropriate facility, e.g. at an oil re-refinery.

13.2.24 For landfill disposal of waste, recommendations followed EPD advice: carcasses should be preferably sealed in plastic bags and transported in enclosed compartments; and decaying and offensive carcasses must be deposited into pre-excavated trenches and be generously sprinkled with lime.

Land Contamination

13.2.25 It was recommended that during construction a health and safety plan is prepared by the Works Contractor that covers aspects such as the discovery of large amounts of stained and odourous soils, underground tanks and other hazardous materials that may have been deposited at the Site. The plan should contain details of PPE that should be worn and details of how to deal with and dispose of any materials detected on Site.

13.2.26 If suspected contaminated materials are discovered during the construction works, the Project Proponent shall carry out a Land Contamination Assessment and submit the relevant reports to EPD for endorsement prior to the commencement of any construction works within the Site. Relevant reports would include a CAP, CAR, RAP and RR.

13.2.27 It was recommended that the conceptual model (***Table 8-1***) should be reviewed if further information is obtained or the planned change of use is altered.

13.2.28 Should fuel tanks be required for the operation of the PSC (e.g. for back-up diesel generators), these should be located above ground, with a bund beneath, to prevent undetected leakage (which would be a potential problem with underground tanks).

Human Health Risk

13.2.29 A hierarchy of control was developed to identify the necessary mitigations measures and operational practice that should be employed. The hierarchy of control recommends measures for minimising the risk to human health from the operation of the PSC.

13.2.30 In the unlikely event that infected poultry are detected at the PSC, the Operators will activate an “emergency response plan”, which will include the option to immediately stop all slaughtering activities at the PSC.

13.2.31 A written policy on the hygiene procedures on regularly cleaning and disinfection of all operational areas, plant and equipment shall be developed by the Operators and agreed with FEHD / DoH. A written policy on disinfection of reusable PPE shall also be developed by the Operators and agreed with FEHD. The Department of Health would provide advice accordingly.

13.2.32 Workers shall be fully aware of how to correctly use PPE, including gowning and de-gowning.

Landscape and Visual Impact

13.2.33 In order to mitigate landscape and visual impacts, measures were recommended to be implemented for the construction areas and buildings. Details of the recommended mitigated measures for minimising the landscape and visual impacts were described in ***Section 10.9***.

13.2.34 Construction mitigation comprised recommendations for: site offices and construction yards; height of site offices; hoarding and screening; construction plant and building material; and construction lighting.

13.2.35 Operation mitigation measures comprised recommendations for tree compensation (compensation:tree loss ratio shall be at least 1:1 in terms of quantity); and trees that require removal shall be transplanted to the location identified.

13.2.36 A well-designed external façade will provide less visual impact than the existing use.