Water Supplies Department

Hong Kong Special Administrative Region Government

The Decommissioning of Underground Fuel Tanks at Tsuen Wan No.1 Pumping Station Environmental Impact Assessment

Environmental Impact Assessment Report

(Final Revised Report)

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ABBREVIATIONS

AAB	Antiquities Advisory Board
AMO	Antiquities and Monuments Office
ANLs	Acceptable Noise Levels
APCO	Air Pollution Control Ordinance
Arup	Ove Arup and Partners
ASR	Air Sensitive Receptors
BNLs	Basic Noise Levels
BOD_5	5-day Biochemical Oxygen Demand
CAP	Contamination Assessment Plan
CED	Civil Engineering Department
CNP	Construction Noise Permit
DEP	Director of Environmental Protection
EIA	Environmental Impact Assessment
EIAO	Environmental Impact Assessment Ordinance
EM&A	Environmental Monitoring and Audit
EP	Environmental Permit
EPD	Environmental Protection Department
ER	Engineer' s Representative
ET	Environmental Team
HKAQO	Hong Kong Air Quality Objective
HKPSG	Hong Kong Planning Standards and Guidelines
NCO	Noise Control Ordinance
NSRs	Noise Sensitive Receivers
PCW	Prescribed Construction Work

PER	Preliminary Environmental Review
PME	Powered Mechanical Equipment
SPME	Specified Powered Mechanical Equipment
SWL	Sound Power Level
TMs	Technical Memoranda
TM-CW	Technical Memorandum on Noise from Construction Work other than Percussive Piling
TM-DA	Technical Memorandum on Noise from Construction Work in Designated Areas
TM-EIA	Technical Memorandum on Environmental Impact Assessment Process
TM-Water	Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters
TPH	Total Petroleum Hydrocarbon
WDO	Waste Disposal Ordinance
WSD	Water Supplies Department

1 INTRODUCTION

1.1 Background

Ove Arup & Partners (Arup) was commissioned by the Water Supplies Department (WSD) to conduct an Environmental Impact Assessment (EIA) Study for the decommissioning, dismantling and removal of four underground diesel fuel storage tanks at Tsuen Wan No.1 Pumping Station (Figures 1.1 to 1.3). This decommissioning work forms part of the project - uprating the safety, reliability and efficiency of the aged mechanical and electrical plant at Tsuen Wan No. 1 Pumping Station.

The Pumping Station has been in operation since 1955. All pumpsets and associated power supply and control equipment are now approaching the end of their serviceable lives. To improve the operation of the Pumping Station, the existing manned equipment including pumpsets, electrical switchgears, and piping and valving systems will be replaced. The seven electrical motor driven and three diesel engine driven pumpsets currently in use are to be replaced by eight electrical pumpsets. The future general layout of the rehabilitated pumping station is shown in Figure 1.4.

With the phasing out of the three diesel engine driven pumpsets, the four underground diesel fuel storage tanks at the Pumping Station, each with a capacity of 64,000 litres will be decommissioned, dismantled and removed.

The work element – decommissioning and removal of the underground diesel fuel storage tanks, of the Project is categorized under Item 16 Part II of Schedule 2 of the Environmental Impact Assessment Ordinance (Cap 499) (EIAO)[1] as a Designated Project. An EIA study shall be carried out in accordance with the Study Brief (ESB-045/1999)[2] issued by Environmental Protection Department (EPD) in January 2000.

1.2 Site Description

Tsuen Wan No.1 Pumping Station is situated at the southeast corner of the intersection between Wai Tsuen Road and Miu Kong Street. The location of the site is shown on Figure 1.1. The existing layout of the Pumping Station is shown on Figure 1.3.

The Pumping Station is surrounded by various sensitive receivers, which include residential buildings, education centres, an indoor recreation centre and historical buildings. Figure 1.1 gives the locations of these sensitive receivers.

1.3 Scope of Work

The Scope of Works for this study is:

- To conduct an EIA study for the decommissioning of the underground diesel tanks at Tsuen Wan No.1 Pumping Station, in accordance with the Study Brief: ESB-045/1999 issued by EPD in January 2000.

- To conduct a land contamination assessments, for evaluation of the potential land contamination, as part of the EIA study.
- To prepare an EIA report to summarise the assessment findings and the required mitigation measures to ensure the residual impacts comply with the relevant environmental standards.
- To act on behalf of WSD to apply to the Director of Environmental Protection (DEP) for approval of the EIA report, and lodge the application for obtaining the Environmental Permit (EP).
- To present the EIA report, when required, to the EIA Sub-committee of Advisory Council on the Environment and the District Council as part of the public consultation exercise.

1.4 Approach of Study

This study will identify and quantify the potential environmental impact during the decommissioning of the underground diesel tanks. Mitigation measures will be proposed to minimise the environment nuisance once the impacts are found to have adverse effects on the environment. In addition, an EM&A and implementation schedule will be established to ensure the control measure will have to be adopted by the contractor.

1.5 Report Structure

The structure of this EIA report is outlined below for easy reference:

Section	Description
1	*Introduction* of the background information and layout of the report
2	*Project Description* to outline the objectives and scope of the study
3	*Available Technical Information* to list the key information reviewed
4	*Construction Noise Assessment* to present the assessment methodology, results and recommendation for construction noise impacts
5	*Air Quality Assessment* to present the assessment methodology, results and recommendation for air quality impacts
6	*Land Contamination Assessment* to present the assessment methodology, results and recommendation
7	*Cultural Heritage Assessment* to present the assessment methodology, results and recommendation for cultural heritage
8	*Waste Management Implications* to present the assessment methodology, results and recommendation for waste management
9	*Water Quality Assessment* to present the assessment methodology, results and recommendation for water quality impacts
10	*Environmental Monitoring and Auditing Programme* to outline the EM&A requirements

2 PROJECT DESCRIPTION

2.1 Study Objectives

EPD's study brief requires the study to cover the potential impacts of the following environmental key issues:

- Construction noise
- Air Quality Impact
- Land contamination
- Cultural heritage
- Waste management
- Water Pollution

Mitigation measures will be proposed to minimise the pollution, environmental disturbance and nuisance, if any, during the decommissioning project. The environmental monitoring and audit requirements will be designed and specified to ensure the implementation and the effectiveness of the environmental protection and pollution control measures adopted.

2.2 Decommissioning of the Underground Diesel Tanks

The methodology of decommissioning and removal of the underground diesel tanks are summarised as follows:

- The top soil (turf) will be removed to expose the concrete slab cover;
- The concrete slab cover will be removed and broken up;
- The diesel storage tanks will be cleaned of diesel residue before dismantling;
- The cleaned diesel storage tanks and the associated pipeline will be dismantled by flame-cutting method;
- The underground concrete lined chamber and the concrete pedestals will be broken up by hand held breaker, and the spoils will be removed by excavator and dump trucks; and
- The empty chambers will be filled up by soil and/or other suitable materials.

3 AVAILABLE TECHNICAL INFORMATION

A summary of the information provided by WSD is given below:

- Methodology for demolition of underground fuel tanks (ref (15)in WSD/ST 469/00 Pt.2)[3] dated 19 Feb 2001 (Appendix 2)
- Preliminary Project Feasibility Study Report for Replacement of Mechanical and Electrical Equipment at Tsuen Wan No.1 Pumping Station - Preliminary Environmental Review (PER)[4] dated March 2000

4 CONSTRUCTION NOISE ASSESSMENT

4.1 Legislation and Standards

Control over the generation of construction noise in Hong Kong is governed by the Noise Control Ordinance (NCO) (Cap 400)[5] and the EIAO and their subsidiary requirements. Various Technical Memoranda (TMs) have been issued under the NCO and the EIAO to stipulate control approaches and criteria. These TMs prescribe the maximum permitted noise levels for the use of Powered Mechanical Equipment (PME) and certain construction activities and processes, according to the type of equipment or activity, the perceived noise climate of the area, and the working hours of equipment operation and usage. The TMs applicable to the control of noise from construction activities in this project are:

- Technical Memorandum on Noise from Construction Work other than Percussive Piling (TM-CW)[6]
- Technical Memorandum on Noise from Construction Work in Designated Areas (TM-DA)[7]
- Technical Memorandum on Environmental Impact Assessment Process (TM-EIA)[8]

4.1.1 Noise Standards in Normal Working Hours

Noise arising from general construction works during normal working hours is governed by the TM-EIA under the EIAO. In accordance with the TM-EIA, the noise criteria as laid down in Table 4.1 for the construction of designated project shall be met as far as practicable. All practicable direct mitigation measures shall be exhausted and the residual impacts are minimised.

Table 4.1: Noise standards for daytime (0700 to 1900 hours) construction activities

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

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

4.1.2 Noise Standards in Restricted Hours

The NCO provides statutory controls on general construction works during the restricted hours (ie 1900 to 0700 hours from Monday to Saturday and at any time on Sundays or public holidays). The use of PME for construction works during the restricted hours would require a Construction Noise Permit (CNP). The TM-CW details the procedures adopted by EPD for assessing such

application. The granting of a CNP is subject to conditions stated in the permit and it may be revoked at any time for failure to comply with the stated conditions.

In addition to the general controls on the use of PME during the restricted hours, the use of Specified Powered Mechanical Equipment (SPME) and the undertaking of Prescribed Construction Work (PCW) during the restricted hours in a designated area are controlled by the TM-DA. Construction plant or equipment classified as SPME under the TM-DA includes hand-held breakers, bulldozers, concrete mixer lorries, dump trucks and poker vibrators. PCW includes the erection or dismantling of formwork or scaffolding, hammering, handling of rubble, wooden boards, steel bars, or scaffolding material, and the disposal of rubble through plastic chutes.

The TM-DA details the procedures that should generally be adopted by EPD for assessing the use of SPME during the restricted hours and for determining whether a CNP would be issued.

Maximum noise levels from construction activities during the restricted hours at affected Noise Sensitive Receivers (NSRs) are controlled under the TMs and shall not exceed the specified Acceptable Noise Levels (ANLs). These ANLs are stipulated in accordance with the Area Sensitivity Ratings established for the NSRs. The ANLs for construction works in designated areas are more stringent than those given in the TM-CW, as reflected from the corresponding Basic Noise Levels (BNLs) stated in Table 4.2 below.

Table 4.2: BNLs for construction noise other than percussive piling

Time Period	**Area Sensitive Ratings**		
	A	**B**	**C**
All weekdays during the evening (1900 to 2300 hours), and general holidays (including Sundays) during the day and evening (0700 to 2300 hours)	60(45)	65(50)	70(55)
All days during the night-time (2300 to 0700 hours)	45(30)	50(35)	55(40)

Note: Figures in brackets are BNLs for SPME construction work in designated areas

4.2 Construction Noise Prediction Methodology

It has been advised that the construction work, i.e. decommissioning, dismantling and removal of the underground diesel fuel tanks, will be undertaken from June 2002 to December 2002. The demolition works will be carried out at normal working hours only (ie 0700 to 1900 hours on any day other than Sunday or public holiday). No construction works will be carried out during the restricted hours (ie 1900 to 0700 hours from Monday to Saturday and at any time on Sundays and public holidays). This assessment therefore focuses on the construction works during the normal working hours. The following procedures apply to the assessment of construction noise impacts:

- identify representative NSRs that may be affected by the works;

- determine plant items for corresponding construction activities based on the agreed plant inventory with WSD;
- determine the sound power levels of the plant items according to the information stated in the TM-CW or other recognised sources of reference, where appropriate;
- calculate the correction factors based on the distance between the NSRs and the notional noise source positions of the work site;
- apply corrections including façade correction, distance, barrier attenuation, acoustic reflection where applicable, in the calculations;
- predict construction noise levels at the NSRs in the absence of any mitigation measures; and
- conduct assessment of noise impacts at NSRs to quantify the level of impact expected, in accordance with TM-CW.

Initial assessments were conducted for the scenario without any mitigation measures. Where noise level exceedances were identified, further assessments were made assuming different combinations of mitigation measures to be incorporated for controlling the residual impacts.

4.3 Construction Noise Assessment

Despite any description or assessment made in the following paragraphs, the Noise Control Authority will be guided by the relevant TM in assessing an application, once filed, for a CNP. He will consider all the factors affecting his decision taking contemporary situations/conditions into account. Nothing in this report shall bind the Authority in making his decision. There is no guarantee that a CNP will be issued. If a permit is to be issued, the Authority shall include any condition he thinks fit and such conditions are to be followed while the works covered by the permit are being carried out, failing which will lead to cancellation of the permit and prosecution action under the NCO.

4.3.1 Noise Sensitive Receivers

All NSRs within 300m from the study area have been identified in accordance with the Hong Kong Planning Standards and Guidelines (HKPSG)[9] and the TM-EIA. There are no planned/ committed noise sensitive development near the Site[10]. The worst affected NSRs during the demolition works are listed in Table 4.3 below and the locations are shown in Figure 4.1.

Table 4.3: NSRs for construction noise assessment

NSR	Description	Uses	Noise Criteria(iii)	Separation Distance(iv) (m)
N1	Caritas Adult Education Centre(i)	Educational Institution	70 (65)	13
N2	Fong Hon Chu Gifted Education Centre(ii)	Educational Institution	70 (65)	30
N5	Luk Yeung Sun Chuen	Domestic Premises	75	70
N7	Waldorf Centre	Domestic Premises	75	183

NSR	Description	Uses	Noise Criteria[iii]	Separation Distance[iv] (m)
N8	Cheong On Building	Domestic Premises	75	150
N9	Cheong Ning Building	Domestic Premises	75	134
N10	Ho Fai Garden	Domestic Premises	75	114
N11	Tsuen Wan Police R&F Married Quarters	Domestic Premises	75	69

Note:
(i) N1 – all windows for classrooms are designed with a cover of uncrated wall. All rooms are provided with air conditioners
(ii) N2 – all classrooms are installed with double-glazed windows and air conditioners
(iii) Figure in brackets is the noise criteria for education institution during examination
(iv) Distance between NSRs and the notional noise source positions of the work site

4.3.2 Potential Sources of Impacts

Potential noise impacts from the decommissioning works will arise mainly from PME. As confirmed by WSD, the following PME will be required:

Table 4.4: Powered mechanical equipment used for demolition of fuel tanks

Powered Mechanical Equipment	CNP No.	Quantity	Sound Power Levels, dB (A)
Hand Held Breakers, mass <=10kg	023	1	108
Air Compressor, air flow <=10m^3/min	001	1	100
Excavator	081	1	112
Crane-mounted Truck/ Lorry	048/ 141	1	112/ 112
Total Sound Power Level			116

4.3.3 Predictions of Impacts – Unmitigated Scenario

Façade noise levels at the NSRs were calculated based on the Sound Power Levels (SWLs) and corrections for distance attenuation given in the TM-CW. Details of construction noise calculations are given in Appendix 3. The predicted unmitigated maximum noise levels at NSRs at ground level zone during the decommissioning works are shown in Table 4.5.

Table 4.5: Predicted maximum noise levels at NSRs – unmitigated scenario

NSR	Description	Noise Criteria[i], $L_{eq\ 30min}$, dB(A)	Maximum Predicted Noise Level, $L_{eq,30min}$, dB(A)	Exceedance, dB(A)
N1	Caritas Adult Education Centre	70 (65)	84	14 (19)
N2	Fong Hon Chu Gifted Education Centre	70 (65)	81	11 (16)
N5	Luk Yeung Sun Chuen	75	74	0

NSR	Description	Noise Criteria[(i)], $L_{eq\ 30min}$, dB(A)	Maximum Predicted Noise Level, $L_{eq.30min}$, dB(A)	Exceedance, dB(A)
N7	Waldorf Centre	75	66	0
N8	Cheong On Building	75	67	0
N9	Cheong Ning Building	75	68	0
N10	Ho Fai Garden	75	70	0
N11	Tsuen Wan Police R&F Married Quarters	75	64	0

Note:
(i) Figure in brackets is the noise criteria for education institution during examination

Noise impacts up to 19dB(A) exceedance from daytime construction noise criteria were predicted at nearby residential and educational NSRs. The maximum noise levels predicted were 84dB(A) at Caritas Adult Education Centre (N1) and 81dB(A) at Fong Hon Chu Gifted Education Centre (N2). The dominant noise sources were excavator and crane-mounted truck/ lorry.

At the other identified NSRs, the construction noise levels were within the criteria.

4.3.4 Evaluation of Impacts

It should be noted that the noise levels represent the worst case scenario, since the calculations assume that all of the available plant items for a phase of works are in use for 100% of the time. In practice this is unlikely to be the case as a number of plant items will operate sequentially with spatial constraints within the work site, and all equipment items would unlikely be operated at the same location. As will be explained in the following sections, these constraints are recommended as part of the noise mitigation control strategy at some critical NSRs.

4.3.5 Recommended Mitigation Measures

The predicted noise levels show that unmitigated construction works are likely to give rise to adverse daytime noise impacts at the NSRs in the vicinity of the pumping station, and mitigation measures are therefore required. Noise emissions from the site could be minimised by the following means:

- use of good site practices to limit noise emissions at the source;
- scheduling of construction works outside school examination periods/ during summer holiday;
- use of "quiet PME" and working methods;
- use of site hoarding as noise barriers (with careful design) to screen noise at ground level zone;
- use of temporary and movable noise barriers;
- arrange the sequence of plant uses, where practicable; and

- limiting the operating time of construction equipment on site, wherever practicable.

4.3.5.1 Good Site Practices and Noise Management Techniques

Good site practice and noise management could considerably reduce the noise impact from construction site activities on nearby NSRs. The following measures should be followed during the demolition of fuel tanks:

- only well-maintained plant should be operated on-site and plant should be serviced regularly during the construction programme;
- machines and plant (such as trucks, lorry) that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum;
- plant known to emit noise strongly in one direction, where possible, be orientated so that the noise is directed away from nearby NSRs;
- silencers or mufflers on construction equipment should be properly fitted and maintained during the construction works;
- mobile plant should be sited as far away from NSRs as possible and practicable; and
- material stockpiles, mobile container site office and other structures should be effectively utilised, where practicable, to screen noise from on-site construction activities.

The noise benefits of these techniques can vary according to specific site conditions and operations. The environmental noise climate would certainly be improved through these control practices, although the improvement can only be quantified during implementation when specific site parameters are known.

4.3.5.2 Scheduling of Construction Works Outside School Examination Period/ During Summer Holidays

During school examination periods, the daytime construction noise criterion is 65 dB $L_{Aeq, 30min.}$ which is lower than the normal daytime school criterion (70 dB $L_{Aeq, 30min.}$) by 5dB(A). Scheduling of all construction works outside school examination period to less intrusive periods would definitely reduce the noise impacts on the NSRs. For noisy activities such as breaking up the concrete slab cover, it is recommended to conduct this part of works during the summer holidays (i.e. from mid July to end of August), as normal teaching activities are not anticipated during this period. This relieves the need to incorporate more stringent noise mitigation measures required to ensure compliance with the construction noise criteria.

4.3.5.3 Use of "Quiet" Equipment and Working Methods

The use of quiet plant is identified as a feasible solution to tackle adverse noise impacts associated with the construction works. It is generally known (supported by field measurement) that particular models of construction equipment are quieter than standard types given in the TM-CW. Whilst it is generally considered too restrictive to specify the use of specific models or items of plant, it is reasonable and practicable to set plant noise performance specifications for specific PME so that some flexibility in selection of plant is allowed. A pragmatic approach

would be to request that the Contractor independently verifies the noise level of the plant proposed to be used and demonstrates through furnishing of these results, that the plant proposed to be used on the site meets the requirements.

The benefits achievable in this way can be considerable but will depend on the level of control given to the project engineer under the contract conditions and the ability and willingness to use these powers to control the level of environmental noise.

British Standard "Noise Control on Construction and Open Sites, BS5228: Part 1 : 1997"[11] contains examples of SWLs for specific silenced PME. Examples known to be available are given in Table 4.6 below.

Table 4.6: Listing of "quiet" equipment

Power Mechanical Equipment (PME)	Power Rating and/or size	BS5228 Table No.	Maximum SWL, dB(A)	CNP Reference in TM-CW	SWL in TM-CW
Mini excavator	57kW	C3 Ref 108	97	CNP081	112
Lorry	16t	C3 Ref 92	104	CNP141	112

It should be noted that while various types of silenced equipment could be found in Hong Kong, the EPD when processing a CNP application for evening or night time works may apply the noise levels specified in the TM-CW and TM-DA, unless the noise emission of a particular piece of equipment can be validated by certified site measurement or demonstration.

4.3.5.4 Purpose Built Temporary Noise Barriers/ Site Hoarding

Purpose built temporary noise barriers 3 to 5m high located on the site boundaries between noisy construction activities and NSRs could generally reduce noise levels by up to 5-10 dB(A) through partial screening. It would be possible for the Contractor to provide these in the form of site hoardings to achieve this attenuation effect, provided that the barriers have no openings or gaps and have a superficial surface density of at least $13kgm^{-2}$.

Given the pumping station is rectangle in shape, a 3.5m high site hoarding of adequate surface mass could provide partial screening to NSRs at lower floors from construction works at grade. In general this would provide minimum 5dB(A) attenuation. This has been assumed in the calculations for low level NSRs provided that the decommissioning works are at grade.

4.3.5.5 Movable Noise Barriers

Movable noise barriers that can be located close to noisy plant and be moved iteratively with the plant along the site can be very effective at screening noise from NSRs. A typical design which has been used in Hong Kong is a 3.5 m high wooden framed barrier with a small cantilevered upper portion of superficial density no less than $13kg/m^2$ on a skid footing with 25mm thick internal sound absorptive lining. Barriers of this type can be placed within a short distance from mobile plant such as an excavator, etc.

Where these screening effects can be achieved at upper floors of NSRs, greater benefits would be gained at lower floors. To achieve noise screening to NSR at high level e.g. 5 to 15-storey zones, cantilevered top cover would be required.

It is anticipated that suitably designed noise barriers could achieve up to 10dB(A) for static plant and 5dB(A) noise reduction for mobile plant. The noise screening benefit for the plant items considered in this assessment is as follows:

- stationary plant – 10 dB(A) screening for PME e.g. air compressor, hand-held breakers
- mobile plant – 5 dB(A) sceening for PME e.g. excavator, crane-mounted trucks

All barriers designed should satisfy this noise performance in order to control the emission of noise from PME. The Contractor should pay particular attention to ensure barriers are close fitting around plant items thereby gaining greater noise reduction benefit.

4.3.5.6 Sequencing of Plant Operating

Avoiding all equipment operating at the same time would reduce the noise impact from construction activities on nearby NSRs. For example, the excavator could be scheduled to remove the spoils after the concrete slab has been broken up by using hand-held breaker. The excavator and truck shall be operated sequentially to minimise the cumulative noise impact.

4.3.5.7 Limiting Operating Time of Construction Equipment On-Site

The calculations for "unmitigated" scenario have been assumed that all of the available plant items for a phase of works are in use for 100% of the time. In practice, the lorries, concrete truck mixer and mobile crane only operate for 20 minutes in every consecutive 30-minute period and the hand held breakers for about 15 minutes. A noise benefit of 2dB(A) for excavator and crane-mounted truck/ lorry, and 3dB(A) for hand held breaker could be achieved at any 30-minute period.

4.3.6 Prediction of Mitigated Noise Levels

The noise mitigation measures described above regarding the use of quiet plant, temporary/ movable noise barrier, sequencing the plant items and limiting operating time have been applied to the predicted noise levels in Table 4.5 and the resultant noise levels with mitigation measures are shown in Table 4.7 below.

Table 4.7: Predicted mitigation noise levels

NSR	Description	Noise Criteria, $L_{eq\ 30min}$, dB(A)	Maximum Predicted Noise Level, $L_{eq.30min}$, dB(A)	Exceedance, dB(A)
N1	Caritas Adult Education Centre	70	68	0
N2	Fong Hon Chu Gifted Education Centre	70	65	0

4.3.7 Residual Impacts and Further Mitigation to be considered

It is revealed that all mitigated construction noise levels are within the noise standard stipulated in the TM-CW. Residual noise impacts and further noise mitigation measures are therefore not required.

4.4 Conclusion

The assessment has been conducted based on daytime noise criteria and it is understood that evening and night-time works (1900-0700) would not be required. It is predicted that the unmitigated construction noise impacts associated with the decommissioning works for the diesel fuel tanks would exceed the criteria.

Noise mitigation measures have been identified which could reduce the noise levels to within the noise criteria at all NSRs. Measures including the use of silenced PME, installation of temporary/ movable barriers, sequencing the separate use of PME and limiting the operating time of construction plant should be incorporated into the Contract Specifications and Implementation Schedules.

With the recommended mitigation measures, construction noise impacts could be controlled to within the required noise limits.

5 AIR QUALITY ASSESSMENT

5.1 Legislation and Standards

5.1.1 Air Pollution Control Ordinance

The Air Pollution Control Ordinance (APCO)[12] requires that the impacts from all air pollutant emissions from industrial activities and other sources to comply with the Hong Kong Air Quality Objectives (HKAQO). The HKAQO stipulates a set of air quality objectives for 7 common air pollutants. The following table summarises the HKAQO.

Table 5.1: Hong Kong Air Quality Objectives

Pollutant	Concentration in micrograms per cubic metre (i)				
	1 Hour (ii)	8 Hours (iii)	24 Hours (iii)	3 Months (iv)	1 Year (iv)
Sulphur Dioxide	800		350		80
Total Suspended Particulates	500		260		80
Respirable Suspended Particulates (v)			180		55
Carbon Monoxide	30,000	10,000			
Nitrogen Dioxide	300		150		80
Photochemical Oxidants (as ozone) (vi)	240				
Lead				1.5	

Notes:
(i) Measured at 298K(25 ^{o}C) and 101.325 kPa (one atmosphere).
(ii) Not to be exceeded more than three times per year.
(iii) Not to be exceeded more than once per year.
(iv) Yearly and three monthly figures calculated as arithmetic means.
(v) Respirable suspended particulates means suspended particles in air with nominal aerodynamic diameter of 10 micrometres and smaller.
(vi) Photochemical oxidants are determined by measurement of ozone only.

5.1.2 Air Pollution Control (Construction Dust) Regulation

This regulation[13] stipulates the need of duct control for the construction activities of specified notifiable and regulatory works and all other excluded works (e.g. work carried out exclusively for asbestos investigation, abatement and removal, and work carried out entirely under water). The contractors are required to ensure the construction activities to be carried out in accordance with the Schedule of the Regulation. The requirements for various Notifiable (e.g. site formation) and Regulatory (eg road opening) Works are given in Parts 1 & 2 of the Schedule respectively. Part 3 of the Schedule stipulates the general control requirements (e.g. site boundary and entrance) for construction dust. The control requirements for individual activities (eg stockpiling of dusty material) are given in Part 4 of the Schedule.

5.1.3 Asbestos Investigation

Asbestos Work is controlled under Part IX of the APCO. Any premises may be suspected of any asbestos containing material, the owner should engage a registered asbestos consultant to carry out an investigation on the material. An Asbestos Investigation Report (AIR) should be

submitted for EPD' s approval on the investigation results. Once asbestos containing material is found in the premises, an Asbestos Abatement Plan (AAP) should be prepared on the removal and handling of the asbestos containing materials.

An asbestos investigation for the Tusen Wan No.1 Pumping Station is being conducted in a separated study and hence is not included in this EIA study.

5.2 Air Quality Assessment

5.2.1 Air Sensitive Receptors

The Air Sensitive Receptors (ASRs) within 500m from the study area have been identified in accordance with the HKPSG and the TM-EIA. The worst affected ASRs during the demolition works are listed in Table 5.2 below and the locations are shown in Figure 5.1.

Table 5.2: The worst affected air sensitive receptors

ASR	Description	Building Floor	Uses	Horizontal Distance from Underground Diesel Tanks (m)
A1	Caritas Adult Education Centre	5	Educational Institution	10
A2	Fong Hon Chu Gifted Education Centre	3	Educational Institution	20
A3	Wai Tsuen Indoor Recreation Centre	2	Sport Stadium	50
A4	Tin Hau Temple	1	Cultural Heritage	130
A5	Luk Yeung Sun Chuen	Approx. 30	Domestic Premises	65
A6	Sam Tung Uk Museum	1	Cultural Heritage	110
A7	Waldorf Centre	Approx. 30	Domestic Premises	180
A8	Cheong On Building	Approx. 30	Domestic Premises	140
A9	Cheong Ning Building	Approx. 30	Domestic Premises	130
A10	Ho Fai Garden	Approx. 30	Domestic Premises	110
A11	Tsuen Wan Police R&F Married Quarters	5	Domestic Premises	65

5.3 Major Construction Activities

Only limited number of PME will be used for this decommissioning project and all decommissioning works will be carried out within the pumping station for a short period. These activities would not generate large amount of construction dust.

5.4 Odour Assessment

A number of site visits conducted in December 2000 and April 2001 revealed that no odour emission was identified within the boundary of pumping station. However, in order to reduce the odour nuisance to the environment after removal of the concrete slab cover and during the demolition of the underground storage tanks, it is recommended to cover the exposed area with tarpaulin every day after work. Temporary fencing should also be installed on all sides, and a warning signal placed in conspicuous positions of the work site.

In the event that odour is found during the decommissioning works, the stand-by blower will be turned on to dilute the odour concentration as much as possible, and to miminise the odour impact to the acceptable level.

5.5 Recommendations

The Contractor is obliged to follow the procedures and requirements given in the Air Pollution Control (Construction Dust) Regulation. The Contractor should also be requested to conduct an audit and monitoring programme during the construction stage to ensure the construction dust impacts are controlled with the HKAQO.

5.6 Conclusion

Construction air quality impact should be minor and effective control can be achieved by implementing the procedures and requirements given in the Air Pollution Control (Construction Dust) Regulation and an audit and monitoring programme.

Site survey concluded that odour impact is not anticipated. However, mitigation measures have been recommended to ensure the environmental performance during the decommissioning activities comply with the relevant statutory standards.

6 LAND CONTAMINATION ASSESSMENT

6.1 Legislation and Standards

Legislation and non-statutory guidance for carrying out the land contamination assessment is provided in the following Environmental Protection Department (EPD) publications:

- Technical Memorandum on Environmental Impact Assessment Process (TM-EIA)[8].
- ProPECC PN 3/94 – Contaminated Land Assessment and Remediation[14]; and
- Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol Filling Stations, Boatyards, and Car Repair/Dismantling Workshops[15].

6.2 Aims and Scope of the Assessment

The main objective of the assessment is to determine the likelihood of contamination at the area around the diesel storage tanks. The assessment study should also identify the types and extent of contaminants, and to assess the requirements for the disposal of contaminated soil and groundwater, if any. It should be noted in accordance with EPD's *Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol Filling Stations, Boatyards, and Car Repair/Dismantling Workshops,* the disposal of contaminated soil to landfill is only to be used as a last resort, and alternative methods of disposal should be used where possible. Any potential impacts to the construction programme or to the demolition workers will also be considered and mitigation measures advised, where appropriate.

6.3 Potential Sources of Contaminants

The most hazardous activity at the subject site is the operation of the underground diesel storage tanks/pipeline. Spillage or leakage of diesel oil may pose potential contamination problems.

6.4 Assessment Methodology

The assessment is carried out by review the historical information of the subject site such as the site geological information, maintenance records and aerial photos, consultation with the site operation staff and site inspections for the checking the current status of the diesel storage tanks and pipelines.

All collected information and inspection findings will be reviewed thoroughly to evaluate the potential of the land contamination, which might be caused by the spillage of diesel fuel.

6.5 Contamination Assessment

6.5.1 Site Geology

A thorough search of existing geotechnical SI reports within or near to the Pumping Station has been conducted at the CED library.

Only one report relates to a site investigation carried out in 1984 by John Connell & Associate Consulting Engineers for the proposed public park at Ham Tin, Tsuen Wan is considered relevant to this study. The results from the boreholes are given in Appendix 4.

The previous SI records showed that the top layer soil (5-10m) of the Pumping Station was mainly composed of clayey silty soil (colluvium) and fill material. The ground water level recorded at the investigation borehole was about 7.0–7.5 meters below the surface.

6.5.2 Site History

The Tsuen Wan No.1 Pumping Station is currently owned by WSD and has been in operation since 1955. Historical aerial photographs obtained from the Lands Department show that the site area was occupied by green land and farm land before 1955, which indicated that no industrial activities was conducted previously. The aerial photographs taken in 1949 and 1963 are shown in Figure 6.1.

6.5.3 Site Inspection

Two site inspections were conducted by Mr. Thomas Chan of Arup in December 2000 and April 2001. The principle objective of the site inspection was to obtain more detailed information regarding the current and past industrial activities of the subject site by visual inspection, record checking and consultation with the operational staff.

6.5.3.1 Underground Diesel Storage Tank

In the first site inspection, the underground diesel storage tanks were thoroughly inspected. All four diesel tanks are not located on ground, each inside a separate concrete lined chamber and supported by four concrete pedestals from the day one of the commencement of the tanks. Each pair of diesel tanks is connected to the pumpsets through individual underground pipelines. There are no direct contact between the tanks and the housing chambers at the earlier stage of the project.

All 4 diesel tanks are maintained in a relatively good condition, except for the minor rusting. There is no obvious sign of diesel spillage or leakage. No major cracks were observed on the concrete lining of the housing chamber.

After consultation with the supervisor of the Pumping Station, it is understood that two of diesel storage tanks had not been used for at least 15 years. It is also understood that no compliant was received from the public and other government departments since the commencement of the Pumping Station.

The supervisor of the Pumping Station also confirmed that the Pumping Station is mainly operated with the electrical pumpsets. Moreover, the diesel pumpsets are considered less environmental friendly due to its high operational noise level and its generation of the exhaust

flue gas. Therefore, the diesel pumpsets has been serving only as "Backup" for the entire operation of the Pumping Station.

6.5.3.2 Diesel Pipeline

In the second site inspection, the diesel pipeline system of the Pumping Station was checked thoroughly, which included the areas that could not be accessed perviouly.

After the second inspection, it is confirmed that the diesel pipeline system is either concealed in concrete lined chamber & trench, or is exposed above ground. It is also confirmed with the supervisor of the Pumping Station that none of the diesel pipeline system sections have been embedded in soils since the commencement of Pumping Station in year 1955.

Although minor signs of diesel leakage were observed at the flange joints of the pipeline, it should not escape to the underground soils as the pipeline system is concealed in the concrete lined trench, this could not have resulted in contamination through the chamber sub-drainage systems. The supervisor of the Pumping Station also confirmed that routine checking and maintenance of the diesel pipeline is conducted regularly to ensure no leakage of diesel from the pipeline and flange joints. The pipelines exposed above ground are also confirmed with the supervision of the pumping station that no sign of diesel leakage were observed in the past. The routing of the diesel pipeline system is shown in Figure 6.2. Photos showing various locations of the diesel pipeline system are attached in Figures 6.3 to 6.6.

6.5.4 Assessment Result

The existing building layout (since the commencement of the pumping station) and the future building layout provided by the WSD were reviewed. The historical information and the current conditions of the Pumping Station indicated that the potential of land contamination of the subject site is very low. Moreover, none of the diesel storage tanks and diesel pipeline sections are embedded in soils. Previous spillage or leakage of diesel fuel into the soils and groundwater is not anticipated.

A Contamination Assessment Plan (CAP) had been prepared to summarise the land contamination assessment result and approved by EPD. The approved CAP is given in Appendix 5.

6.6 Recommendations

Although the risk of land contamination of the subject site area is very low, confirmatory samples are still required to be taken from the ground below the tanks when the concrete chambers lining has been removed so as to provide a quantitative checking. A minimum of 5 soil samples (4 at corners and 1 at middle) shall be taken at the depth of 0.5m under each concrete chamber. The collected soil samples shall be analysed for TPH, and the testing result shall be compared with the Dutch List to evaluate any potential contamination.

The following precautionary measures shall also be implemented to minimise any potential hazard on the workers during decommissioning of the underground diesel storage tanks.

- Personal Protective Equipment (PPE) such as safety hat, chemical protective gloves, masks (for both dust and vapour) eye goggles, protective clothing and protective footwear etc.

shall be provided to staff who would be involved in the decommissioning works. No works should be allowed without the suitable PPE.

- Workers shall inspect and check their PPE before, during and after use. In cases where any of the PPE is impaired, the worker shall stop work immediately and inform the site agent. The worker shall not be allowed to re-start his work until the impaired PPE is replaced.

- Workers shall always maintain basic hygiene standard (e.g. hand wash before leaving the contaminated work zone). Workers shall also be responsible for cleaning and storing their own PPE in a secure place before leaving the site.

- Eating, drinking and smoking must be strictly prohibited within the site area.

- The decommissioning works, particularly the breaking of the concrete chamber of the diesel storage tank and removal of the broken concrete, shall be carried out in dry weather condition to prevent any surface run-off. The decommissioning works shall be stopped immediately once surface water run-off caused by rainfall or otherwise is observed.

- Stockpiling of excavated material (i.e. broken concrete and the associated soils) shall be avoided. Where this cannot be avoided, temporary cover such as tarpaulin shall be provided for the stockpile material (if any).

- The site agent or other site management representatives must be informed if any workers feel uncomfortable physically or mentally during the decommissioning works. All workers shall leave the work areas and the work shall be temporarily suspended until the reason for the uncomfortable feeling has been identified.

- The decommissioning works shall be stopped or discontinued when any typhoon signals yellow, red or black storm signals are hoisted. All stockpile materials (if any) shall be covered immediately by tarpaulin or other similar protective and waterproof materials.

In the event that any suspected petroleum contaminated soils (e.g. discoloured soil or visual/olfactory signs of contamination) were observed, apart from the confirmatory test and above precautionary measures, the following procedures shall also be followed:

- The site agent/site management representative shall stop the decommissioning works immediately and inform the relevant party (e.g. EPD Local Control Office).

- A minimum of 2 samples of the potential petroleum contaminated soils from each suspected area shall be collected for the analysis of Total Petroleum Hydrocarbon (TPH) to confirm whether the soil is contaminated. A qualified Land Contamination Specialist shall be engaged to supervise the soil sampling and interpret the laboratory results for evaluation of the contamination level.

- If the soils is confirmed as contaminated (i.e. exceed the Dutch B value), a 5m-diameter boundary and 2.5m depth (around the sampling point where the contaminated soils was collected) of the soil shall be excavated. All excavation work of the contaminated soils shall be carried out in dry weather condition to prevent any contaminated pond and surface runoff.

- The contaminated soils shall be excavated by mechanical excavators. Manual excavation shall be avoided.

- Stockpiling of the excavated contaminated soils shall be avoided. However, if stockpiling is required, the contaminated soils shall be stockpiled in a designated concrete paved and bunded area.

- The stockpiled contaminated soils shall be covered by water proved material (i.e. tarpaulin) to prevent contaminated surface runoff. Fencing with warning sign shall be erected around the stockpiled area to prevent unauthorised entry.

- Following the excavation of the contaminated soils, confirmatory soil samples shall be collected from the base and perimeter of excavation and tested for TPH. A minimum of 5 samples (4 boundary and 1 from the centre of the excavation) shall be collected from each excavation location. All sampling shall be supervised and the results interpreted by a qualified Land Contamination Specialist. If the analytical results of any one sample exceeded the Dutch B value, the excavation must be extended by a 0.5m increment (vertically and horizontally) and the sampling regime repeated until all contaminated soils is excavated.

- As TPH contaminated soils is treated as chemical waste, approval from the Facilities Management Group of EPD shall be obtained prior to the disposal of the contaminated soils to co-disposal landfill or other authorised disposal sites. A licensed contractor shall be appointed for the collection, transportation and disposal of the TPH contaminated soils.

6.7 Conclusion

A land contamination assessment has been conducted for the decommissioning works. The historical information such as site geology and aerial photos of the Pumping Station have been reviewed. The current condition of the Pumping Station, particularly the underground diesel storage tanks and diesel pipelines were inspected.

The potential of land contamination of the subject site is assessed as very low. Moreover, as none of the diesel storage tanks and diesel pipeline sections are embedded in soils, previous spillage or leakage of diesel fuel into the soils and groundwater is not anticipated. Therefore, site investigation for the evaluation of soil and groundwater contamination is considered not required for this EIA study.

Confirmatory samples have been recommended to be collected from the ground below the tanks to evaluate any potential contamination. Precautionary measures have been recommended for the decommissioning stage to minimise any potential hazard to the workers. The procedures on any suspected petroleum contaminated soils, in case were observed, recommended in this report shall also be followed.

It is therefore expected that, if the recommendations put forward in this report are conscientiously acted upon, the decommissioning works should present minimal health and environmental impacts.

7 CULTURAL HERITAGE ASSESSMENT

7.1 Legislation and Standards

The Antiquities and Monuments Ordinance (Cap. 53)[16], provides powers for the designation of Antiquities and Monuments Sites or Declared Monuments in Hong Kong. The Ordinance provides statutory protection against the threat of development for gazetted monuments, historic buildings and archaeological sites which have been recommended by the Antiquities Advisory Board (AAB) and approved by the Antiquities Authority, i.e. Secretary for Home Affairs.

Deemed Monuments are identified by the Antiquities and Monuments Office (AMO) and agreement reached with the owners of the Monument to provide for specific measures to ensure preservation. Deemed Monuments have the potential to be upgraded to statutory Declared Monuments.

A wide range of buildings and structure are identified and recorded by the AMO. Recorded buildings and structures are classified into grades I, II and III to indicate their relative importance. Although the grading is for AMO' s internal reference and carries no statutory status, the recorded and graded built heritage might be required to be protected under EIAO or by administrative measures.

Section 11 (and its relevant sub-section) of the Antiquities and Monuments Ordinance requires any person who discovers an antiquity or supposed antiquity to report to the Antiquities Authority. There is also a need to ensure that procedures and mechanisms are in place, to ensure the preservation or formal notification of previously unknown archaeological resources that may be revealed or discovered during project assessment or construction, are identified early in project planning.

7.2 Assessment Methodology

All historical buildings and structures, which fall within the AMO' s definitions, will be recorded for cultural heritage impact assessment.

A detailed desktop study[17] will be carried out to identify any archaeological sites, historical buildings and structures adjoining the site. Information will be collected from relevant publications, archaeological investigation reports, historical documents, public libraries, university libraries and relevant government offices. Liaison meetings with AMO will also be arranged as necessary.

The assessment will also take into account the demolition methodology, location and equipment. In the event that potential impacts are identified, the possibility of all alternatives will be assessed to avoid impact. Practical mitigation measures will be proposed to minimise or compensate for adverse impacts to the sites of cultural heritage. The residual impacts after the implementation of recommended mitigation measures will be determined.

7.3 Cultural Heritage Assessment

7.3.1 Baseline Study

Information of the adjoined monuments was collected from AMO and other literatures. There are two historical buildings, namely Sam Tung Uk (AM1) and Tin Hau Kung (AM2) that may be affected by the decommissioning work. The locations are illustrated in Figure 7.1.

7.3.1.1 Sam Tung Uk

Sam Tung Uk, a Declared Monument, is located at approximately 110m to the west of the Pumping Station. It is bound by Kwu Uk Lane to the north, Sai Lau Kok Road to the southwest and Wai Tsuen Road to the southeast.

Sam Tung Uk[18, 19] is a square, walled Hakka village built some 200 years ago by the Chan family. Initially, as its name indicates, it contained three rows of village house in the centre and a row of village house each on the two sides. Their descendants later added another one row of house at the back. The family's ancestral altar was placed in the main hall lying on the central axis facing the entrance. The four Chinese characters signifying "Chan's Family Ancestral Hall" was engraved on the granite above the doorframe. This is an excellent example of a single-clan walled village. It was restored in 1987 and has since been open to the public as a museum of the Leisure and Cultural Services Department.

7.3.1.2 Tin Hau Kung

Tin Hau Kung is located at approximately 130m to the northwest of the Pumping Station. It is bound by the Luk Yeung Sun Cheun to the west and Wai Tsuen Road to the north and east.

Tin Hau Kung is a Grade II Historical Building. It was constructed in the reign of the Emperor of K'ang-his (1900 A.D.) of Qing dynasty, and has over 100 years history. There were six renovations carried out over the past one hundred year. Due to the rapid development of Tsuen Wan Satellite City and the construction of MTRC Tsuen Wan Line, which passed through the front area of Tin Hau Kung, a major renovation was carried out in 1987. A new main gate was also constructed in front of the building. After the renovation in 1984, the management of Tsuen Wan Tin Hau Kung has been transferred to Tsuen Wan Tin Hau Kung Management Committee, a sub-committee of Tsuen Wan Rural Committee.

7.3.2 Demolition Methodology of the Underground Fuel Tanks

The demolition methodology of the underground fuel tanks provided by WSD has been reviewed. It is revealed that only one hand held breaker and one air compressor will be employed for the breaking of the underground concrete lined chamber. The spoils will be removed by one excavator and dump truck. All decommissioning works will be carried out within the boundary of the pumping station.

7.3.3 Assessment Result

Both historic buildings are located over 100m from the Pumping Station and only limited number of PME will be used within the pumping station for this decommissioning project. The

diesel storage tanks to be decommissioned will be totally screened by the pump room of the Station itself. Adverse vibration and dust impacts are not anticipated on the cultural heritage buildings.

7.4 Recommendations

Although no adverse vibration and dust impacts are anticipated on the identified built heritage, practical mitigation measures, which are agreed by the AMO, shall be designed and implemented if any adverse impacts are proved in the course of the project.

7.5 Conclusion

A cultural heritage assessment has been conducted for the decommissioning works. The records maintained by AMO on the list of declared and deemed monuments, and location of sites of cultural heritage, historical buildings and structures have also been reviewed. A field evaluation has also been conducted to verify the findings from the desktop research.

There are two historical buildings that may be affected by the decommissioning work. They are Sam Tung Uk (a Declared Monument) and Tin Hau Kung (a Grade II historic building) located at approximately 110m to the west and 130m to the northwest from the Pumping Station respectively.

All works will be carried out within the boundary of the pumping station and will involve only limited number of PME. Adverse vibration and dust impacts on the cultural heritage are not anticipated. However, practical mitigation measures shall be designed and implemented if any adverse impacts are proved in the course of the project.

8 WASTE MANAGEMENT IMPLICATIONS

8.1 Legislation and Standards

The following legislation relates to the handling, treatment and disposal of waste in Hong Kong, and will be considered in assessing potential impacts and their avoidance or mitigation:

- The Waste Disposal Ordinance (Cap 354)[20];
- The Waste Disposal (Chemical Waste) (General) Regulation (Cap 354)[21];
- The Land (Miscellaneous Provisions) Ordinance [22];
- The Public Health and Municipal Service Ordinance (Cap 132) – Public Cleansing and Prevention of Nuisances (Urban Council and regional Council) By-laws[23]; and
- Dumping At Sea Ordinance (Cap 466)[24].

The Waste Disposal Ordinance (WDO) prohibits the unauthorised disposal of wastes. Construction waste is not directly defined in the WDO but is considered to fall within the category of "trade waste". Under the WDO, wastes can only be disposed of at sites licensed by EPD.

The Waste Disposal (Chemical Waste) (General) Regulation requires all producers of chemical wastes (including asbestos) to register with EPD and to treat their wastes, either by utilising on-site plant licensed by EPD, or by arranging for a licensed collector to take the wastes to a licensed facility. The regulation also prescribes storage facilities to be provided on site, including labelling and warning signs, and requires the preparation of documented procedures and training to deal with emergencies such as spillage, leakage or accidents arising from the storage of chemical wastes.

Construction wastes, which are wholly inert, may be taken to public filling areas. Public filling areas usually form part of land reclamation schemes operated by the Civil Engineering Department (CED). The Land (Miscellaneous Provisions) Ordinance requires that dumping licences be obtained by individuals or companies who deliver suitable construction wastes to public filling areas. The licences are issued by the CED under delegated powers from the Director of Lands.

The Public Cleansing and Prevention of Nuisances By-Laws provide further controls on the illegal tipping of wastes on unauthorised (unlicensed) sites.

The following documents and guidelines also relate to waste management and disposal in Hong Kong:

- Waste Disposal Plan for Hong Kong (December 1989), Planning, Environmental and Lands Branch, Hong Kong Government Secretariat[25];
- Environmental Guidelines for Planning In Hong Kong (1990), Hong Kong Planning and Standards Guidelines, Hong Kong Government[9];
- New Disposal Arrangements for Construction Waste (1992). Environmental Protection Department and Civil Engineering Department[26];

- Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes (1992), Environmental Protection Department[27];
- Works Branch Technical Circular No. 6/92, Fill Management[28];
- Works Branch Technical Circular No 2/93, Public Dumps[29];
- Works Branch Technical No 16/96, Wet Soil in Public Dumps[30];
- Environmental Protection Department Technical Circular No. 1-1-92, Classification of Dredged Sediments for Marine Disposal[31];
- Technical Circular No. 22/92, Marine Disposal of Dredged Mud, Works Branch[32];
- Works Bureau Technical Circular No. 4/98, Use of Public Fill in Reclamation and Earth Filling Projects[33];
- Works Bureau Technical Circular No. 5/98, On-site Sorting of Construction Waste on Demolition Site[34];
- Works Bureau Technical Circular No. 5/99 & 5/99A, Trip-Ticket System for Disposal of Construction & Demolition Waste[35];
- Technical Circular No. 03/2000, Management of Dredged/ Excavated Sediment, Works Bureau[36]; and
- Technical Circular No. 29/2000, Waste Management Plan[37].

8.2 Assessment Methodology

The assessment of environmental impacts from waste generation from the decommissioning of the diesel storage tanks is based on three factors:

- The type and nature of waste generated;
- The amounts and rates of waste types generated; and
- The proposed reuse, recycling, storage, collection, transport and disposal method, and the impacts of these methods.

8.3 Impact Assessment

8.3.1 Types and Nature of Principal Waste Generated

The demolition activities will result in the generation of a variety of wastes that can be divided into distinct categories based on their constituents, as follows:

- Excavated inert material;
- Demolition waste;
- Chemical waste; and
- General Refuse

8.3.1.1 Excavated Inert Waste

Any excavated materials are expected to be disposed of at land based disposal sites, but the final location of deposition will be based on a number of factors, including quantity, material type, moisture content and reuse potential.

Excavated inert material is defined as inert virgin material removed from the ground and sub-surface. In this decommissioning project, excavated inert material will be generated during the removal of topsoil (turf) prior to the removal of the concrete slab cover.

8.3.1.2 Demolition Waste

Demolition waste may be generated during the destruction of the diesel storage tanks, the concrete lined chamber and the concrete pedestals. Materials with scrap value, such as metals, are normally recycled. The remaining materials will be separated into inert and non-inert material for disposal at public filling area and sanitary landfill respectively.

8.3.1.3 Chemical Waste

Chemical waste, as defined under the Waste Disposal (Chemical Waste)(General) Regulation, includes any substance being scrap material, or unwanted substance specified under Schedule 1 of the Regulation. A complete list of such substances is provided under the Regulation, however substances likely to be generated by this decommissioning project will be the diesel residues in the storage tanks. In order to minimise the explosive hazards during the flame cutting process, the diesel tanks will be washed and purged and the purged water will be treated as chemical waste.

8.3.1.4 General Refuse

The presence of a demolition site with a number of workers and site offices and canteens will result in the generation of a variety of general refuse materials requiring disposal. General refuse may include food wastes and packaging, and other wastes that does not fit into any of the categories previously described.

8.3.2 Prediction and Evaluation of Impact

The quantities of various waste type generated is estimated based on the following criteria:

- The nature of each stage of the decommissioning project as mentioned in Section 8.3.1; and
- The dimensions of the concrete lined chamber & diesel storage tank.

The estimated quantities of various waste types and its associated environmental impacts are described in the following sections.

8.3.2.1 Excavated Inert Material

In accordance with the information provided by WSD, it is estimated that about $30m^3$ of excavated inert material will be generated during the removal of the topsoil (turf). The topsoil will be reused to fill up the empty chambers after decommissioning of the diesel tanks. Disposal offsite is therefore not required.

8.3.2.2 Demolition Waste

The storage, handling, transport and disposal of demolition waste have the potential to create visual, water, dust, and associated traffic impacts.

The dimensions of the underground diesel storage tanks, the concrete lined chamber and concrete pedestals are shown in Figure 8.1.

In accordance with the provided dimensions, it is estimated that about 11 tonnes of scrap metals and 80m^3 of spoils (broken up concrete) will be generated.

The disposal of demolition wastes is unlikely to raise any long term concerns because of the inert nature of most demolition waste. To conserve void space at landfill sites, demolition waste with more than 30% (by weight) inert material should not be disposed of at a landfill site. It is therefore of good practice to implement on-site waste segregation before disposing of inert materials at public filling areas for reclamation works and non-inert materials at a controlled landfill site.

8.3.2.3 Chemical Waste

In this decommissioning project, the quantity of chemical waste is estimated as about 10m^3 of diesel residues, and 260m^3 of the diesel contaminated water generated by the cleaning and purging works before flame cutting of the diesel tanks.

Chemical wastes may pose serious environmental and health and safety hazards if not stored and disposed of in an appropriate manner as outlined in the Waste Disposal (Chemical Waste) (General) Regulation and the Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes[38]. These hazards include:

- Toxic effects to workers;
- Adverse effects on air, water and land from spills;
- Fire hazards; and
- Disruption to sewage treatment works due to potential damaging effect on the sewage biological treatment systems if chemical waste is allowed to enter.

8.3.2.4 General Refuse

The storage of general refuse has the potential to give rise to adverse environmental impacts. These include odour if the waste is not collected frequently (e.g. daily), windblown litter, water quality impacts if waste enters water bodies, and visual impact. The sites may also attract pests, vermin, and other disease vectors if the waste storage areas are not well maintained and cleaned regularly.

Only limited number of demolition workers, such as less than 20, will be employed, and no site offices and canteens will be built for this decommissioning project. It is expected that, approximately 0.5 kg of general refuse will be generated per person per day. Therefore, it is estimated that about 10 kg per day of general refuse will be produced.

8.4 Recommended Mitigation Measures

8.4.1 Waste Management Hierarchy

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

- Avoidance and minimisation, i.e. not generating waste through changing or improving practices and design;
- Reuse of materials, thus avoiding disposal (generally with only limited reprocessing);
- Recovery and recycling, thus avoiding disposal (although reprocessing may be required); and
- Treatment and disposal, according to relevant regulations, guidelines and good practice.

The contractor responsible for this decommissioning project should consult the Waste Disposal Authority on the final disposal locations of waste.

8.4.2 Excavated Inert Materials

As the $30m^3$ of excavated materials (topsoil) will be reused for filling up the empty chambers, adverse impacts are not anticipated.

There will be a need for proper segregation to avoid possible contaminated materials being allowed for reused on-site.

8.4.3 Demolition Waste

Proper segregation of demolition waste on-site will increase the feasibility that certain components of the waste can be recycled. Specialist collectors should be consulted for recycling of the dismantled diesel storage tanks and the associated pipeline as these wastes pose scrap value.

In accordance with the New Disposal Arrangements for Construction Waste, Environmental Protection Department and Civil Engineering Department, 1992, disposal of the demolition waste can either be at a specified landfill, or at a public filling area, with the latter being the preferred option. Therefore, it is recommended to dispose of the spoils at Pak Shek Kok Reclamation Public Filling Area or Tuen Mun Reclamation Public Filling Area.

8.4.4 Chemical Waste

During the dismantling of the diesel storage tanks, a licensed waste collector will be standby on-site to collect the chemical waste for disposal off site. This avoids any need for storage on-site. The chemical waste will then be transported to a facility licensed to receive chemical waste, such as the Chemical Waste Treatment Facility at Tsing Yi. This type of facility often also offers chemical waste collection service and supplies the necessary containers.

In case temporary storage become necessary for the chemical waste, it should be handled in accordance with the Code of Practice on the Packaging, Handling and Storage of Chemical Waste as follows:

Containers used for the storage of chemical wastes should:

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

The storage area for chemical wastes should:

- Be clearly labelled and used solely for the storage of chemical waste;
- Be enclosed on at least 3 sides;
- Have an impermeable floor and bunding, of capacity to accommodate 110% of the volume of the largest container or 20% by volume of the chemical waste stored in that area, whichever is the greatest;
- Have adequate ventilation;
- Be covered to prevent rainfall entering (water collected within the bund must be tested and disposed of as chemical waste if necessary); and
- Be arranged so that incompatible materials are adequately separated.

8.4.5 General Refuse

The existing refuse management approach of the Pumping Station will be adequate for handling the general refuse generated during the decommissioning period.

The general refuse will be stored in enclosed bins or compaction units. A reputable waste collector will be employed to remove general refuse from the site daily to minimise odour, pest and litter impacts. The burning of refuse on site is prohibited in accordance with the legal requirements.

8.4.6 Storage Areas for Different Waste Types

Different types of wastes should be segregated and stored in different containers, skips or stockpiles to enhance reuse or recycling of materials and their proper disposal. An on-site temporary storage area should be provided.

8.4.7 Trip-ticket System:-

In order to monitor the disposal of C&DM at public filing facilities and landfills, and control of fly-tipping, a trip-ticket system should be included.

8.4.8 Records of Wastes:-

A recording system for the amount of wastes generated, recycled and disposed (including the disposal sites) should be proposed.

8.4.9 Training

Training should provided to workers about the concepts of site cleanliness and appropriate waste management procedure, including waste reduction, reuse and recycling.

8.5 Conclusion

A waste management study has been conducted for the decommissioning works. The quantities of various types of waste, which might be generated in this decommissioning project have been evaluated. The environmental impact associated with various types of waste have been assessed.

The excavated inert material will be reused on-site. Only small amounts of demolition and chemical wastes will be generated.

Mitigation measures relating to good practice have been recommended to ensure that adverse environmental impacts are prevented and that opportunities for waste minimisation and recycling are followed. It is therefore expected that, if the recommendations put forward in this report are conscientiously acted upon, the storage, handling, collection, transport and disposal of waste should present minimal environmental impacts.

9 WATER QUALITY ASSESSMENT

9.1 Legislation and Standards

The regulatory requirements and standards to protect water quality are the Water Pollution Control Ordinance (WPCO)[39], its subsidiary technical memoranda, and various technical circulars issued by the Works Branch and EPD. Whilst the technical circulars are non-statutory, they are generally accepted as best guidelines in Hong Kong and have been adopted as relevant for this assessment.

9.1.1 Water Pollution Control Ordinance (WPCO)

Under the WPCO, Hong Kong waters are divided into 10 Water Control Zones (WCZs). Each WCZ has a designated set of statutory Water Quality Objectives (WQO). The standards to be met in each WCZ depend on the classification of the receiving waters (e.g. inland, inshore, marine or foul sewer). The standards are applied to effluents through licences issued by EPD under Sections 15, 16 and 20 of the WPCO. The relevant standards are set out in the Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters[40] (TM-Waters).

9.1.2 Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters

This TM issued under Section 21 of the WPCO defines acceptable discharge limits to different types of receiving waters.

Effluents discharged into the inshore and marine waters of the Victoria Harbour WCZ are subject to standards stipulated in Tables 9a and 9b of the TM. The standards in Tables 10a and 10b of the TM apply to effluent discharged into the inshore and marine waters of the Northwestern and Western Buffer WCZs respectively. For Deep Bay WCZ, the standards in Table 8 of the TM apply.

In this assessment study for the decommissioning of underground diesel storage tanks, the standards for the effluent discharged into the marine waters of Victoria Harbour WCZ (Phase 1), which stipulated in Table 9b of TM should be referred.

Discharges of effluents into the foul sewerage system need to comply with the standards listed in Tables 1 and 2 of the TM.

For cooling water discharges, in addition to the TM requirements (which only apply to discharges of up to 6,000m^3 per day), the EPD has required that discharges of between 6,000 and 1,000,000 m^3 per day have a temperature of not more than 35°C and not more than 10°C above influent temperature, and contain not more than 0.2mg/l of total residual chlorine.

9.1.3 Construction Site Drainage Guidelines

The Practical Note for Professional Persons on Construction Site Drainage (PN1/94)[41] issued by EPD provides basic environmental guidelines for the handling and disposal of construction site discharges to minimise impacts on water quality.

9.2 Assessment Methodology

Current decommissioning methodology has been reviewed to assess the proximity of the proposed dismantling activities to existing and committed WSRs. The WSRs were identified according to guidance provided in HKPSG, and verified by field surveys and area appraisals.

Decommissioning stages, sequence and duration were reviewed to identify activities likely to impact upon identified WSRs and other water courses.

Following the identification of WSRs and potential water quality impacts, the scale, extent and severity of potential net (i.e. unmitigated) construction impacts were evaluated, taking into account all potential cumulative effects including those of adjacent projects, with reference to the WPCO criteria.

Where net water quality impacts exceed the appropriate WPCO criteria, practical water pollution control measures/mitigation proposals will be identified to ensure compliance with reference to the WPCO criteria for the beneficial uses of the fresh water courses. Water quality monitoring and audit requirements will be subsequently developed to ensure the efficacy of the decommissioning stage water pollution control and mitigation measures.

9.3 Impact Assessment

9.3.1 Water Sensitive Receivers (WSRs)

The Pumping Station is located in an urban-developed area. No WSR is identified within 200m of the site boundary of Pumping Station.

9.3.2 Potential Source of Impact

Potential sources of impacts to water quality from the decommissioning of the underground diesel storage tanks are shown below:

- Construction Runoff ; and
- Sewage effluents generated from the decommissioning workforce.

9.3.3 Prediction and Evaluation of Impact

9.3.3.1 Construction Runoff

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

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

b) Used water from purging of the diesel storage tanks; and

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

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

Construction runoff containing SS will be generated if the stockpile of the excavated topsoil is not covered appropriately. Used water containing diesel fuel residuals will also be generated from purging of the diesel tanks.

The water quality impacts from these decommissioning activities are likely to be minimal provided that site boundaries are well maintained and good construction practices are applied to ensure that fuel, oil, solvents and lubricants are properly managed, stored, handled and disposed.

9.3.3.2 Sewage Effluents

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

The existing toilet facilities of the Pumping Station will be provided for use by the workforce. Additional sanitary facilities are therefore not required.

9.4 Recommendation

9.4.1 Construction Runoff

Exposed soil areas should be minimised to reduce the contamination of runoff and erosion. As mentioned in Section 8.3.2.1, it is estimated that about $30m^3$ of excavated inert material will be generated during the removal of the topsoil (turf), and will be reused to fill up empty chambers after decommissioning of the diesel tanks. Therefore, a designated area far from the nearby storm drain and fowl sewers should be provided for temporary stockpiling of the topsoil. Temporary covers (i.e. tarpaulin) should also be provided to minimise the generation of high SS runoff.

As mentioned in Section 8.4.4, a licensed waste collector will be standby on-site to collect the chemical waste as well as the used water from diesel tank purging. The used water will then be

transported to a facility liscened to receive chemical waste, such as Chemical Waste Treatment Facility at Tsing Yi.

9.4.2 Sewage Effluents

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

9.5 Conclusion

The potential water quality impacts arising from the decommissioning of the underground diesel storage tanks have been assessed. Assessment results indicate that no insurmountable residual water quality impacts will be generated from the decommissioning works provided that the recommended mitigation measures are implemented.

10 ENVIRONMENTAL MONITORING AND AUDITING PROGRAMME

10.1 EM&A Manual for EIA Study

Environmental Monitoring and Audit (EM&A) is an important aspect in EIA studies. It specifies the time frame and responsibilities for the implementation of the environmental mitigation measures identified in the EIA process. Requirement on the monitoring (including baseline and impact monitoring) will be given.

The EM&A system to be adopted should be systematic, efficient and with clear line of authority. A common approach to EM&A is for the EIA consultant to devise an EM&A Manual for the concerned project, based on the latest information available during the EIA stage. The manual should specify the following:

- Responsibilities of the Contractor, the Engineer or Engineer's Representative (ER), Environmental Team (ET) with respect to the EM&A requirements during the decommissioning of the underground diesel tanks ;
- Information on project organisation and programming of decommissioning activities for the project;
- Requirement with respect to the decommissioning schedule and the necessary environmental monitoring and audit programme to track the varying environmental impact;
- Full details of the methodologies to be adopted, including all field, laboratory and analytical procedures, and details on quality assurance;
- Definition of Action and Limit levels;
- Establishment of event and action plans;
- Requirements of reviewing pollution sources and working procedures required in the event of non-compliance of the environmental criteria and complaints;
- Requirements of review of EIA predictions, implementation of mitigation measures, and the effectiveness of the environmental project and pollution control measures adopted;
- Requirements of presentation of environmental monitoring and audit data and appropriate reporting procedures.

An EM&A Manual for this EIA study will be prepared based on the latest available information and EPD's generic EM&A manual. An Implementation Schedule will also be included in the EM&A Manual.

10.2 Amendment to EM&A Manual

The Contractor shall be requested to review the mitigation measures and Implementation Schedule with respect to their decommissioning methodology. In case where the Contractor needs to update the mitigation measures and the Implementation Schedule, an updated EM&A Manual shall be submitted to the ER for approval. The Contractor shall seek EPD's prior approval on these amendments before decommissioning commences.

10.3 Environmental Mitigation Implementation Schedule

An Environmental Mitigation Implementation Schedule has been prepared to summarise all the required mitigation measures that need to be implemented during the decommissioning of the underground diesel tanks. The implementation responsibilities are also identified. The implementation schedule is given Appendix 6.

11 SUMMARY OF ENVIRONMENTAL OUTCOMES

The decommissioning project will be carried out during day-time period and all work are prohibited between 1900 and 0700. This eliminates the noise impact during the night-time period. During decommissioning, noise mitigation measures including the use of silenced PME, installation of temporary/ movable barriers, sequencing the separate use of PME and limiting the operating time of construction plant have been proposed to controlled the noise level at critical NSRs (i.e. N1-Caritas Adult Education Centre and N2-Fong Hon Chu Gifted Education Centre) to within the statutory limits.

The contractors are also required to follow the designed implementation schedules to minimise all potential impacts. For example, waste recovery and recycling to avoid disposal of waste, the demolition waste and chemical waste are needed to be transported and disposal of in accordance with the procedures set by CED and EPD respectively so as to minimise the impact.

As the 4 underground fuel tanks have been in use since the operation of pumping station at 1955, it is time to upgrade the safety, reliability and efficiency of such aged mechanical and electrical plant. It will also refrain the risk of land contamination from the leakage of diesel fuel in the future. Thus, the removal of the tanks will impose a long term environmental benefit.

12 CONCLUSION

An environmental impact assessment has been completed for the decommissioning, dismantling and removal of four underground diesel fuel storage tanks at Tsuen Wan No.1 Pumping Station, in accordance with the requirements given in the EIA study brief and the TM-EIA. The environmental aspects that have been thoroughly studied include:

- Construction noise
- Air quality
- Land contamination
- Cultural heritage
- Waste management
- Water quality

Environmental assessments have been conducted based on the available information provided by WSD. Assessment results on construction noise, air quality, land contamination, cultural heritage, waste and water quality assessment indicate that the decommissioning works would not impose adverse impacts on the neighbouring environmental sensitive receivers with implementation of appropriate mitigation measures.

13 REFERENCE

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