Chapter 12

CONCLUSION

12. CONCLUSION

Land Contamination

12.1 Site investigation (S.I.) at CLS site for land contamination assessment has been carried out which includes 443 soil borings (316 original and 127 additional borings), 56 groundwater wells (33 original and 23 additional groundwater wells), and 3.1-km trial trenches. Based on the laboratory results, soil contamination is noted in Areas 1, 2 and 3 of CLS site. The soil in Area 1 is contaminated predominantly with 'metals' and 'metals/TPH/SVOCs' whereas the soil in Area 3 is predominantly contaminated with 'metals' and 'dioxins/metals/TPH/SVOCs'. The soil in Area 2 is contaminated with 'metals', 'metals/TPH/SVOCs' and 'dioxins/metals/TPH/SVOCs'.

12.2 The volumes of contaminated soil in different areas have been estimated based on the laboratory results of soil samples collected. Various remedial methods have been evaluated and screened for dioxin- and non-dioxin-contaminated soils. The proposed remediation methods are recapitulated below:

Soil Contaminants	Proposed Remediation Methods	Quantities (m^3)
Metals only	Cement Solidification	48,000
TPH/SVOCs	Biopiling	700
Metals and TPH/SVOCs	Biopiling followed by Cement Solidification	8,300
Dioxins and Metals/ TPH/SVOCs	Thermal Desorption followed by Cement Solidification	30,000
	Total =	87,000

12.3 The above remedial methods are proposed based on the evaluation of their effectiveness and implementability.

12.4 During remediation, the contaminated soil will be excavated and treated on site for metal-only-contaminated soil or off site at TKW for other types of contaminated soil. With the incorporation of environmental mitigation measures during excavation and operation of the remediation system, as well as the provisions of safety measures to site workers, residue impact arising from land contamination is minimal.

12.5 The IEC, through their own assessment, conclude that the remedial approaches recommended in this report can effectively meet the remedial action objectives and goals for the CLS site. The IEC also concur with this report's selected remedy of excavation and treatment of metals-impacted soils by cement stabilisation, TPH and SVOC-impacted soils by biopiling, and thermal treatment of dioxin-impacted soils by thermal desorption.

Air Quality Impact

12.6 Dust emission from the site is an area of the concern for the building demolition and slope improvement works of CLS. TSP would be generated from materials handling, excavation and truck movement over haul roads. With the incorporation of dust control measures stipulated in the *Air Pollution Control (Construction Dust) Regulation,* the TSP level at the ASR will be low and comply with the criteria.

12.7 During excavation of contaminated area, pollutants such as dioxins bind tightly onto the soils, may be dispersed in form of dust. Mitigation measures have been recommended to limit emission of the contaminated soil. Modelling results confirm that the air quality impacts at the ASRs are low and satisfy the criteria.

12.8 Solidification will be conducted at the CLS to stabilise heavy metals in soil. Biopiling, thermal desorption and solidification as parts of the decontamination process will be conducted at the TKW. Design of biopiles will control the TOC emission to 20 mg/m^3 in maximum. Off-gas from biopiles shall be treated by back-up carbon absorber to remove 99% pollutant and ensure that the TOC emission limit is satisfied prior to discharge. The solidification process could immobilise the heavy metal. The thermal description process together with the air treatment unit could limit dioxins and organic gas emission by 0.0001% of the contaminant in the soil. Air emissions from these facilities have been modelled and assessed to be within the respective criteria. Air quality impacts associated with decommissioning of the treatment facility are low.

12.9 The health risk level associated with the operation of the treatment facilities is insignificant.

Waste Management

12.10 C&D material will be generated during the demolition of the shipyard facilities and the estimated quantity is about $10,000m^3$. In addition, about 1,000 tonnes of steel and 5,000 m^3 of general refuse will also be generated.

12.11 During slope improvement phase, around $40,000m^3$ uncontaminated soil and $2,100m^3$ uncontaminated rock will be generated during excavation and soil nailing.

12.12 During remediation, about $39,000m^3$ contaminated material will be excavated from Cheoy Lee Shipyard and will be transported to To Kau Wan for off-site treatment whereas $48,000m^3$ metal-contaminated soil will be treated on-site at CLS. Environmental and safety measures have been recommended to minimise secondary environmental impacts and health risks during collection and transportation of contaminated soils from CLS to TKW. After both on-site and off-site treatment, around $100,000m^3$ clean inert materials suitable for public filling will be generated. The condensate of around $600m^3$ as the end product of the treatment and other chemical wastes will be collected and disposed of at the Chemical Waste Treatment Centre. Thus, no residual waste impact and health risk concerns are expected.

12.13 During decommissioning of TKW, around $5,000m^3$ C&D material and 500 tonnes steel will be generated. C&D material will be transported to PFAs and metal will be recycled, therefore, no residue impact is envisaged.

12.14 The overall total of C&D material to be generated by this Project is estimated around $0.4Mm^3$. The C&D material will be reused and recycled as far as practicable in the land

formation works within CLS site so as to minimise the amount of C&D material to be disposed of at PFAs.

12.15 To ensure proper waste handling and management procedures are strictly followed, the Contractor shall prepare the following documents for the Engineer's approval prior to work.

- Waste Management Plan;
- Building Decommissioning Plan;
- Spill Handling Contingency Plan; and
- Operational Plan for the Operation of Treatment Facilities at TKW.

12.16 In addition, the following registration/ licence/ approval/ permit are required for the production, storage, collection, and off-site treatment of chemical waste:

- Waste Producer Registration: The Contractor is required to be registered under the *Waste Disposal (Chemical Waste) (General) Regulation*;
- Waste Collection Licence: A Waste Collection Licence under the *Waste Disposal Ordinance* is required for the transport/ delivery of chemical wastes to off-site waste disposal facilities;
- Waste Disposal Licence: A Waste Disposal Licence is required for the operation of the off-site treatment facility a TKW for the treatment for dioxin-contaminated soil.
- Approval for Using Large Container: Approval is required under the *Waste Disposal (Chemical Waste) (General) Regulation* for using chemical waste container with a capacity exceeding 450L.
- Part A Notification: Prior notification to the Environmental Protection Department is required before any collection of Part A chemical waste.
- Noise Permit: A Noise Permit under *Noise Control Ordinance* is required for night-time operation of the decontamination system and transportation of contaminated soil by trucks to TKW at night.

Water Quality Impact

Building Demolition and Slope Improvement

12.17 During the building demolition and slope improvement, adverse water quality impacts arising from runoff and sewage effluent generated by the construction workforce are not likely with the implementation of 'best practical' site procedures. Regular site audits are therefore recommended to ensure that 'best site practices' and relevant mitigation measures be implemented throughout the Project.

Soil Remediation

At Cheoy Lee Site

12.18 After demolished the building, contaminated soils at CLS would be excavated for on-site and off-site treatment. Local groundwater will be drawn out (i.e. dewatering) when excavation proceeds below the water table. The groundwater with elevated metal and TPH levels, though not contaminated in accordance with risk-based assessment, would impose water quality impact if being directly discharged into the drainage channel. As a mitigation measure, the groundwater pumped out shall be recharged within CLS site in such a manner that it would not cause local rising of water table leading to contaminant migration. Wheel wash water and decontamination water generated during this phase will be considered contaminated. A mitigation measure to install a centralised water treatment unit is recommended to treat the effluent before discharged. With the implementation of the mitigation measures, no adverse water quality impact is envisaged.

12.19 Impact of groundwater seepage to nearby marine water via the future drainage channel to the north of CLS site was also assessed. The drainage channel would be built above the existing CLS ground level thus this effectively isolates the groundwater from seeping into the channel. In any case, the groundwater, if any seeped into the channel would be diluted a lot, therefore water quality impact arising from the groundwater seepage to the nearby marine water is not likely. No impact on the artificial lake of the future water recreation centre is predicted arising from groundwater seepage. This is because:

- the planned water level of the artificial lake will be higher than the CLS water table level;
- there is an impermeable liner at the bottom of the lake to subsurface contaminants infiltration; and
- the soil contamination would be cleaned up during the CLS decommissioning, thus removing the contaminant source.

12.20 Pending receipt by the solidification facility, there would be temporary stockpiles of metal-contaminated soil. It is recommended that temporary stockpiles be lined with impervious sheeting, bunded and covered by impermeable sheeting during rain events whereby the quantity of contaminated runoff and leachate would be reduced. The generation of contaminated runoff and leachate would be further minimised respectively by sheltering the solidification facility and controlling water addition during the solidification process. In the end, a licensed centralised wastewater treatment unit is recommended for treating the contaminated runoff and leachate prior to their discharging into local drainage.

At To Kau Wan Site

12.21 Biopile, thermal desorption process and solidification are the major decontamination processes conducted at the To Kau Wan decontamination site. Potential water quality impact would be arising from the plant leachate from contaminating the underlying soil/groundwater, contaminated run-off from the thermal desorption plant, wheel wash water and the decontamination water . Installation of a centralised wastewater treatment unit to treat the effluent before discharged is therefore recommended. With the wastewater treatment unit in place and in operation, no adverse water quality impact is envisaged.

12.22 With the mitigation measures implemented (e.g. floor lining and impermeability cover for the biopile, perimeter leachate collection system for the biopile, soil storage bin and thermal desorption plant and concrete bunds for biopile and thermal desorption plant to contain the contaminated runoff), water quality impacts associated with the remediation plants operation is expected to be insignificant and no residual impact is anticipated.

Ecological Impact

12.23 Based on the assessment, works associated with this project have the potential to cause high level impacts on ecological resources.

12.24 The greatest possible disturbance is to Rice-fish habitats at Mong Tung Hang Stream, and restricted and protected plant species around CLS.

12.25 Detailed measures to mitigate high level ecological impacts arising from this project were recommended. Good construction practice is recommended to avoid / minimise disturbance to other habitats surrounding the shipyards.

12.26 With the proposed mitigation measures in place, residual impacts arising from the Project are considered acceptable.

Impact on Cultural Heritage

12.27 An archaeological survey has been conducted for the CLS, and revealed artifacts of high archaeological values in CLS. Many artifacts of different periods, including the Late Neolithic period, Bronze Age, Tang Dynasty. Song Dynasty, Ming Dynasty and Ching Dynasty have been recovered in CLS, along the ancient coastal area.

12.28 Potential impact to archaeological resources may arise from landtake, ground compaction, topsoil or subsoil disturbance during construction, change in watertable and a limitation on accessibility for future investigation, which may result in damage to, or loss of the archaeological remains. Preservation measures include covering the archaeological potential sites, where are not subject to rescue excavation, by impermeable sheeting before filling. Detailed design of filling work should include diversion of site runoff to prevent any waterlogged conditions at the archaeological sites. For areas where preservation in situ is not possible, the impact on the heritage resources should be mitigated by rescue excavation. All rescue works have to be completed prior to the decontaminated works of CLS.

Environmental Monitoring and Audit

12.29 Environmental monitoring and audit are recommended for land contamination, air quality, water quality, waste management and ecology. Details of the recommended mitigation measures, monitoring procedures and locations will be presented in a stand-alone Environmental Monitoring and Audit Manual (EM&A). This will enable the Contractor to have early warning and provide necessary action to reduce impacts at specific areas if the assessment criteria are approached. The effectiveness of on-site control measures could also be evaluated through the monitoring exercise. All the recommended mitigation measures should be incorporated into the EM&A programme for implementation.

Overall Conclusion

12.30 The findings of this EIA have provided information on the nature and extent of environmental impacts arising from the decommission of the CLS. The EIA has, where appropriate, identified mitigation measures to ensure compliance with environmental legislation and standards.

12.31 Overall, the EIA Report for the decommission of the CLS has predicted that the Project will generally comply with all environmental standards and legislation after the proposed construction and operational stage mitigation measures are implemented. This EIA has also demonstrated the general acceptability of the residual impacts from the Project and the protection of the population and environmentally sensitive resources. Environmental monitoring and audit mechanisms have been recommended during the decommissioning of CLS, where necessary, to verify the accuracy of the EIA predictions and the effectiveness of recommended mitigation measures.

12.32 The nature of the project is primarily of environmental improvement. Contaminated materials are permanently removed from the ground and cleaned up, removing a source of long term liability. After the shipyard is decommissioned, it provides room for the infrastructure in support of the Theme Park Development. The safety of the slopes is improved. The habitat of a locally restricted/protected fish species will be recreated, and restricted/protected plants will be conserved on-site, or transplanted to a suitable receptor site. The archaeological artefacts are rescued or preserved from the site.