15. ENVIRONMENTAL MONITORING AND AUDIT

15.1 Introduction

15.1.1 The development of appropriate environmental monitoring and audit (EM&A) programmes and methodologies are a vital part of the environmental management and control of the Project. This chapter provides an outline of the EM&A requirements for the Project, highlighting the environmental parameters to be monitored, timing of the monitoring work and the frequency of the monitoring and audit work. A detailed scope of work will be provided in the EM&A Manual, prepared in accordance with Annex 21 of the TMEIA and EPD's *EM&A Guidelines for Development Projects in Hong Kong*.

15.1.2 The broad objectives of the monitoring and audit process are:

(i) to clarify and identify sources of pollution, impact and nuisance from the works;

(ii) to establish a record of change associated with the implementation of a project;

(iii) to verify all or selected parameters measured are in compliance with legal and contract specifications, internal policies and standards;

(iv) to provide an early warning system for impact prevention;

(v) to provide a database of environmental parameters against which to determine any short term or long term environmental impacts;

(vi) to propose timely, cost-effective and viable solutions to actual or potential environmental issues;

(vii) to setup event and action plans and determine the degree and scope of any necessary remedial measures in case of exceedance of compliance, for which environmental monitoring forms the basis, or the recommendation of environmental controls in the event that the environmental objectives are not achieved;

(viii) to monitor performance of the mitigation measures and to assess their effectiveness and, whenever necessary, identify any further need for additional measures;

(ix) to verify the EIA predicted impacts and compare the impact predictions with actual impacts for the purpose of assessing accuracy of impact predictions in EIA;

(x) to collate information and evidence for use in public and Government consultation; and

(xi) to audit the environmental performance.

15.2 EM&A Requirements

15.2.1 In accordance with the EIA, EM&A procedures are required during the design, construction and operational phases of the project implementation only and a summary of the requirements for each of the environmental parameters is detailed in Table 15.1 below.

Table 15.1 Summary of EM&A Requirements

Parameter	EM&A Phase		
	Design Phase	Construction Phase	Operational Phase
Air Quality	-	Y	-
Noise	-	Y	-
Water Quality	-	Y	Y
Ecology	-	Y	-
Landscape and Visual	Y	Y	Y
Cultural Heritage	-	Y	-
Hazard to Life	Y	-	Y
Fuel Spillage Risk	Y	-	Y
Fisheries	-	-	-
Land Contamination	Y	-	Y
Waste	-	Y	-

15.2.2 The EM&A works during the design phase shall comprise an iterative audit process of specific design elements by a suitably qualified auditor(s). This role could be filled by the Independent Checker (Environment). The specifications for certain risk and spill control mitigation measures will be required to be designed during the detailed design phase of the project. These items will include:

- land and marine spill response plan;
- pipeline leak detection and automatic shut-off system;
- pipeline rock armour protection;
- tank high level shut-off;
- tank bunding;
- tank leak drainage isolation and containment system;
- on-site fire fighting equipment;
- jetty protection; and
- emergency shut down valves for fuel delivery.

15.2.3 In addition, the landscape design drawings and dolphin exclusion zone during dredging in the Marine Park and along the entire length of the pipeline will require specifications during the detailed design and could require the input of specialists.

15.2.4 It should be noted that as the percussive piling for the jetty has already been completed under the previous EP, the following recommendations of the previous EIA (April 2002) have already been carried out:

- dolphin acoustic monitoring;

- dolphin exclusion zone;
- underwater noise monitoring to supplement visual dolphin surveillance;
- pre-construction abundance monitoring;
- piling acoustic decoupling methods; and
- bubble jacket trial, design and use.

15.2.5 The design audit shall be undertaken as and when the relevant design aspects are produced and the Design Auditor will be required to prepare a Design Audit Report at the end of the detailed design which will confirm that the requirements of the EIA have been fully taken into account in the project design. The Design Audit report should be submitted to EPD, AFCD and the proponent at least. Other relevant parties should be identified at the time of issue.

15.2.6 During the construction phase, the EM&A requirements are divided into environmental monitoring and/or project auditing in the form of site inspection and supervision. The environmental monitoring will be conducted in three distinct stages, as follows:

(i) baseline (pre-construction);
(ii) construction phase impact; and
(iii) operational phase impact.

15.2.7 Environmental monitoring and audit for water quality during the construction phase is recommended in order to ensure all proposed mitigation measures are implemented and effective. Obtaining a suitable and representative baseline data set will be critical to the whole monitoring and audit process because it forms the standard against which environmental impacts are assessed. Thus, baseline monitoring for water quality will be required prior to the start of construction. This parameter will also be subject to audit through site supervision.

15.2.8 Site supervision and procedures audit will be required during the construction phase to ensure the proper handling, storage, transportation and disposal of the various waste arisings from the project.

15.2.9 Post construction dolphin abundance monitoring will be required to ensure the effectiveness of the mitigation measures undertaken during the piling for the jetty. As some construction activities commenced in November 2005, before the Judgement of the Court of Final Appeal of July 2006, the pre-construction abundance monitoring was undertaken in late 2005 and the results are provided in Appendix F3. As such, the post-construction dolphin abundance monitoring will be required to be undertaken for a period of 28 days prior to operation of the PAFF.

15.2.10 Monitoring in the form of regular site inspections shall also be required to ensure dust and noise levels are kept to a minimum and ecological measures in the form of tree transplantation and establishment are being implemented and are effective. EM&A for landscape resources will extend through the construction phase into the operational phase to ensure that the planting/replanting has been effective.

15.2.11 As detailed in Section 3, the initial phase of the tank farm development will comprise 8 tanks which will be operational from 2009. However, the ultimate capacity of the tank farm is proposed to be 12 tanks and future expansion of the facility will commence after 2025 when the initial capacity has been reached. The tanks will be built taking into account the latest technology, standards and statutory requirements. In order to ensure that the required mitigation measures are undertaken at that time, it is recommended that a review of the EIA report be undertaken at the planning stage for the future expansion if the latest technology, industrial standards and statutory requirements have changed by that time.

15.2.12 In addition, in order to ensure the on-going adequacy of the fuel spill contingency plan and that it is being implemented as required, it is proposed that an Environmental Management System be set up for the operational phase of the project to allow regular audits of the systems/mitigation measures incorporated in the project and the fuel spill contingency plan.

15.2.13 The details of monitoring are discussed in the following sections and summarised in Table 15.2 below.

Table 15.2: Framework for Environmental Monitoring Plan

Monitoring	Period	Parameters	Monitoring Frequency	Responsibility
Noise **Dust** **Waste**	Baseline	n/a	n/a	n/a
	Construction Phase Impact	Routine supervision of construction works	As per site inspection schedule	Environmental Team
Water	Baseline	Measurements of suspended solids, turbidity, dissolved oxygen and pH.	Baseline data daily on both flood and ebb tides for at least one week before the start of the construction.	Environmental Team
	Construction Phase Impact	Survey of drainage channels in area of construction site. Measurements of suspended solids, turbidity, dissolved oxygen and pH.	Daily when marine construction works are being undertaken within 1000m of the Lung Kwu Chau and Sha Chau Marine Park and for dredging along the entire pipeline.	Environmental Team
	Operational Phase Impact	Suite of parameters including but not limited to TPH and PAH to be determined by the Franchisee within 3 month so the commencement of the PAFF	Routine to be determined by the Franchisee within 3 months of the commencement of the PAFF	Franchisee

Monitoring	Period	Parameters	Monitoring Frequency	Responsibility
Ecology	Construction Phase Impact	250m Dolphin Exclusion Zone Works will be restricted to a daily maximum of 12 hours within daylight hours Avoidance of calving season (March to August) Post Marine Construction Dolphin Abundance Monitoring	During dredging in Marine Park and along the length of the pipeline. During dredging in Marine Park and along the length of the pipeline except for the section crossing Urmston Road Channel. During dredging in Marine Park and along the length of the pipeline 28 days worth after all marine works are completed	Dolphin Specialist(s) / underwater acoustic specialist as members of the Environmental Team)
Landscape/ Visual Resources	Design	Detailed landscape proposals and specifications	As and when designs are produced.	Auditor(s) designated by the Design Consultants
Landscape/ Visual Resources	Baseline	Walkover tree survey and vegetation identification.	Once immediately prior to construction works.	Landscape Architect (member of the Environmental Team)
	Construction Phase Impact	Survey of protection measures for trees and landscaping.	Twice a month during construction works	Landscape Architect (members of the Environmental Team)

Monitoring	Period	Parameters	Monitoring Frequency	Responsibility
	Operational Phase Impact	Survey of coverage and growth of plantings.	Once every two months for one year after the completion of the construction works	Landscape Architect (members of the Environmental Team)
Cultural Heritage	Construction Phase Impact	Watching brief during dredging within 25m of subsurface anomalies SS1 and SS2	During dredging period only	Marine Archaeologist (members of the Environmental Team)
Hazard to Life Fuel Spill Risk Land Contamination	Design	Specifications for: - land and marine spill response plan; - pipeline leak detection and automatic shut-off system; - pipeline rock armour protection; - tank high level shut-off; - tank bunding; - tank leak drainage isolation and containment system; - on-site fire fighting equipment; - jetty fenders; and fuel delivery emergency shut down valves.	As and when designs are produced.	Auditor(s) designated by the Design Consultants

Monitoring	Period	Parameters	Monitoring Frequency	Responsibility
	Operational Phase	Prepare an Environmental Management Plan to ensure the on-going adequacy of the fuel spill contingency plan and that it is being implemented as required and that the above mitigation measures have been incorporated and are effective. For future development phase, review of EIA report to ensure that the required and latest standards an legislation are taken account in the design of future tanks. (required only if the standards and guidelines have changed by that time).	EMP should be prepared within 3 months of the operation of the PAFF Audits should be undertaken at least once every 24 months. Once during planning stage for future (phase II) tank construction	Franchisee
		Regular inspections and audits will be undertaken during the operational phase of the facility: - inspections of the tank farm, jetty and pipelines; - inspection of the whole sub sea pipelines; - Health, Safety and Environmental audit of the facility - inspection of the structural integrity of the tanks	 Twice per year Every 5 to 10 years once every 3 years Once per year	Franchisee

15.3 Baseline Monitoring

15.3.1 Water Quality

15.3.1.1 Baseline water quality monitoring of the marine environment in the study area will be carried out daily on both flood and ebb tides for a period of 1 week to measure suspended solids, turbidity, dissolved oxygen and pH at all monitoring stations.

15.3.2 *Landscape/Visual Resources*

15.3.2.1 Baseline monitoring for the landscape will comprise a walkover vegetation survey of the vegetation and trees on the site. Representative vegetation types will be identified along with typical species composition.

15.4 Construction Phase Impact Monitoring

15.4.1 *Action and Limit Levels*

15.4.1.1 Monitoring stations will be set up at representative sensitive receivers and the results will be used to ensure compliance with determined performance criteria, based upon specific action and limit levels. The definition of these are as follows:

- the *Action Level* represents a level at which some appropriate action will be required to prevent conditions deteriorating to the extent that statutory or guide criteria are breached; and

- the *Limit Level* represents the upper limit permitted and is generally equivalent to the statutory levels specified in legislation.

15.4.1.2 The construction phase monitoring and relevant audit criteria for water quality are highlighted below. Action plans will be developed for use in the event of exceedances, or non conformities in the case of ecology, landscape and visual and waste, and these will be included in the EM&A Manual.

15.4.1.3 Action plans and audit criteria are not relevant to the noise, air, waste, cultural heritage and landscape and visual EM&A. However, the supervision methodology is highlighted below.

15.4.2 *Water Quality*

15.4.2.1 Daily surveys are to be undertaken for marine water quality on both flood and ebb tides while dredging activities are being undertaken within 1000m of the Marine Park. For monitoring during other dredging activities, water quality impact monitoring stations shall be positioned 500m to the north/northwest and south/southeast of any dredger when operating at a distance greater that 1 km from the boundary of the Lung Kwu Chau and Sha Chau Marine Park. The surveys should include measurements of suspended solids and dissolved oxygen. In addition to these water quality parameters, other relevant data shall also be measured, including monitoring location/position, time, water depth, water

temperature, salinity, pH, DO saturation, weather conditions, sea conditions, tidal stage, and any special phenomena and work underway at the construction site etc.

15.4.2.2 Any noticeable change to water quality should be recorded, investigated and remedial actions shall be undertaken to reduce impacts. The key assessment parameters are dissolved oxygen and suspended sediment and thus Action and Limit Levels based on the assessment criteria are identified for these. However, turbidity can also provide valuable instantaneous information on water quality and thus an Action Limit is also recommended for this parameter to facilitate quick responsive action in the event of any apparent unacceptable deterioration attributable to the works. The proposed Action and Limit Levels are shown in Table 15.3.

Table 15.3: Action and Limit Levels for Water Quality

Parameters	Action (mg/L)	Limit (mg/L)
DO in mg/L (Depth Average & Bottom)	Depth Average 4.5 mg/L; and upstream control stations' mean D.O. (at the same tide of the same day) Bottom 2.5 mg/L; and upstream control stations' mean D.O. (at the same tide of the same day)	Depth Average 4.0 mg/L; and upstream control stations' mean D.O. (at the same tide of the same day) Bottom 2.0 mg/L; and upstream control stations' mean D.O. (at the same tide of the same day)
Suspended Solids (depth averaged)	30 mg/L; and 130% of upstream control stations' mean SS (at the same tide of the same day)	39mg/L; and 130% of upstream control stations' mean SS (at the same tide of the same day)
Turbidity in NTU (depth averaged)	130% of upstream control stations' mean Turbidity (at the same tide of the same day)	N/A

Notes:
- For DO, non-compliance of the water quality limits occurs when monitoring result is lower than the limits.
- For SS, non-compliance of the water quality limits occurs when monitoring result is higher than the limits.
- All the figures given in the table are for reference only and these may be amended with the agreement of DEP.
- "Depth Averaged" is calculated by taking the arithmetic mean of the in-situ parameters readings at all three depths. For suspended solids "depth averaged" is calculated by combining all three samples into one mixed sample which is analysed to produce a physical arithmetic mean.

15.4.3 Noise, Air, Waste

15.4.3.1 Supervision of the construction works should be undertaken on a weekly basis during site inspections to ensure that waste material is being properly stockpiled and handled and that

measures as recommended in the EIA are being undertaken to minimise noise and dust. Any malpractice should be reported and remedial measures recommended. Review of the waste documents shall be undertaken on a weekly basis to ensure waste management is being undertaken in accordance with the Waste Management Plan.

15.4.4 *Landscape and Visual*

15.4.4.1 The landscape construction works will be closely monitored to ensure all measures specified to promote the healthy establishment of plants are undertaken fully and that any defects or omissions are rectified at the earliest opportunity and before the end of the construction period.

15.4.4.2 The protection provided to all trees identified will be monitored throughout the construction period to ensure that it is kept in a good condition. Any damage by the Contractor or by other parties to the protection of the trees will be noted for remedial action.

15.4.4.3 Operations relating to the supply of specialist plant material (including the collecting, germination and growth of plants from seed) will be monitored to ensure that plants will be available in time to be used within the construction works.

15.4.4.4 The progress of the engineering works will be regularly reviewed on site to identify the earliest opportunities for the landscape works to be undertaken.

15.4.5 Ecology

15.4.5.1 A 250m dolphin exclusion zone will be applied to all dredging within the marine park and along the entire pipeline. A qualified dolphin specialist will ensure that no dolphins are within the exclusion zone for a period of 30 minutes before dredging can commence. In addition, dredging works should be restricted to a daily maximum of 12 hours within daylight hours except for the section crossing Urmston Road Channel and should not be undertaken in the main calving season between March and August along the whole pipeline.

15.4.5.2 In addition, a monitoring programme is required to span a period of 28 days prior to operation of the PAFF. An action plan has also been defined to indicate that should dolphin numbers be significantly different (i.e., at least 30% reduction taking into account naturally occurring alterations to distribution patterns such as due to seasonal change and the difference is of statistical significance at an alpha level of 0.05) to the pre-construction activity following the 28 days post-construction monitoring, recommendations for a further 28 days monitoring will be required. This action plan is detailed in the EM&A Manual. The monitoring specification is detailed in Section 7 and the EM&A Manual.

15.4.5.3 It should be noted that as some construction activities commenced in November 2005, before the Judgement of the Court of Final Appeal of July 2006, the pre-construction abundance monitoring was undertaken in late 2005 and the results are provided in Appendix F3.

15.4.6 Cultural Heritage

15.4.6.1 A watching brief for two sub sea anomalies has been recommended by the result of the Marine Archaeological Investigation detailed in Appendix G. This should be undertaken by a specialist marine archaeologist as part of Environmental Team and should comprise:

- Dredge operators to be made aware of the potential presence of cultural heritage material. The operators would be required to report to the AMO any unusual resistance and/or recovery of timbers, anchors or other wreck related material Any obstacles encountered during the dredging that are of timber should be reported to the maritime archaeologist. The obstacle should be avoided and not removed until it has been assessed by the marine archaeologist as to whether the obstacle is of cultural heritage importance;
- A marine archaeologist shall be on board the dredging barge during dredging within 25m either side SS1 and SS2 (Figure 5a and 5b, MIA Task 4.1, Appendix G) in the event of any unusual resistance occurring or blockages which requires the dredge head to be bought on deck for cleaning and examination; and
- Dredging to cease in the nominated area SS1 after 3 metres of sediment removal and after 1 metre for SS2. A dive survey will then be undertaken to examine the trench for possible cultural remains.

15.4.6.2 During the course of the watching brief, if the targets are identified as being potentially archaeologically important, then an immediate marine archaeological impact assessment in accordance with EIAO TM Annex 19 will be required to be undertaken by a qualified marine archaeologist. In addition, it is recommended that any changes, additions or alterations to the dredging method and alignment should be further assessed by a marine archaeologist to determine if any further assessment is required.

15.5 Operational Impact Monitoring

15.5.1 Post construction monitoring is limited to monitoring landscaping to ensure the viability of the planting/replanting. Site inspections shall be undertaken once every 2 months for the first year of operation.

15.5.2 In order to ensure the on-going adequacy of the fuel spill contingency plan and that it is being implemented as required, it is proposed that an Environmental Management System be set up for the operational phase of the project to allow regular audits of the systems/mitigation measures incorporated in the project and the fuel spill contingency plan. The Environmental Management System shall be developed within 3 months of the commencement of the operation of the PAFF and it is recommended that audits are undertaken at least every 24 months and the audits should be undertaken by an environmental specialist appointed by the Franchisee.

15.5.3 Also, the following regular inspections and audits will be undertaken by the Franchisee during the operational phase of the facility:

- two inspections every year of the tank farm, jetty and pipelines including one

undertaken pursuant to the Joint Inspection Group (JIG) explained above;

- inspection of the whole sub sea pipelines every 5 to 10 years;
- Health, Safety and Environmental audit of the facility once every 3 years; and
- inspection of the structural integrity of the tanks once per year.

15.5.4 In addition, it is recommended that the Franchisee undertake some routine monitoring of water quality in the vicinity of the PAFF site to check the effectiveness of the proposed precautionary measures implemented for on-site spill control. The details of the monitoring to be undertaken will be prepared by the Franchisee as part of the PAFF Operations Manual and the details will be agreed with the relevant authorities within 3 months of the commencement of operation of the PAFF. However, the monitoring should include but not be limited to the parameters of TPH and PAH and reference should be made to the existing monitoring programme undertaken for the fuel tank farm on the HKIA platform.

15.5.5 In order to ensure that the required design measures are taken into account during the planning and design for the future tank development, a review of the EIA report will also be undertaken at the planning stage for the future expansion (around 2025 as required). The review is required only if the latest technology, standards and statutory requirements are deemed to have changed by that time. The review should be undertaken by an environmental specialist appointed by the Franchisee at that time.

15.6 EM&A Responsibilities

15.6.1 In respect of the design phase EM&A, the Consultant commissioned to undertake the Design and Construct contract will be required to designate an auditor(s) to undertake an environmental audit of the design of these measures in order to ensure that the recommendations of the EIA have been fully and properly specified. The design audit shall be undertaken as and when the relevant design aspects are produced. The Consultant shall use suitably qualified staff to undertake the audit.

15.6.2 During the construction and operational phase of the project, an Environmental Team Leader (ETL) is to be employed by the Contractor. He shall ensure the Contractor's compliance with the project's environmental performance requirements during construction and undertake the post construction EM&A works and his responsibilities will include field measurements, sampling, analysis of monitoring results, reporting and auditing. The ETL shall be approved by the ER and shall be competent and shall have at least 7 years relevant environmental monitoring and audit experience on projects of a similar scale and nature.

15.6.3 The ETL will require suitably qualified support staff (the Environmental Team, (ET)) to carrying out the EM&A programme. Both the ETL and members of the ET shall be independent and shall not be in any way connected to the Contractor's company. Due to the specialist nature of some of the EM&A works required for this project, the ET should comprise professionals proficient to undertake the tasks involved. Thus, the ET should include personnel experienced in noise and dust mitigation, water quality monitoring, supervision of waste management, compensatory tree planting, underwater acoustic monitoring and dolphin spotting and supervision.

15.6.4 Accordingly, a Registered Landscape Architect, as defined by the Landscape Architect's Registration Board, will be required on the ET to monitor and audit the landscaping installation works. In addition, a marine archaeologist to the acceptability of the AMO will be required to undertake the recommendations defined by the Marine Archaeological Investigation.

15.6.5 In addition to the ETL, an Independent Environmental Checker (IEC) shall advise the ER on environmental issues related to the project. The role of the Checker shall be independent from the management of construction works, but the Checker shall be empowered to audit the environmental performance of the construction activities and operational mitigation. The IEC shall have project management experience in addition to the requirements of the ETL specified in Section 15.6.2 and the appointment of the IEC will be subject to the approval of the ER. The IEC may require specialist support staff in order to properly carry out his duties.

15.7 Reporting

15.7.1 Deliverables during the design phase will comprise a Design Audit Report at the end of the detailed design which will confirm that the requirements of the EIA have been fully taken into account in the project design. Construction and operational reporting will be in the form of the baseline survey report and regular and summary EM&A Reports which should be prepared in accordance with the requirements of Annex 21 of the TMEIA. It is recommended that EM&A Reports are issued monthly and bi-monthly for the construction and operational stages respectively. Further details on the contents of these reports is provided in the EM&A Manual.

15.8 Implementation Schedules

15.8.1 The recommended mitigation measures specified in this EIA report have been summarised in the Environmental Mitigation Implementation Schedules provided in Appendix B for air, water quality, waste, ecology, landscape and visual, cultural heritage, contaminated land and fuel spill risk