MAUNSELL CONSULTANTS ASIA LTD

Annex(1) to EP1/N7/14 (17)-1

TSUNG PAK LONG FLOOD PROTECTION SCHEME
Environmental Monitoring and Audit Manual

September 1995

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CES (ASIA) LTD DOCUMENT RELEASE FORM			
TITLE	Tsung Pak Long Flood Protection Scheme Environmental Monitoring and Audit Manual		
CLIENT	Maunsell Consultants Asia Ltd		
REPORT NO.	698	PROJECT NO.	96210
STATUS	Final	DATE OF ISSUE	22/9/95
QUALITY CONTROL	NAME	SIGNATURE	DATE
CHECKED BY	W Tung	W Tung	21/9/95
TECHNICAL REVIEWER	S Howard	S. Howard	21/9/95
APPROVED BY	S Howard	S. Howard	21/9/95

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1 INTRODUCTION

1 INTRODUCTION

1.1 Purpose and Structure of this Document

This Manual outlines the monitoring and audit programme to be undertaken for the development of the Tsung Pak Long Flood Protection Scheme. It aims to provide systematic environmental procedures for monitoring and controlling the environmental impacts associated with the works.

Hong Kong environmental regulations for air quality, noise and water quality, the Hong Kong Planning Standards and Guidelines, and the Final Assessment Report (FAR) recommendations have served as environmental standards and guidelines in the preparation of this report.

Three main areas have been identified as necessitating quantitative environmental monitoring and auditing (EM & A):

- water quality
- noise
- air quality

The implementation status of environmental mitigation measures are to be assessed for:

- ecology
- historical and cultural heritage
- visual impacts and landscaping
- community issues

1.2 Background

The villages of Tsung Pak Long and Tai Tau Leng, near Sheung Shui, are subject to frequent flooding. This low lying area is located to the south of the Sutlej River and is drained by two tributaries of the Sutlej. Tidal conditions affecting water levels in the Sutlej cause drainage water under high flow conditions to back up in the tributaries and thus flood. A scheme to alleviate flooding has been proposed and a Final Assessment Report (FAR) on the environmental impacts of the scheme was produced in 1995 by Consultants in Environmental Sciences (Asia) Limited as subconsultants to Maunsell Consultants Asia Limited. The project proponent is the Territory Development Department (TDD).

1.3 Summary of the Flood Protection Scheme

Works involved in the proposed flood protection scheme consist of:

- Building a retaining wall along the southern edge of the River Sutlej which will retain floodwater during storm conditions, preventing spill over onto the low lying ground surrounding the villages.
- Provision of embankments along the watercourse to the west of Tsung Pak Long which will extend from the River Sutlej to the Tsung Pak Long access road.

- Provision of a box culvert to divert the eastern watercourse to the western watercourse at times of high flow. This culvert will be routed mostly along the alignment of the Tsung Pak Long access road.
- Channelisation of part of the eastern watercourse in a simple concrete lined channel with embankments.
- Provision of a storm water pumping station to deal with flows when flood levels are too high to permit gravity discharge.
- An associated water storage area for storage of floodwater draining from the village areas prior to higher-level discharge to the River Sutlej.
- Enlargement will be considered of an existing culvert for the passing of flood waters from the adjacent catchment where the eastern watercourse crosses Castle Peak Road, and the raising of the road level from 6.8 mPD to 7.5 mPD.
- Demolition of an existing footbridge and the construction of a new footbridge.

During normal tidal and flow conditions, drainage from the low lying village areas of Tsung Pak Long and Tai Tau Leng will drain to the River Sutlej by gravity. During flood conditions, gravity connections to the river will be closed with an automatic penstock and flow will be diverted to the sump of the pumping station and pumping will commence. Only flows in excess of the pumping rate will be stored temporarily in the adjacent storage pond.

2 SUMMARY OF ENVIRONMENTAL ASSESSMENT STUDIES

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2.1 Ecology

2.1.1 Existing Environment

The study area contains a variety of habitats including woodland planted for amenity, ornamental and fruit purposes, natural secondary woodland associated with watercourses, semi-aquatic and aquatic vegetation associated with watercourses, wasteground, actively cultivated and abandoned cultivated areas. Animals of note include two rare species of South-East Asian butterfly (*Horaga onyx* and *Horaga albimacula*) and other rare butterfly species (*Castalius morsimon, Neope muirheadis,* and *Charaxes bernadus*). These are found principally in the small woodland/open area adjacent to the Tsung Pak Long Village access road and to the east of the goldfish rearing ponds. The habitat requirements of these butterflies are of critical importance.

2.1.2 Impact Assessment

Potential impacts include the deterioration or elimination of existing habitats, alterations in species compositions due to changes in water flow patterns and disturbance to wildlife, especially invertebrates and birds through disturbance (noise, vibration, dust, habitat clearance).

2.1.3 Mitigation Measures

- Retention of important natural habitat areas, including the woodland, individual trees and wetland areas around the stream courses. During delineation of the working boundary on site, a landscape architect/ecologist should be consulted to ensure important habitats are avoided.
- Retention of habitat important to rare butterflies.
- Restoration planting scheme designed by a landscape architect/ecologist concentrating on native tree species found in the locality and the planting of food plants for larvae and adults of rare butterfly species.
- The planting scheme will include the creation of wildlife habitats such as woodland and 'edge' habitats.
- Contract documents drafted with the advice of an ecologist/landscape professional, to ensure protection for wildlife habitats, with regard to the methods of working, works areas, storage areas, access routes, use of chemicals, protection from fire, etc.
- Full briefing of the contractor and resident engineer on the ecological issues associated with the project.

2.2 Water Quality

2.2.1 Existing Environment

The western watercourse is polluted with anoxic sediments, and during low flow conditions is odorous. The eastern watercourse is used more extensively for irrigation of fields close to the Sutlej and appears to be of better quality. Samples of stream water and sediments from the western watercourse were analysed and the results summarised in a Key Issue Report. Some of the sediment in the surface 300 mm showed high levels of contamination with certain metals when compared to the sediment classification criteria adopted for marine sediments in Hong Kong (EPD, 1992) and also compared with Dutch Guidelines for classification of contaminated sediment (Min. of Housing, et al., 1994). The sediments from the western watercourse were also significantly elevated in organic pollutants, presumably from the animal waste discharged to the stream above the site. Water quality in the western watercourse was polluted with very low dissolved oxygen and very high turbidity.

2.2.2 Impact Assessment

Construction of the flood protection scheme could give rise to elevated suspended solids levels. During operation, the quantities of pollutants entering the watercourses will not change. However, the faster runoff hygrograph will marginally increase the time the watercourses are in the low flow condition. Since the low flow condition predominates anyway, this effect is not considered significant. There is unlikely to be a major impact on sedimentation downstream.

Disposal of excavated mud could cause environmental impacts such as deterioration of water quality or other parameters. The mud in question is contaminated as a result of discharge of livestock waste. Approval has been given by the Environmental Protection Department to dispose of it to an approved landfill site.

2.2.3 Mitigation Measures

- Elevated levels of suspended solids are to be mitigated by carrying out construction during dry conditions, temporarily diverting residual stream flows around the excavation area and minimising the exposed area of bare soil.
- Temporary stockpiles of materials would not be allowed, or if permitted by agreement with EPD, would be provided with silt traps and drainage in order to reduce suspended solids in any effluent to standards specified in the Technical Memorandum.
- Contaminated material from the western watercourse must be removed from the site during dry conditions and before the main excavation commences.
- Discharges of site effluent (such as from construction site toilet facilities) into watercourses are to be prohibited.
- If fuel is stored on site a bunded area will be provided and oil separation facilities installed for the drainage water.

- The implementation status of mitigation measures and their effectiveness shall be regularly determined.

2.3 Noise

2.3.1 Existing Environment

Most Noise Sensitive Receivers (NSRs) in Tsung Pak Long village are sufficiently remote from the New Territories Circular Road (NTCR) or shielded by intervening structures, that traffic noise levels are low or imperceptible. There is little traffic and no industrial activity within the village. Tai Tau Leng village experiences a higher ambient noise level resulting from its closer proximity to the NTCR and Po Shek Wu Road. The area between the NTCR and Castle Peak Road, which accommodates mostly single-storey houses clustered around the small stream, is dominated by noise from the NTCR.

2.3.2 Impact Assessment

The noise generated by construction of the flood control works during the non-restricted daytime hours (07.00 to 19.00) has been assessed with reference to the criterion of 75 dB(A) (L_{eq} 30 mins). Works at the site are expected to cease before 1900 hours, so evening and night-time Noise Control Ordinance criteria are not relevant. Construction noise at a set of 15 selected representative NSRs, both residential and school, has been assessed, based on an assumed construction methodology, schedule, and list of equipment.

Representative noise sensitive receivers identified in the FAR are shown in Figure 2.1, and those predicted to have mitigated noise levels greater than 75 dB(A) are listed in Table 2.1.

Table 2.1 Identified NSRs Predicted to Have Mitigated Noise Levels Greater than 75 dB(A)

Location	Remarks	
NSR-1	West Tsung Pak Long	1-storey isolated temporary residence
NSR-3	West Tsung Pak Long	1-storey mixed agricultural and residential temporary structures
NSR-5	West Tsung Pak Long	1-storey isolated residence on stilts
NSR-14	Cottage Area	1-storey permanent residence
NSR-15	Cottage Area	1-storey temporary residence

Construction works will require the use of powered mechanical equipment for channel and embankment formation, concreting, and surface finishing/reinstatement. The construction noise assessment found that exceedances of the assessment criterion could be expected at NSRs that were close to the works. In certain areas, such as along the eastern and western watercourses, some NSRs are so close to the construction works that unmitigated construction noise levels are expected to exceed 75 dB(A) by almost 20 dB(A). The noise levels at the majority of the NSRs are predicted to be above 75 dB(A). Therefore mitigation measures of temporary noise barriers and quietened equipment recommended in the FAR are essential for NSRs 1, 2, 3, 4, 5, 6, 8, 9, 10, 12, 13, 14 & 15. An assessment based on the use of quietened equipment and temporary noise barriers found that one or both of these measures could reduce noise to acceptable levels at all but the very closest NSRs.

2.3.3 Mitigation Measures

Temporary Noise Barriers

Purpose built temporary noise barriers will be used at specific sensitive receivers or located close to the noise source. The acoustic panels shall be absorptive, having a noise reduction capability of up to 10 dB(A). Barrier material should have a mass per unit surface area in excess of 7 kg m^{-2}; alternatively, sandbags may be used to form a temporary screen. It should be noted that some sound will pass around the ends of a short barrier. In order to minimise this occurrence, the length of the barrier should be about five times its height, or the barrier should be curved around the noise source. The minimum height of the barrier should be such that no part of the noise source is visible from the NSR.

Quietened Equipment

Items of Stationary and Earth-moving Plant include concrete pumps, excavators, bulldozers, and dump trucks. Noise reduction shall be achieved through proper maintenance of the exhaust system, and through exhaust silencers. Additionally, engine noise is amenable to reduction through isolation of vibrating engine components, installation of partial or full acoustic enclosures of noise-generating components, and damping of vibrating panels.

General Construction Noise Reduction Measures

- Noisy equipment and activities will be sited by the Contractor as far from sensitive receivers as is practical.
- Noisy plant or processes will be replaced by quieter alternatives where possible. For example, pneumatic concrete breakers can be silenced with mufflers and bit dampers, or can be replaced with electric hydraulic breakers. If appropriate, a concrete cruncher (hydraulically-powered jaws) may be used; the cruncher emits a sound power level about 20 dB(A) lower than that of an electric breaker. Silenced diesel and gasoline generators and power units, as well as silenced and

super-silenced air compressors, can be readily obtained. Manual operations are generally quietest, but may require long periods of time.

- The power units of non-electric stationary plant and earth-moving plant can be quietened by vibration isolation and partial or full acoustic enclosures for individual noise-generating components.
- Construction plant will be properly maintained and operated. Construction equipment often has silencing measures built in or added on, e.g., bulldozer silencers, compressor panels, and mufflers. Silencing measures will be properly maintained and utilised.
- Idle equipment will be turned off or throttled down. Noisy equipment shall be properly maintained and used no more often than is necessary.
- Limited hours of use for powered mechanical equipment are recommended; a ten-hour period from 8.00 a.m. to 6.00 p.m. is suggested. Hours of use could be further restricted by the Resident Engineer if sufficient and justifiable complaints from affected villagers are received.
- Noisy activities shall be scheduled to minimise exposure of nearby NSRs to high levels of construction noise. For example, noisy activities can be scheduled for midday, or at times coinciding with periods of high background noise (such as during peak traffic hours). As far as possible, noisy operations during teaching hours shall be avoided near the schools at Tsung Pak Long. Prolonged operation of noisy equipment close to dwellings should be avoided.
- Construction activities can be planned so that parallel operation of several sets of equipment close to a given receiver is avoided.

2.4 Air Quality

2.4.1 Existing Environment

The area around Tsung Pak Long and Tai Tau Leng is mainly agricultural. It is therefore assumed that background levels of pollutants in the area are low. No information on air quality in the area is available.

2.4.2 Impact Assessment

Air dispersion modelling for 10 representative air quality sensitive receivers (shown on Figure 2.1) demonstrated that the embankment construction activities are likely to cause elevated dust levels at sensitive receivers. Nevertheless, the dust impacts would only occur sporadically during periods of worst case meteorological conditions coincident with maximum construction activities. Modelling results indicate that there would not be exceedance of the 1-hour average TSP guideline level and the 24-hour and annual average TSP AQOs at any of the sensitive receivers except two exceedances and one exceedance of the 1-hour average TSP guideline level at receivers 3 and 5 respectively. Based on the 1990 Ta Kwu Ling meteorological data, exceedances of the 1-hour average TSP guideline level at receivers 3 and 5 occurred during low wind speed conditions. By implementing the dust suppression measures in Section 5.4 and adopting more frequent watering of dusty site surfaces, especially those close to receivers 3 and 5, during low

wind speed conditions, exceedance of the TSP guideline level and AQOs at the sensitive receivers is not expected.

2.4.3 Mitigation Measures

- The temporary noise barrier between the site and sensitive receivers 3 and 5 could also reduce the dust impacts.
- Use of regular watering to reduce dust emissions from exposed site surfaces and unpaved roads, at least twice daily with complete coverage, particularly during dry weather.
- Use of frequent watering for particularly dusty static construction areas and areas close to sensitive receivers 3 and 5 where construction operations are taking place.
- Open stockpiles to be avoided or covered. Where possible, prevent placing dusty material storage piles near sensitive receivers.
- Side enclosure and covering of any aggregate or dusty material storage piles to reduce emissions. Where this is not practicable owing to frequent usage, watering should be employed to aggregate fines.
- Provision of barriers, which maybe the temporary noise barrier, between the site and nearby sensitive receivers to act as dust barriers.
- Tarpaulin covering of all dusty vehicle loads transported to, from and between site locations.
- Establishment and use of vehicle wheel and body washing facilities at the exit points of the site, combined with cleaning of public roads where necessary.
- Provision of wind shield and dust extractor at the loading points and use of water sprinklers at the loading area.
- Imposition of speed controls for vehicles on unpaved site roads. 15 km hr^{-1} is the recommended limit.
- Where feasible, routing of vehicles and positioning of construction plant at maximum possible separation distance from sensitive receivers especially sensitive receivers 3 and 5.
- Instigation of a control programme to monitor the construction process in order to enforce controls and modify methods of work if dusty conditions arise.

By implementing dust suppression measures given above and adopting more frequent watering of dusty site surfaces, in particular those close to receivers 3 and 5, during low wind speed conditions, dust impact at the sensitive receivers can be further reduced.

It should be noted that the works should be in compliance with the Air Pollution Control (Construction Dust) Regulations which are currently in draft, should they be enacted during the term of the works. In such event, a variation to contract will be issued.

2.5 Historical and Cultural Heritage

2.5.1 Existing Environment

There are a number of grave sites around the village area, areas of Fung Shui trees and a Hakka Wai walled village at Tsung Pak Long.

2.5.2 Impact Assessment

The current proposals do not impinge directly on any of the sites.

2.5.3 Mitigation Measures

- Prior notification of the limits of each site to the contractor is advised as a precautionary measure.

2.6 Visual Impacts and Landscaping

2.6.1 Existing Environment

The study area encompasses the two settlements of Tsung Pak Long and Tai Tau Leng. The villages are set within low lying agricultural land that provides an open green setting, contrasting with the narrow streets and limited view corridors between the buildings.

2.6.2 Impact Assessment

There will be significant temporary alteration of visual character, with agricultural land converted into a construction site. Removal of existing vegetation as well as disruption of existing roads will heighten the visibility of the project area from certain viewpoints. Excavation and construction of the retaining wall along the Sutlej River and the pedestrian footbridge will disrupt the river bed area affecting all the identified sensitive receivers. Construction of the pumping station will be highly visible. There will be an increase in traffic activity generated by construction vehicles.

2.6.3 Mitigation Measures

- Construction working areas to be limited to the minimum practicable size.
- Enclosure of working areas adjacent to sensitive receivers, with hoardings to screen construction activities.
- Heights of storage materials to be maintained at low levels.
- Alignment of the works so that where possible existing trees can be retained.
- Planting to screen the permanent works during the construction stage, to assist in mitigating construction impacts.
- Construction of the pumping station shall reflect the small unit size of the rural style buildings, and light coloured materials shall be used so that the building is less obtrusive when viewed against the skyline.
- The footbridge across the River Sutlej to be finished in light coloured materials to reduce its impact when viewed against the sky. Lighting of the bridge should be concealed within the structure. The structure itself ought not to be flood lit.
- Screen planting between Tsung Pak Long and the storage pond to screen the pumping station as effectively as possible.
- The retaining wall along the River Sutlej shall be granite faced on both sides to improve its appearance from all sensitive viewpoints.

- Planting of trees, shrubs and climbers within the verge along the Sutlej River retaining wall.
- Planting of trees and shrubs in the 2 metre flat zone at the top of the embankment to the north of the Sutlej River.
- The top section of the inside of the western water channel shall have a grass-crete finish to achieve a green appearance. The outside edges of the bunds shall remain soft so that screen planting can be included. Screen planting shall incorporate trees that will not only screen the bunding but will also screen the pumping station from sensitive viewpoints to the west on the higher ground.
- Reinstatement planting in areas disturbed by works on the eastern watercourse. Planting could be incorporated on the outside edge of the bunds to screen the open section of the watercourse.

Further details are to be provided in the detailed landscape plan.

2.7 Community Issues

2.7.1 Existing Environment

Access by road and pedestrian path is important for Tsung Pak Long due to its relatively isolated position.

2.7.2 Impact Assessment

Disruption of access will occur during the construction phase.

2.7.3 Mitigation Measures

- The contract will require a minimum of a one way traffic flow and pedestrian access to be maintained at all times. This is of particular importance for school children who require safe access from the surrounding areas to the school at Tsung Pak Long.

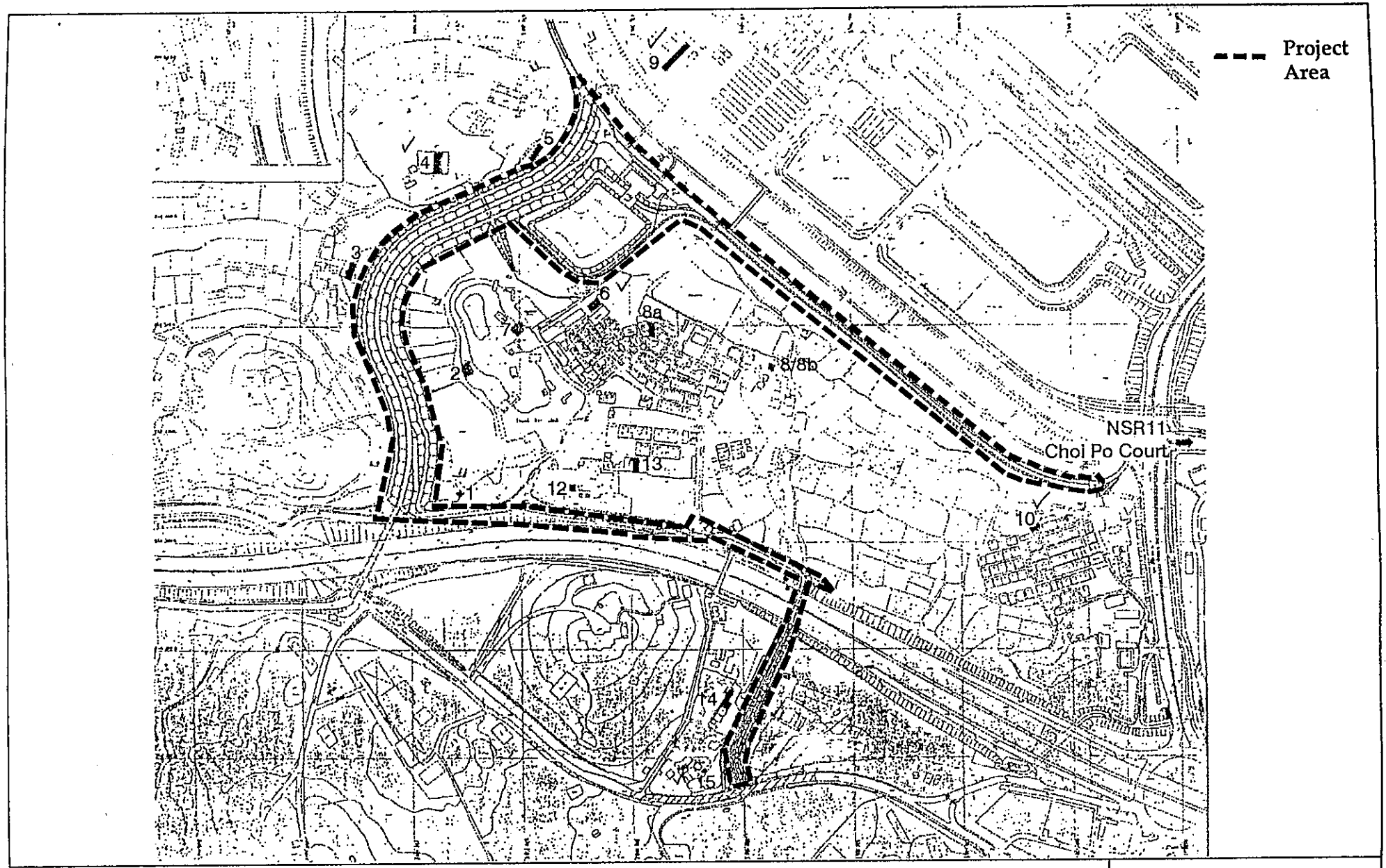

Figure 2.1 Representative Noise Sensitive Receivers (NSRs) & Air Quality Sensitive Receivers (ASRs)

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3 PROJECT PROGRAMME

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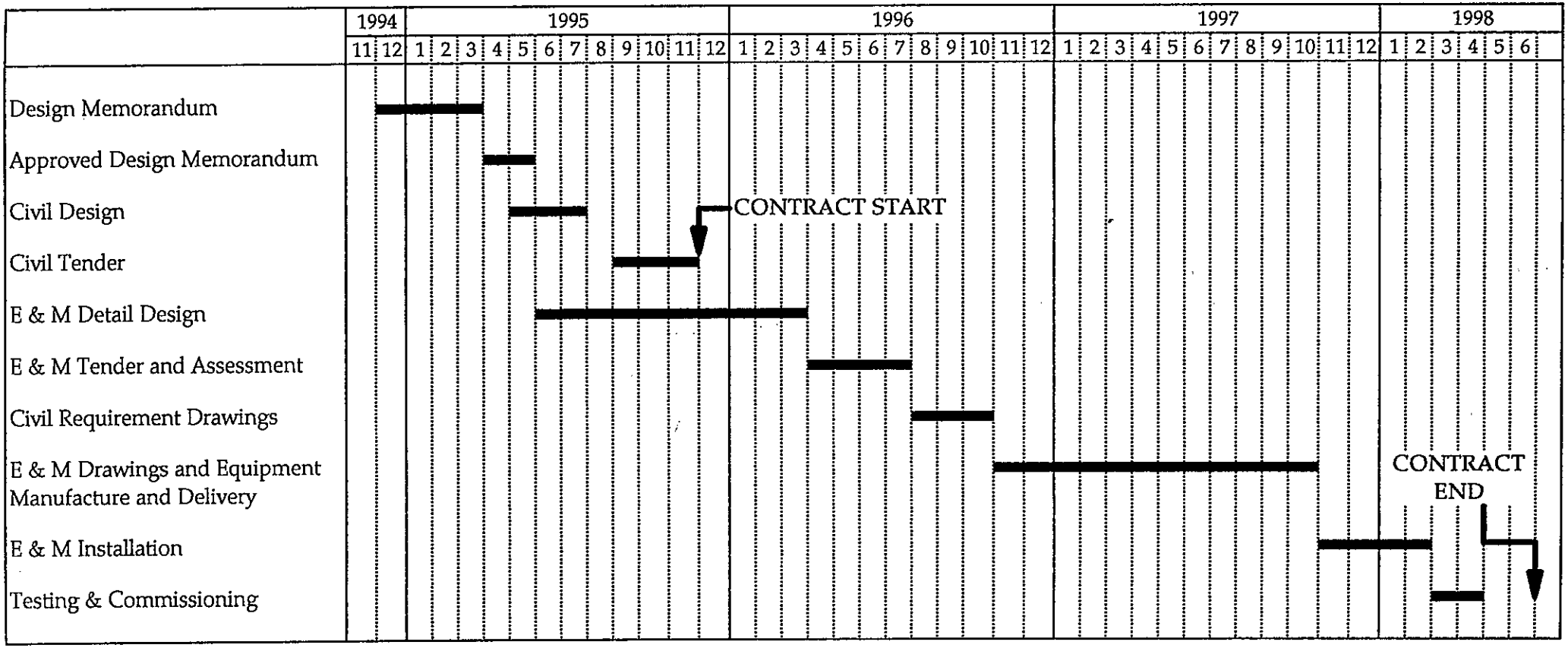

Figure 3.1 Project Programme

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4 PROJECT ORGANISATION

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4.1 Project Management Team

The monitoring and audit work should be carried out by an Environmental Team and contracted to an independant organisation not directly responsible for cost and programme considerations. This will ensure that the environmental monitoring and auditing programme is not constrained by conflict of responsibilities. The structure of the project team is given in Figure 4.1.

4.2 Organisation of the Environmental Team

The Environmental Team is responsible for collection of any baseline data required and for monitoring during construction activities. The team will consist of (i) a Team Leader who is experienced in monitoring and audit of construction work, and (ii) a field team of technical staff who are competent in the measurement of environmental parameters on site using instrumentation and in the collection, storage and transport of environmental samples.

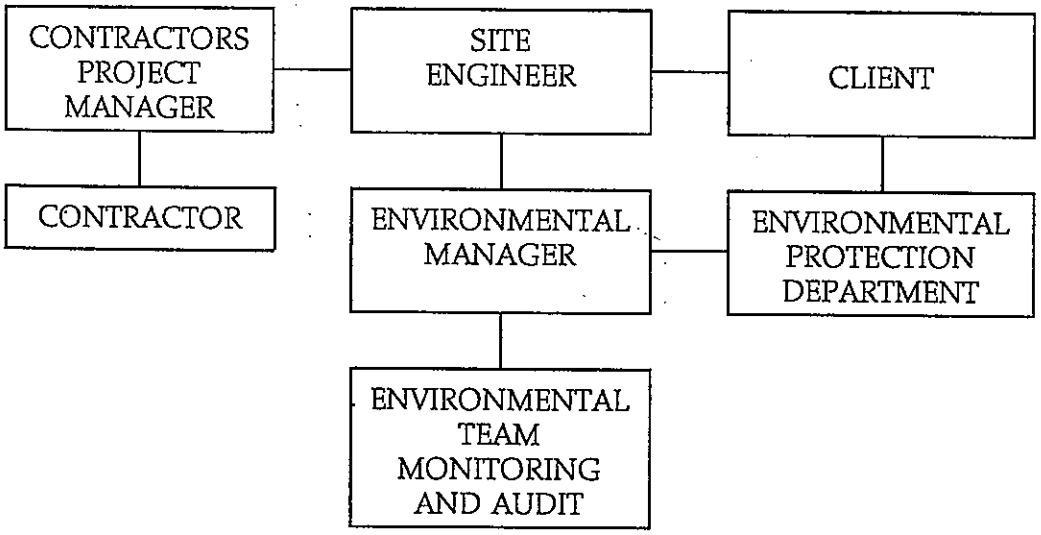

Figure 4.1 Structure of Project Management Team

5 ENVIRONMENTAL MONITORING AND AUDIT REQUIREMENTS

5 ENVIRONMENTAL MONITORING AND AUDIT REQUIREMENTS

5.1 Monitoring Schedule

Monitoring is recommended for water quality, noise and air quality. Monitoring is not considered necessary for ecology; historical and cultural heritage; visual impacts and landscaping; and community issues.

5.2 Baseline Monitoring

Baseline monitoring of noise, water quality and air quality before the project starts is required to ascertain the existing conditions of the site area for setting the trigger, action and target (TAT) levels required during construction.

5.2.1 Water Quality

The baseline parameter of turbidity shall be established by daily sampling of the eastern watercourse for four weeks prior to the commencement of construction works.

5.2.2 Noise

Baseline monitoring of noise is not required, as background levels are presently low.

5.2.3 Air Quality

Baseline monitoring should be carried out by the Engineer prior to the commencement of the construction work to determine the ambient dust (TSP) levels at specified monitoring stations. The baseline monitoring should be carried out for a period of at least two consecutive weeks (14 readings) prior to commissioning of the construction work - daily for 24-hour sampling, at least 3 times per day for 1-hour sampling while the highest dust level is expected.

5.3 Compliance Monitoring

Compliance monitoring of noise, water and air quality during construction shall be undertaken with respect to acceptance criteria. This will provide an early indication if any of the environmental control measures or construction practices are failing to achieve the required standards, so that proactive mitigation measures can be adopted.

5.3.1 Water Quality

Turbidity is to be monitored daily, at survey locations positioned within 10 m upstream and downstream of the works on the eastern watercourse.

5.3.2 Noise

Daytime compliance monitoring to be undertaken at least three times per week, involving measurement over a 30-minute period of typical activity.

5.3.3 Air Quality

Compliance monitoring during the course of the construction should be undertaken at a frequency not lower than one 24-hour measurement per six days and 1-hour monitoring should be carried out 3 times for every 6 days at the highest dust impact occasion. Should the monitoring results indicate a deteriorating situation, closer monitoring may be undertaken by the Engineer until the monitoring results indicate an improving and acceptable level of air quality. Meanwhile, the Engineer may direct the Contractor to take mitigation measures concerning potential dust sources and working procedures.

5.4 Trigger, Action, and Target Levels

It is an accepted practice to apply a preset range of Trigger, Action and Target (TAT) levels as a framework for interpreting monitoring results. These levels are defined as follows:

Trigger - trigger levels provide an indication of deteriorating ambient environmental quality

Action - action levels indicate the necessity to adopt appropriate remedial actions to prevent the environmental quality from going beyond the target limits. If levels go above target, appropriate remedial action, including critical review of plant and work methods would be required

Target - target levels are stipulated in relevant pollution control ordinances, Technical Memoranda, Hong Kong Planning Standards and Guidelines. These are the maximum levels at which the works could be permitted to proceed

TAT levels for water and air quality will be established after the completion of baseline monitoring to provide effective environmental management of the project as well as in accordance with methods to be specified or approved by EPD.

TAT levels must be realistic, and related to existing conditions as well as statutory guidelines. Levels should not be set too low. If levels are set too low, a continuous series of exceedances will diminish the effectiveness of monitoring. In cases where the exceedance of guidelines and statutory standards already exist, levels must take account of this. Alternatively, if levels are set too high, they will not be useful in indicating deteriorating conditions which could be controlled by mitigation measures.

5.4.1 Water Quality

TAT levels will be derived from baseline readings taken daily for four weeks prior to construction commencing. Simultaneous upstream control measurements shall be taken to provide an indication of natural variations in turbidity.

- Trigger Level: 99 %ile of baseline monitoring and 10 % greater than the upstream control value.
- Action Level: mid-way between the Trigger and Target values.
- Target Level: 99 %ile of baseline and 30 % greater than upstream control value.

5.4.2 Noise

- Trigger Level: receipt of one independent complaint (directed either to EPD or the site office).
- Action Level: receipt of more than one independent complaint in a four-week period.
- Target Level: in the absence of statutory controls to limit daytime (07.00-19.00hrs) construction noise, a limit of 75 dB(A) (L_{eq} 30 min) may be adopted as the Target level. To be reduced to 70 dB(A) for schools and 65 dB(A) during school examination periods.

5.4.3 Air Quality

TAT levels will be derived from baseline readings taken daily for two weeks prior to construction commencing.

- Trigger Level: 95%ile of the baseline monitoring results, for TSP(24-hr) and TSP(1-hr).
- Action Level: mid-way between the Trigger and Target Levels.
- Target Level: Air Quality Objective of 260 μgm^{-3} for TSP(24-hr) and the guideline of 500 μgm^{-3} for TSP(1-hr).

Table 5.1 Air, Noise and Water TAT Levels

Parameter		Trigger Level	Action Level	Target Level
Air Quality	TSP (1hr) TSP (24 hr)	Baseline + 30% or 95 %ile of baseline if Baseline + 30% is too low to function*	Average of Trigger and Target Levels	500 μgm^{-3} (TSP-1 hr) 260 μgm^{-3} (TSP-24hr)
Noise	$L_{Aeq\ (30\ min)}$	1 complaint	> 1 independent complaint in a four week period	75 dB(A)**
Fresh Water Quality	turbidity	95 %ile of baseline and 10 % > upstream control	Mid-way between Trigger and Target Levels	99 %ile of baseline and 30 % > upstream control

Notes * To be agreed with EPD when baseline data are available.

** Applies during non-restricted hours (0700-1900 hrs weekdays, except for public holidays). Reduced to 70 dB(A) near schools and 65 dB(A) at examination periods. During restricted hours a Construction Noise Permit would be required, and the conditions stipulated in the CNP should be followed.

5.5 TAT Action Plans

When exceedance of TAT levels occurs, recommended action has to be undertaken to control environmental impacts to acceptable levels. The action plans in event of exceedance of TAT levels are shown in Tables 5.2 and 5.3.

Table 5.2 Action Plan in Event of Exceedance of Water or Air Quality TAT Levels

	Actions		
	Environmental Team Leader	Engineer's Representative (ER)	Contractor
Trigger Limit			
1. Exceedance for one sample	1. Identify source 2. Inform ER 3. Repeat measurement to confirm finding	1. Notify Contractor 2. Check monitoring date and Contractor's working methods	1. Rectify any unacceptable practice
2. Exceedance for two or more consecutive samples	1. Identify source 2. Inform ER 3. Repeat measurements to confirm findings 4. Increase monitoring frequency 5. Discuss with ER for remedial actions required. 6. If remedies required, contact ER to make arrangement 7. If problem is short term, continue monitoring 8. If exceedance stops, cease additional monitoring	1. Notify Contractor 2. Check monitoring data and Contractor's working methods 3. Discuss with Contractor for remedial works, if necessary	1. Rectify any unacceptable practice 2. Consider changes to working methods
Action Limit			
1. Exceedance for one sample	1. Identify source 2. Inform ER 3. Repeat measurements to confirm findings 4. Increase monitoring frequency to daily	1. Notify Contractor 2. Check monitoring data and Contractor's working methods	1. Rectify any unacceptable practice 2. Amend working methods if appropriate
2. Exceedance for two or more consecutive samples	1. Identify source 2. Inform ER 3. Repeat measurement to confirm findings 4. Increase monitoring frequency to daily 5. Discuss with ER for remedial actions required 6. If exceedance continues, arrange meeting with ER 7. If exceedance stops, cease additional monitoring	1. Confirm receipt of notification of failure in writing 2. Notify Contractor 3. Check monitoring and Contractor's working methods 4 Discuss with Environmental Supervisor and Contractor on potential remedial actions 5. Ensure remedial actions properly implemented	1. Submit proposals for remedial actions to ER within 3 working days of notification 2. Implement the agreed proposals 3. Amend proposal if appropriate
Target Limit			
1. Exceedance for one sample	1. Identify source 2. Inform ER and EPD verbally 3. Repeat measurement to confirm finding 4. Increase monitoring frequency to daily 5. Assess effectiveness of Contractor's remedial actions and keep EPD and ER informed of the results	1. Confirm receipt of notification of failure in writing 2. Notify Contractor 3. Check monitoring data and Contractor's working methods 4. Discuss with Environmental Team Leader and Contractor potential remedial actions 5. Ensure remedial actions properly implemented	1. Take immediate action to avoid further exceedance 2. Submit proposals for remedial actions to ER within 3 working days of notification 3. Implement the agreed proposals 4. Amend proposal if appropriate
2. Exceedance for two or more consecutive samples	1. Identify source 2. Inform ER and EPD the causes & actions taken for the exceedances 3. Repeat measurement to confirm findings 4. Increase monitoring frequency to daily 5. Investigate the causes of exceedance 6. Arrange meeting with EPD and ER to discuss the remedial actions to be taken 7. Assess effectiveness of Contractor's remedial actions and keep EPD and ER informed of the results 8. If exceedance stops, cease additional monitoring	1. Confirm receipt of notification of failure in writing 2. Notify Contractor 3. Carry out analysis of Contractor's working procedures to determine possible mitigation to be implemented 4. Discuss amongst Environmental Team Leader and the Contractor potential remedial actions 5. Review Contractor's remedial actions whenever necessary to assure their effectiveness 6. If exceedance continues, consider what portion of the work is responsible and instruct the Contractor to stop that portion of work until the exceedance is abated.	1. Take immediate action to avoid further exceedance 2. Submit proposals for remedial actions to ER within 3 working days of notification 3. Implement the agreed proposal 4. Resubmit proposals if problem still not under control 5. Stop the relevant portion of works as determined by the ER until the exceedance is abated

Table 5.3 Action Plan in Event of Exceedance of Noise TAT Levels

	Actions		
	Environmental Team Leader	Engineer's Representative (ER)	Contractor
Trigger Level			
When a complaint is received	1. Notify Contractor 2. Conduct Measurement 3. Investigate Noisy Operations		-
Action Level			
When more than one complaint is received within 2 weeks on the same event or at the same location	1. Notify Contractor 2. Analyse investigation 3. Require Contractor to propose measures for the analysed noise problem 4. Increase monitoring frequency to check mitigation effectiveness		1. Submit noise mitigation proposals to Environmental Team Leader/Engineer's Representative 2. Implement noise mitigation proposals
Target Level			
Non-statutory -75* dB(A) exceeded between 0700-1900 hrs on normal weekdays;	1. Notify Contractor 2. Notify EPD# 3. Require contractor to implement mitigation measure 4. Increase monitoring frequency to check mitigation effectiveness		1. Implement mitigation measures 2. Prove to Environmental Team Leader ER effectiveness of measure applied
Statutory - 60/65/70** dB(A) exceeded between 0700-2300 hrs on holidays and 1900 - 2300 hrs on all Statutory other days; 45/50/55** dB(A) exceeded between 2300 - 0700 hrs of next day			

* reduce to 70 dB(A) for schools and 65 dB(A) during school examination periods
**to be selected based on Area Sensitivity Rating
only applicable to projects of significant scale

5.6 Monitoring Locations and Parameters

5.6.1 Water Quality

The survey locations are within 10 m of the works, both upstream and downstream on the eastern watercourse. The parameter to be monitored is turbidity.

/5.6.2 Noise

Measurements are to be carried out 1 m from the worst-affected external facades of NSRs 1, 2, 3, 4, 5, 6, 8, 9, 10, 12, 13, 14 & 15, (see Figure 2.1), but may be re-positioned at any other point considered appropriate by EPD.

5.6.3 Air Quality

Air quality is to be measured at two monitoring stations, close to the site boundary, free from local obstructions or shelters. One should be near sensitive receivers 3 or 5, and the other in the main part of Tsung Pak Long Village. The exact locations should be reviewed in relation to practical site constraints.

5.7 Monitoring Equipment

5.7.1 Water Quality

Turbidity is to be measured using a HACH 2100P Turbidimeter or equipment with similar specifications. The instrument shall operate on a nephelometric principle and shall be portable, weatherproof and with a comprehensive operation manual. The equipment shall be operable from a DC power source and with a photoelectric sensor capable of measuring turbidity between 0-200 NTU and with a cable at least 30 m long.

5.7.2 Noise

Noise shall be monitored using Bruel and Kjaer modular precision sound level meter type 2231, with statistical analysis module BE 7101 or other suitable instruments which comply with the International Electrotechnical Commission Publications 651:1979 (Type 1) and 804:1985 (Type 1) specifications.

5.7.3 Air Quality

For air quality monitoring, the following or similar equipment will be used:

- GMWL-2000 High Volume Air Sampling System
- Haz-dust HD-1000 portable dust meter
- WD401 Wind Speed and Direction Sensor connected to a MET EL8 Data Logger will be used to collect meteorological data in accordance with the monitoring programme.

The TSP monitor will be a high volume sampler as referenced in the USEPA Standard Method 40, CFR Part 50, Appendix B.

5.8 Calibration

All monitoring equipment shall be maintained in calibration at all times. Re-calibration shall be carried out in accordance with requirements stated in this manual or that recommended by the manufacturers (whichever is more stringent).

5.8.1 Water Quality

The Turbidimeter shall be standardised with reference formazin gel solutions every time before use. Every two months the Turbidimeter shall be calibrated using standard formazin solutions, by an independent laboratory which is HOKLAS accredited for this test.

5.8.2 Noise

The sound level meters to be calibrated using a Bruel and Kjaer Sound Level Calibrator Type 4230, or other similar equipment, prior to and after each set of measurements. The results of the calibration shall be recorded on a field data form. The measurement shall be discarded if the calibrations before and after do not agree to within 1 dB(A), then repeated until the calibrations before and after agree to within 1 dB(A). An annual calibration check shall be carried out by the manufacturer.

5.8.3 Air Quality

The flow rate of each high volume sampler with mass flow controller will be calibrated using an orifice calibrator. Initial five point calibration will be conducted upon installation and prior to commissioning. One point flow rate calibration will be carried out every two months. Five point calibration will be carried out initially and every six months thereafter.

The portable dust meters will be calibrated against a known standard on each occasion the meter is used.

5.9 Methodology

5.9.1 Water Quality

Two consecutive readings of turbidity will be taken at each specified location immediately below the surface. If the two consecutive readings do not agree to within 25%, the readings will be discarded and repeated.

5.9.2 Noise

Daytime compliance monitoring to be undertaken at least three times per week, involving measurement over a 30-minute period of typical activity. Measurement shall be carried out 1 m from the worst-affected external facades of designated NSRs, but may be re-positioned at any other point considered appropriate by EPD.

Noise measurements shall be made in terms of the A-weighted equivalent continuous sound pressure level (L_{eq}) measured with an integrating sound level meter. Where applicable, such measurements shall be made over a 30 minute period to give 6 consecutive L_{eq}(5 min) readings. The readings must be undertaken in accordance with the

methodology specified in the relevant Technical Memorandum on construction noise. Where applicable, the L_{eq}(30 minute) reading shall be calculated from the L_{eq}(5 minute) readings within the noise meter, based on standard acoustical principles. Noise measurements should not be made during periods of high background noise (such as during peak traffic hours), or in the presence of fog, rain, or excessive steady or gusty winds.

5.9.3 Air Quality

TSP is sampled by drawing air through a conditioned, pre-weighed filter paper inside the high volume sampler at a controlled flow rate. After 24 hours of sampling the filter paper with retained particulates would be collected and returned to the laboratory for drying in a desiccator, followed by accurate weighing. TSP levels are calculated from the ratio of mass of particulates retained on the filter paper to the total volume of air sampled. The analysis process normally takes approximately two days. All procedures will follow USEPA Standard Method 40, CFR, Part 58, Appendix B.

Sample collection filters will comprise of glass fibre, quartz fibre or teflon fibres in order to minimise sample degradation.

5.10 Data Recording

Standard pro-formas shall be used for recording field data. The data shall then be input into a computerised database. These will serve as a systematic method of recording and storing data. In the event of complaints or evidence of unacceptable environmental impacts being obtained from the monitoring results, these data should be easy to reference.

Monitoring staff shall record observations regarding activities/events that could affect the monitoring results.

5.11 Contingency Planning

Contingency plans to be made for the following eventualities:

- delay in equipment delivery or set-up;
- delay in provision of monitoring sites;
- problems with power supply;
- problems with laboratory facilities;
- prolonged non-availability of key personnel;
- requirements for additional monitoring staff, equipment or sites if the frequency or scope of monitoring is increased eg in implementing Action Plans;
- failure or theft of equipment; and
- adverse weather conditions.

All efforts will be made to acquire, prepare and install the equipment to meet the start date of the programme. Should there be a delay in installation, the Client and EPD shall be informed of the revised start date for that environmental parameter. The monitoring programme for unaffected environmental parameters will proceed as scheduled.

In the absence of key monitoring personnel for longer than 2 weeks, a suitable replacement shall be found within 1 week of the commencement of the period of non-availability. In the interim period, the responsibilities of the individual in question shall be assumed by another member of the monitoring team who is experienced in the monitoring procedures.

Provisions are to be made for the case of equipment failure or theft. The contractor is to have access to back-up equipment, which can be made available within 1 week of equipment failure or theft. This is to assure that the monitoring programmes will not be interrupted for an extended time period due to equipment failure or loss.

Should changes in the schedule occur due to any of the above reasons, the client and EPD are to be notified as soon as possible of the inability to sample according to the original schedule. The monitoring is to be rescheduled as soon as practicable.

5.12 Reporting

A monthly Monitoring and Audit Report shall be prepared within 10 days of the end of each month with the first report due in the month after construction commences. Reports shall be submitted to the contractor and EPD. The report shall include:

- Summary of the main points of the report.
- Synopsis of the project organisation, project programme, and management liaison structure.
- Monitoring equipment used, calibration schedule, locations, duration and frequency.
- Monitoring Results: Parameter, date, time, environmental conditions and locations. Results should be presented as full page graphs of each parameterson a cumulative time basis at all the stations with TAT levels clearly shown on the graph.
- Audit Result: Review of pollution sources and working procedures in the event of non-compliance with environmental monitoring levels; action taken in the event of non-compliance; and follow up procedures related to earlier non-compliance actions. Summary of the number of TAT level exceedances in the month. List of active construction noise permits.
- Compliance with environmental legislation.
- Complaint: Liaison and consultation undertaken, subsequent action, database of telephone/written complaints, location of complaints, action plan, and follow-up procedures.
- Implementation status of specified mitigation measures.

It should be noted that under normal circumstances, non-compliance and remedial action will be addressed in the monthly Environmental Monitoring and Audit reports, but would also need to be dealt with on a day to day basis through the issue of action plans detailing deviations from the specification and requesting the contractor to correct the deviations.

5.13 Environmental Complaints Response Procedure

The EPD hotline shall be used to receive complaints regarding environmental quality impacts arising from the project area. Any complaints received shall be passed to the ET. The following steps shall be taken upon receipt of complaints:

- log complaint and date of receipt onto the complaint database
- investigate the complaint to determine its validity, and to assess whether the source of the problem is due to recurring works activities
- if complaint is valid and due to works, identify mitigation measures
- undertake additional monitoring and audit to verify the situation as necessary, and address the issue in the Monthly Monitoring and Audit report
- log the data and results of the investigation onto the database
- notify complainants of results of complaint investigation
- audit procedures to ensure that any valid reason for complaint does not recur

The procedures are outlined in Figure 5.1.

Figure 5.1 Complaints Response Procedure