SHEK O QUARRY CASTING BASIN

ENVIRONMENTAL IMPACT ASSESSMENT

FINAL KEY ISSUES REPORT

MARCH 1994

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REPORT

ON

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ENVIRONMENTAL IMPACT ASSESSMENT

FINAL KEY ISSUES REPORT

MARCH 1994

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SUMMARY

1 The construction of a casting basin within Shek O Quarry for the purpose of forming immersed tube tunnel units for the Western Harbour Crossing (WHC) has been proposed.

2 Detailed proposals for the rehabilitation of Shek O Quarry were submitted by the operator, Pioneer Quarries, in 1991 in a report entitled "Preliminary Report for Development and Landscape Restoration". The proposed landform following rehabilitation included a marine cove developed from the excavation and subsequent flooding of the quarry floor. This proposal conformed to the proposals under Metroplan which identified the site as a potential marine cove.

3 A preliminary EIA has been submitted by the quarry operator relating to the rehabilitation proposals which have been approved in principle pending additional studies as follows :

- o Mathematical modelling of the proposed marine cove to assess water quality
- o Method statement for construction of the proposed marine cove
- o Details of existing, interim and final treatment of stormwater run-off and drainage

4 The primary focus of the present study is therefore the impacts of Casting Basin operations *per se*, although the cumulative aspects of the quarrying activities which influence or impinge upon the Casting Basin have also been evaluated.

5 A baseline monitoring programme for this study was completed during July and August 1993. The programme included assessments of noise, air, marine water quality and sediments, water current speed and direction in Tai Tam Bay, terrestrial and marine ecology.

6 Key issues are summarised as follows :

- o Vehicle emissions are not considered to be a key issue.
- o With the exception of To Tei Wan, the majority of the sensitive receivers are a considerable distance from the site. Model predictions indicate that there should be compliance with Air Quality Objectives (AQO's) and guideline levels from combined Casting Basin and Quarry operations.
- o The monitoring programme has shown that current dust levels are at times in exceedance of the statutory AQO's at the site boundary and To Tei Wan Village. However, dust levels at the village may not necessarily all be derived from the Quarry. Modelling has indicated that TSP and RSP concentrations from combined Quarry and Casting Basin operations should be within the AQO's at the closest inhabited areas. The Casting Basin contributes only a small percentage of the dust.
- o The topography of the area provides local villages with shielding from noise from the quarry. The potentially affected receivers are Redhill, American Club and Stanley. The overall operational noise level at Red Hill may exceed the statutory day-time criteria by 1 dB(A). However, the assessment is conservative. Noise levels arising specifically from operational casting activities will be insignificant.

- o If night-time working is required this assessment indicates that the criteria may be exceeded at the Red Hill peninsula and at Stanley. There would be a requirement to reduce noise levels by 1 dB(A) to meet criteria. This should be achievable by control of plant activities on site.

- o Water quality in Tai Tam Bay is good but there is potential for nutrient enrichment. Sewage effluent and dredged sediments are sources of nutrients. All sewage will be treated off-site, thus removing any potential for nutrient enrichment from this source. The use of a cofferdam will reduce impacts from sediment dredging and available nutrients from this source are expected to be small.

- o In view of the use of a cofferdam to allow dry blasting and excavation, and the limited volume of sediments to be dredged for the base of the cofferdam, effects on the marine communities and ecology from these activities are likely to be very small and temporary.

- o Marine sediments are uncontaminated and the disposal of dredged materials is not a key issue.

- o The only terrestrial ecology issues lie outside the quarry and casting basin sites. The area to the southwest of the quarry face, immediately adjacent to the D'Aguilar Peninsula SSSI is considered to have high conservation significance. This has implications for the current rehabilitation proposals which have identified this area as land-take required for grading of the quarry face. It is recommended that the current proposals are re-assessed by Pioneer Quarries, their consultants and relevant Government Departments, to investigate alternative viable options to permit, if possible, the retention of cliff faces in the southern part of the quarry which offer opportunities for wildlife enhancement, and protection to the existing SSSI.

- o The combined quarry and casting basin operations will generate little waste. Bulk sewage will be treated off-site and cleaning of the basin prior to opening the sea gates will ensure that wastes will not be a key issue.

7 The construction and operation of a casting basin in Shek O Quarry will result in relatively minor impacts on the environment and will not significantly increase the environmental impact of the existing quarry operations. With suitable mitigation measures and control of site activities based on an Environmental Monitoring and Audit Manual, the impacts of the individual and cumulative activities of the casting basin and quarry should not result in a deterioration in current environmental standards.

1 INTRODUCTION

1.1 Background to the Study

The construction of a casting basin within Shek O Quarry for the purpose of forming immersed tube tunnel units for the Western Harbour Crossing (WHC) has been proposed.

Shek O Quarry has been one of Hong Kong's principal quarries throughout the 1980's, being operated under a CED supervised contract (445/81). Under Metroplan proposals endorsed by LDPC in 1989, Shek O was identified as an area of degraded landscape requiring rehabilitation measures.

Detailed proposals for the rehabilitation of Shek O Quarry were submitted by the operator, Pioneer Quarries, in 1991 in a report entitled "Preliminary Report for Development and Landscape Restoration". The proposed landform following rehabilitation included a marine cove developed from the excavation and subsequent flooding of the quarry floor. This proposal conformed to the proposals under Metroplan which identified the site as a potential marine recreation activity centre. No marine facilities were to be provided within the rehabilitation contract other than the provision of the cove.

In 1992 the operator applied to GEO on behalf of the consortium bidding for the WHC franchise to proceed with the excavation of the marine cove in order that the quarry floor might be utilised as a casting basin for the fabrication of the WHC immersed tube units.

Following submission of a preliminary EIA of the casting basin by the quarry operator in June 1992, it is understood that the after use and rehabilitation proposals for the quarry have been endorsed by EPD subject to further work on

- Mathematical modelling of the proposed marine cove to assess water quality
- Method statement for construction of the proposed marine cove
- Details of existing, interim and final treatment of stormwater run-off and drainage

The primary focus of the present study, commissioned by the WHC joint venture, is therefore on the casting basin operation *per se* and associated impact assessment and to evaluate cumulative areas of overlap between quarry and casting basin operations.

1.2 Purpose of the Report

The purpose of this Environmental Impact Assessment is to provide information on the nature and extent of environmental impacts arising from the formation and operation of the proposed casting basin and from all other activities taking place concurrently at Shek O Quarry.

Preceded by a Draft Initial Assessment Report and a Draft Final Key Issues Report, this report incorporates comments received from Government Departments on the former documents and effectively constitutes a combined Final Initial Assessment and Final Key Issues Report. Comments on the Draft Initial Assessment and Draft Final Key Issues Report are presented in Appendix I.

1.2.1 The objectives of the environmental impact assessment are as follows :

a) to describe the proposed use(s) and requirements for carrying out the proposed use(s);

b) to identify and describe the elements of the community and environment likely to be affected by the proposed use(s);

c) to propose infrastructure provision or mitigation measures to minimise pollution, environmental disturbance and nuisance during construction and operation of the developments;

d) to identify, assess and evaluate the residual (ie. after practicable mitigation) environmental impacts and cumulative effects expected to arise during the construction and operation phases of the casting basin in relation to the neighbouring land uses and water bodies;

e) to identify, assess and specify methods, measures and standards to be included in the detailed design, which are necessary to mitigate these impacts and reduce them to acceptable levels; and

f) to design and specify the environmental monitoring and audit requirements necessary to ensure the effectiveness of the environmental protection measures adopted.

1.2.2 Although the above objectives refer to construction and operational phases for the casting basins, two categories of activity need to be considered:

a) Quarry activity

Quarry activity and mineral processing will continue throughout the formation of the casting basin and also during the tunnel segment casting operations in order to supply the raw materials for the process and for various other internal and external users.

b) Casting basin operations

Casting basin operations will be distinct from the quarry operations, relating to the formation and transport of the tunnel segments.

1.2.3 The emissions and nuisance from the above two categories, in terms of the normal environmental parameters, may be calculated independently; however, the impacts on sensitive receivers must be assessed as the result of the cumulative effects of all the impacting sources. The EIA will consider both quarry operations and casting basin impacts together as one integrated study.

1.2.4 While it is necessary to evaluate the cumulative impacts of both the construction and operation of the casting basin and impacts associated with the quarrying activities, it should be noted that the casting basin operators will take delivery of the preformed basin, the excavation of which will be the responsibility of the quarry operator, under the existing quarry contract.

2 SITE DESCRIPTION

2.1 The Quarry

Shek O Quarry is located on the western side of the D'Aguilar Peninsula facing Stanley and presently covers an area of approximately 35 hectares (Figure 2.1). The future area of the Quarry will be approximately 46 ha but the boundaries have yet to be finalised. The quarry is surrounded by high ground and the present terraces present vertical faces set into the hillside. Quarry operations extend from the Shek O Road to the coast where a barging facility is located.

The quarry abutts the Shek O Country Park and at present it does not extend into the park. Under rehabilitation proposals submitted to the Government by the quarry operator the quarry will commence operations on the country park side of Shek O road in order to reduce the existing slope and to achieve the final land form proposed under the rehabilitation scheme.

The nearest village is 400 m distant at To Tei Wan (population approximately 15) and the area in general has a very low population and poor coastal access. The inshore area adjacent to To Tei Wan is classed as an inshore recreation area, and adjacent to the southeast boundary of the proposed quarrying area is the Cape D'Aguilar Site of Special Scientific Interest (SSSI).

2.2 Casting Basin

2.2.1 The Site

The proposed casting basin and infrastructure will occupy a site of approximately 14 hectares in the base of the existing quarry (Figure 2.2). Two basins will be formed; one for casting and a smaller basin for storing the formed sections prior to removal from site. The former basin will be excavated to a depth of -10m PD and the latter to -8m PD. Each basin will have a connecting channel with the sea. The site has good access by road and sea. A temporary jetty will be constructed on the southern perimeter of the site.

Access roads for the basins and other areas will be covered by granular material. A U-channel will be constructed along the edge of the basin and two pump pits will be constructed at the end of the U-channel. One settlement tank will be installed at each outlet point.

2.2.2 Operations

The construction of the immersed tube tunnel requires that the site be occupied for approximately three years. Prior to the channels being opened, a cofferdam will be constructed up to approximately 40m offshore to provide protection to the marine environment from blasting and dredging effects (Figure 2.2). Dredging will be relatively small scale with a maximum of 15,000 - 30,000 m^3 of sediment removed, to a maximum depth of -8m PD, as the water depth in Tai Tam Bay adjacent to the casting basin is adequate for the formed sections to be floated out. The proposed area for dredging is shown in Figure 2.2.

Raw materials will be brought in by road and sea. Cement and Pulverised Fuel Ash (PFA) will be delivered by road tanker and aggregate will originate from Shek O Quarry. No stockpile is required for aggregate and cementitious material inside the plant. Aggregate will be delivered by tipper truck and top-loaded into a transfer hopper before being transferred to overhead storage bins via a conveyor. Cement and PFA will be blown to silos via sealed pipe directly from the delivery tankers. Site storage capacity for cement is 400 tonnes. A diagrammatic representation of the concrete batching process, which will be operated by Pioneer Quarries, is given in Figure 2.3.

Steel will be brought in by ship. A total of 39,000 tonnes of bar and plate will be required.

Projected numbers and types of vehicles and plant to be used on site are given in Table 4.6 (page 17).

The formed units will be of reinforced concrete construction. Each unit will comprise seven 15m long sections and two short make-up sections, one for each end which will be fabricated using a purpose-made sliding steel framework. The short sections will be rebated to form part of the final connection with each unit. It will also contain recesses to house the temporary bulkheads which will be installed prior to floating. Tunnel units will be constructed at Shek O Casting Basin in three batches of four units each.

The units will be constructed on beds of granular material, which is essential to ensure that each unit will lift freely when the casting basin is flooded. Each unit will incorporate 2,500 tonne of steel reinforcing bar, 9,440 litres of Form Oil and 6,780 litres of Concrete Surface Retarder. Approximately 1200m^3/day of concrete will be poured to meet the programmed batch production time. Horizontal construction joints will be provided to allow the pouring of units to be done in three sections i.e. base, wall and roof.

A first batch of four concrete units will be constructed in the basin prior to the connecting channel being excavated inside the cofferdam. This will minimise the amount of sea dredging required (Shek O Quarry has been Gazetted for dredging). The formed units will then be floated out of the basin, one of which will be towed directly to the WHC site and, for subsequent castings, the remaining three units will be stored in the smaller basin. The first batch of units may, however, be ready before the holding basin is available and these units will have to be stored in an area agreed by the Marine Department and subject to approvals from AFD and EPD.

Following completion of the above operation, concrete caisson gates will be put into position to close the connecting channels and allow the basins to be pumped out ready for casting the next sections. Flooding and dewatering will be achieved using 30, 8" water pumps. The caissons will be 36m long, 14m wide and 14.3m high. When not in use the gates will be stored within their respective casting basins. Water will be used to ballast the gates and they will be operated by winches.

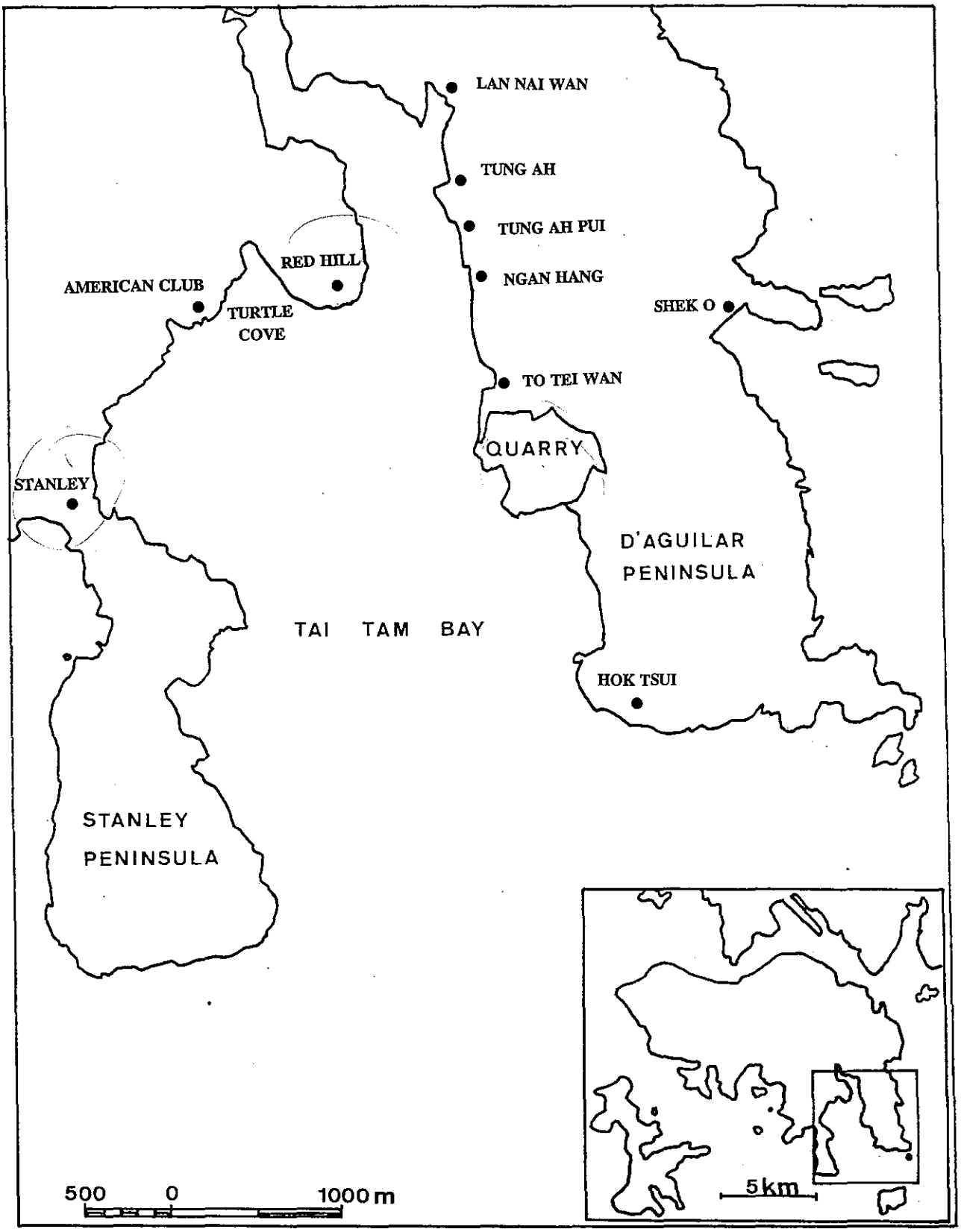


Figure 2.1 Location of Shek O Quarry

Figure 2.2 Layout of the Proposed Shek O Casting Basin

Key
- A Main Casting Basin
- B Storage Basin
- C Concrete Batching Plant
- D Component Fabrication Areas
- E Office Area
- F Marine Works Area
- ▬ ▬ ▬ Gazetted Dredging Area
- • • • • Limit of Cofferdams
- ☷☷☷☷ Channels to be Excavated/Dredged to -8 m PD

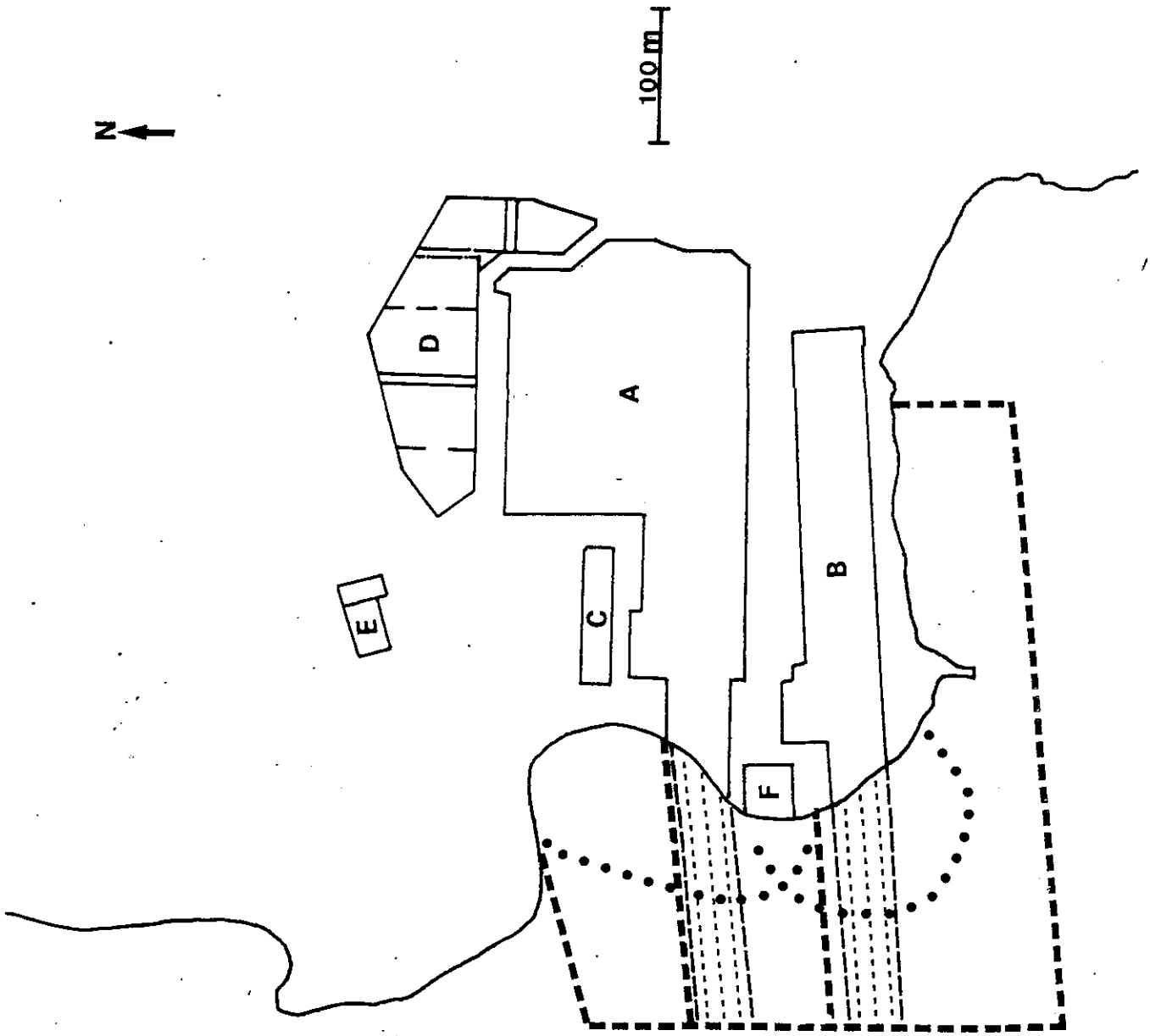
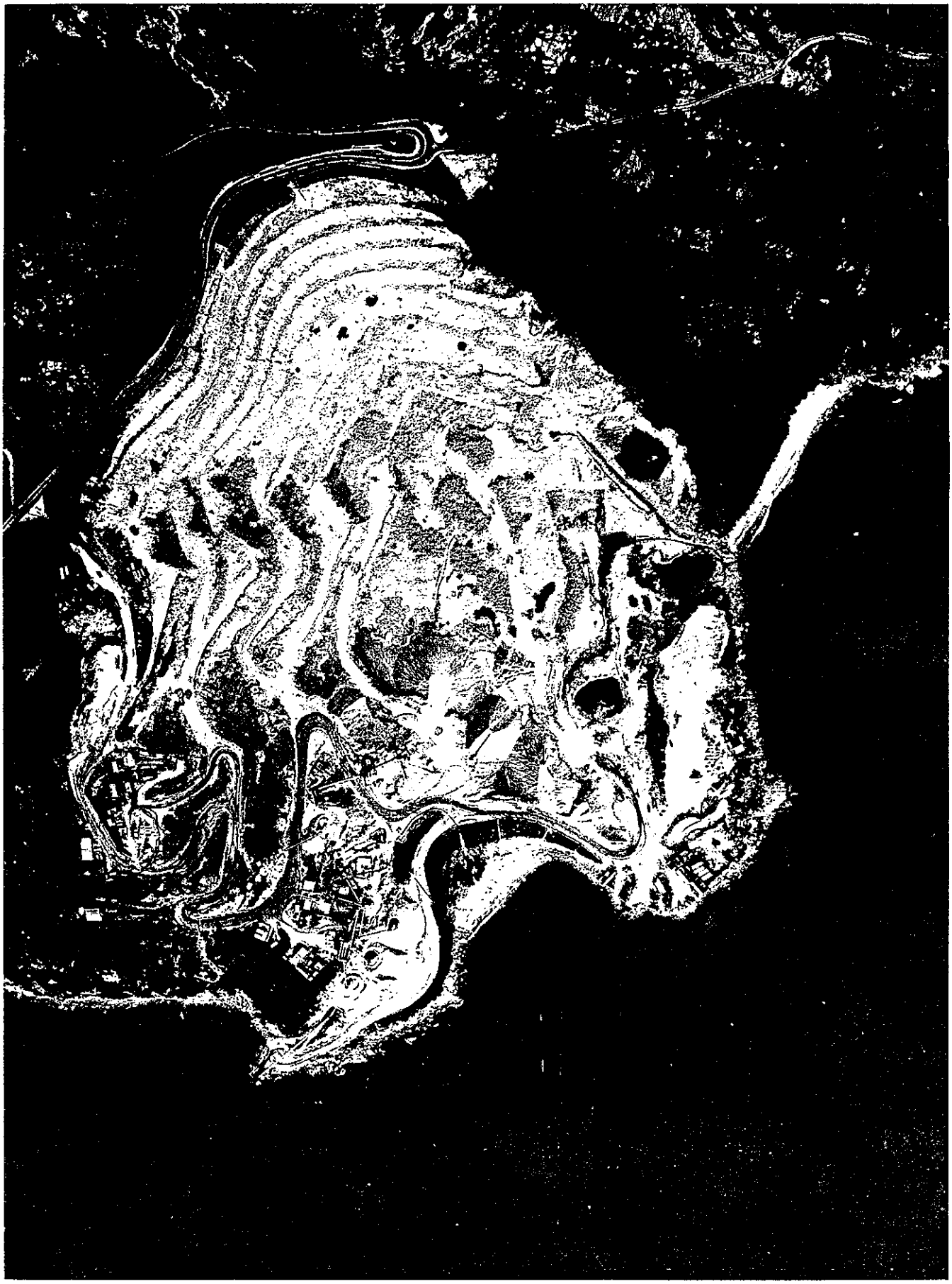


Figure 2.2 **Layout of the Proposed Shek O Casting Basin and Cofferdam**



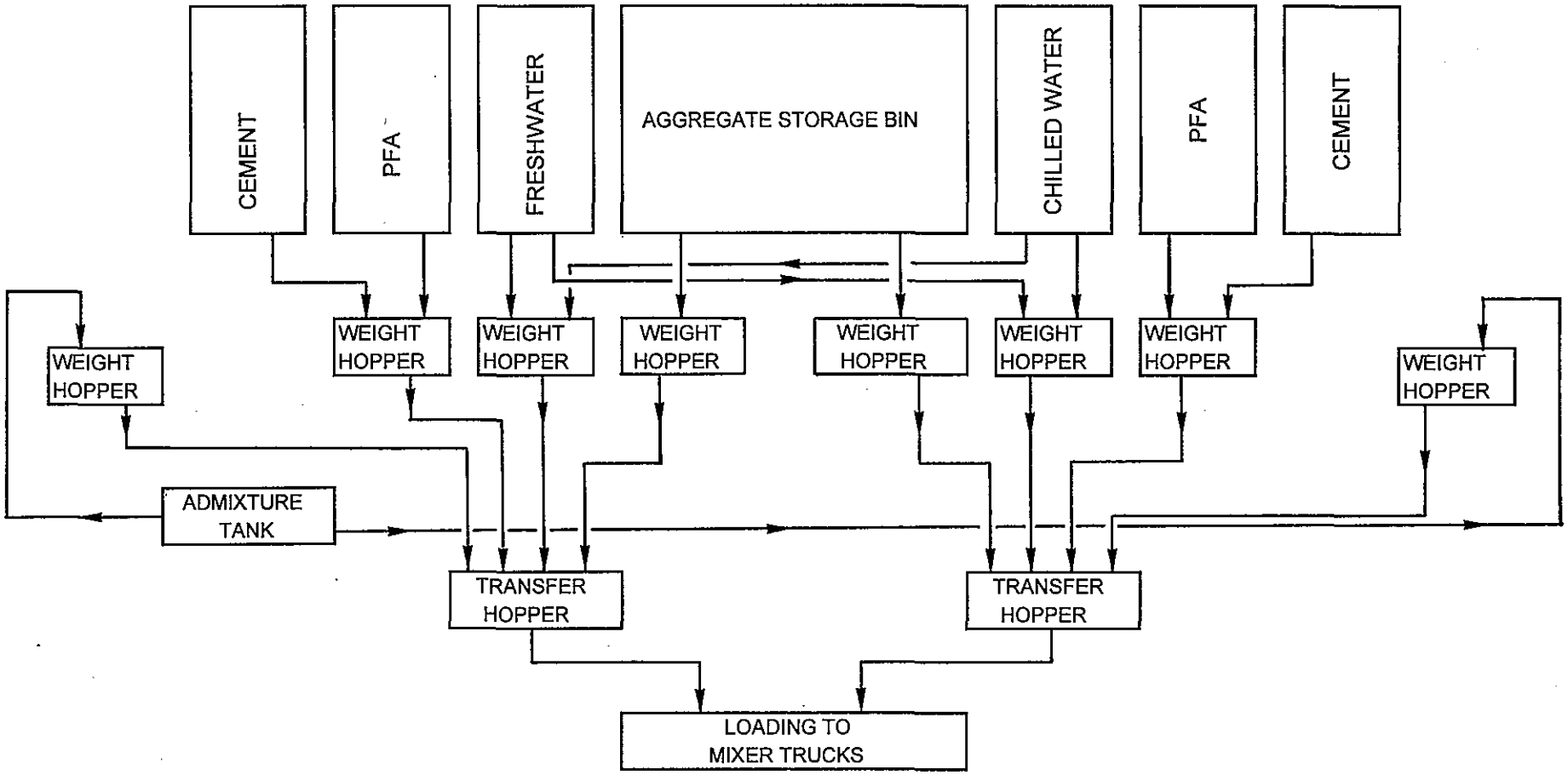


Figure 2.3 **Concrete Batching Plant for Shek O Casting Basin**

3 AIR

3.1 General

Air quality impacts are essentially concerned with dust emissions arising from the concrete batching and tunnel unit casting. There will be some vehicle movements associated with the casting operation, ie. the concrete will be transported from the batcher to the casting area in ready mix trucks. However, in view of the isolated location of the site, vehicle emissions are not considered to be a key issue. Dust will be generated from concrete batching, materials handling, vehicle movements over unpaved site surfaces and wind erosion of exposed site areas. There will be no exposed stockpiles associated with the Casting Basin operations; aggregates will be stored in an enclosed bin, and cement and PFA will be stored in enclosed silos. In this case, dust is used as a generic term for total suspended particulates (TSP) and respirable suspended particulates (RSP).

The cement works is classified as a Specified Process under the terms of the Air Pollution Control Ordinance. There will be a requirement to obtain a licence prior to operating a batching plant. The licence will require provision of best practical means for dust reduction.

3.2 Statutory and Guideline Criteria

The Air Pollution Control Ordinance (APCO) (Cap. 311, 1983) provides authority for controlling air pollutants from a variety of stationary and mobile sources, including fugitive dust emissions from construction sites, and encompasses a number of Air Quality Objectives (AQO). Currently AQOs stipulate concentrations for sulphur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), and total and respirable suspended particulates (TSP/RSP) in ambient air over the Territory. These are listed in Table 3.1.

Table 3.1 Hong Kong Air Quality Objectives (AQOs)

Parameter	Maximum Average Concentration $\mu g/m^3$			
	1-Hour*	8-Hour	24-Hour**	Annual
SO_2	800		350	80
CO	30000	10000		
NO_2	300		150	80
TSP	500***		260	80
RSP			180	55

* Not to be exceeded more than three times per year

** Not to be exceeded more than once per year

*** In addition to the above established legislative controls, it is generally accepted that an hourly average TSP concentration of 500 $\mu g/m^3$ should not be exceeded. Such a control limit is particularly relevant to construction work and has been imposed on a number of construction projects in Hong Kong in the form of contract clauses.

The TSP and RSP AQOs are of relevance to casting basin operations.

The APCO specifies a number of processes which require licensing and are subject to special controls. Recent amendments to the APCO gave provision to include concrete batching as a Specified Process. This was enacted in August 1993, so batching at this site will require to be licensed. The licensing requirements are for Best Practical Means (BPM) dust suppression measures to be employed. There are also provisions for on-going monitoring and audit, to be undertaken by the operators, with submission of the results to the Authority. Compliance with limits imposed under the licence may also be monitored directly by the Authority (EPD). Non-compliance with licence conditions may result in fines and denials in licence renewal.

Hong Kong Planning Standards and Guidelines (HKPSG) provides non-statutory guidelines for buffer distances between pollution sources (such as major roads and industrial establishments) and sensitive receivers (in particular residential and active recreational areas) to minimise the potential air quality impacts.

3.3 Sensitive Receivers

To Tei Wan Village is the closest inhabited area to the casting basin site and is exposed to dust from the existing quarry activity. Dust deposits are found on buildings and property at the village from time to time. The extent of the existing problem was examined through the monitoring programme described in Section 3.4.

There are a number of other potential receivers, these are listed in Table 3.2 and shown in Figure 2.1.

Table 3.2 Locations of Other Potential Sensitive Receivers

Location	Distance from Site (km)
Ngan Hang Village	1.0
Tung Ah Pui Village	1.3
Shek O Village	1.3
Red Hill	1.3
Hok Tsui Village	1.3
Tung Ah Village	1.5
Turtle Cove	1.7
American Club	1.9
Lan Nai Wan Village	2.2
Stanley Town	2.2

In view of the distances of these receivers from the site, and the nature of the local topography, it is considered extremely unlikely that these areas will be subject to dust impact from the casting basin operation.

3.4 Existing and Future Conditions

There are no existing data with regard to the existing dust levels in the vicinity of the quarry. In order to establish the current situation, monitoring was undertaken continuously over a 14 day period from 14.7.93 until 28.7.93. The monitoring location was selected as close to the site boundary as practical, but was limited by the need for mains power and to have a safe location. Twenty-four-hour average TSP and RSP concentrations were monitored using high volume samplers. Meteorological conditions were also monitored using a mobile meteorological station. The location is shown in Figure 3.1.

A further period of monitoring was carried out at To Tei Wan Village. Unfortunately few results were obtained, because of typhoon damage to monitoring equipment.

The results of the monitoring are shown in Table 3.3.

It can be seen that the dust levels as measured at the quarry boundary were high, frequently in exceedance of the 24-hour average AQO. Concentrations can be seen to decrease at weekends when quarrying does not take place.

It is difficult to comment on future baseline conditions following the cessation of quarry activity in this area. Quarrying is proposed to move to the other side of Shek O Road, and will be subject to tighter controls under the powers of the Air Pollution Control Ordinance.

An acknowledgement is made to Pioneer Quarries Ltd for allowing access to the existing site for the purposes of monitoring.

The monitoring at To Tei Wan was disrupted because of typhoon damage to the monitoring equipment. However, even over the short monitoring period, there were exceedances of the 24-hour average AQO for TSP at the village. High dust levels in this area were evidenced by the deposition of dust on properties and yachts in the village.

However, monitoring results may be subject to local interference or exceptional quarry operational activity. It should be noted that monitoring is indicative of the existing situation; this will improve with introduction of new quarry plant which will significantly reduce dust emissions in future.

Table 3.3 Results of Dust Monitoring

Date	Concentration (μgm^{-3})		Met. Conditions *		
	TSP	RSP	Wind Speed	Wind Direction	Rainfall (mm)
Quarry Site Boundary					
14-Jul-93	1237	275	5.4	160	0
15-Jul-93	4400	550	4.7	190	0.8
16-Jul-93	1742	412	6.2	240	T
17-Jul-93	N/A	307	7.9	250	T
18-Jul-93	176	95	9.3	250	0
19-Jul-93	1396	218	9.0	250	0
20-Jul-93	2094	404	+	+	T
21-Jul-93	1428	398	+	+	T
22-Jul-93	1170	315	+	+	80.8
23-Jul-93	1258	210	+	+	T
24-Jul-93	1019	188	+	+	0.1
25-Jul-93	186	83	+	+	0
26-Jul-93	538	164	+	+	T
27-Jul-93	233	63	+	+	0.4
To Tei Wan Village					
18-Aug-93	40	+	+	+	+
19-Aug-93	244	115	+	+	+
24-Aug-93	276	+	+	+	+
25-Aug-93	326	+	+	+	+
26-Aug-93	207	+	+	+	+
27-Aug-93	61	+	+	+	+
28-Aug-93	81	+	+	+	+
30-Aug-93	94	+	+	+	+
31-Aug-93	142	+	+	+	+

* Royal Observatory data used because of equipment failure
\+ Not available for inclusion in this study.
T Trace rainfall

3.5 Assessment Methodology

In order to establish the potential impacts from the casting basin operation, it was considered that computer simulation dispersion modelling should be undertaken.

The USEPA approved Industrial Source Complex short term (ISCST) model was used for air quality modelling. Projected work rates were used as the basis for dust generation, as provided by the basin operator. TSP and RSP concentrations for 1-hour, 24-hour and annual average time periods were predicted, and presented in the form of concentration contour plots.

3.5.1 Dust Emissions

Dust emission data were provided by Pioneer Quarries Ltd, following consultation with EPD (Table 3.4). The emissions represent the present situation of the Quarry equipment. The calculations and assumptions used for the dust emission data are provided in Appendix 3A.

3.5.2 Simulation Modelling

The ISCST model was used to calculate 1-hour, 24-hour and annual average dust levels at varying distances from the site. One hour sequential meteorological data from the Hong Kong South meteorological station were used. The years 1990-1992 were available.

The above model is limited by the inability to simulate accurately the effects of complex terrain. It is recognised that the protective effect of the natural topography is an important factor in establishing the potential impacts from the site. Modelling parameters were adjusted to account for a more realistic simulation.

To approximate the effects of the terrain more accurately, the notional datum level was set to the elevation of the lowest main area source. Receiver elevations were then input into the model as 'flagpole' heights.

These assumptions were agreed for the assessment at Anderson Road Quarry, where similar problems were encountered in the model limitations. However, in terms of receivers, this area will be less sensitive to dust nuisance.

Particle size distribution data from on-site samples were used to calculate deposition rates.

3.6 Impact on Receivers

Figures 3.2 - 3.19 show the predicted dust concentration contours (in $\mu g.m^3$) around the casting basin site. It can be seen that there should be compliance with AQOs and guideline levels arising from the combined casting and quarry operations. The casting activity will only contribute a small percentage of the overall future dust levels. Additional mitigation measures implemented on installation of new plant at the quarry will further reduce the predicted dust levels by approximately 30%.

Table 3.4 Predicted Dust Emissions from the Casting Process and Quarry Activity Before Upgrading the Quarry (kg year^{-1})

Activity	kg year^{-1}	
	TSP	RSP
BATCHING		
Dust from unpaved road - batcher to basin	1800	648
Dust from unpaved road - aggregate delivery	1090	393
Dust from unpaved road - cement/PFA delivery	737	265
Aggregate dump to hopper	794	286
Aggregate to weigh hopper	221	80
dump to ready to mix truck	0	0
Site erosion	2	1
QUARRY (Estimated)		
Drilling	680	68
Blasting	25006	5001
Loading Trucks	7704	2773
Site erosion	149	75
Transport to crusher	20594	7414
Dump at crusher	6265	2255
Primary crusher	10710	5355
Secondary crusher	10710	5355
Tertiary Crusher	10710	5355
Screening	68000	51000
Load stock piles	2938	1088
Reclaim from stockpiles	2890	187
Stock pile erosion	413	206
Total from batching activity	4644	1673
Total from quarry activity	166769	86132
TOTAL	171413	87805

3.7 Control and Mitigation

Although the casting operation will not be the major source of dust, mitigation should still be adopted by the operators to minimise dust generation, in accordance with the requirements given in the Specified Process Licence. Measures conforming to the definition of best practicable means will be adopted where applicable.

For a typical concrete batching plant, the use of filters on vents, regular watering, water sprays at vehicle loading points and partial or total enclosure of the truck loading area would reduce dust emission by the order of 90%.

A commitment to adopt good operational practices by the operators for dust minimisation should reduce the nuisance to a minimum. A number of practical measures are listed below. These reflect the general measures as given in the best practicable means Specified Process requirements, and measures specific to operations at this site should include, wherever practicable, the following :

- frequently used site roads will be watered on a regular basis
- vehicles will use wheel wash facilities or will be hosed before leaving the site
- wind shield and dust extractor will be provided at the loading point
- water sprinkler will be used at the loading area
- conveyors will be used to deliver aggregate from transfer hoppers to the storage bins
- conveyors will be enclosed or protected with wind boards
- conveyor drop heights will be minimised where practical
- conveyor drops will be shielded wherever possible
- deliveries of cement and PFA will be from tankers to silos through an enclosed system
- open stockpiles will be avoided through the use of silos and storage bins;
- cement silos will fitted with a high level alarm and all vents will be fitted with fabric filters
- weigh hoppers will be vented to suitable fabric filters
- the site will be watered and cleaned regularly, particularly during dry weather
- speed controls for on-site vehicles will be applied and enforced. A maximum speed of 8 km/h is recommended by EPD, and may become a legislative requirement
- during the selection of plant, consideration will be given to the level of dust suppression measures provided
- Concrete will be loaded wet to the mixer trucks

3.8 Monitoring and Audit

The requirements for monitoring and audit will be provided through the licence requirements, and will be considered in more detail in the Audit and Monitoring manual. Standard procedures for monitoring are:

- Provision of a high volume sampler(s) and a suitable area(s) for location of equipment within one week of commencement of work.

- The monitoring location(s) should be agreed with the Authority, these should be free from obstructions or sheltering.

- Equipment and procedures should follow Part 50 of Chapter 1 Appendix B of Tile 40 of the Code of Federal Regulations of the USA.

- Monitoring for 24-hour average TSP should be conducted once per six day period, the results should be submitted to the Authority within a three month period.

The situation at Shek O is complicated in that the majority of dust generated arises from the quarry activity. The Monitoring and Audit Manual addresses trigger levels and action plans.

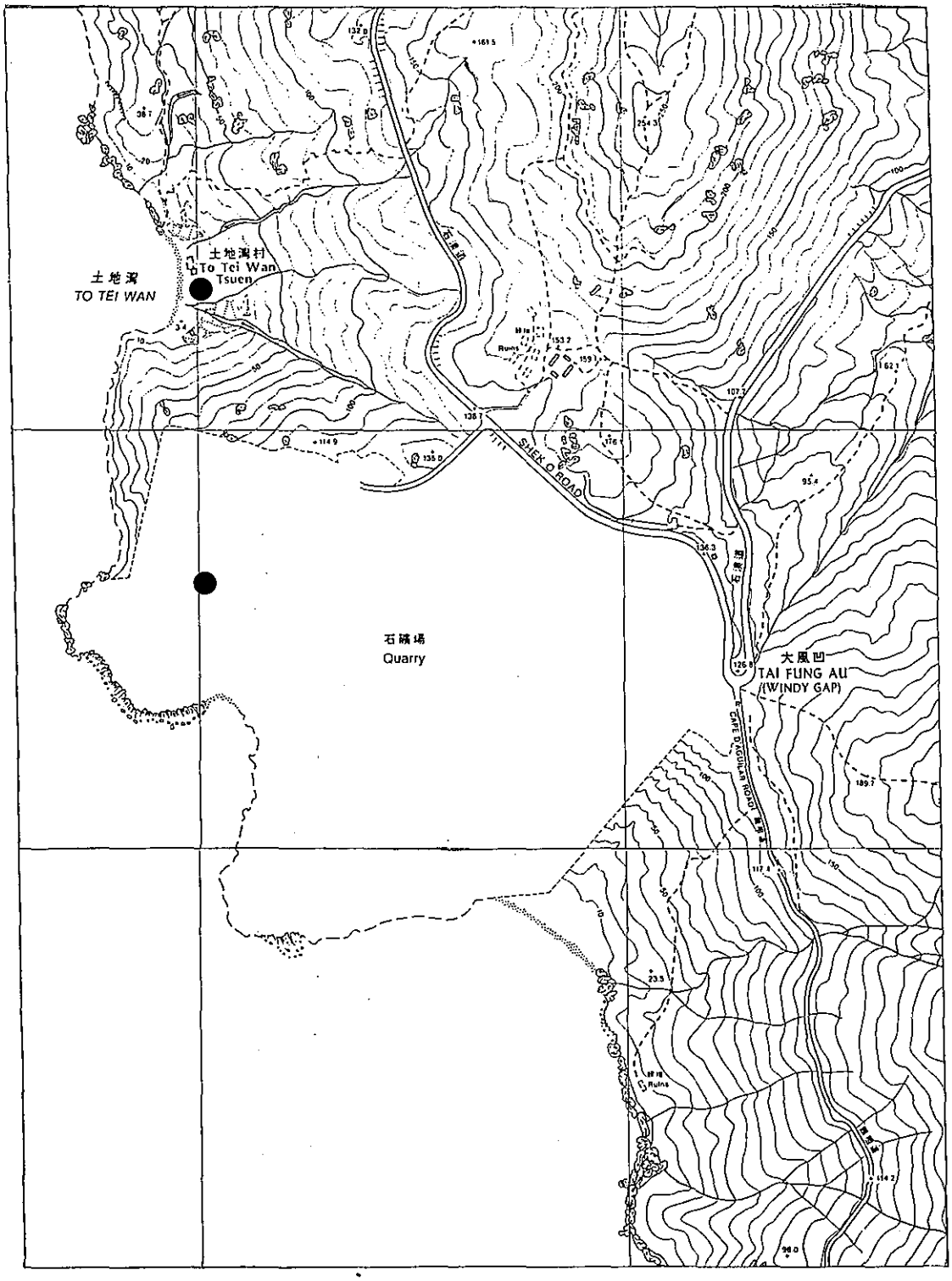


FIGURE 3.1 Locations of the Air Quality Monitoring Stations

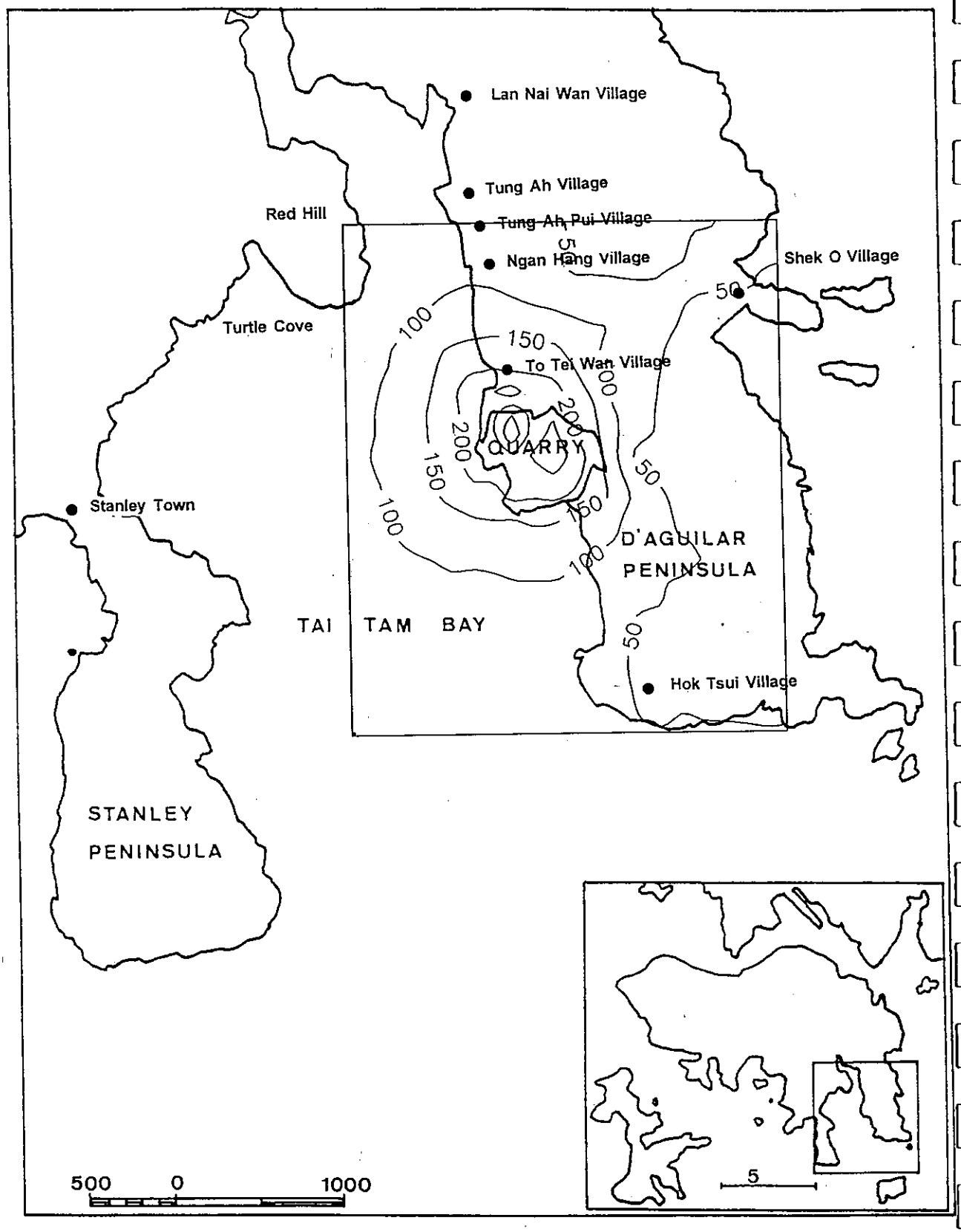


FIGURE 3.2 TSP Concentration Contours for 1-Hour Averaging Period for Casting Basin and Quarry Operation using 1990 Hong Kong South Meteorological Data

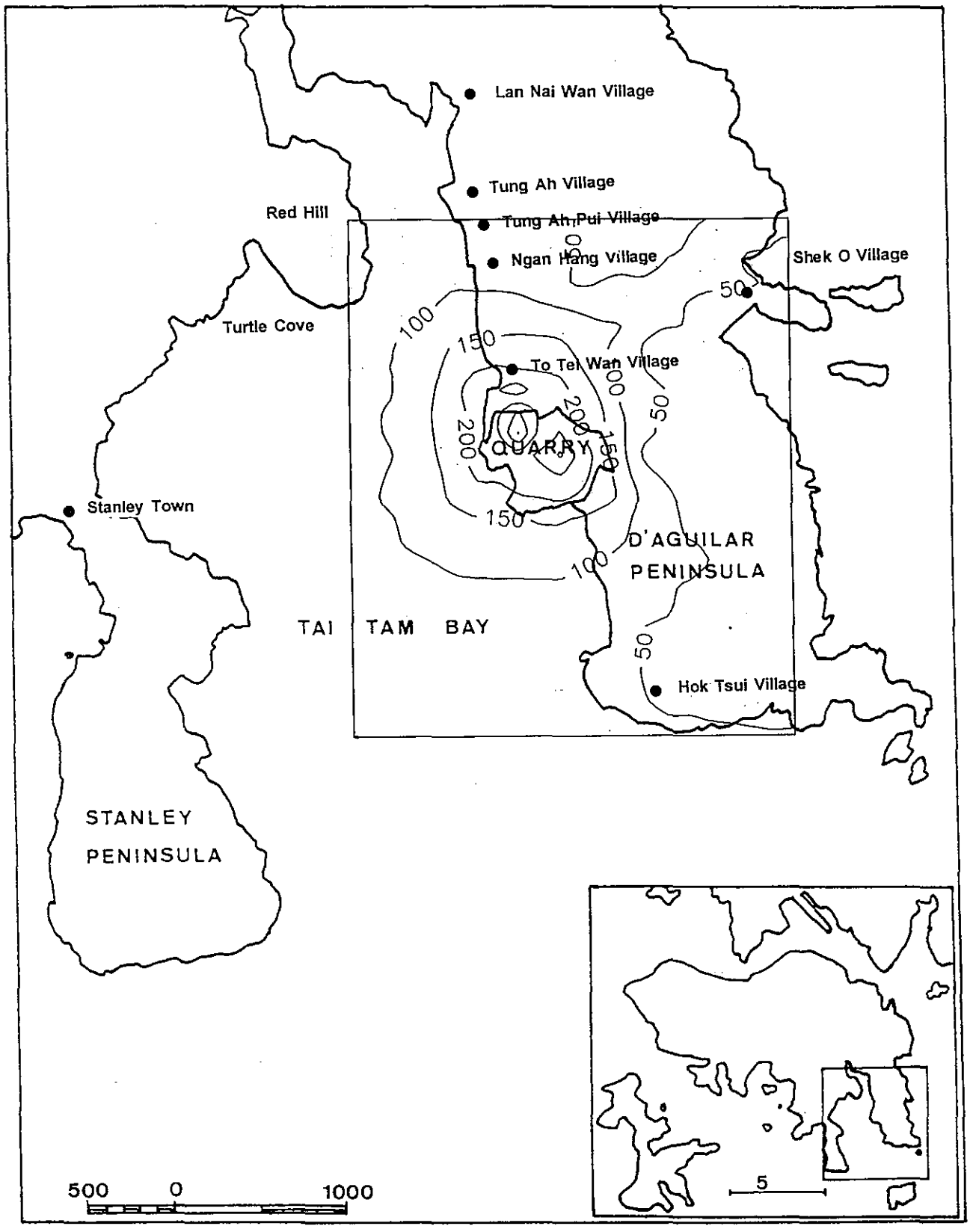


FIGURE 3.3 TSP Concentration Contours for 1-Hour Averaging Period for Casting Basin and Quarry Operation using 1991 Hong Kong South Meteorological Data

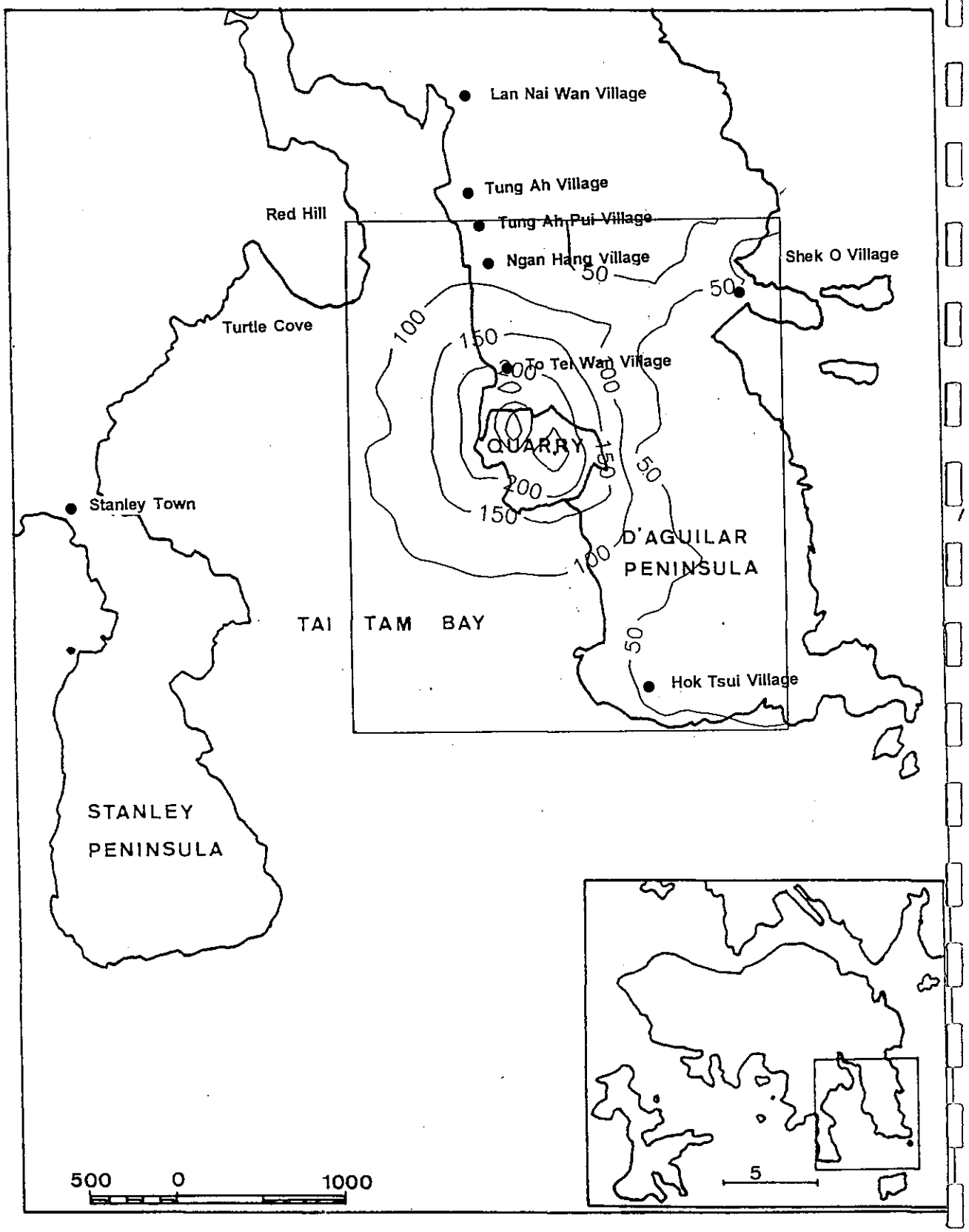


FIGURE 3.4 TSP Concentration Contours for 1-Hour Averaging Period for Casting Basin and Quarry Operation using 1992 Hong Kong South Meteorological Data

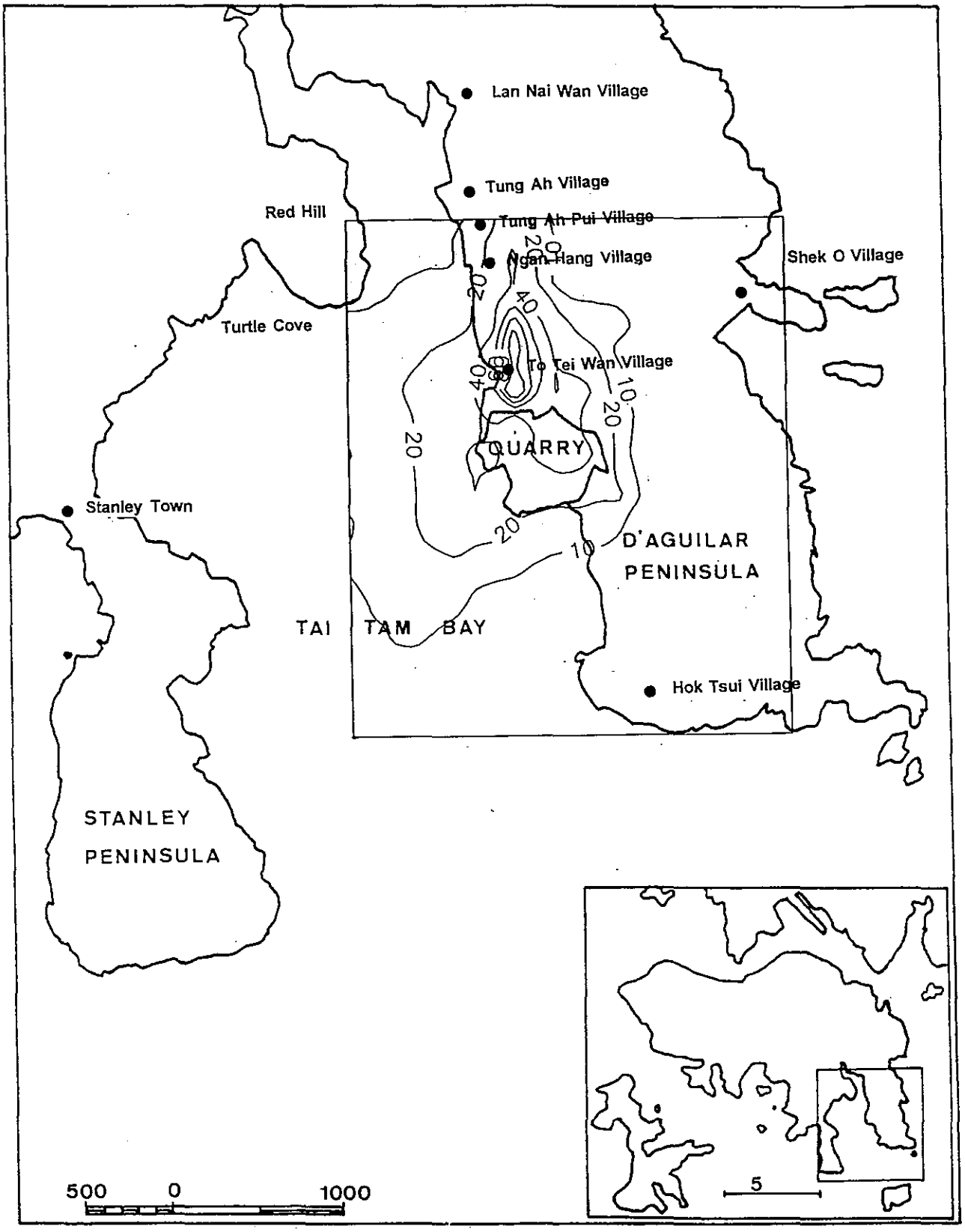


FIGURE 3.5 TSP Concentration Contours for 24-Hour Averaging Period for Casting Basin and Quarry Operation using 1990 Hong Kong South Meteorological Data

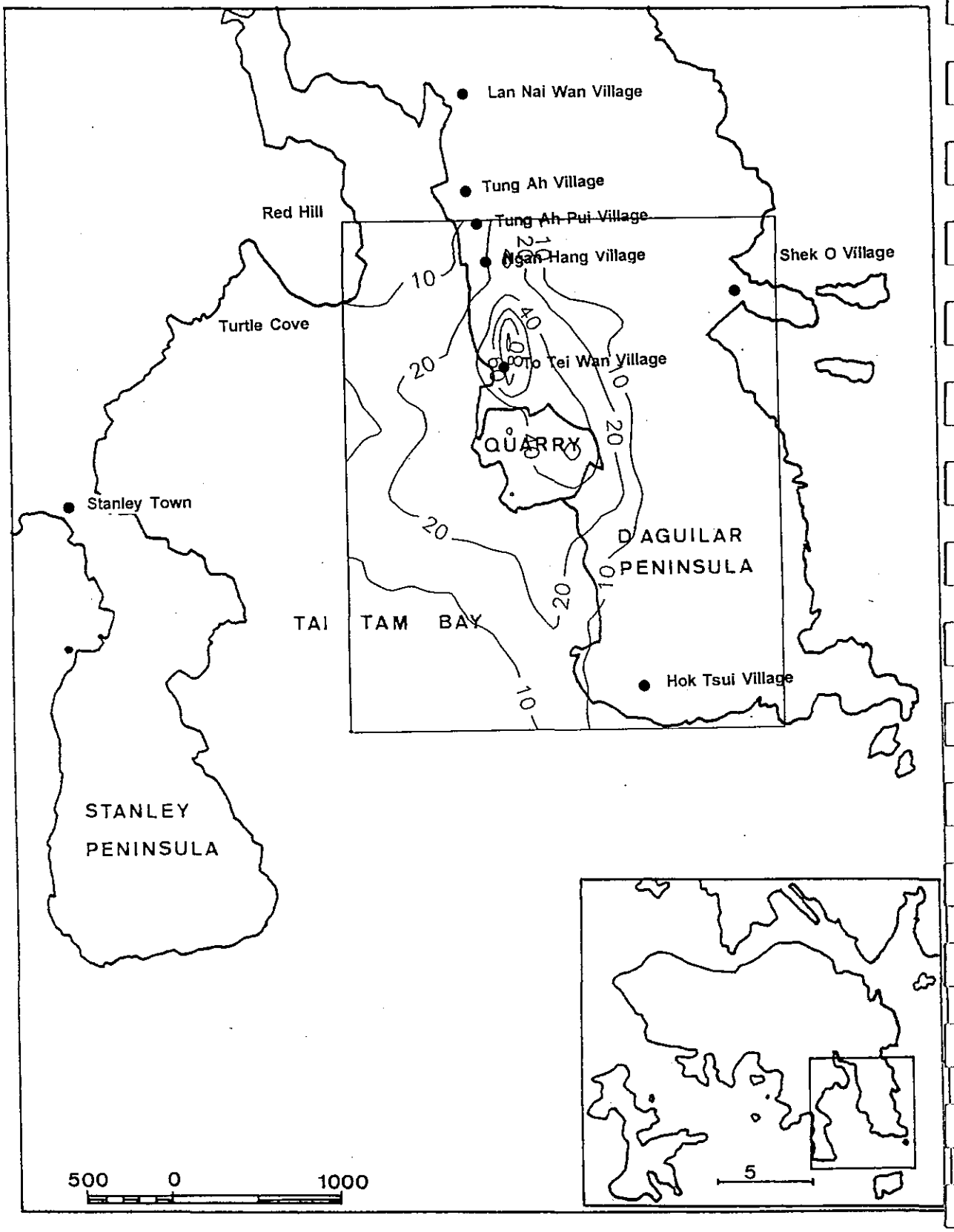


FIGURE 3.6 TSP Concentration Contours for 24-Hour Averaging Period for Casting Basin and Quarry Operation using 1991 Hong Kong South Meteorological Data

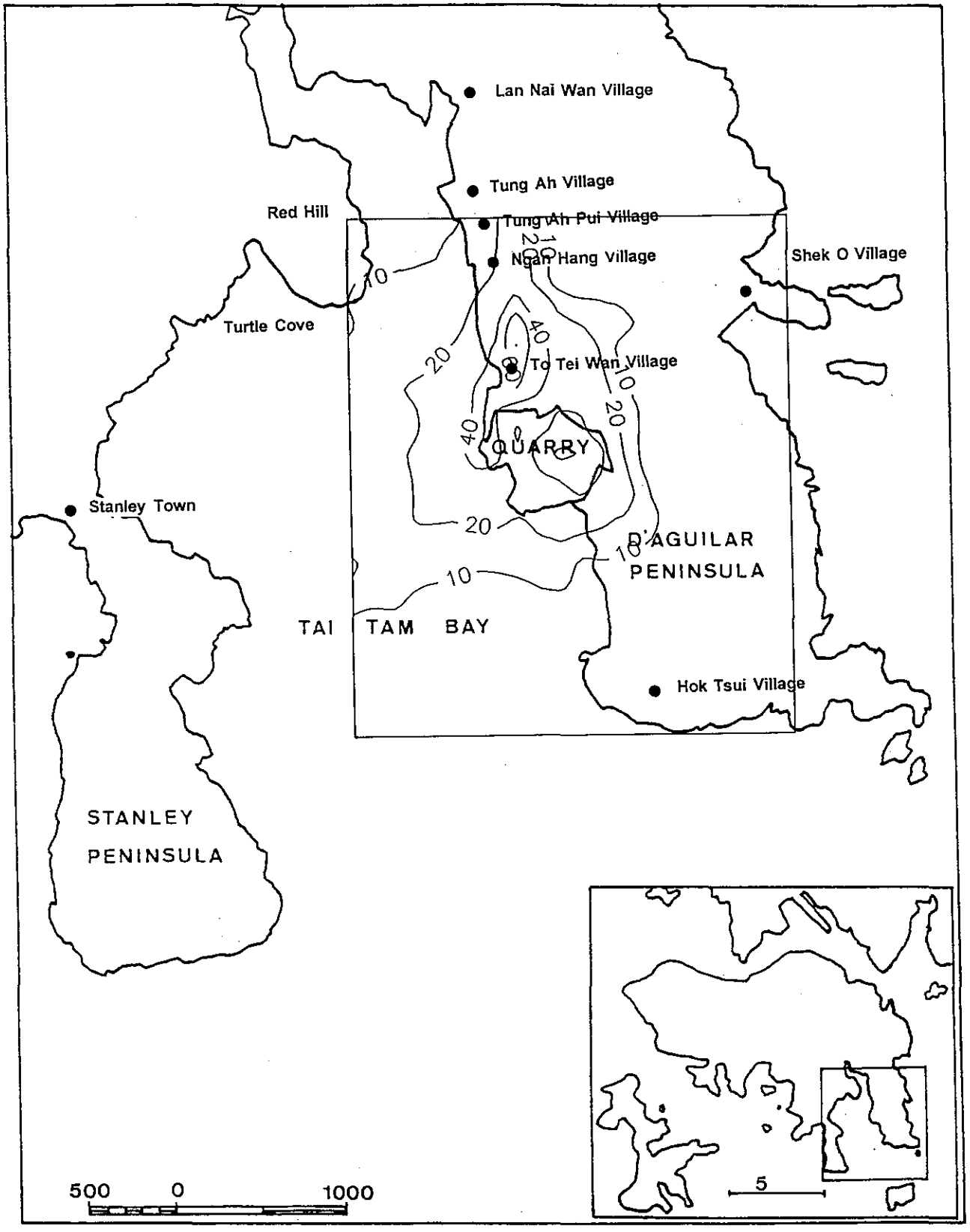


FIGURE 3.7 TSP Concentration Contours for 24-Hour Averaging Period for Casting Basin and Quarry Operation using 1992 Hong Kong South Meteorological Data

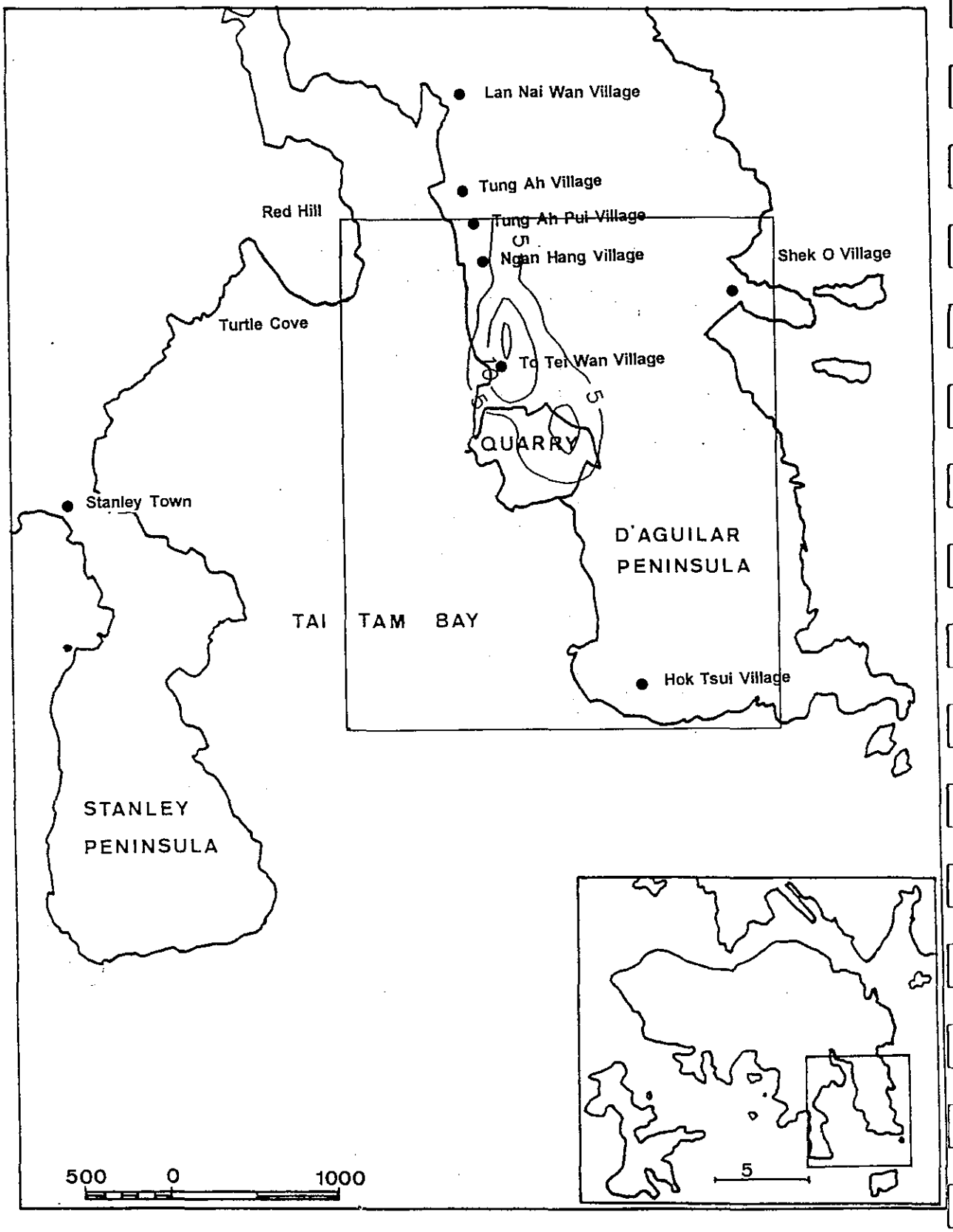


FIGURE 3.8 TSP Concentration Contours for Annual Averaging Period for Casting Basin and Quarry Operation using 1990 Hong Kong South Meteorological Data

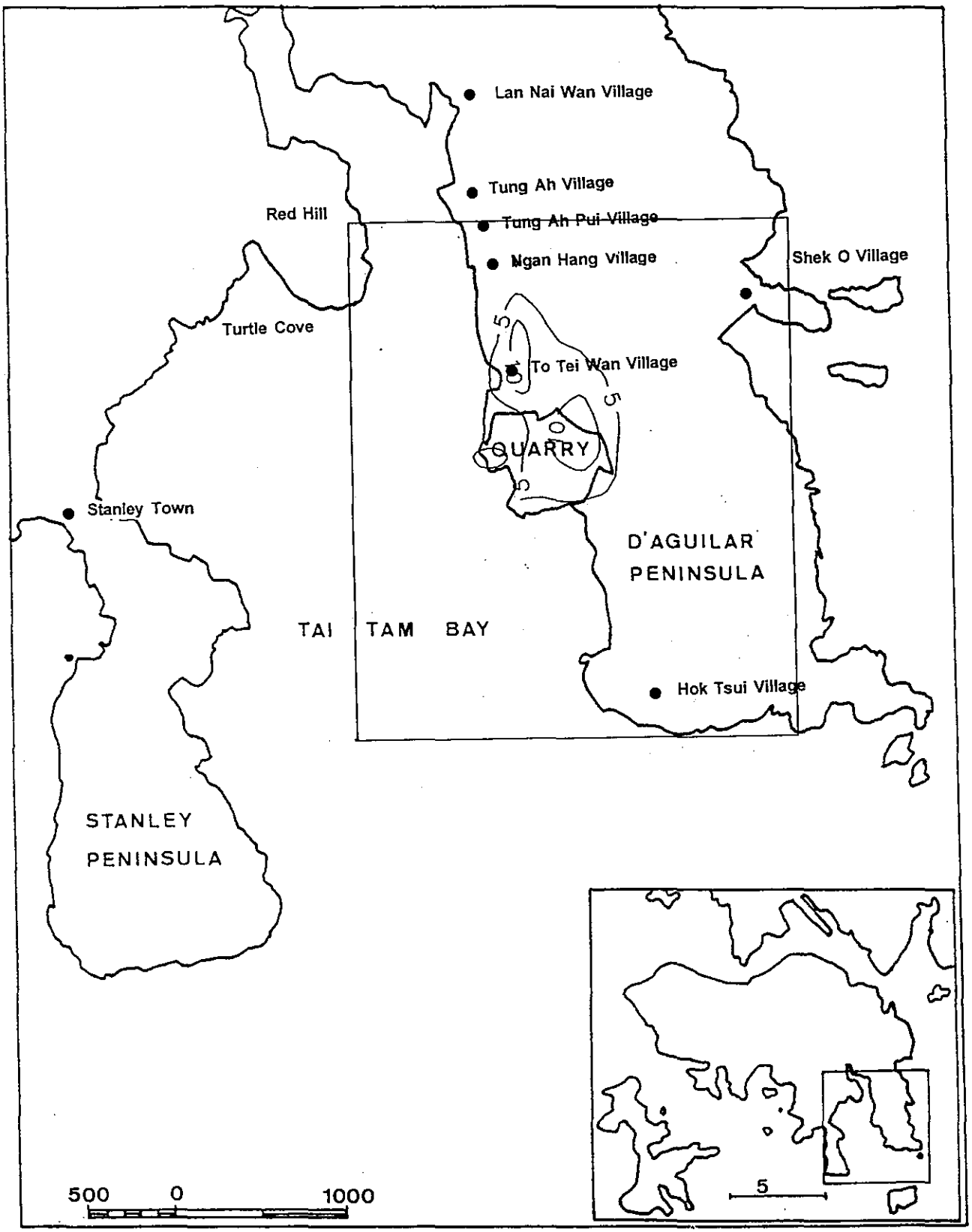


FIGURE 3.9 TSP Concentration Contours for Annual Averaging Period for Casting Basin and Quarry Operation using 1991 Hong Kong South Meteorological Data

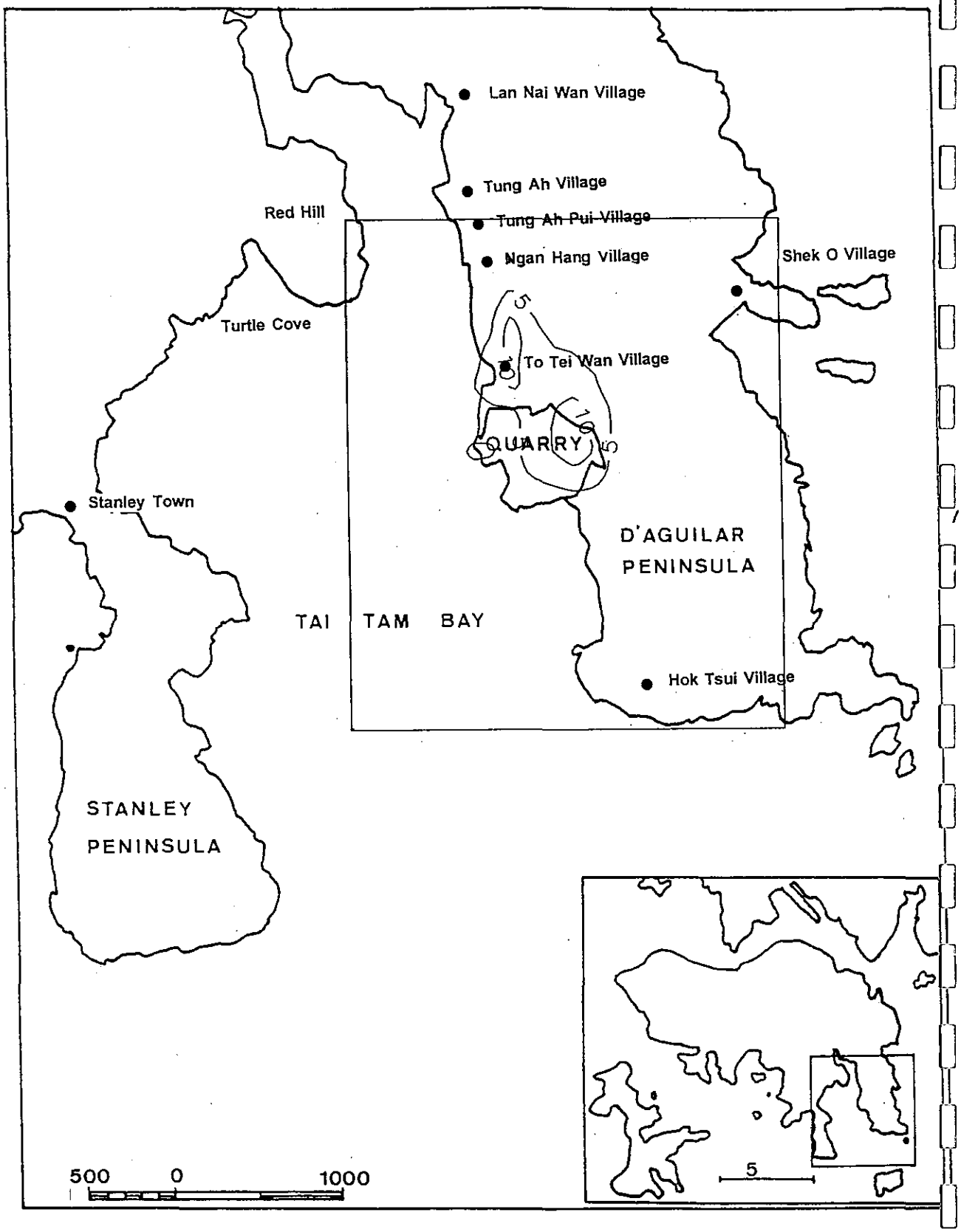


FIGURE 3.10 TSP Concentration Contours for Annual Averaging Period for Casting Basin and Quarry Operation using 1992 Hong Kong South Meteorological Data

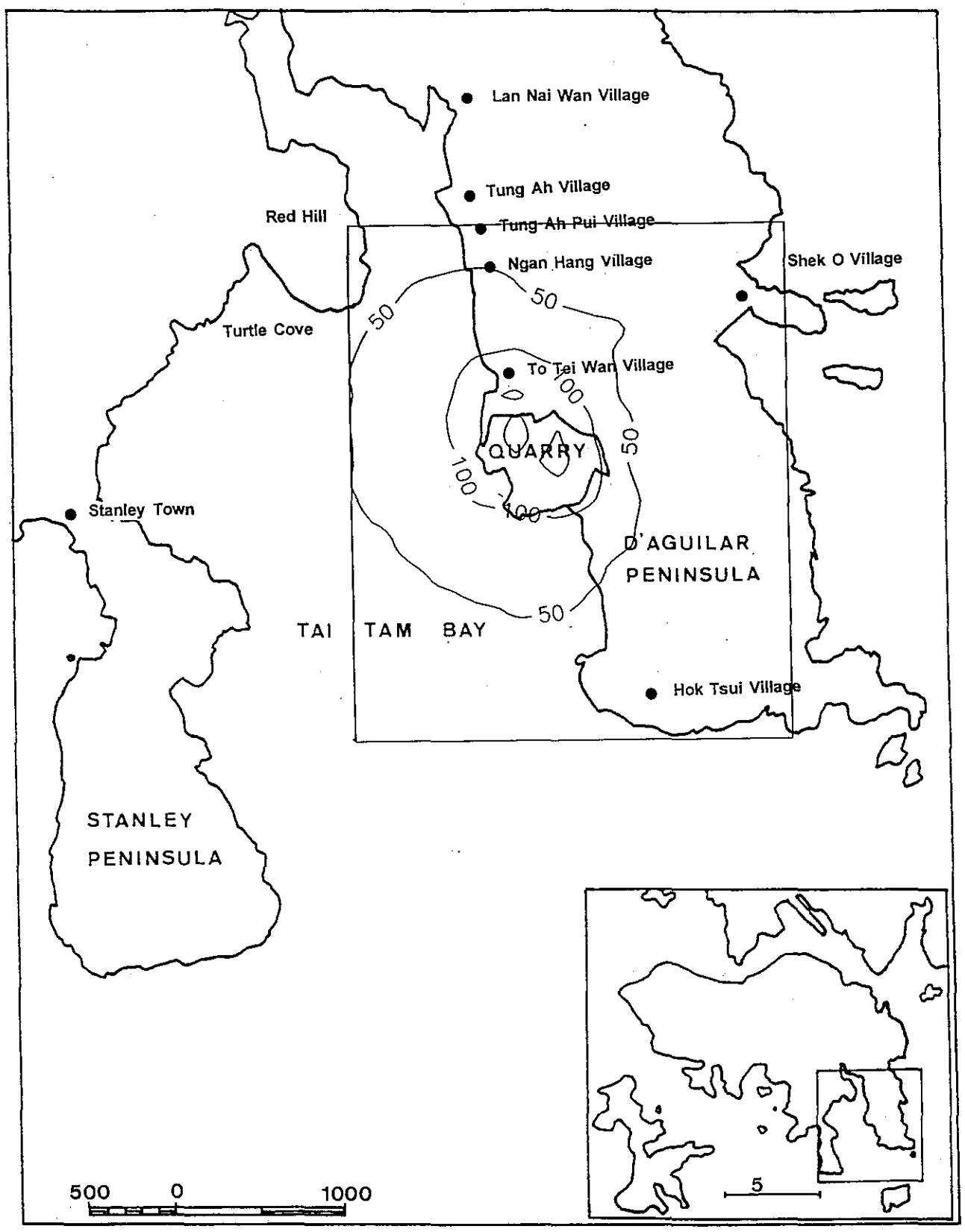


FIGURE 3.11 RSP Concentration Contours for 1-Hour Averaging Period for Casting Basin and Quarry Operation using 1990 Hong Kong South Meteorological Data

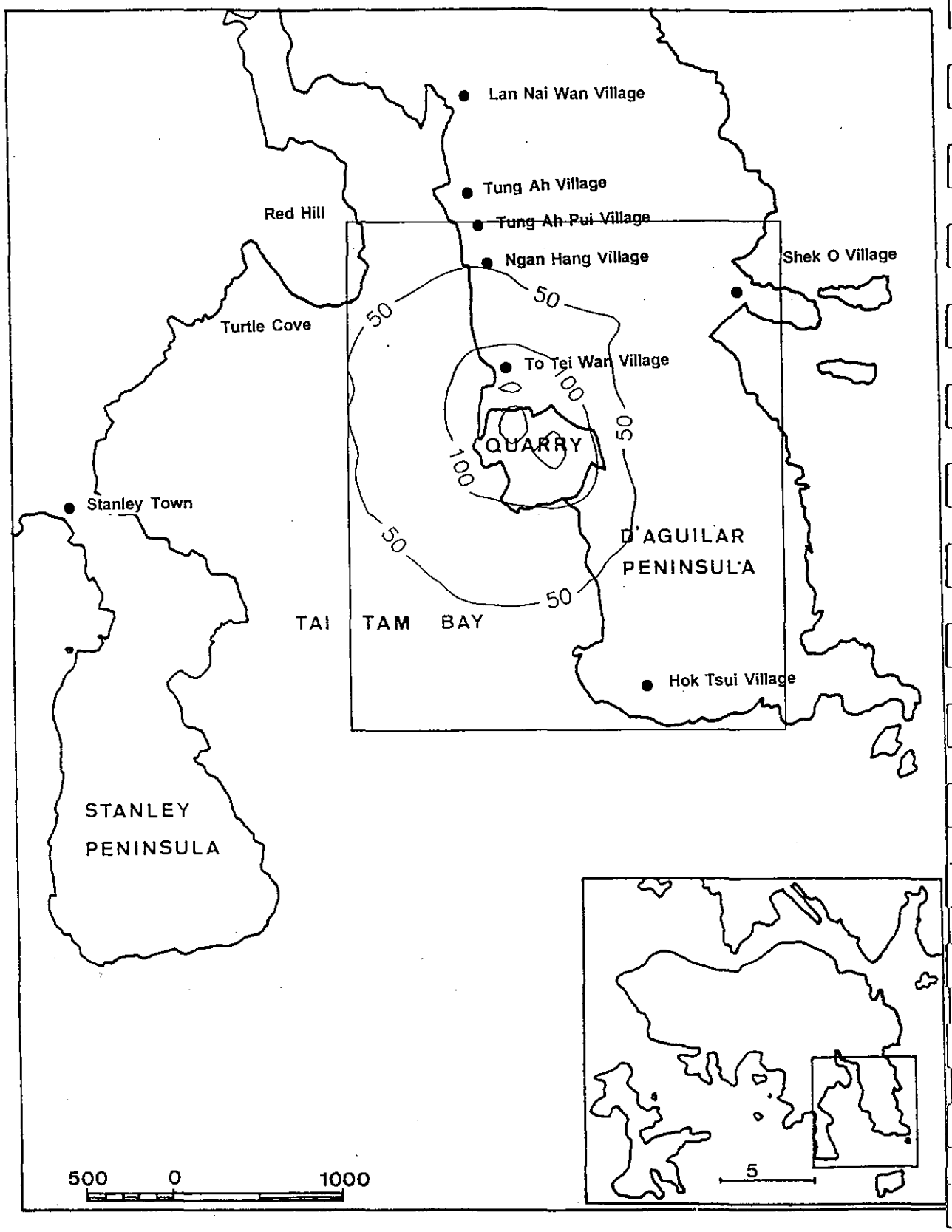


FIGURE 3.12 RSP Concentration Contours for 1-Hour Averaging Period for Casting Basin and Quarry Operation using 1991 Hong Kong South Meteorological Data

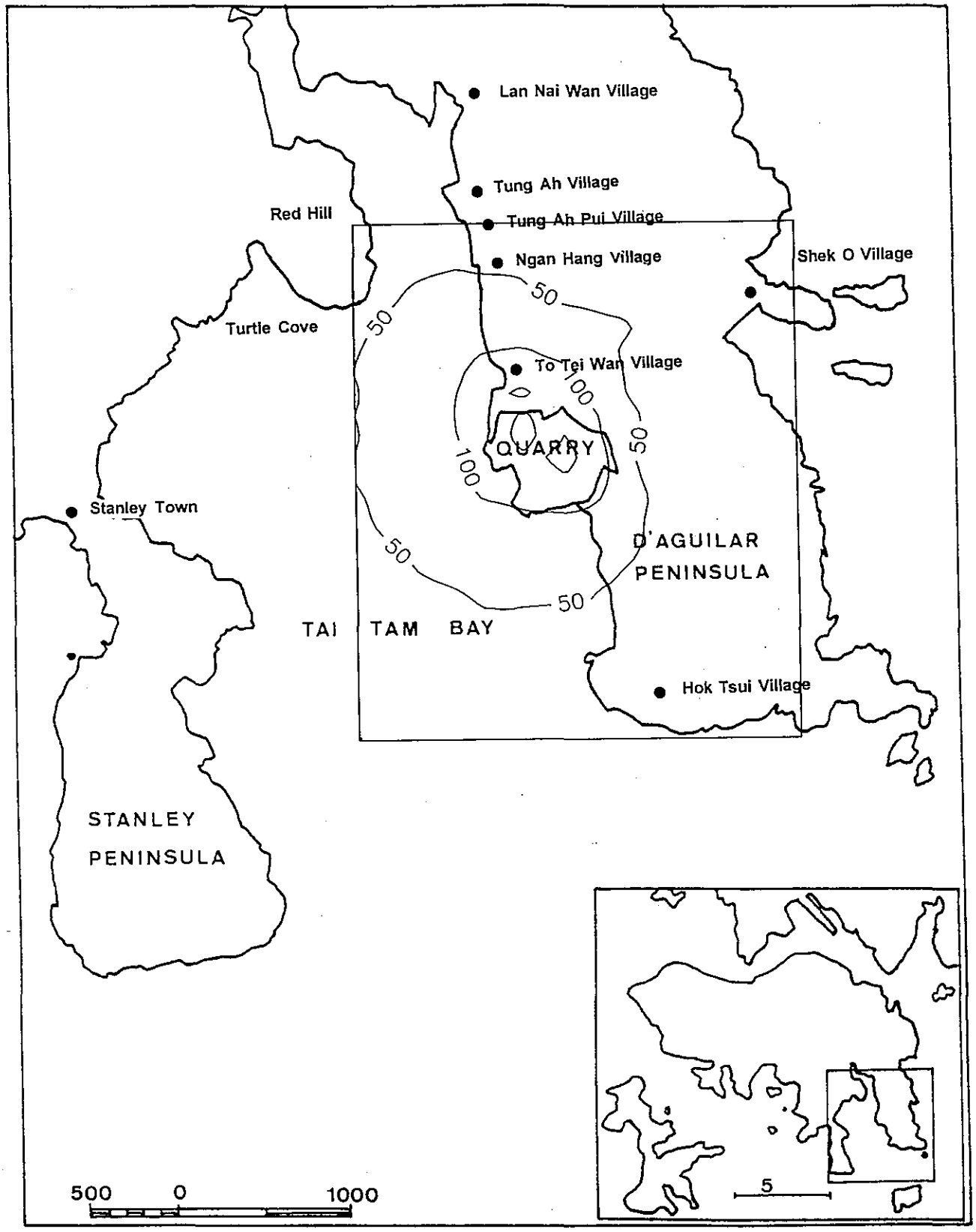


FIGURE 3.13 RSP Concentration Contours for 1-Hour Averaging Period for Casting Basin and Quarry Operation using 1992 Hong Kong South Meteorological Data

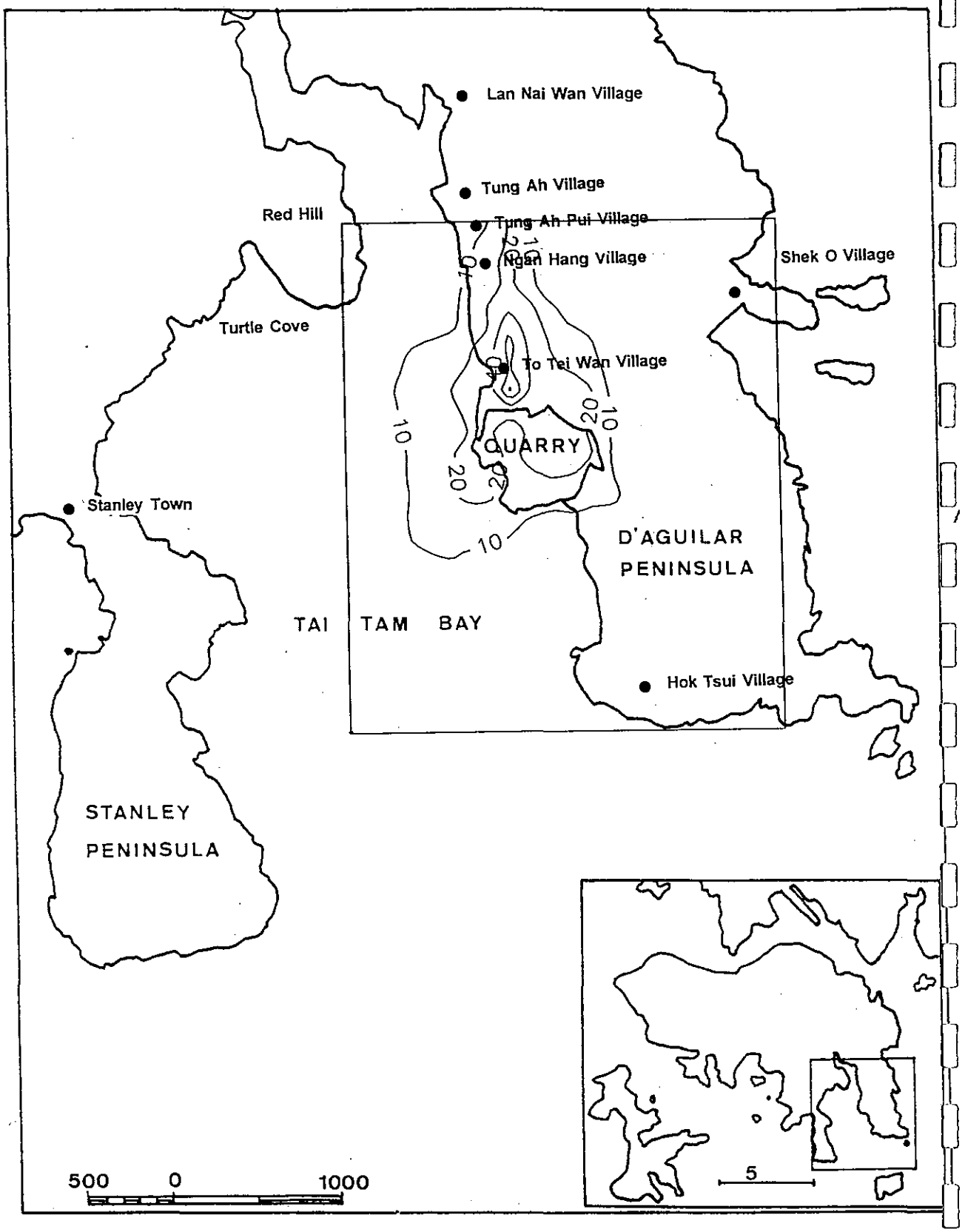


FIGURE 3.14 RSP Concentration Contours for 24-Hour Averaging Period for Casting Basin and Quarry Operation using 1990 Hong Kong South Meteorological Data

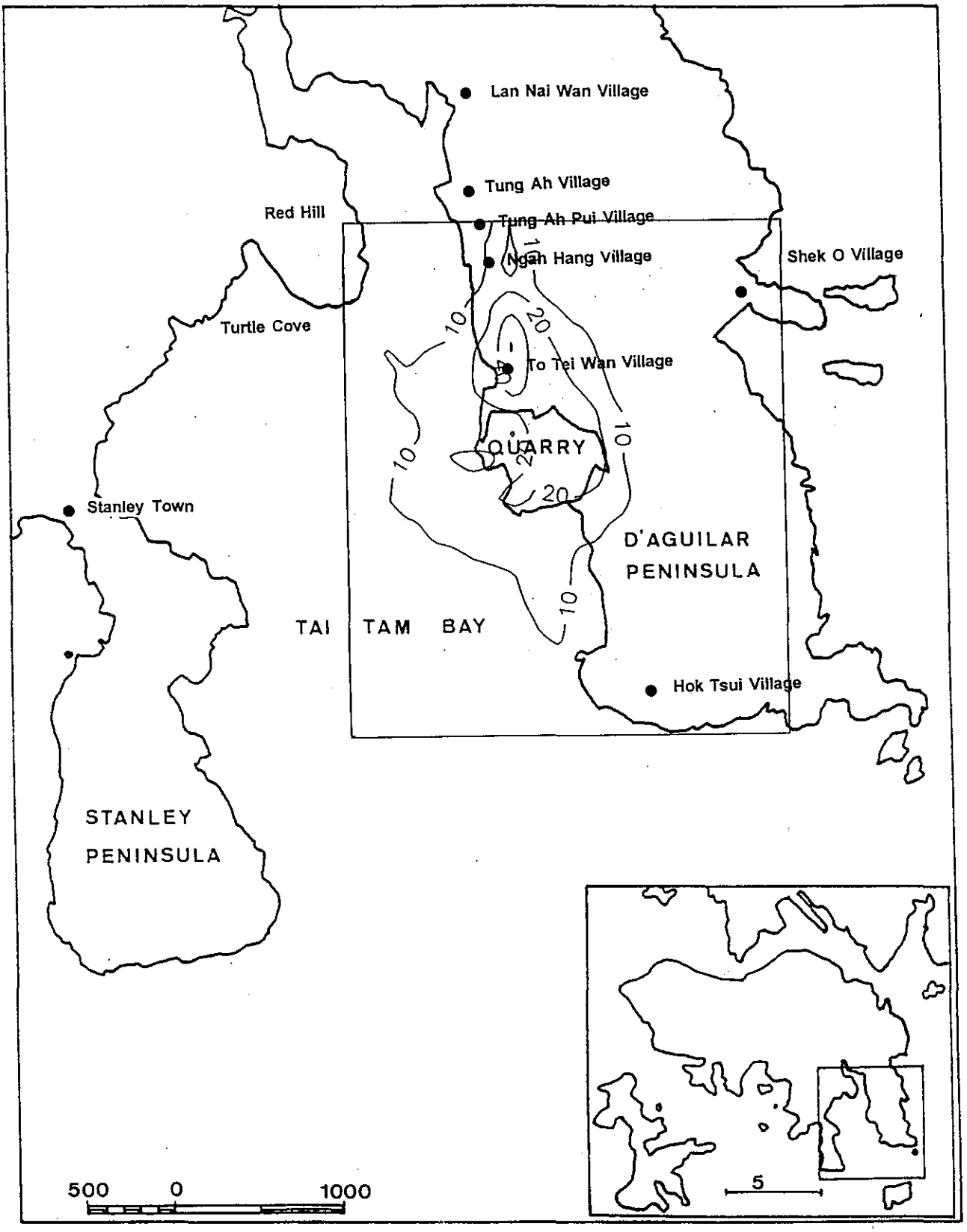


FIGURE 3.15 RSP Concentration Contours for 24-Hour Averaging Period for Casting Basin and Quarry Operation using 1991 Hong Kong South Meteorological Data

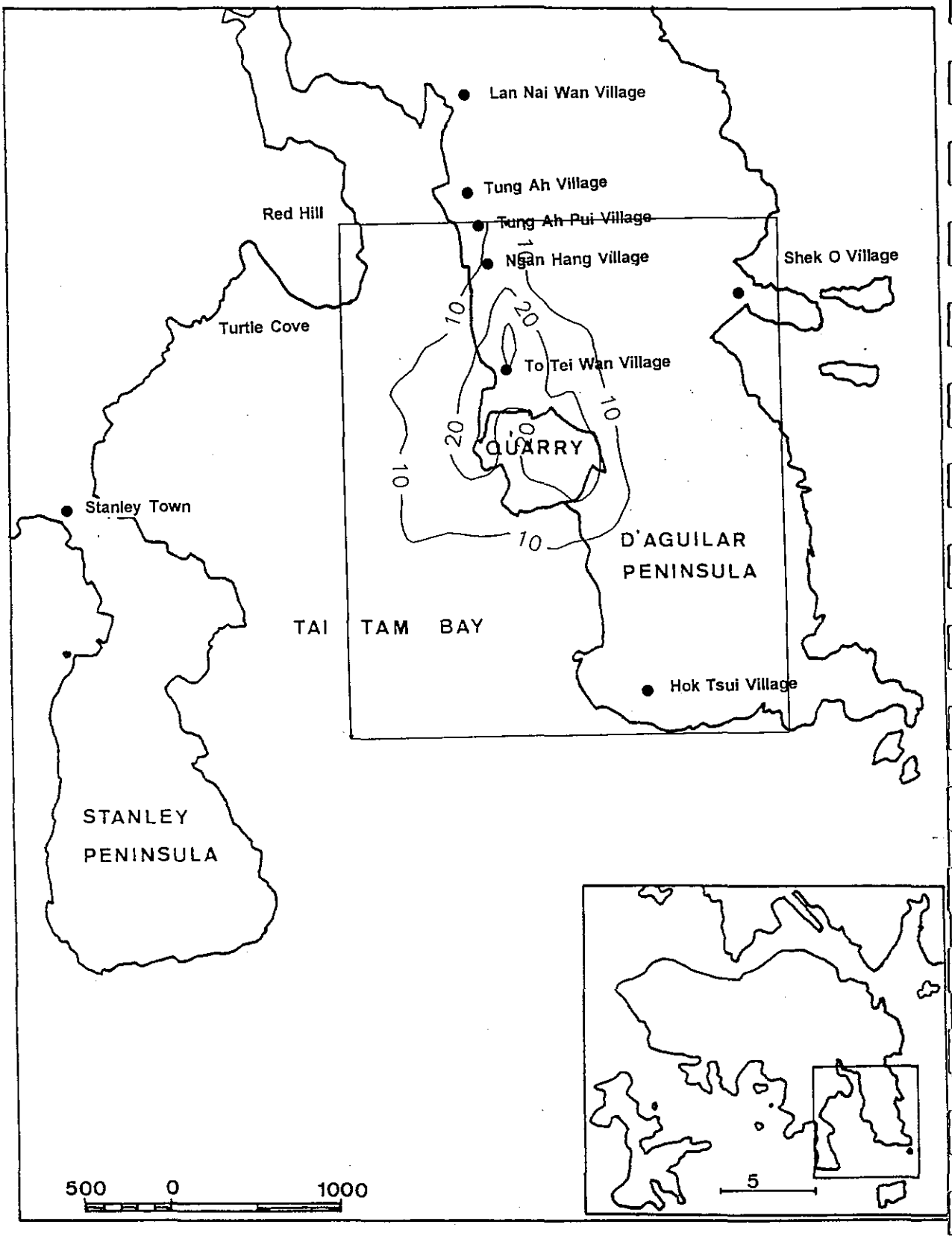


FIGURE 3.16 RSP Concentration Contours for 24-Hour Averaging Period for Casting Basin and Quarry Operation using 1992 Hong Kong South Meteorological Data

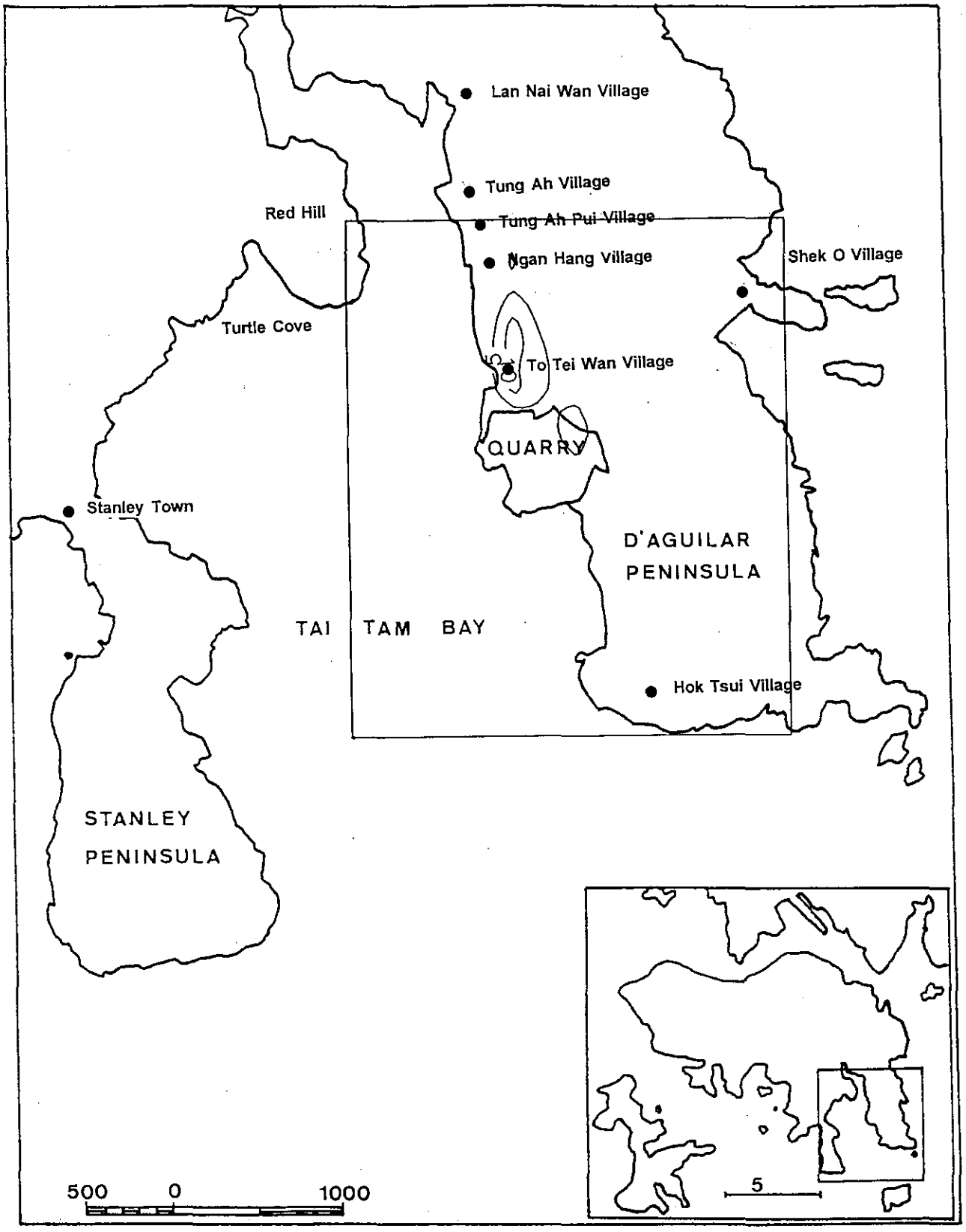


FIGURE 3.17 RSP Concentration Contours for Annual Averaging Period for Casting Basin and Quarry Operation using 1990 Hong Kong South Meteorological Data

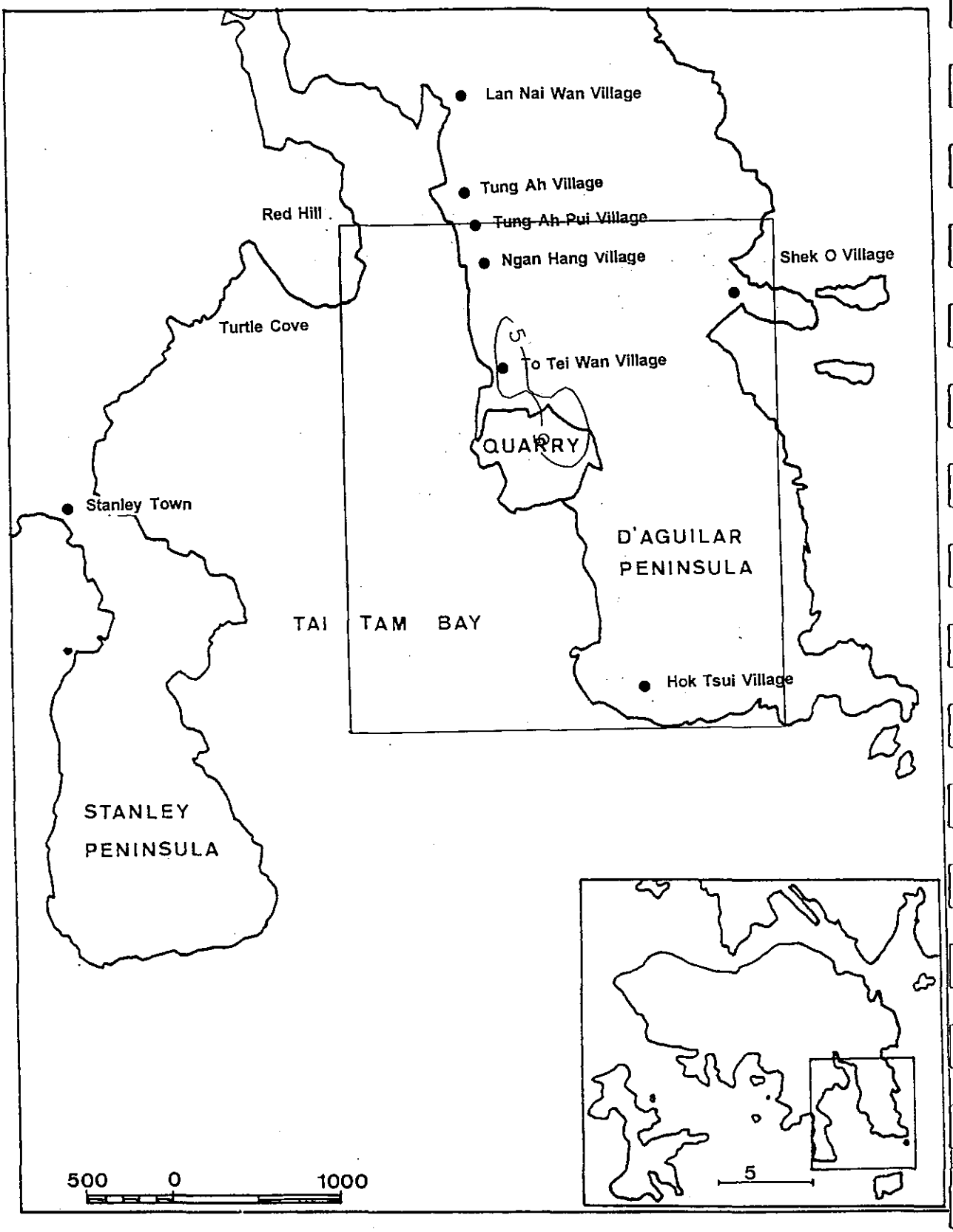


FIGURE 3.18 RSP Concentration Contours for Annual Averaging Period for Casting Basin and Quarry Operation using 1991 Hong Kong South Meteorological Data

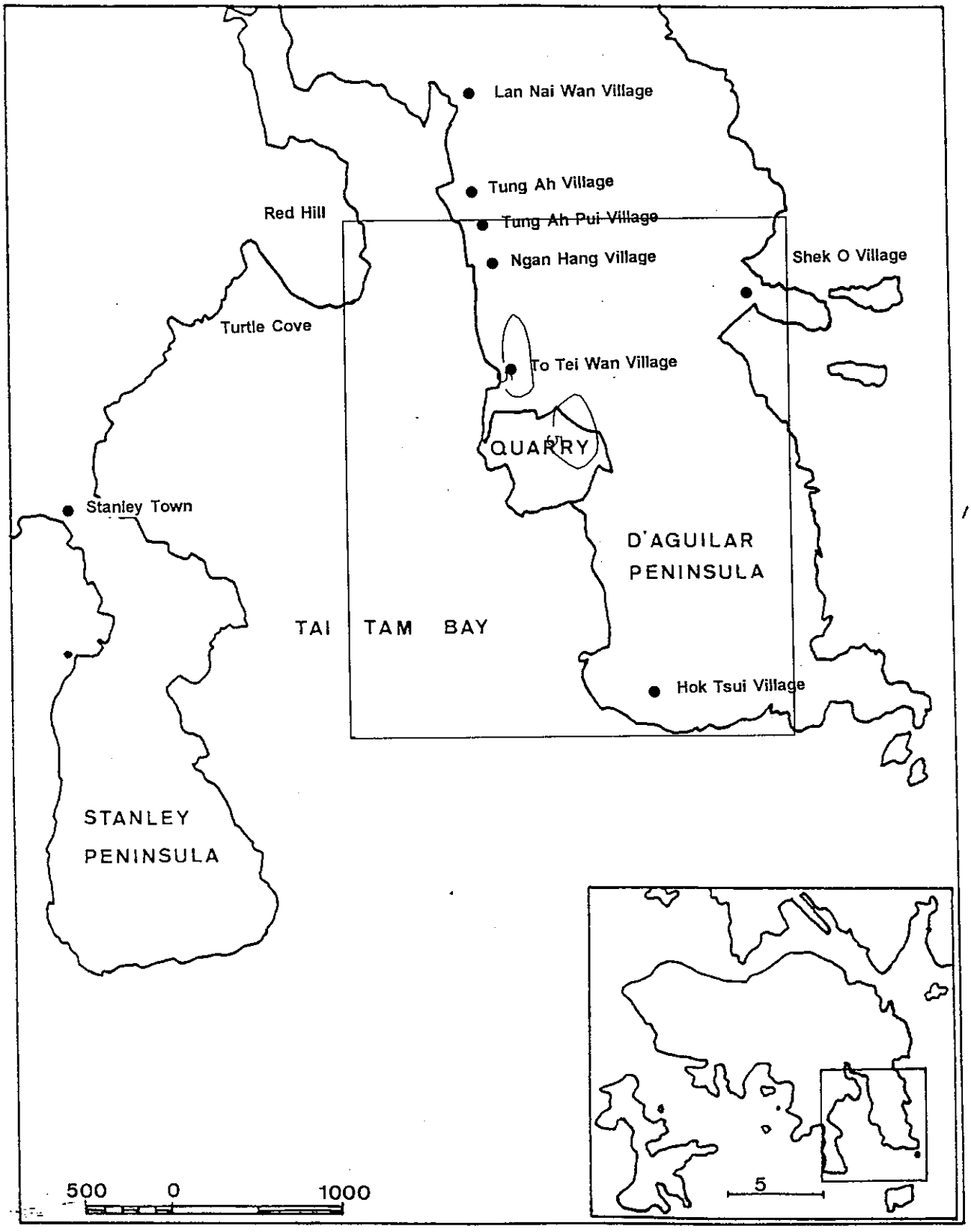


FIGURE 3.19 RSP Concentration Contours for Annual Averaging Period for Casting Basin and Quarry Operation using 1992 Hong Kong South Meteorological Data

4 NOISE

4.1 General

Noise will result from the use of powered mechanical equipment (PME) associated with the batching and casting operations. The topography of the site means that there is considerable shielding of the sensitive areas from the casting basin activity. Also, the trucks and some plant will operate effectively below sea level on the casting basin floor, which will be at a level of -10m mPD. Noise is not considered to be a major issue at Shek O.

4.2 Statutory and Guideline Criteria

The Noise Control Ordinance (NCO) provides the statutory framework for noise control. This defines statutory limits applicable to equipment used in quarry operations and construction. In addition, EPD has stated that for better planning and in order not to contravene the NCO, consideration should be taken of the HKPSG. Besides setting out planning guidelines with respect to noise, the HKPSG presents the only published limits on traffic noise in Hong Kong, although these have no statutory basis.

The NCO invokes three technical memoranda (TM) which define the technical means for noise assessment. Together, the NCO and the TM provide a mechanism for assessing noise levels and the statutory power to control noise.

4.2.1 Fixed sources

The TM for the Assessment of Noise from Places Other Than Domestic Premises or Construction Sites provides the statutory control and mechanism for assessing noise from plant items. It provides a method for determining the Area Sensitivity Rating (ASR) of a Noise Sensitive Receiver (NSR), and the Acceptable Noise Level (ANL). Table 4.1 shows the criteria for determining the ASR and Table 4.2 shows the ANLs with respect to the time of the day.

The HKPSG recommends that noise levels received at sensitive facades from fixed noise sources should be 5 dB(A) below the appropriate ASR.

Table 4.1 Area Sensitivity Rating (ASR)

Type of Area	Degree to which NSR is affected by Influencing Factors		
	Not Affected	Indirectly Affected	Directly Affected
Rural area, including country parks or village type developments	A	B	B
Low density residential area consisting of low-rise or isolated high-rise developments	A	B	C
Urban area	B	C	C
Area other than those above	B	B	C

Table 4.2 Acceptable Noise Levels (ANL)

Time Period		ANL dB(A)		
		A	B	C
Day	(0700 to 1900)	60	65	70
Evening	(1900 to 2300)			
Night	(2300 to 0700)	50	55	60

EPD has indicated that the receivers likely to be affected by noise from the casting basin would be assigned an ASR of 'A'.

4.2.2 Construction Noise

The concrete batching activity will be regarded as a fixed noise source. However, in the Brief there is also a requirement to investigate impacts from construction activities. In this case, the basin will be formed outside the casting contract by the existing quarry operators. This will be undertaken as part of normal quarry activity. However, there is a requirement for a small amount of dredging and construction of a cofferdam, which would be considered as a construction activity.

The NCO divides construction noise into activities involving powered mechanical equipment excluding percussive piling, and percussive piling activity. The criteria for the assessment of noise from construction are therefore similarly divided.

Activity other than Percussive Piling

Under the Technical Memorandum on 'Noise from Construction Work other than Percussive Piling' noise from activity excluding piling is not restricted during the period 0700-1900 hours (except Public Holidays). However, the Government White Paper 'Pollution in Hong Kong - A time to Act' has signalled a desire to improve the noise environment in Hong Kong whenever reasonably practical. To this end, EPD has suggested a daytime general construction noise limit of 75 dB(A) (Table 4.3). This should be assumed to apply during the construction planning and contract tender assessment stages; it is understood that the limit has no statutory significance with respect to Construction Noise Permits.

Between 1900 and 0700 hours and all day on Sundays and public holidays, activity is prohibited unless a permit is obtained. A permit will be granted provided that the Acceptable Noise Level (ANL) for the noise sensitive receiver can be complied with. ANL's are assigned depending upon the Area Sensitivity Rating (ASR). For the receivers in the vicinity of Shek O Quarry, NSRs would be assigned an ASR of 'A' and the corresponding basic noise levels (BNLs) for evening and night time periods are given in Table 4.3.

Table 4.3 Construction Noise Criteria for Activity Other Than Percussive Piling

Basic Noise Level dB(A)				
$L_{Aeq\ (30\ min)}$ *	$L_{Aeq\ (5\ min)}$			
Daytime (all ASR's)	Evening +		Night	
	ASR 'A'	ASR 'B'	ASR 'A'	ASR 'B'
75	60	65	45	50

* Recommended by EPD, but not statutory

\+ includes day-time and evening on Sundays and on Public Holidays

4.2.3 Road traffic

The HKPSG defines guideline limits for road traffic noise at various NSRs. However, this will not be applicable to casting basin operations.

4.3 Sensitive Receivers

The sensitive receivers identified in relation to air quality would also be the closest receivers affected by noise from batching and casting. The locations of the receivers are shown in Figure 2.1. However, To Tei Wan is completely shielded from normal activity, although there may be some noise from dredging and during tunnel unit launching. Impacts of these latter activities at Red Hill and Stanley are not likely to be as noisey as normal site activities.

Other receivers are typically 1-2 km away, where it is extremely unlikely that casting activities will be audible above normal prevailing background conditions.

Country Park visitors using the Hong Kong Trail are already subject to the impact of quarrying operations. Their exposure is limited in duration and is not expected to be worse as a result of Casting Basin operations.

4.4 Existing and Future Conditions

A review of the existing noise was undertaken in relation to the Quarry activity in 1990. These results were presented in the 'Preliminary Environmental Assessment, Casting Basin Site, Shek O Quarry Report, June 1992, by P & T Wallace Evans Ltd for Pioneer Quarries Ltd. Table 4.4, which is reproduced from this report, shows the prevailing background noise levels at areas around the quarry.

Table 4.4 Noise Levels Around the Active Quarry

Location	Receiver	$Leq_{(1\text{-}min)}$, dB(A)	Remarks
A	Shek O Quarry Office	74	Office about 50m from primary crushers
B	Shek O Road	51	Adjacent to quarry
C	To Tei Wan Beach	45	
D	Ngan Hang Village	48	
E	Redhill	58	Principal noise sources within Redhill (under construction) *
F	Stanley Beach	50	Principal noise sources were local traffic etc
G	Cape D'Aguilar Road	59	
H	Lookout on Shek O Road	45-55	Depending on Traffic

* Observations indicated that the current quarry activity is inaudible at Redhill, except when barge loading operations take place. However, this is not an activity related to the casting operation.

In addition to the above data, 3 days of continuous monitoring was undertaken at To Tei Wan Village. The results are summarised in Table 4.5.

Table 4.5 Noise Levels as Monitored at To Tei Wan Village (dB(A))

Day	$Leq_{(30\ min)}$, dB(A)
19/7/93 - 20/7/93	47.1 - 56.1
20/7/93 - 21/7/93	45.7 - 58.8
21/7/93 - 22/7/93	42.6 - 60.0

The results follow a distinct pattern in that the lower levels occur during the day and at night. The higher noise levels all occur during the evening period. This would arise from normal village activity, rather than quarry noise. The casting area will be fully shielded from To Tei Wan. On the basis of the results of the monitoring programme, casting operations will not result in an increase in noise levels at the village.

4.5 Assessment Methodology

The assessment followed the procedures given in the TM on Noise from Construction Work other than Percussive Piling. Attenuation for distances over 300 m is not provided in the TM. For the purpose of assessment of noise arising from power mechanical equipment, the distance attenuation was calculated using the standard formula:

$$\text{Distance Attenuation in dB(A)} = 20 \log D + 8$$

where D is the distance in metres.

In view of the large distance between the quarry and the NSRs, atmospheric absorption should be considered for predicting the noise impacts on NSRs. The correction factors for the prediction of Noise Levels at distances over 300 m are presented in Table 4.6.

The most convenient calculation method is given by Sutherland's Theory. The approximate atmosphere absorption figures are taken from "Method for Calculating the Absorption of Sound by the Atmosphere" by L.C. Sutherland, J.E. Piercy, H.E. Bass and L.B. Evans (1974); published in J. Acoust. Soc. Am., 56, SI(A).

The atmosphere absorption is evaluated in accordance with:

(i) the dominant frequencies from quarry operation generally range from 125 Hz to 500 Hz;

(ii) average temperature of 23°C and relative humidity of 77% for the 30 years from 1961 to 1990 were adopted in accordance with the "Surface Observations in Hong Kong 1991" published by Royal Observatory Hong Kong.

Activities in the Casting Basin may be undertaken up to 1.00 am to finish off concrete pours. The operators have identified the fixed and mobile plant required for batching and casting operations during the day-time, evening and night-time and the schedules are shown in Tables 4.7 and 4.8 respectively, along with the associated noise levels. Tables 4.7 and 4.8 also include an estimate of the likely noise levels arising from quarry activity to allow 'cumulative' impacts to be assessed. No quarry activity will be undertaken in the evening and during night-time. It should be noted that this does not constitute an EIA for the quarry activity. Quarrying and rock crushing are not carried out outside normal daytime hours. The number of items of equipment for construction activity is reduced in the evening and during night-time.

EPD has advised that casting activities should be regarded as construction, and the actual concrete batching should be considered as a fixed noise source. Likewise for quarrying, the TM defines all extraction from the earth as construction, but the operation of the fixed plant is viewed as an industrial process.

The construction activity includes the equipment required for cofferdam formation. However, this activity will only take place for approximately one month. Data are sourced from the TM of the noise control ordinance, BS5228, and from measurements taken at other sites in Hong Kong.

Table 4.6 Overall Correction Factors for the Prediction of Noise Levels on NSRs at Distances from 301 m to 2700 m

Distance, m	Correction, dB(A)	Distance, m	Correction, dB(A)
301 - 318	58	1016 - 1120	70
319 - 355	59	1121 - 1234	71
356 - 396	60	1235 - 1359	72
397 - 441	61	1360 - 1493	73
442 - 491	62	1494 - 1638	74
492 - 547	63	1639 - 1794	75
548 - 608	64	1795 - 1961	76
609 - 675	65	1962 - 2140	77
676 - 748	66	2141 - 2331	78
749 - 829	67	2332 - 2534	79
830 - 918	68	2535 - 2700	80
919 - 1015	69		

It is considered that noise from the casting activities (construction) will only be experienced at Red Hill, American Club and Stanley Town. The levels are calculated including the shielding effects of the natural topography. The casting basin is at -10m mPD, all equipment involved in the casting process will be located within casting basin. Hence, in accordance with the TM, a noise reduction of 10 dB(A) can be expected. Noise levels arising from casting activities (operational) will be insignificant.

Table 4.7 Plant used on Site and Associated Noise Levels during Day-time

Construction				Operation			
Casting Basin							
Activity	No.	SWL, dB(A)	Total SWL, dB(A)	Activity	No.	SWL, dB(A)	Total SWL, dB(A)
Ready Mix Truck	15	109	121	Batcher	1	112	112
Crane Lorry	6	112	120				
Clam Shell Lorry	1	112	112				
Generator	2	108	111				
Concrete Pump Car	5	109	116				
Tower Crane	4	95	101				
Gantry Crane	2	95	98				
Compressor	6	104	112				
Hydraulic Crane	10	110	120				
Concrete Vibrator	20	113	126				
Water Pump 8"	10	88	98				
Water Pump 4"	6	88	96				
Water Pump 2"	6	88	96				
Vibratory Hammer	1	115	115				
Grab Dredger	1	112	112				
Barge	1	104	104				
Total SWL, dB(A)			**129**	Total SWL, dB(A)			**112**
Quarry							
Hydraulic Drilling Rigs	2	123	126	Primary Crusher	1	122	122
Wheel Loaders	2	112	115	Secondary Crusher	1	122	122
Tracked Face Shovel	1	115	115	Tertiary Crusher	1	122	122
Dump Trucks	5	117	124	Conveyor	1	90	90
				Barge	1	104	104
Total SWL, dB(A)			**129**	Total SWL, dB(A)			**127**

Table 4.8 Plant used on Site and Associated Noise Levels in the Evening and during Night-time

Construction				Operation			
Casting Basin							
Activity	No.	SWL, dB(A)	Total SWL, dB(A)	Activity	No.	SWL, dB(A)	Total SWL, dB(A)
Ready Mix Truck	10	109	119				
Crane Lorry	2	112	115				
Concrete Pump Car	2	109	112				
Compressor	2	104	107				
Hydraulic Crane	2	110	113				
Concrete Vibrator	6	113	120				
Water Pump	8	88	97				
Total SWL, dB(A)			124	Total SWL, dB(A)			0

4.6 Impact on Receivers

Based on the absolute worst case when all equipment operates simultaneously, noise levels at sensitive receivers were calculated using standard acoustic principles and in accordance with the requirements of the TM. The results are shown in Tables 4.9 and 4.10.

It is observed that the cumulative construction noise levels at all NSRs at any time of day are acceptable. If casting activity is required in the evening or during night-time, it will be necessary to obtain a Construction Noise Permit to operate the casting facility. This assessment indicates that the night-time criteria will be satisfied at Redhill peninsula. However, the analysis corresponds to a worst case scenario which is considered as conservative. The actual noise levels may be lower than the predicted levels.

In addition to the site noise, there will be a small number of tankers delivering PFA and cement to the casting site. However, vehicle flows are likely to be less than 5 per day. Providing deliveries are limited to normal daytime hours, there should not be a noise nuisance at receivers along the delivery route to the site.

Table 4.11 indicates that the day-time operational noise level may exceed the planning guideline criteria as given in HKPSG (i.e. ANL - 5 dB(A) = 55 dB(A)). There would be a requirement to reduce noise levels by 1 dB(A) to meet the criteria. However, the noise is dominated by the quarry activity and this cannot be controlled by the operators of the casin basin. The predicted noise levels of 33 dB(A) at Redhill caused by the batching plant at the casting basin is 22 dB(A) below the HKPSG criteria. It is considered that noise from the operational activities at the casting basin will be insignificant at the NSRs.

Table 4.9 Predicted Noise Levels [dB(A)] at the Closest Sensitive Areas from Casting Basin Activity Only

Location	Distance from Site, km	Construction Noise Level, dB(A)			Operational Noise Level, dB(A)
		Day	Evening	Night	
To Tei Wan Village	0.3	*	*	*	*
Ngan Hang Village	1.0	*	*	*	*
Tung Ah Pui Village	1.3	*	*	*	*
Shek O Village	1.3	*	*	*	*
Red Hill	1.3	50	45	45	33
Hok Tsui Village	1.3	*	*	*	*
Tung Ah Village	1.5	*	*	*	*
Turtle Cove	1.7	*	*	*	*
American Club	1.9	46	41	41	29
Lan Nai Wan Village	2.2	*	*	*	*
Stanley Town	2.2	44	39	39	27

Table 4.10 Predicted Noise Levels [dB(A)] at the Closest Sensitive Areas from Quarry Activity

Location	Construction		Operation	
	Distance from Site, km	Noise Level, Day dB(A)	Distance from Site, km	Noise Level, Day dB(A)
To Tei Wan Village	0.5	*	0.4	*
Ngan Hang Village	0.9	*	0.9	*
Tung Ah Pui Village	1.4	*	1.3	*
Shek O Village	1.1	*	1.4	*
Red Hill	1.7	57	1.5	56
Hok Tsui Village	1.5	*	1.4	*
Tung Ah Village	1.5	*	1.3	*
Turtle Cove	1.8	*	1.5	*
American Club	2.2	54	1.7	55
Lan Nai Wan Village	2	*	2	*
Stanley Town	2.6	52	2.4	51

* These villages are separated from the casting area by substantial natural topographical features. Noise from casting is unlikely to be experienced at these locations.

Table 4.11 Predicted Noise Levels [dB(A)] at the Closest Sensitive Areas from Cumulative Casting Basin and Quarry Activity

Location	Overall Construction Noise Level, dB(A)			Overall Operational Noise Level, dB(A)
	Day	Evening	Night	Day
To Tei Wan Village	*	*	*	*
Ngan Hang Village	*	*	*	*
Tung Ah Pui Village	*	*	*	*
Shek O Village	*	*	*	*
Red Hill	58	45	45	56
Hok Tsui Village	*	*	*	*
Tung Ah Village	*	*	*	*
Turtle Cove	*	*	*	*
American Club	55	41	41	55
Lan Nai Wan Village	*	*	*	*
Stanley Town	53	39	39	51

Note: +3 dB(A) facade effect was included.

4.7 Control and Mitigation

Noise mitigation is an inherent feature of the casting basin layout. The batching plant is orientated to present the least area to the sensitive areas across Tai Tam Bay. The haul route from the batcher to the basin is located to the north of the basin so that the moving trucks are shielded by the natural topography. The ancillary works are located to the north of the basin, again in the most sheltered location.

4.8 Monitoring and Audit

Monitoring and audit requirements are presented in the Monitoring and Audit Manual.

4.9 Summary of Key Issues

The topography of the area provides local villages with shielding from the quarry. The potentially affected receivers are Redhill and Stanley. However, these are distant from the site, and assessment indicates that these will not experience noise impact from casting operations, unless operations are envisaged at night. The quarry activity will be the dominant fixed noise source at this site, the casting basin activity will be negligible in comparison.

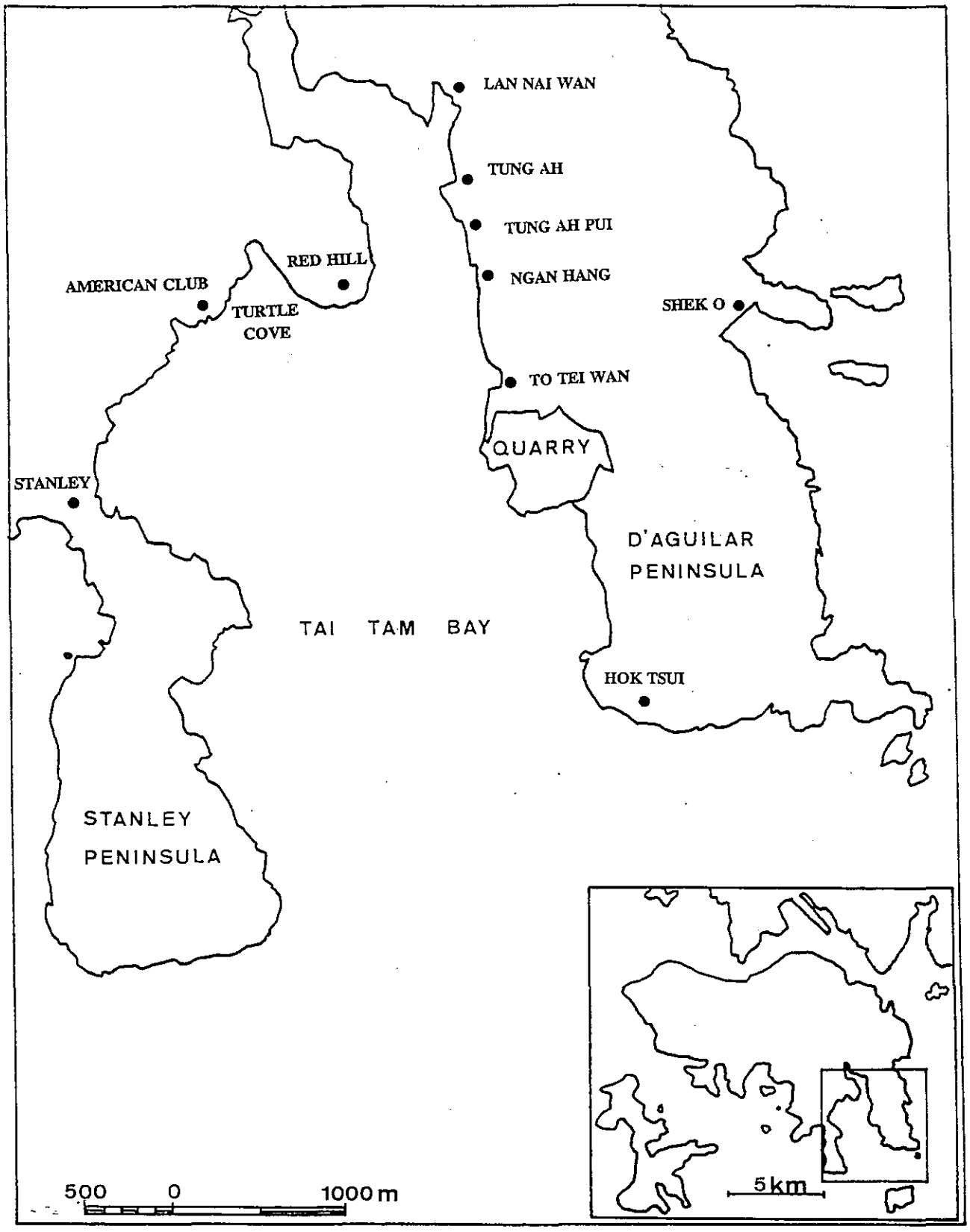


Figure 4.1 Closest Sensitive Receivers to Shek O Quarry

5 MARINE WATER QUALITY

5.1 General

Tai Tam Bay is approximately 8 km^2 in area and lies within the Southern Waters Control Zone (declared in 1988 under the Water Pollution Control Ordinance). Topographically, the Bay is a confined basin with limited dispersive capacity. Nonetheless, the area is considered to be of acceptable water quality by the authors of the Territorial Development Strategy Environmental Study (1992).

Water depth at the mouth of the Bay is approximately 15 m and gradually decreases to 8m at the entrance to Tai Tam Harbour. Adjacent to the quarry, depths of 10m are found close to the shore. There are few data available on water circulation or current speeds for Tai Tam Bay but recent mid-depth measurements undertaken as part of the baseline monitoring for this study gave results of between 0.05 m/s and 0.50 m/s at four stations within the Bay over a range of tidal conditions, with maximum velocities on spring tides (full data provided in Appendix 5A). Current speeds of up to 0.41 m/s on spring tides were reported for outer Tai Tam Bay by EGS Ltd in their 1989 oceanographic report relating to the Hong Kong Island South Sewerage Master Plan, which agrees well with the recent data.

Tidal behaviour in Hong Kong is complex with a regular transition from semi-diurnal (two tides a day) on spring tides to diurnal (one tide per day) on neap tides. There is also a diurnal inequality in the tides; from October to March the early morning low tide is lower than that at the middle of the day, and from April to September the evening tide is the lower of the two (Morton and Morton, 1983). The incoming tide tends to flow from the south-east to the northwest and brings oceanic water into Hong Kong's coastal environs. Ebb tide flow is to the east and the influence of the Pearl River estuarine water is maximum at this time.

From measurements made as part of this study (for spring tides), flow into and out of Tai Tam Bay tended to run due north and south on the flood and ebb tides respectively, following the north-south axis of the Bay. Major changes in current direction approximately coincide with Low and High Waters at Waglan Island tide gauge station, approximately 7 km to the south-east. Local variation to this general observation can be expected at different sites within Tai Tam Bay. Tidal range for Waglan Island on spring tides is 2.0 m and 0.5 m on neaps.

5.2 Statutory Legislation and Guidelines

5.2.1 The Water Pollution Control Ordinance (WPCO) Cap. 358 (1980) lays down the framework for designation of Water Control Zones (WCZ's) throughout the Territory. Each such zone is characterised by specific water quality objectives. Principal features of the WPCO and its subsidiary legislation are as follows:

- The Ordinance specifies prohibited discharges and deposits.
- This is reinforced by the Technical Memorandum to the WPCO which further provides standards for effluents discharged into drainage and sewerage systems, inland waters and coastal waters.

- The Water Pollution Control (Amendment) Ordinance 1990 made various changes to the WPCO including the removal of the 'right to discharge' certain pollutants taking place prior to the gazettal of a Water Pollution Control Zone.

- The Specific legislation pertinent to water quality in the present case includes:

  Water Pollution Control Ordinance : Cap 358 (1980)
  Water Pollution Control Regulations (1988)
  Water Pollution Control (Southern Water Control Zone) Order (1988)
  Water Pollution Control (Southern Water Control Zone) Amendment (1991)
  Southern Water Control Zone Statement of Water Quality Objectives (1988)
  Legal Supplement No 2 1990 : Water Pollution Control (Amendment) Regulations 1990
  Special Supplement N°5 : Technical Memorandum standards for Effluents Discharged into Drains and Sewerage Systems, Inland and coastal waters.
  APP III Dumping at Sea Act 1974 (Overseas Territory Order (1975).

5.2.2 Activities at Shek O Quarry and any discharges, run off, or flows discharging to the marine environment are regulated under the Water Pollution Control (Southern Water Control Zone) Order (1988) and the Technical Memorandum on Standards for Effluents Discharged into Drains and Sewerage Systems, Inland and Coastal Waters.

In the case of the former the water quality objectives specified under the legislation are presented in Table 5.1

Table 5.1 Summary of Water Quality Objectives for the Southern Water Control Zone

Parameters	Objectives	Sub-Zone
Offensive Odour, Colour, Tints	Not to be present	Whole Zone
Visible foam, oil, scum, litter	Not to be present	Whole Zone
E. coli	Not to exceed 610/100 ml calculated as geometric mean for whole year	Secondary contact Recreation sub-zone
	Running geometric mean not to exceed 180/100 ml.	Bathing beaches
DO within 2.0 m of bottom	Not less than 2.0 mg/l for 90% of samples	Whole Zone
Depth average DO	Not less than 4.0 mg/l for 90% of samples	Whole Zone except Fish culture zones
	Not less than 5.0mg/l for 90% of samples	Fish Culture Zones
pH	To be in the range 6.5-8.5, change due to waste discharge not to exceed 0.2	Whole zone except bathing beaches
Salinity	Change due to waste discharge not to exceed 10% of ambient	Whole zone
Temperature	Change due to waste discharge not to exceed 2.0°C	Whole Zone
Suspended Solids	Not to raise the ambient level by 30%	Whole zone
Toxicants	Not to be present	Whole Zone
Ammonia	Annual mean not to exceed 0.021 mg/l calculated as unionised form	Whole Zone
Nutrients	Shall not cause excessive algal growth	Whole Zone
	Annual mean depth average inorganic N not to exceed 0.1 mg/l	

The mechanism that will regulate discharges from the site including run off from storm drains and any liquid effluents is the Technical Memorandum (TM), 'Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters'. The Memorandum establishes effluent standards that apply to different receiving water bodies. All such effluents covered by this TM are required to be licensed. Tables 5.2 and 5.3 illustrate the standards required for discharge into the inshore and marine waters of the SWCZ (Southern Waters Water Control Zone). For the purposes of this legislation, inshore waters refer to all waters of less than 6m depth at MLW or within 200 metres of the low water mark.

5.3 Sensitive Receivers

Receivers most likely to be affected by any change in water quality in Tai Tam Bay include bathers, water sports enthusiasts, fishing activities and sedentary marine organisms. The latter are discussed under Section 6 'Marine Ecology'.

There are no official fish culture zones within Tai Tam Bay although other commercial fishing activities have the potential to be affected particularly if any enrichment of nutrients arises as a result of casting basin operations, leading to eutrophication and plankton blooms.

The nearest public beaches are at To Tei Wan, more than 400 m north of the casting basins, and Stanley, 2.2 km west. There is a hobiecat sailing club and a canoe club based at To Tei Wan beach, and the Bay adjacent to To Tei Wan village is classified as an inshore recreation area.

5.4 Existing and Future Conditions

Data have been reviewed from the collaborative programme between the Environmental Protection Department (EPD) and Hong Kong University which was initiated in 1987. This programme was designed to establish the baseline conditions in Tai Tam Bay with the intention of obtaining data for a relatively unpolluted area against which other marine areas could be compared. These data have been supplemented by more recent EPD monitoring results (Appendix 5B) and by field surveys conducted as part of the present environmental impact assessment (Appendix 5A).

During winter months the water column is well mixed and water temperatures are typically 16° to 18°C (Lui, 1991). With the onset of summer, a thermocline develops wherein surface water temperatures approach 30°C with bottom waters some five degrees lower. The thermocline is generally gradual with no sharp demarcation between surface and bottom waters although at times of calm weather the thermocline can become confined to a narrow depth band. The greatest rate of change in the Bay in the vicinity of the quarry occurs between 3m and 7m below the surface.

Dissolved oxygen during the summer shows a similar trend to temperature with higher saturation in surface (>100%) than bottom waters (<50%). The reduced dissolved oxygen has been attributed to higher rates of organic decomposition from summer blooms of planktonic organisms which sink to the seabed after dying (Lui, 1991). Autumn winds mix the water column thoroughly and dissolved oxygen at this time and throughout winter is fully saturated.

Table 5.2 **Standards for Effluents Discharged into the inshore waters of the Southern Water Control Zone (All units in mg/L unless otherwise stated; all figures are upper limits unless otherwise indicated)**

Flow rate (m^3/day) / Determinand	≤10	>10 and ≤200	>200 and ≤400	>400 and ≤600	>600 and ≤800	>800 and ≤1000	>1000 and ≤1500	>1500 and ≤2000	>2000 and ≤3000	>3000 and ≤4000	>4000 and ≤5000	>5000 and ≤6000
pH (pH units)	6 - 9	6 - 9	6 - 9	6 - 9	6 - 9	6 - 9	6 - 9	6 - 9	6 - 9	6 - 9	6 - 9	6 - 9
Temperature (°C)	40	40	40	40	40	40	40	40	40	40	40	40
Colour (lovibond units) (25mm cell length)	1	1	1	1	1	1	1	1	1	1	1	1
Suspended solids	50	30	30	30	30	30	30	30	30	30	30	30
BOD	50	20	20	20	20	20	20	20	20	20	20	20
COD	100	80	80	80	80	80	80	80	80	80	80	80
Oil & Grease	30	20	20	20	20	20	20	20	20	20	20	10
Iron	15	10	10	7	5	4	3	2	1	1	0.8	0.6
Boron	5	4	3	2	2	1.5	1.1	0.8	0.5	0.4	0.3	0.2
Barium	5	4	3	2	2	1.5	1.1	0.8	0.5	0.4	0.3	0.2
Mercury	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Cadmium	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Other toxic metals individually	1	1	0.8	0.7	0.5	0.4	0.3	0.2	0.15	0.1	0.1	0.1
Total toxic metals	2	2	1.6	1.4	1	0.8	0.6	0.4	0.3	0.2	0.1	0.1
Cyanide	0.2	0.1	0.1	0.1	0.1	0.1	0.05	0.05	0.03	0.02	0.02	0.01
Phenols	0.5	0.5	0.5	0.3	0.25	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Sulphide	5	5	5	5	5	5	2.5	2.5	1.5	1	1	0.5
Total residual chlorine	1	1	1	1	1	1	1	1	1	1	1	1
Total nitrogen	100	100	80	80	80	80	50	50	50	50	50	30
Total phosphorus	10	10	8	8	8	8	5	5	5	5	5	5
Surfactants (total)	20	15	15	15	15	15	10	10	10	10	10	10
E. coli (count/100 ml)	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000

Source : EPD Technical Memorandum on Effluent Standards, Table 10a

Table 5.3 **Standards for effluents discharged into the marine waters of Southern, Mirs Bay, Junk Bay, North Western, Eastern Buffer and Western Buffer Water Control Zones (All units in mg/L unless otherwise stated; all figures are upper limits unless otherwise indicated)**

Flow rate (m^3/day) / Determinand	≤10	>10 and ≤200	>200 and ≤400	>400 and ≤600	>600 and ≤800	>800 and ≤1000	>1000 and ≤1500	>1500 and ≤2000	>2000 and ≤3000	>3000 and ≤4000	>4000 and ≤5000	>5000 and ≤6000
pH (pH units)	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10
Temperature (°C)	45	45	45	45	45	45	45	45	45	45	45	45
Colour (lovibond units) (25 mm cell length)	4	1	1	1	1	1	1	1	1	1	1	1
Suspended solids	500	500	500	300	200	200	100	100	50	50	40	30
BOD	500	500	500	300	200	200	100	100	50	50	40	30
COD	1000	1000	1000	700	500	400	300	200	150	100	80	80
Oil & Grease	50	50	50	30	25	20	20	20	20	20	20	20
Iron	20	15	13	10	7	6	4	3	2	1.5	1.2	1
Boron	6	5	4	3.5	2.5	2	1.5	1	0.7	0.5	0.4	0.3
Barium	6	5	4	3.5	2.5	2	1.5	1	0.7	0.5	0.4	0.3
Mercury	0.1	0.1	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Cadmium	0.1	0.1	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Other toxic metals individually	2	1.5	1.2	0.8	0.6	0.5	0.32	0.24	0.16	0.12	0.1	0.1
Total toxic metals	4	3	2.4	1.6	1.2	1	0.64	0.48	0.32	0.24	0.2	0.14
Cyanide	1	0.5	0.5	0.5	0.4	0.3	0.2	0.15	0.1	0.08	0.06	0.04
Phenols	0.5	0.5	0.5	0.3	0.25	0.2	0.13	0.1	0.1	0.1	0.1	0.1
Sulphide	5	5	5	5	5	5	2.5	2.5	1.5	1	1	0.5
Total residual chlorine	1	1	1	1	1	1	1	1	1	1	1	1
Total nitrogen	100	100	80	80	80	80	50	50	50	50	50	50
Total phosphorus	10	10	8	8	8	8	5	5	5	5	5	5
Surfactants (total)	30	20	20	20	15	15	15	15	15	15	15	15
E. coli (count/100 ml)	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000

Source : EPD Technical Memorandum on Effluent Standard, Table 10b.

Salinity stratifications within Tai Tam Bay are regarded as slight although occasionally can be as low as 23 parts per thousand at times of local rainfall run-off compared to a norm of 30-34 parts per thousand. Reduced salinities are confined to surface waters, and are frequently associated with overspill from Tai Tam Reservoir and run-off from the adjacent catchment to inner Tai Tam Bay.

Nutrient concentrations are low throughout the Bay (mean inorganic nitrogen <0.075 mg/l; mean phosphate <0.01 mg/l) but increase slightly towards its outer margin (Lui, 1991). This suggests that the source of nutrients lies outside of the Bay. Biochemical Oxygen Demand (BOD) is also low with a mean value of <1mg/l. No obvious seasonal variations in nutrient concentrations have been found.

Sediments within the Bay are mainly composed of silt (>90% dry weight <63mm) with a slight increase in particle size towards the outer bay. Total organic carbon (TOC) is relatively low at 0.9-1.4% w/w but nitrogen and phosphorus were relatively enriched with mean values of 770 mg/kg and 320 mg/kg respectively. Thus while the water quality within Tai Tam Bay is considered relatively good, there is potential for eutrophication if nutrient loadings to the bay are increased (Lui, 1991). A nitrogen concentration of 0.3 mg/l in the water column is regarded as a typical concentration at which significant eutrophication effects occur, thus although Tai Tam Bay has potential for eutrophication, the present mean value of < 0.1 mg/l nitrogen for waters in the Bay suggests a reasonable safety margin in this respect.

Sediment samples have been collected from seven stations in Tai Tam Bay adjacent to the quarry as part of the baseline monitoring conducted for this present study. Analysis was carried out to determine trace metal concentrations in accordance with the requirements of Works Branch Circular 9/92 and EPD Technical Circular 1-1-92. Data for these stations are shown below in Table 5.4.

Table 5.4 Sediment metal concentrations for CES Stations 1 to 7 taken from Tai Tam Bay, July 1993. (All analyses conducted on the silt fraction and quoted as $mg.kg^{-1}$ dry weight)

Sample Number	Copper $mg.kg^{-1}$	Cadmium $mg.kg^{-1}$	Chromium $mg.kg^{-1}$	Lead $mg.kg^{-1}$	Nickel $mg.kg^{-1}$	Zinc $mg.kg^{-1}$	Mercury $mg.kg^{-1}$
Station 1	16.0	<0.05	28.0	29.0	16.0	72.0	0.18
Station 2	20.0	0.14	28.0	30.0	17.0	73.0	0.13
Station 3	20.0	<0.05	28.0	33.0	18.0	80.0	0.10
Station 4	20.0	<0.05	28.0	45.0	17.0	83.0	0.10
Station 5	20.0	<0.05	28.0	33.0	18.0	80.0	0.08
Station 6	20.0	<0.05	28.0	34.0	17.0	83.0	0.09
Station 7	21.0	0.06	28.0	36.0	17.0	83.0	0.10

Metal concentrations in the sediments were relatively constant between samples and were within the concentration range of Class A sediments according to Works Branch Technical Circular 9/92. Class A contaminated sediments are defined as 'uncontaminated or mildly contaminated material for which no special dredging, transport or disposal methods are required except those which would normally be applied for the purpose of ensuring compliance with EPD's Water Quality Objectives, or for protection of sensitive receptors near the dredging or disposal areas'.

Studies of plankton dynamics and primary productivity indicate fertile water conditions throughout the Bay (Chan *et al*, 1991). Productivity was found to correlate positively with nitrogen levels in the water column but not with phosphorus. Also, increases in biomass and chlorophyll during the duration of the two year study together with relatively high productivity values indicate that the situation in Tai Tam Bay needs to be closely monitored in order to afford some protection to the area by means of controls on nutrient loading to the Bay.

Faecal coliform bacteria numbers are low throughout Tai Tam Bay with geometric means of < 10/100 ml. Occasional individual results exceeded 1000/100 ml but in general the bacterial water quality of the Bay is very good (Lui, 1991).

5.5 Impact on Receivers

5.5.1 Nutrients

Of primary concern is the potential elevation of nutrient concentrations in an area recognised as being incipiently eutrophic. Sources of nutrients could be from resuspended sediments during dredging of the entrances to the casting basins and excavating the seabed to -8 m PD to enable the formed sections to be towed out of the basins. Similarly, suspended sediment loads could also be elevated during construction of the temporary jetty and berth.

Run-off from the quarry area following rainfall is unlikely to be a significant factor with respect to nutrients. Input from this source will be the same as at present and because of the podzolic nature of the decomposed granite of the area, material from this source will be low in nutrients.

Several options for sewage disposal from the site have been considered including septic tank/soakaway, aerated lagoon and small package plants but there are limitations on land availability and quality of effluent. The number of personnel on site will be 600, allowing for both office and casting basin. It has been decided that provision will be made on-site for sewage containment and all sewage will be taken off-site for disposal. Nutrients from sewage will therefore not be a key issue.

5.5.2 Suspended Solids

A consequence of dredging without some form of barrier is the increased suspended particulate load in the water column. The physical effects of this are reduced transparency of the water which can result in lower phytoplankton productivity, clogging of the respiratory processes of zooplankton, fish and sessile organisms, and in extreme cases, smothering.

The tidal characteristics of the area suggest that the dispersion potential of suspended material will be limited. In addition, dredging activity will be primarily directed at removing boulders that will impede the installation of sheet piling, used to mitigate against the effects of sediment resuspension and blasting impacts. It is provisionally estimated that the total volume of dredged material will be in the range of 15,000 to 30,000 m^3 (maximum of 15,000 m^3 per channel). Dredging activity will be confined to the formation of the navigation channel, a maximum of 100 m from the low water mark, and to the removal of boulders for sheet piling.

Removal and resuspension of sediments will be minimised in all cases. Recent consultation with EPD has identified the cofferdam option as the preferred method for minimising dredging in Tai Tam Bay as the barrier steel sheet pile will reduce the impact on water quality of the Bay. With the cofferdam in place, dredging of the channel outside of the dam will probably be unnecessary. It has been estimated from site investigations being conducted by Kumagai Gumi that the water depth at the outside of the cofferdam will be approximately -8 m PD. Formation of the cofferdam will be achieved using marine sand to form the bund which supports the sheet piling. Depositing the sand on site will not result in significant quantities of suspended sediment due to the relatively coarse grain size of the sand. Rapid settlement will occur which will also limit the transport of the material by the weak water currents in the area.

Run-off will also carry suspended solids from the present quarrying operations together with material from the construction of the Casting Basin. However, due to a concommittent change in quarry activities the total output from the combined operations is similar to that at present and impacts are not expected to change significantly.

5.5.3 Sewage

Faecal coliforms and viruses arising from sewage treatment associated with the casting basin were of potential concern with respect to bathers and water contact sports enthusiasts. However, with the proposed off-site treatment for the bulk effluent, there will not be any input of sewage effluent to Tai Tam Bay.

5.5.4 Casting Basin Flooding and Draining

Activities relating to the flooding and emptying of the Casting Basin for the removal of the formed tunnel units have the potential to impact on water quality. Water in the Basin may be expected to be contaminated with particulates from cement and concrete which could affect pH. Seawater has a high natural buffering capacity and as the Basin will be flooded with 390,000 m^3 of seawater, the effect on pH of the discharged waters is likely to be negligible. Suspended solids in the flooded Basin may be expected to be elevated above background although, as for pH, the large volume of water in the Basin will tend to reduce this impact. A period of settling of 24 hours before opening the basin to the sea would allow much of the suspended material to settle out. Wash-down, oil, grease, mould-releasing agents and concrete curing waters are also potential contaminants and are discussed below under 'Control and Mitigation'.

5.5.5 Marine Traffic

Steel required for operations will be brought in by ship. A total of 39,000 tonnes of bar and

plate will be required. Each batch of four units requires 10,000 tonnes of steel reinforcing bar thus there will be a maximum of three deliveries. The remainder of the steel is for formwork, which is re-usable and will be delivered at the same time as the reinforcing bar. All other materials will be delivered by road.

A grab dredger will be on site for a limited duration and deliveries of marine sand for the cofferdam will entail daily barges for approximately one month. Removal of the cofferdam at the end of the programme will require a dredger and barge for approximately 1.5 months.

The present and future quarry operations require three barges per day for export of quarry products. The additional marine traffic resulting from the casting basin operation is therefore unlikely to adversely affect marine traffic within Tai Tam Bay.

Transport of formed tunnel sections from the casting basin to the Western Harbour Crossing site will involve disruption to marine traffic. Close liaison between the basin operators and the Marine Department will be essential on those occasions.

5.5.6 Rainwater Runoff

The impacts of rainwater runoff will be the same as at present, if not slightly reduced due to the basin trapping some of the runoff which will then pass to the settlement pits.

5.6 Control and Mitigation

5.6.1 Dredging

A cofferdam will be installed by the operator to minimise the effects of sediment dispersion during dredging operations. This barrier will not be removed until the first tunnel sections are ready to be floated out of the casting basin. Because of the small area to be dredged outside of the cofferdam a mechanical grab dredger will be used and will be fitted with a closed sealed grab. Dredged material will be loaded onto a split barge with a water tight seal. Overflowing will not be permitted. Slow hoist speeds will be used to further reduce suspension of sediments in the water column.

Typical cross-sections of the construction sequence are shown in Figures 5.1 to 5.3. EPD/WSG have agreed with Kumagai Gumi that the dredging and placing of marine sand operations will be carried out in the winter season for a duration of approximately 5 months. As directed by EPD only bottom dumping barges will be allowed to perform the placing of embankment sand fill until the depth of water is too shallow for the barge. After this stage, the final material will be placed by belt conveyor. Trailing dredgers are prohibited.

During the construction stage, the Trigger, Action and Target Limits defined by EPD in the Environmental Monitoring and Audit Manual will be strictly applied. Mitigation measures such as silt curtains will be used in the event of suspended sediment limits being exceeded.

Removal of the cofferdam will occur when the first tunnel units are ready to be moved out of the Casting Basin. This will be carried out using a grab dredger.

5.6.2 Sewage

Effective sewage treatment measures will be employed to minimise sources of nutrients and faecal bacteria. All sewage will be treated off-site, therefore there will be no input to Tai Tam Bay from this source.

In accordance with the Environmental Guidelines for Planning in Hong Kong, supporting facilities such as vehicular access will be provided to enable proper operation and maintenance of the sewage storage facilities.

5.6.3 Operations

The greatest source of potential contaminants arises from the casting operation which involves the use of form oil (a mould-release agent) and concrete curing materials. Form oil will be used to coat the formwork (moulds) to facilitate separation of the formwork from the cast units. The form oil is hydrocarbon-based and applied to the formwork by spray or by hand. Excess form oil and any over-spray and spillage will drain into the gravel base of the Basin. Separation of the formwork from the cast units will contribute further contamination to the Basin floor, in addition to cement particles. Impact in the basin can be reduced by preparing formwork, as far as is practicable, in an area outside of the Basin provided with a solid concrete base and sides. This area can be connected to the Casting Basin water treatment tank. To further reduce potential impacts, a non-phenolic form oil will be used.

Once formed, tunnel sections need to be cured so that the concrete achieves maximum strength. This will be achieved using curing water, in which a constant flow of clean water flows over the newly-formed sections for up to 14 days. In the process, the curing water will become contaminated with cement and form oil. Concrete curing water will drain through the Basin floor and be pumped to treatment tanks prior to discharge to the sea. The waters will be routed to an oil-water separator after leaving settlement pits. Recovered oil will be properly contained, labelled and stored on site prior to collection by licensed collectors for disposal. The maximum volume of curing water is estimated to be 10 m^3 per day per section for a limited duration.

5.6.4 Casting Basin Washdown, Flooding and Draining

Prior to flooding the Casting Basin a washdown will be carried out. The design of the Basin has incorporated U-channels along the edge of the Basin provided with two pump pits. Settlement tanks will be installed at each outlet point. Washdown waters (and concrete curing waters) will drain through the gravel base of the Basin and be pumped to the treatment tank. Contaminants are likely to include oil, grease, suspended solids and mould-release agents. Settlement of wastes and oil removal will take place prior to discharge to the sea. If necessary, pH of the effluent can be controlled at this stage. Discharges from the treatment tank will have to comply with the 'Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters' (refer to Table 5.2).

The washdown will remove most of the oil which may be present but oil clean-up aids will be available as outlined in Section 8.4.3 for deployment when the Basin is opened to the sea.

Oil spills entering the Basin from plant will be minimised by conducting refuelling and maintenance outside of the Basin and this is covered further in Section 8.4.3.

During the flooding of the Basin with seawater (accomplished by pumps) no escape of water could occur as the cofferdam will still be in place. Prior to opening a channel through the cofferdam, water inside the Basin will be skimmed of floating debris and any oil. The channel through the cofferdam will only be opened with the approval of the Site Engineer to the effect that all reasonable steps had been taken to remove contaminants.

Draining of the Basin will take place after the caisson gate has been put in position. The seawater within the Basin will be pumped out and will not contain contaminants as these will all have been removed during the washdown and flooding operations. Draining the basin should not require control relative to tidal movement as the water in the basin will be clean seawater.

5.7 Monitoring and Audit

Water quality in Tai Tam Bay is at present monitored every two months by EPD and it is assumed this will continue throughout the duration of casting basin operations. It is understood that although not Gazetted, To Tei Wan beach is also monitored by EPD and that this also will continue.

Supplementary to the EPD monitoring programme, compliance monitoring during the operational stage of the casting basin should ideally be of suitable frequency to quickly establish the immediate effects on water quality e.g. three times per week. However, the actual frequency of sampling for some determinands is governed by the speed at which analytical results can be obtained. It is the speed of provision of analytical results which controls the response time of the casting basin or quarry operator to indications of adverse environmental impacts. For example, Biochemical Oxygen Demand (BOD) requires incubation for five days so there will be a lag time of five days before action (if necessary) could be taken, by which time, the situation could well have changed. Similarly nutrient analyses can take several days to process (unless done on site by trained personnel) plus any lag time the laboratory may have due to existing work loads. Data of this nature are therefore of historic interest and useful in predicting impacts of future activities rather than controlling present activities, particularly if the latter are short term.

The most practical determinands to comprise an effective monitoring programme are therefore, those which give immediate or rapid results e.g. Dissolved Oxygen (DO), turbidity, pH, suspended solids, salinity and temperature. Of these, DO, turbidity, pH and suspended solids are the most applicable to the proposed activities of the casting basin. The following recommendations for monitoring are based on the above considerations and can be split into requirements for different stages of the casting basin work programme. It is recommended that five monitoring stations, in addition to EPD's SM1, be established as shown in Figure 5.4.

Table 5.5 Outline Monitoring Requirements for Casting Basin Operations

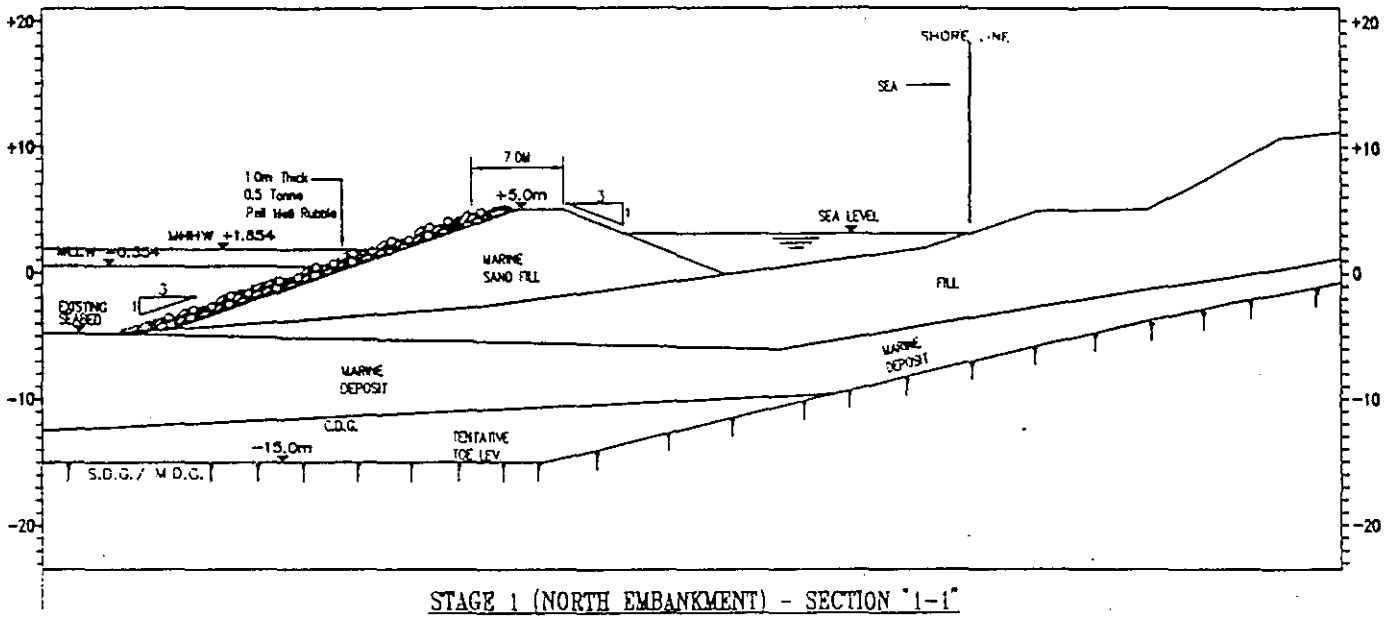
Activity	Determinand	Frequency	Station	Comments
Excavation and Cofferdam Construction	SS, DO, pH, turbidity BOD, nutrients	Three times per week Weekly	WM1 to WM5 and SM1	For the duration of construction
Dredging the Channel	SS, DO, pH, turbidity BOD, nutrients	Three times per week Weekly	WM1 to WM5 and SM1	For the duration of dredging
Production Waters	SS, DO, pH, turbidity Oil, phenol SS, pH	Weekly Three times per week Daily	WM3 Treatment Tank	Effluent from treatment tank and Washdown
Opening the Cofferdam	SS, DO, pH, turbidity BOD, nutrients	Three times per week Once	WM2 to WM4 and SM1	For the duration of the work
Reinstatement	SS, DO, pH, turbidity BOD, nutrients	Three times per week Weekly	WM2 to WM4 and SM1	For the duration of the work

An outline of the operation schedule for the casting basin is given in Figure 5.5.

Compliance monitoring will relate to Southern Water Control Zone Water Quality Objectives (WQO's) with Target Levels equating to the relevant WQO's. As has been previously stated, significant seasonal variations in monitored parameters are expected. It is therefore suggested that EPD monitoring station SM1 be used as a control station. Detailed schedules, Target, Action and Trigger levels and an Action Plan will be incorporated within the Monitoring and Audit Manual following consultation with EPD and are not discussed further here.

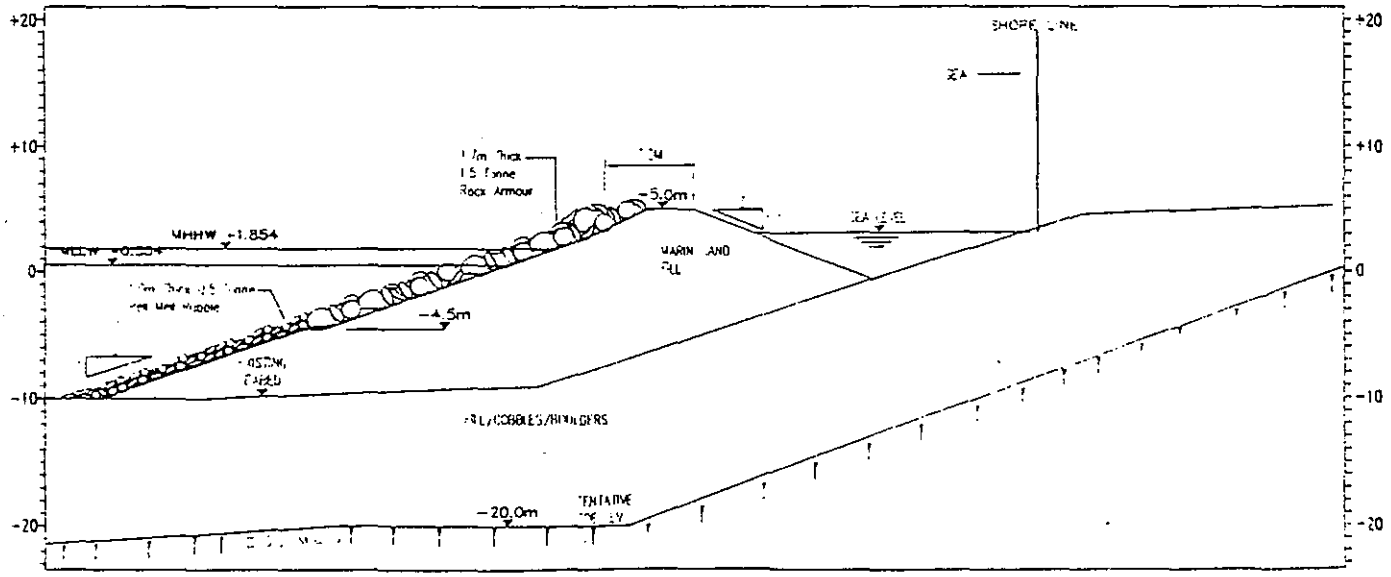
5.8 Summary of Key Issues

The potential key issues were the enrichment of nutrient concentrations in the water column derived from treated sewage effluent and dredged sediment resuspension. Sewage effluent will not be discharged from site and thus will not be an issue of concern. Elevated concentrations of suspended sediments or heavy metals derived from dredging are also not considered to be a key issue due to the use of a cofferdam.



STAGE 1 (NORTH EMBANKMENT) - SECTION "1-1"

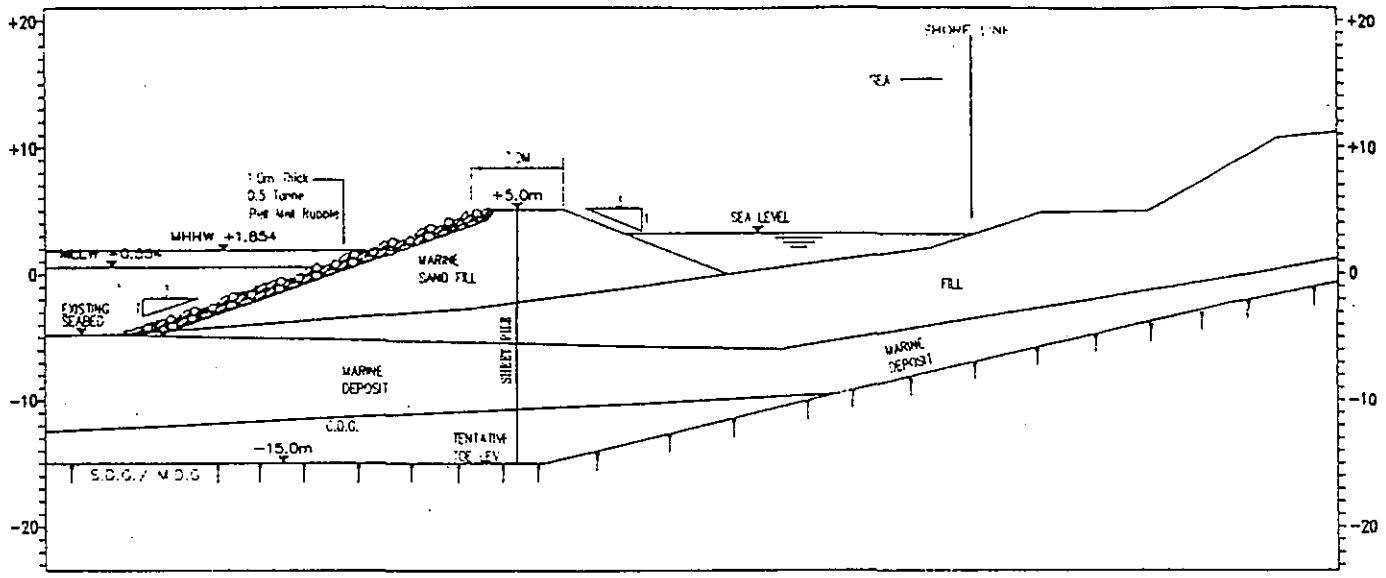
1. Remove boulders from seabed to facilitate sheet pile driving
2. Place marine sand over the existing seabed to form initial embankment
3. Place pell mell rubble on seaward slope



STAGE 1 (SOUTH EMBANKMENT) - SECTION "2-2"

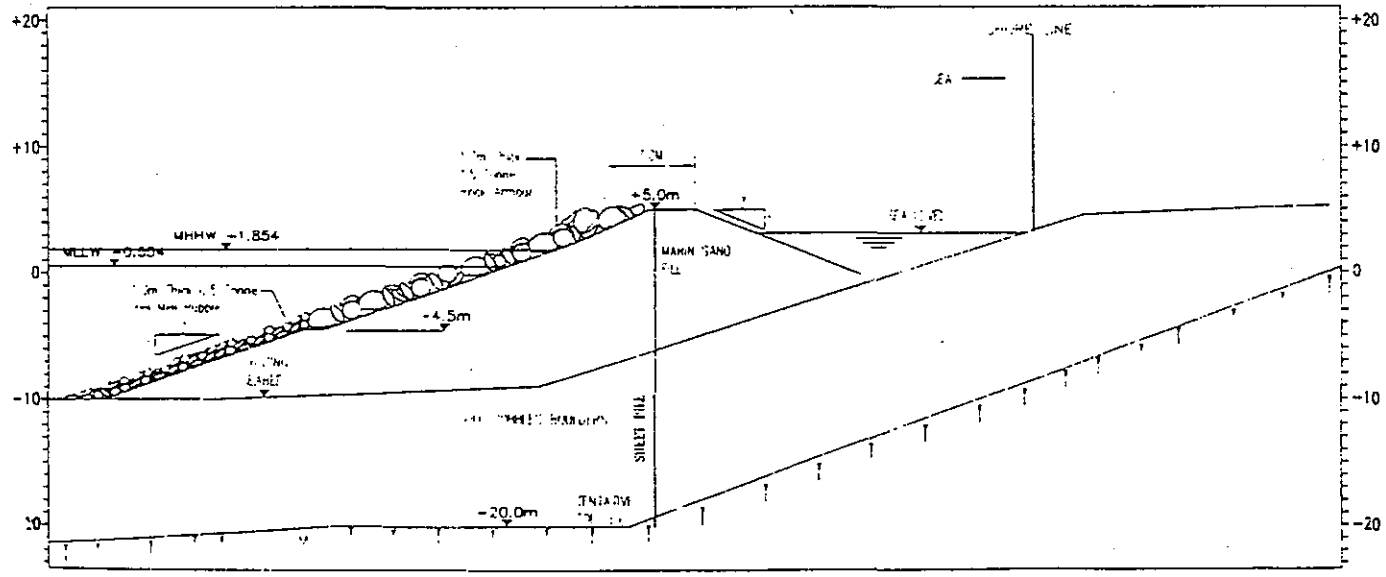
1. Remove boulders from seabed to facilitate sheet pile driving
2. Place marine sand over the existing seabed to form initial embankment
3. Place pell mell rubble and rock armour on seaward slope

Figure 5.1 Cofferdam construction Stage 1



STAGE 2 (NORTH EMBANKMENT) - SECTION "1-1"

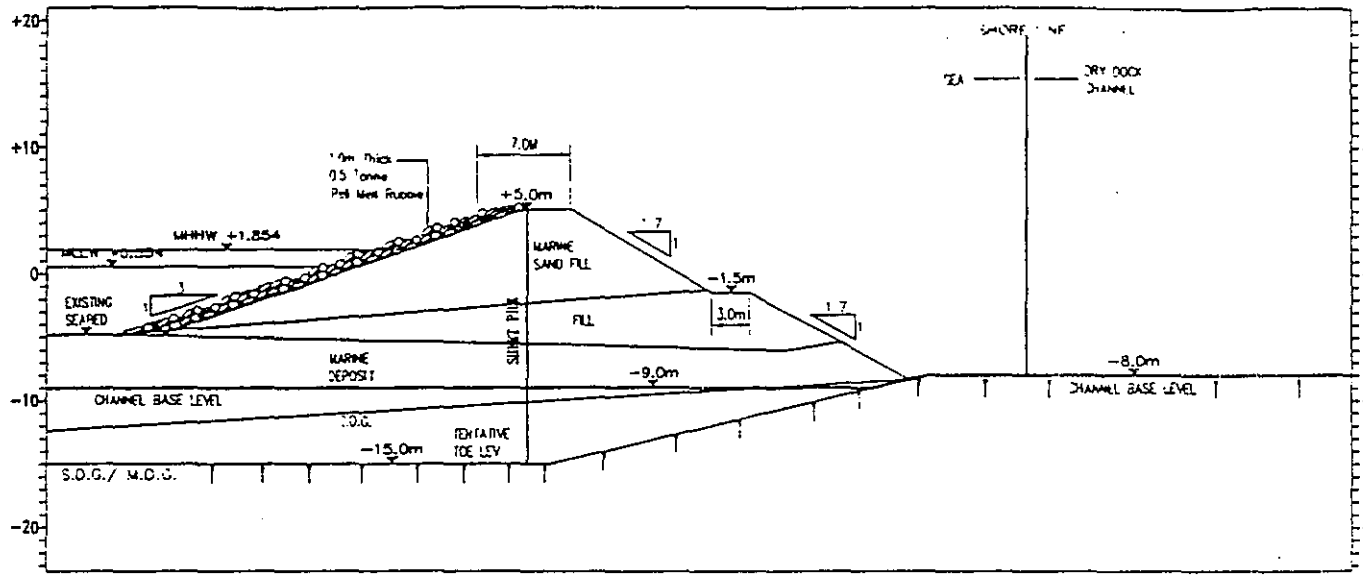
1. Drive continuous sheet piles to refusal along the embankment
2. Carry out cement grouting between ends of sheet pile wall and existing ground (See Plan)



STAGE 2 (SOUTH EMBANKMENT) - SECTION "2-2"

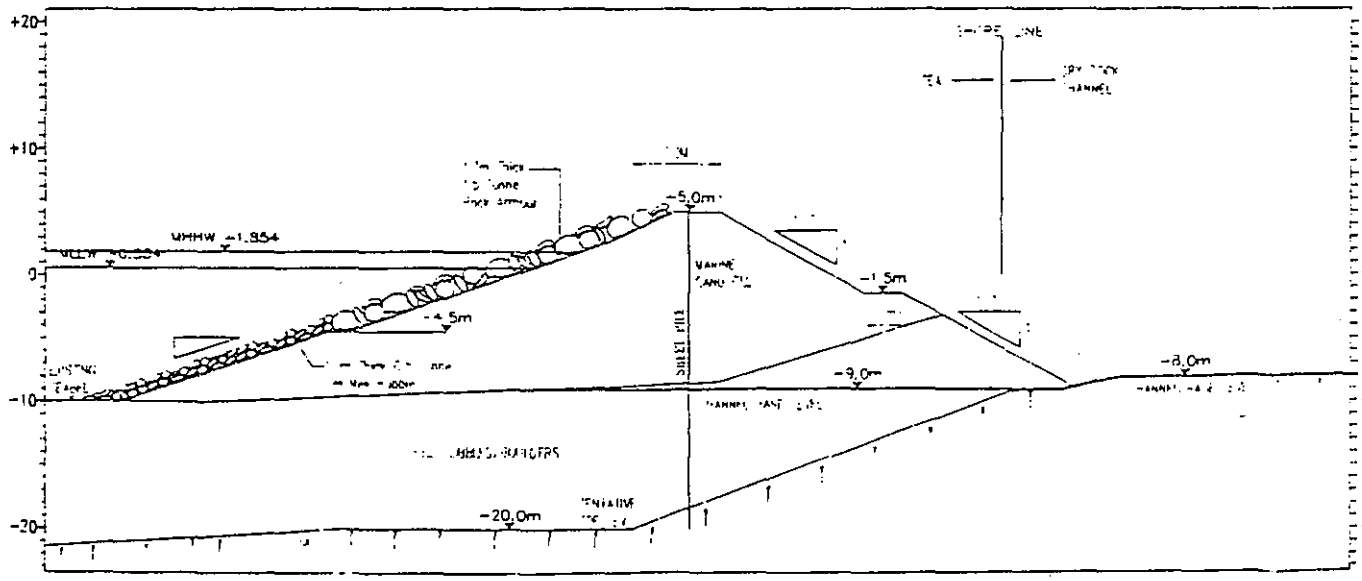
CONSTRUCTION SEQUENCE AS NORTH EMBANKMENT

Figure 5.2 Cofferdam construction Stage 2



STAGE 3 (NORTH EMBANKMENT) - SECTION "1-1"

1. Pump water out of dry dock
2. Cut inner slope to 1:1.7 gradient
3. Install Dewatering deep wells and piezometers
4. Excavate to channel base level



STAGE 3 (SOUTH EMBANKMENT) - SECTION "2-2"

CONSTRUCTION SEQUENCE AS NORTH EMBANKMENT

Figure 5.3 Cofferdam construction Stage 3

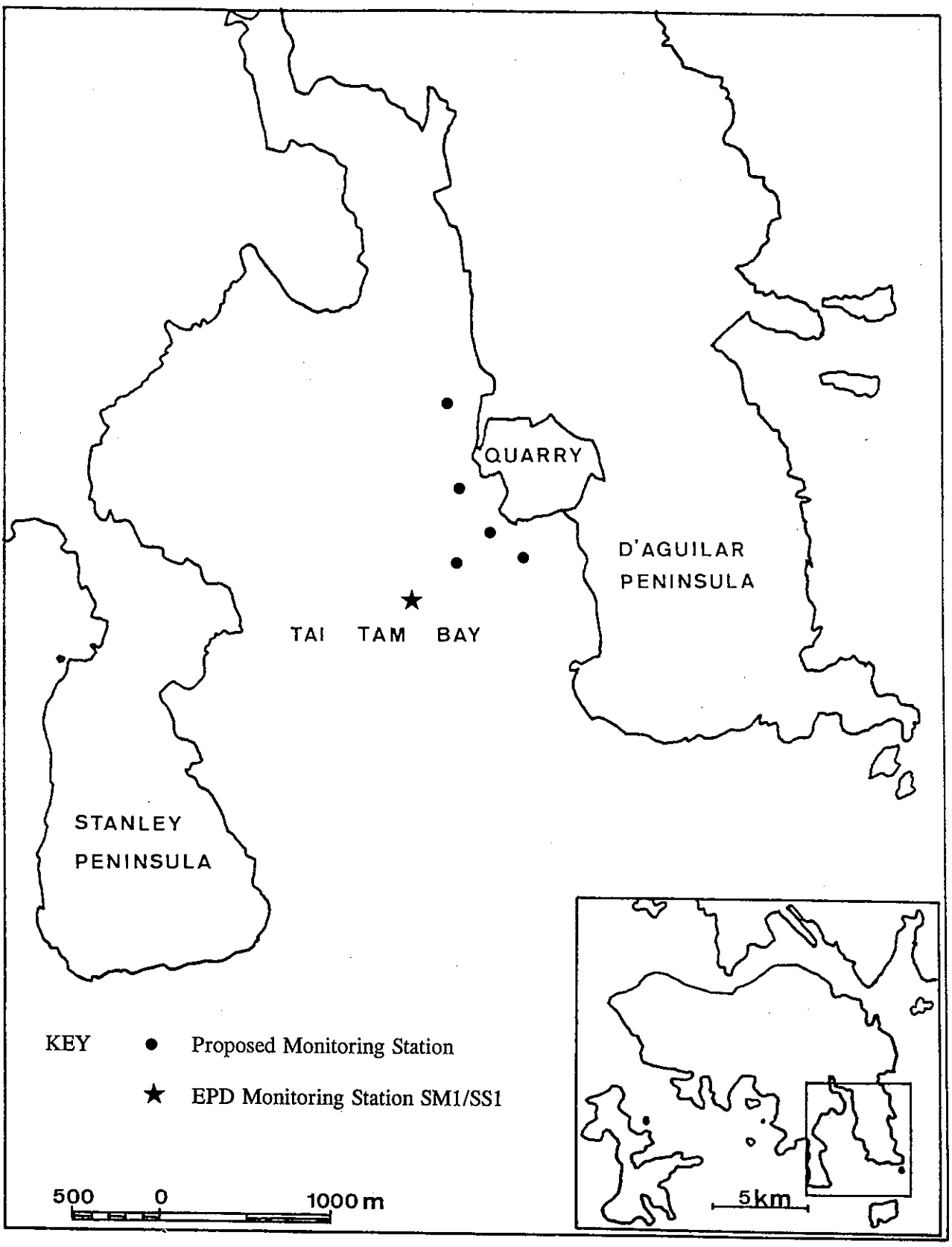
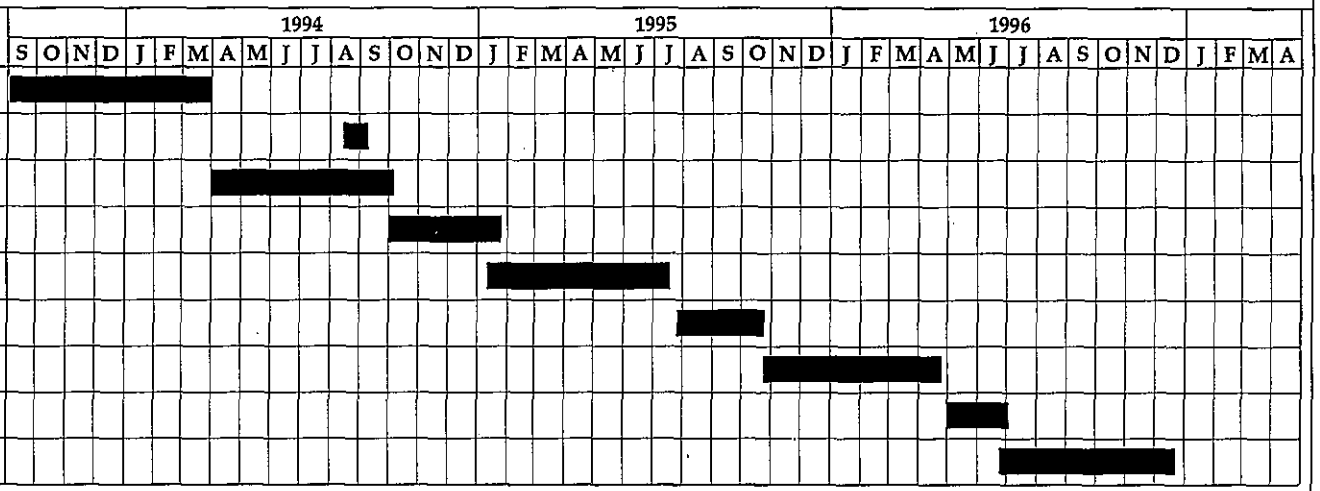


Figure 5.4 **Proposed Water Quality Monitoring Stations During Casting Basin Operations**

Figure 5.5 Proposed Activities Requiring Water Quality Monitoring for the Shek O Casting Basin Operations

ID	Name	Duration	Scheduled Start
1	Excavation	30w	4/9/93
2	Channel Excavation	4w	15/8/94
3	Production Waters 1	27w	1/4/94
4	Gate Operation 1	16.5w	1/10/94
5	Production Waters 2	27w	11/1/95
6	Gate Operation 2	13w	26/7/95
7	Production Waters 3	26.5w	24/10/95
8	Gate Operation 3	9w	2/5/96
9	Reinstatement	26w	24/6/96



Date: 16/12/93

Critical
Noncritical
Progress
Milestone
Summary
Rolled Up

6 MARINE ECOLOGY

6.1 General

Tai Tam Harbour (3km from Shek O Quarry) was recognised as a Site of Special Scientific Interest (SSSI) in 1974 and is the only site on Hong Kong Island to possess a diversity of intertidal habitats with concomitantly diverse plant and animal communities within a small area (Agriculture and Fisheries Department 1974). Cape D'Aguilar Peninsula SSSI (S1/90) includes coastal waters in the extreme south-east of the Peninsula adjacent to the Swire Marine Laboratory. This site (3km from Shek O Quarry) is one of the best examples of rocky shores in Hong Kong. It is rich in coastal features formed by interaction between prevailing wind, tidal action and parent rock. Examples of igneous intrusions, dykes, sea caves, geos, cliffs, sea arch and wave-cut platforms can be found in the site.

Government Departments have proposed the Po Toi group of islands, including Po Toi, Beaufort Island, Sung Kong and Waglan Island as a potential Country Park. These islands lie offshore of Tai Tam Bay, separated from it by strong tidal streams, and are close to large scale commercial dredging activities.

Tai Tam Bay is bounded by a shore of granite boulders and rock with occasional sandy areas. The shoreline is relatively steep and zonation of animals on the rock is well defined. The bed of the Bay consists of sediment with a very high silt content.

6.2 Sediment Infauna

6.2.1 Little information is available on the sediment infauna of the area and the most recent was derived from a collaborative two year study between the Environmental Protection Department and Hong Kong University in 1987-88 (Ong Che and Morton, 1991). This study found the main influence on community type to be sediment composition. All stations sampled within Tai Tam Bay were similar with sediments containing >90% silt-clay.

Typical animals of these stations were the polychaete worms *Agloaphamus toloensis*, *Nephtys polybranchia*, *Lanice conchilega*, *Stemaspis scutata* and several species of spionid. Other species representative of these stations were the bivalves *Theora lata*, *Merisca* sp and *Veremolpa scabra;* the echinoderms *Protankyra bidentata*, *Acaudina molpadioides*, *Schizaster lacunosus* and *Lovenia elongata.* The echiuran *Thalassema sabinum* was also present.

The authors of the above report concluded that a consistent picture of generally good water quality appears from the 1987-88 data on species numbers, abundance, diversity indices and the log-normal distribution of individuals between species. In addition, juveniles of many species have been recorded, indicating normal breeding in an unstressed environment. However, the general presence of *Sigambra tentaculata*, an indicator of moderate pollution, forewarns of a possible deteriorating trend in water quality.

6.2.2 In August 1993, as part of the baseline studies for this Report, samples were taken from the adjacent beach to the south of the quarry. Six one-metre-square quadrats were dug out to a depth of 30 cm; three in the lower beach and three in the upper beach. No marine fauna was recorded from any of the quadrats. The sand was very coarse and lacked shell fragments. Coarse material such as that found at the beach is very mobile and easily disturbed by wave

action which constitutes a hostile environment for marine organisms. It is therefore extremely unlikely that this beach has any importance in the marine ecology of Tai Tam Bay.

6.2.3 Conclusions

A generally higher species diversity in sub-tidal sediments is characteristic of the whole Bay as compared with other study sites in Hong Kong. Ong Che and Morton (1991) however, point out that such comparisons must be treated cautiously as results depend upon the type of sampling gear used and subsequent laboratory protocols employed.

The beach adjacent to the south side of the quarry has no importance with respect to the marine ecology of Tai Tam Bay.

6.3 Pelagic and Demersal Species

6.3.1 Little published information is available on this subject for Tai Tam Bay. For this reason, baseline monitoring conducted as part of this study included the deployment of trawls along the length of the Bay in July 1993 (Figure 6.1). A full species list and results for each trawl are given in Appendix 6A.

Diversity was moderate to high (Shannon-Wiener Index 2.84 - 4.13) with individuals relatively evenly distributed between species (Pielou's Evenness Index 0.66 - 0.75). The number of species in each trawl ranged between 17 and 37; the total number of species recorded was 96. Numbers of individuals in each trawl ranged from 64 to 671.

With the exception of a single species of shrimp, fish constituted the numerical majority of species in the trawls. Most were small or juvenile and belonged to one of eight species. Common fish species included cardinals (*Apogon* sp.), ponyfish (*Leiognathus* sp., possibly just juveniles as all the specimens were very small), snappers (*Lutjanus* sp.), silver meagre (*Agyrosomus argentatus*), threadfin (*Polydactylus* sp.), *Valenciennea* and *Amblygobius* sp. *Siganus fuscescens* (Doctor fish) proved to be the most common fish, present in all but two trawls and found at a maximum of 248 specimens in one trawl.

Occasional species recorded included *Clupanodon panctatus, Fistularia commersonii, Micrognathus/Phoxocampus belcheri, Kuhali mugil, Decapterus maruadsi, Evynnis filamentous, Johnius fasciatus, Parapercis* sp., *Pseudohombius arsius, Engyprosopon multisquama, Cynoglossus lineolatus* and *Cynoglossus joyneri.* In all samples there was a range of benthic and pelagic species.

The most abundant crustacean (and individual species) was the shrimp *Metapenaeus ensis* which ranged in numbers from 7 to 110 per trawl with a mean of 64. Eight out of the twelve trawls contained more than 50 individuals.

The next most abundant crustacea were two crabs of the Family Portunidae. These are 'swimming' crabs many of which are commercially important species. *Portunis sanguinolentus* is collected offshore as a food species. In samples in which this species occurred, the size of the crabs indicated that they were not fully mature. The juveniles of *P. sanguinolentus* live inshore on sandy or muddy substrata and move offshore when they are fully mature. This migratory behaviour occurs in most of the commercially important Portunids. The second Portunid, *P. tweedei*, was found in all the samples and again all specimens were juveniles.

Of other crabs found in the samples most are usually associated with one of two types of sediment, and in depths ranging from 10m to 15m. The species of the Families Dorippidae, Ocypodidae and Leucosidae are all found in muddy substrata and are detritivores. The rest of the crabs found are generally associated with soft sand substrata, although a few of the specimens recorded in small numbers (*Charybdis hellerii, Charybdis acuta,* and *demania scaberrima*) are more commonly found on rocky coasts. One species, *Parthenope platylambrus validus*, is rare in Hong Kong waters and is usually found in deep water.

Of particular biological interest were the *Dorippe* species since these crabs are not particularly common in Hong Kong and are unusual in that they carry an anemone on their carapace (*Carcinactis ichikawai).* Another rarely recorded species was *Calappa philargius*, a resident of sandy shores into which it buries.

Crustacea other than crabs included the snapping shrimp *Alpheus brevicristatus* which lives in long vertical burrows in the sediment, the hermit crab *Calcinus* which inhabits shells of *Nassarius* species, and *Oratosquilla oratorio.* Species in low abundance were *Porcellana picta* and *Harposquilla japonica.*

Other Phyla represented included Phycophyta, a red alga which is quite common in Hong Kong waters and one sponge, a small tube sponge *Siphonochalina.* Coelenterata were represented by *Palythoa* sp and *Pteroeides sparmanni* but these were quite rare in the samples. Species of the Phylum Annelida were relatively common, most of which belonged to the Class Polychaeta and the sub-class Sedentaria. These included *Siphonosoma lumenense*, specimens of Spionidae and Sabellidae and *Myxicola infundibulum.* The sipunculid *Sipunculus nudus* was low in numbers but found in three trawls. These are primarily tube dwellers.

Molluscs were well represented with gastropods, opisthobranchs and bivalves. The commonest gastropods were *Nassarius nodiferus* and *N. teretiusculus* with many specimens in each trawl. Relativey infrequent in the samples were the gastropods *Eunatica papilla, Phalium bisulcatum, Bursa margaritula, Murex aduncospinosus, Babylonia areolata,* and one Buccinidae species. Bivalves included *Trachycardium, Placamen tiara, Pharoanella perna* and a species of *Gafarium,* most of which were relatively rare in abundance. There was one chiton, *Lepidozona coreanica,* normally found under boulders or shells. Decapod molluscs were represented by two species of cuttlefish, *Sepia pharaonis* and *Euprymna berryi.*

Echinoderms were low in abundance but present in the majority of trawls. Sea urchins were the most common and included *Temnopleura reevesi, Salmacis sphaeroides* and *Lovena elongata.*

One ascidian was recorded, *Styela canopus,* and was present in only two trawls.

6.3.2 Conclusion

Tai Tam Bay supports a diverse mixed community of pelagic and demersal species which includes large numbers of juvenile fish and crabs. The adults of some of these species are commercially important in offshore waters. Although the juvenile fish and crabs represent species commercially fished offshore, the indirect impact of casting basin operations in terms of the offshore fishery via the juveniles in Tai Tam Bay will be negligible. The area of the Bay is approximately 8 km^2 and the area likely to be affected by the casting basin will be restricted to an area of foreshore of approximately 700 m^2 relating to the cofferdam and temporary jetty construction. This equates to less than 0.01% of the area of the Bay.

No comment can be made regarding the status of Tai Tam Bay as a possible nursery area during the winter months. Lower water temperatures in winter will probably have an influence on the species present at that time and the juveniles recorded in the summer of 1993 may be absent.

6.4 Rocky Shore Communities

6.4.1 Introduction

In July 1993, a baseline shore survey was carried out in and around Shek O quarry, to identify the habitats and dominant species in the littoral zone of this area. This study was carried out specifically as part of the Environmental Impact Assessment for the proposed casting basin for the Western Harbour Crossing.

The study involved taking 0.25 m^2 photo-quadrats along transects on the rocky shore at six sites on the eastern side of Tai Tam Bay. The species in specific quadrats were recorded for abundance and identified. General observations of the local habitats were also noted. Transect locations are shown in Figure 6.1 and full species records in Appendix 6B.

Shore types on the eastern side of Tai Tam Bay

The position of the quarry on the eastern side of Tai Tam Bay, on the Cape D'Aguillar Peninsula, marks a division between the sheltered shore, to the north, and the more exposed shore, to the south of the quarry. The geology of the peninsula is granite bedrock sloping down to the intertidal zone, where it breaks up into large boulders and rocks on the sandy shore. The resulting coast is characteristically boulder shore interspersed with outcropping rock platforms and a few small sandy bays.

Sites 1-3 Sheltered rocky boulder shore

Description

The transects at sites 1 and 3 were situated on large boulders, which were over 4 metres in height. At site 2, the topography dictated that several smaller boulders spread out through the intertidal zone be used.

Although classical zonation could be observed at all sites, this was much clearer at sites 1 and 3 due to the more vertical nature of the transects, the upper, middle and lower shore being characterized by specific organisms.

Zonation pattern

The High shore was essentially bare granite, with the barnacle *Tetraclita squamosa* settling the upper limits of the splash zone. On the tops of the flatter boulders, the blue-green algae *Kythuthrix* covered the rock in a black layer above the *Tetraclita*. The isopod *Ligia exotica* is commonly found scavenging on the boulders. On the rock face a few gastropod grazers such as *Planaxis sulcatus* and *Nodilittorina pyramidalis* were also observed however these were not as abundant as on the more exposed sites, where the splash zone was greater and extended their range.

The Mid shore was characterized by the presence of the rock oyster *Saccostrea cucullata*, although much of the cover was just the empty shells of dead oysters, and the barnacle *Tetraclita squamosa*. The oyster shells provide refuge for a large number of mobile grazers, such as the dogwhelk *Thais clavigera*, the gastropods *Nerita albicilla, Planaxis sulcatus,* and *Nodilittorina pyramidalis,* as well as sessile organisms like the mussel *Septifer virgatus* and the stalked barnacle *Pollicepes mitella*. The other dominant grazers at this height on the shore are the chitons *Liolophura japonica* and *Acanthopleura loochooana,* and the limpets *Siphonaria japonica* and *Cellana grata*.

Whilst few algae are found at this time of the year, some of the more persistent encrusting and coralline algae were observed on the Low shore, such as *Hildenbrandtia, Ralfsia* and *Corallina*. The Low shore was also characterized by a high abundance of smaller *Tetraclita* and a large specimens of the oyster *Saccostrea cucullata*. In and amongst the shells of dead organisms were found a large number of *Amphipoda* and Portunid crabs, the gastropods *Thais clavigera* and *Nerita albicilla*, in addition to the mussel *Septifer virgatus* and the tube-worms *Serpulorbis imbricatus, Pomatoleios kraussi* and *Spirorbis foraminosus*. At Stations to the south of To Tei Wan beach, small colonies of the green lipped mussel *Perna viridis* are exposed at extreme low spring tides.

Sites 4, 5 & 5a Exposed rocky platforms

Description

Although it had been intended to select similar shore types to the south of the quarry as to the north, site selection was restricted by shore access. It was further observed that the southern sites were in any case more exposed, generally exhibiting a rocky platform aspect, so three similar sites were selected in and to the south of the quarry.

On the rocky platforms similar zonation to the previous sites was also observed, however the zoning bands tended to be larger due to the more horizontal aspect of the face and the higher splash zone due to increased wave exposure. The slopes of the platforms were approximately 30° and the transect length 7 metres.

Zonation pattern

The High shore in the southern sites was characterised by a greater cover of the blue-green algae *Kythuthrix* and a wider but less densely populated zone of *Tetraclita squamosa*. Due to the higher splash zone a larger number of grazing gastropods were found on the high shore, including both *Nodilittorina pyramidalis* and *Nodilittorina millegrana* and the limpets *Cellana grata* and *C. toreuma*. The isopod *Ligia exotica* was found in similar abundance to the northern sites. Also very abundant in the crevices and pools of the High shore were the stalked barnacle *Pollicepes mitella* and the mussel *Septifer virgatus*, which also extended to the Mid and Low shores.

The chiton *Liolophura japonica* was very abundant over the whole shore, but was most abundant on the Mid shore, certainly one of the dominant grazers. The Mid shore was however characterized by the high abundance of both large and small *Tetraclita squamosa*. At all southern sites a large number of grapsid crabs *Grapsus albolineatus* were observed over the whole of the mid and lower shore, taking refuge when disturbed subtidally and in crevices.

A few of the large *Saccostrea cucullata* mentioned previously were found on the Mid shore, however these were far more abundant on the Low Shore. Amongst the barnacles and oysters many gastropods were found, including *Patelloida saccharina* and *Siphonaria japonica*, which were most common and *Cellana grata, Planaxis sulcatus* and *Nerita albicilla*, which were also present.

The Low shore was characterized by the presence of the large *Saccostrea cucullata* and the encrusting and coralline algae mentioned previously. There was in addition to this patches of bleached white coralline algae and a film of green filamentous algae, possibly *Chaetomorpha antennina*. A number of the large tube-worms *Serpulorbis imbricatus* and the smaller *Pomatoleios kraussi* were also present. The mobile organisms of the Low shore consisted predominantly of Amphipoda , Portunid crabs, *Acanthopleura loochooana, Thais clavigera* and *Siphonaria sirius*.

6.4.2 Conclusions

The sheltered and exposed sites exhibited similar species throughout, with differing abundances and distributions. The beaches between the sites were of clean medium-to-coarse, well-sorted sand, which are generally very mobile and thus sparsely populated, characteristically by the bivalve *Donax*.

The communities found on the shores in the vicinity of Shek O Quarry appear to be similar to those descibed elsewhere in Tai Tam Bay and the D'Aguilar Peninsula (Morton and Morton, 1983). As such, they do not represent unusual or outstanding communities.

The beaches are coarse-grained and relatively mobile which makes this habitat difficult to colonise and therefore probably sustains a low diversity community of few individuals.

6.5 Impact on Receivers

6.5.1 Construction Phase

Construction of the bulk of the casting basins will proceed as part of the present normal quarrying activities and therefore represents no change to background impacts. The main factors during construction will be the fabrication of a temporary jetty and the formation of a cofferdam around the proposed entrances to the two basins.

The new jetty will have a very small footprint of 7 m by 8 m and its construction *per se* is unlikely to create a significant impact on sediment infauna. Physical removal of organisms will result from dredging to provide adequate draught for the supply vessels but it is anticipated that recolonisation will take place within a relatively short space of time. Increases in suspended sediments will occur during excavation of the berth but the volume of sediment to be removed is very small. These activities are not therefore expected to create significant adverse effects.

Formation of the cofferdam from marine sands across the entrances of the basins will cause the death of organisms by smothering, and water clarity will also be affected by the suspension of particulate material. It should be noted however that particle size composition is rather course and this will inhibit dispersion of suspended particulates. The water circulation within the Bay also implies that any silt will not be dispersed rapidly by water movement and will settle within a small radius of the bund. This in itself is not seen as particularly damaging to infauna as long as the rate of deposition is low, as sediment infauna are adapted to cope with periodic increases in sediment deposition rates. The maximum area likely to be affected by smothering is estimated as 300 m^2 which is the footprint of the cofferdam.

Sediments in the study area fall within the category of Class A with respect to contamination and therefore are unlikely to create problems arising from the release of metals into the water column.

6.5.2 Operational Phase

Fish are the most sensitive of marine organisms to the effects of blasting and the use of explosives is a well-known method of fishing in some countries. Fish may also avoid areas in which blasting is taking place with obvious consequences for local fisheries interests. Crabs have also been reported as being very sensitive to blasting effects (Westing, 1978) and in view of the numbers of juvenile commercial species found in Tai Tam Bay this is an important consideration. Lobsters and shrimps are less sensitive than fish and crabs (Westing, 1978) and therefore the sensitivty issues should be assessed against the latter two groups.

Excavation of sediments from within the cofferdam will not affect the ecology of the area outside of the bund. There will be loss of organisms inhabiting the dredged sediments from within the bund, but as this is a relatively small area which will probably recolonise following removal of the cofferdam, it is unlikely that there will be a significant lasting effect on the local ecology.

Impacts on intertidal flora and fauna are only likely to arise from increased suspended sediment loads and will probably be restricted to within a small distance of the works. The width of rock to be excavated for the connection between each of the casting basins and the

sea is 40m. Removal of this will represent only a very small proportion of available habitat and is unlikely to significantly alter the ecology of the area.

6.6 Control and Mitigation

The presence of the cofferdam will reduce the potential for damage from blasting and increased sediment loads in the water column. With the cofferdam in place the water inside will be pumped out and the sediments excavated. This will ensure that increased sediment loads in Tai Tam Bay will be minimal and will only be derived during the installation of the cofferdam itself and subsequent pumping out of water which may ingress into the dredged area.

Any water which is pumped out during dredging operations should be diverted to settlement pits before discharge to the Bay. Sediment removed from the settlement pits should be disposed of with the bulk excavated material.

The absence of water within the cofferdam will also minimise the propagation of blasting shock waves into the waters of the Bay. As it is the propagation through water which damages marine organisms, such effects will thus be avoided.

6.7 Monitoring and Audit

Measurements of suspended sediments will be made as part of routine water quality monitoring within Tai Tam Bay, therefore no additional monitoring specific to the cofferdam will be required in this respect. Waters discharged from settlement pits should however be monitored to ensure that there has been adequate time for settlement.

Of particular concern will be the first flooding of the excavated area at the time of removal of the cofferdam. Care must be exercised by controlled flooding using pumps to minimise sediment suspension. This will only happen on the first occasion as caisson gates will be used in subsequent operations. On completion of flooding, the basin should remain closed for approximately 24 hours to allow suspended sediments to settle. In reality, the amount of suspended sediment may be small, as the surface of the sediment would have been exposed to the atmosphere for up to one year and may become compacted and/or hardened. Refer to Table 5.5 in the previous Section for monitoring and audit issues.

6.8 Summary of Key Issues

The Key Issues with respect to the marine ecology in the vicinity of Shek O Quarry are the impacts of blasting and increased suspended sediment loads. It is considered however, that the installation of a cofferdam will significantly reduce the potential impacts of these factors.

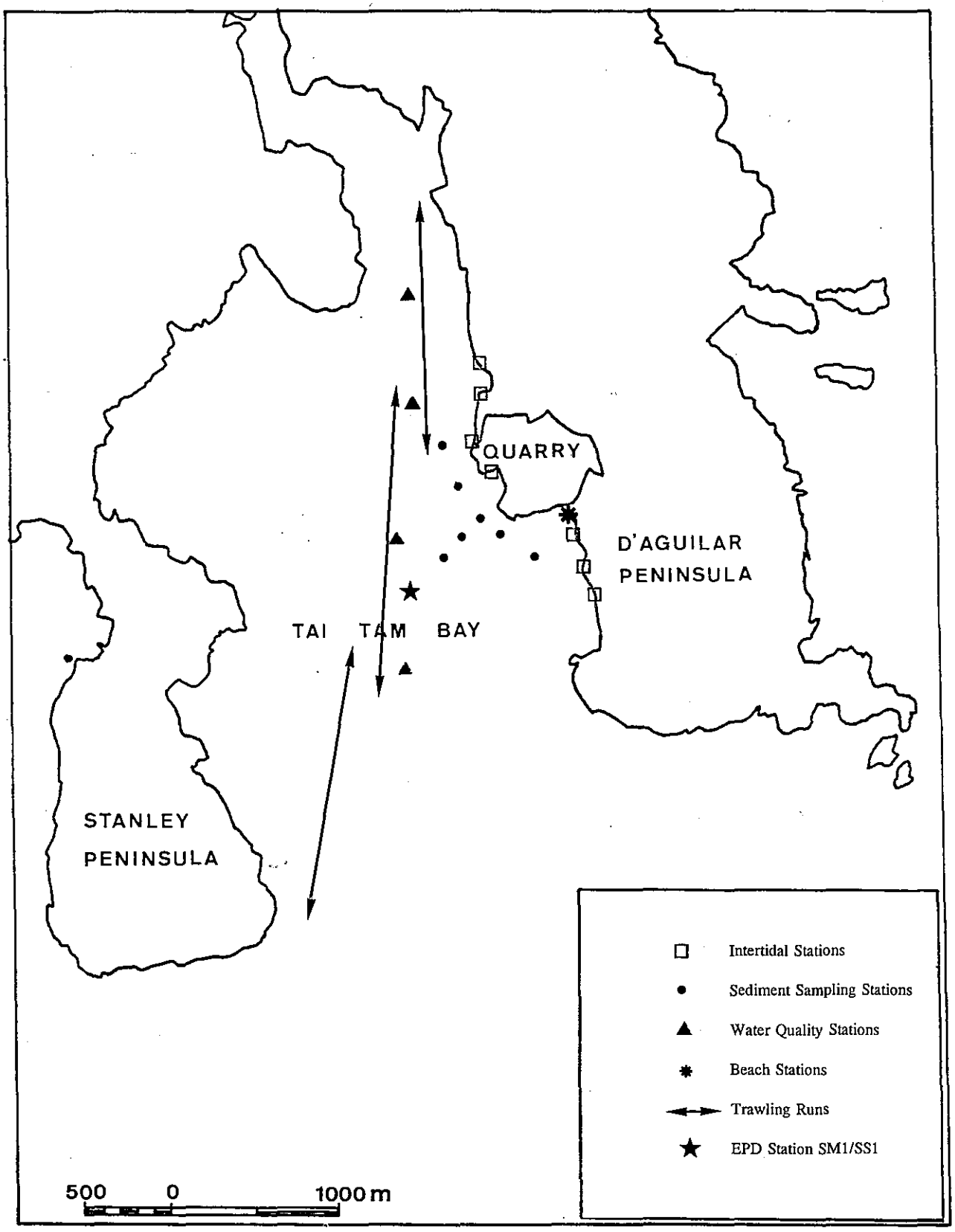


Figure 6.1 Location of Marine Monitoring Stations in Tai Tam Bay, June-July 1993

7 TERRESTRIAL ECOLOGY

7.1 Background

As part of the Environmental Impact Assessment for the proposed casting basin for the Western Harbour Crossing, a terrestrial ecological assessment of the Shek O Quarry has been undertaken.

This has involved reviewing existing data available on the quarry and its surrounding area, including an early but comprehensive M.Phil thesis on the ecology of the D'Aguilar Peninsular, studying aerial photographs and undertaking field survey work (July 1993) to collect baseline information on the flora and fauna of the quarry and its surrounding area.

In order to address the wider issues of the continued quarrying and the future restoration of the quarry, as a supplement to this assessment, further ecological survey work was commissioned in August 1993 to provide more detailed up to date baseline information on the ecology of the area. The results of this preliminary terrestrial ecological survey are given in Appendix 7A and the study area is shown in Figure 7.1.

7.2 Objectives

The specific purposes of this assessment were:

- to identify the habitats and species within the quarry and its surrounding area and to assess their importance,
- to identify possible impacts of constructing a casting basin in the quarry,
- to recommend mitigation measures and opportunities for wildlife enhancement,
- to assess any ecological constraints on the area and to address selected issues relating to the restoration of the quarry,
- to provide guidance on ecological monitoring and audit,
- to summarise the key ecological issues.

7.3 Existing Flora and Fauna Within the Quarry

The quarry bottom supports very little vegetation. The main species found on the quarry floor were scattered areas of grass and herbs including *Eleusine indica*, *Pueraria lobata*, *Youngia japonica*, *Ageratum conyzoides* and *Miscanthus spp.* The quarry face is shear rock and is devoid of vegetation. All the species recorded from the quarry are very common weeds of waste places.

There is no natural vegetation left in the quarry but there are a few small areas of formed cut and fill slopes which have been planted up as part of a restoration programme; species such as *Leucaena leucocephala*, which is known to have the ability to grow on eroded granite and spreads easily, *Acacia confusa* and *Casuarina equisetifolia* have been used.

The area within the quarry is very disturbed and noisy, the activity making the sparse shrub habitat within the site generally unsuitable to birds. A few very common birds have been recorded in and around the quarry including *Pica pica* (magpie), *Acridotheres cristatellus* (Crested Mynah) and *Passer montanus* (Tree Sparrow). *Milvus migrans* (black kites) have been recorded soaring over the site on a regular basis and, on rare occasions, the White-bellied sea eagle has been seen in the air. Nesting holes of the White-breasted Kingfishers were found at several places in embankments along the main access road inside the works area of the quarry.

Given the level of disturbance, lack of vegetation and high levels of dust, it is highly unlikely that any other faunal species are present in the quarry other than the extremely common ubiquitous species such as Diptera, Lepidoptera and Coleoptera (butterflies, moths, flies and beetles etc.).

In summary, the wildlife value of the quarry site is considered to be minimal at present.

7.4 Existing Flora and Fauna of the Surrounding Areas

7.4.1 Flora

The soils of the area surrounding the quarry are heavily eroded red-yellow podzolic soils. In general terms this soil type overlying the granitic rock is heavily eroded, contains large rock outcrops and the growth potential is low. The vegetation around the quarry can be divided into four main areas (see Figure 7.1):

- the beach vegetation to the southeast of the quarry and within the Shek O Country Park.
- the low scrub communities to the north of the quarry near To Tei Wan village outside the Shek O Country Park,
- the scrub/woodland habitats to the south of the quarry within the Shek O Country Park and partly within the D'Aguilar Peninsular SSSI,
- the woodland/scrubland habitats to the north east of the quarry and above the Shek O Road and currently within the Shek O Country Park boundary,

Beach Vegetation

The coastal habitats which occur in the immediate vicinity of the quarry are those of sheltered west-facing rocky and sandy shorelines. The vegetation behind the beach follows a natural continuum from typical salt-tolerant, seashore vegetation to the woodland behind. The plants comprise salt-tolerant tree and shrub species, fleshy shrubs and creepers. Species which were recorded in July/August 1993 on the beach and rocks to the south of the quarry included *Ipomea brasiliensis*, *Wedelia chinensis*, *Wedelia prostrata*, *Synostemon bacciformis*, *Pandanus furcatus*, *Vitex rotundifolia*, *Lantana camara*, *Scaevola sericea*, *Excoecaria agallocha*, *Zoysia sinica*. This vegetation gradually increases in height as the dominant species are replaced by *Leucaena leucocephala* and *Hibiscus tiliaceous*. Further inland these species are interspersed with other terrestrial species and eventually merge with the broadleaf woodland.

In recent years, such beach vegetation has become limited in area in the Territory and many remaining sites are under threat of development. On Hong Kong Island, beach vegetation is now quite scarce.

Scrubland

Three areas of scrubland were recorded in the north, northeast and southeast of the study area. Of these, the latter two fall within the Shek O Country Park. The different types of scrubland recorded in the study area are described in Section 2.2 of Appendix 7A.

In summary, the assemblage of species recorded is typical of scrubland on granitic soils in Hong Kong. However, the scrubland in the vicinity of Shek O Quarry contains a high proportion of uncommon species, including those characteristic of an advanced stage in succession. One possible explanation is the large bare rocks on the hillside, which probably serve as a barrier to the spread of hillfire.

Woodland

In the study area, two types of woodland can be distinguished. One is located within the Shek O Country Park and D'Aguilar Peninsular SSSI on the southeastern side of the quarry and the other is on the northern and northeastern side of the quarry. For full descriptions of these woodland areas, refer to Section 2.3 of Appendix 7A.

The woodland to the south of the quarry is a well developed scrub/woodland community on exposed granite. This habitat is more developed and more species-rich and diverse than the woodland/scrub on the Hong Kong Granite to the north of the quarry. It is also the area of the D'Aguilar Peninsular SSSI and this woodland forms a valuable habitat for a variety of wildlife (see below).

Generally, there is a small strip of vegetation between the road and the quarry face; there is also a disturbed area to the north of the road which is excluded from the Country Park. Species recorded in this area include *Celtis sinensis*, *Acacia confusa* (planted), *Casuarina stricta* and *Casuarina* equisetifolia (planted), *Leucana leucocephala* (planted), *Melaleuca leucodendron* (planted), *Psidium guajava* (planted), *Ficus* spp., *Pandanus tectorius*, *Schefflera octophylla*, *Litsea spp.*, *Macaranga tanarius* (planted), *Lantana camara*, *Ipomea* spp., *Rhapiolepis indica*, *Rhodomyrtus tomentosa*, *Eurya japonica*, *Sapium discolor* and *Melastoma sanguineum*. Many of the species recorded are indicative of secondary or planted woodland, or disturbed areas, whilst others are typical common scrub species found on granitic soils with a low growth potential.

7.5 Fauna

Amphibians and Reptiles

In a recent survey (August 1993), the areas surrounding the quarry including the SSSI were found to be of very limited significance to amphibians with only common and widespread species such as the Lesser Spiny Frog and Asian Common Toad being recorded. The area probably supports a rather diverse reptile fauna similar to that of other shrub-covered dry hillsides in Hong Kong, but rare species are not expected to inhabit this area. The only reptile

species found during the recent survey was the Large-spotted Cat Snake. For full details of the amphibians and reptiles recorded, please refer to Section 3 of Appendix 7A.

Mammals

Three species of small mammal were positively identified on site by the use of mammal traps. These were Chestnut Spiny Rat, Sladen's Rat and Black Rat all of which are typical of the habitats they were trapped in. In addition, droppings of the Masked Palm Civet were observed on top of flat rocks within the SSSI; this species is not very common and is protected in Hong Kong under the Wild Animals Protection Ordinance. Full details of the mammal trapping techniques and results are contained in Section 5 of Appendix 7A. This section also documents sightings of larger mammals on the D'Aguilar Peninsular over the past few years.

Birds

During the bird survey which took place on 31 August 1993, sixteen bird species were recorded. All the birds recorded during this preliminary survey have a widespread distribution in Hong Kong. The majority of the birds recorded were resident with one summer visitor, Black Drongo, being recorded.

The vegetation behind the beach was considered important for birds based on the amount of activity observed, mainly Bulbul species. The stream to the north of To Tei Wan and the quarry itself was found to support White-breasted kingfisher. A Black-eared Kite was observed hunting along the quarry rock face.

The woodland and shrubland habitats to the north and south of the quarry are likely to provide ideal habitats for seasonal visitors such as passage migrants and winter visitors. A further study, for example during October or November, would provide data on migratory birds if this was considered necessary.

Details of the methods used for the bird survey and the results are given in Section 4 of Appendix 7A. This section also lists birds which have been recorded over the past three years along the Cape D'Aguilar Road close to the study area. A number of birds in this list have a rare or scarce status in Hong Kong.

7.6 Existing Designations Around Shek O Quarry

7.6.1 Shek O Country Park

Parts of the study area fall within the Shek O Country Park. Shek O Country Park was designated under the Country Park Ordinance (Cap. 208) in 1979 and covers a total area of 710 hectares. The Shek O Country Park boundary currently abuts the south-eastern and north-eastern boundaries of the quarry site (see Figure 7.2).

On 7th May 1993, the Government gazetted a proposed new map of the Shek O Country Park in accordance with sections 8 - 15 of the Country Parks Ordinance. The proposal (which has undergone public consultation), is to amend the boundary of the Shek O Country Park in the vicinity of the quarry. This is to enable the implementation of the Shek O Quarry rehabilitation and road diversion works to be undertaken. The new map would reduce the

Country Park by nine hectares for a period of approximately 10 to 12 years. The affected area consists mainly of slopes adjacent to the existing quarry and is presently covered with scrub and woodland. No recreation facilities are currently located within the area and public usage is low.

Details of the current and proposed future Shek O Country Park boundaries are shown in Figure 7.2. An assessment of the ecological significance of the restoration proposals can be found in a later section of this report.

7.6.2 D'Aguilar Peninsular Site of Special Scientific Interest (SSSI)

There Site of Special Scientific Interest is located approximately 100 meters from the south western boundary of the Quarry and within the Shek O Country Park. This is a five hectare site known as the D'Aguilar Peninsular SSSI. Details of the boundary of the SSSI and a description of its interest are given in Appendix 7B.

The woodland, within the SSSI is a dense, well-developed and highly diverse native woodland. A list of the dominant tree species and understorey shrubs can be found in Section 2.3.1 of Appendix 7A. Within the woodland, the large rocky outcrops provide refuge for plants in their early stages and have allowed the succession to the present community. The diverse structural organisation as well as the prevalence of native species in this and surrounding areas produce suitable habitat for many animals. Three rare and protected species have been recorded from this SSSI and these are described in the next section.

7.6.3 Protected Species

One rare native orchid and two rare native tree species can be found within the D'Aguilar Peninsular SSSI.

The rare orchid *A campe multiflora* is found within some patches of grassland habitats amongst the rocky outcrops particularly towards the summits of the hills. This rare indigenous ground orchid is one of a large group of epiphytic orchid in Hong Kong usually found clinging to granite boulders. It is protected under the Forestry (Amendment) Regulations 1993, (Cap 96, Section 3).

Other rare species growing in this SSSI are the indigenous trees *Quercus glauca* and *Keteleeria fortunei*. *Quercus glauca* belongs to the Family Fagaceae, a family which characterises the physiognomic and floristic type of the forests of Guangdong Province. In the SSSI, several large individuals and a patch of low bushes were found in the August 1993 survey in the woodland and the scrubland respectively.

Keteleeria fortunei is another indigenous species in the SSSI, which is confined to coastal lowlands. As a relict species its presence is of considerable botanical interest. In Hong Kong, it is protected under the Forestry (Amendment) Regulation 1993, (Cap 96, Section 3). *Keteleeria fortunei* is also listed in China Plant Red Data Book and is under protection in China (Fu and Jin, 1992). It is understood that the population of *Keteleeria fortunei* at Shek O now consists of two individual trees at two locations within the SSSI. The location of the *Keteleeria fortunei* trees recorded during the August 1993 survey are shown in Figure A of Appendix 7A.

There is at least one other known site for *Keteleeria fortunei* in Hong Kong on Bluff Head, Stanley Peninsula. This site is not an SSSI but is fenced off and protected by Military installations. The site has been visited regularly and within the last two years. It has been reported that this population of *Keteleeria fortunei* is very healthy and mature. In addition to being a much larger population than the Shek O site (13 - 14 individuals), there is also extensive natural regeneration taking place on the Bluff Head site.

It should be noted, that within the last decade, seeds from *Keteleeria fortunei* have been germinated by AFD and have been successfully propagated and planted out as seedling trees on restoration projects in Hong Kong and within the Country Parks.

In addition to the above species, the only other protected species positively recorded within the study area was the Masked Palm Civet (*Paguma larvata*). The Masked Palm Civet is protected under the Wild Animals Protection Ordinance (Cap. 170); this Ordinance bans the hunting of many species of birds and mammals.

7.7 Possible Impacts of Constructing a Casting Basin in Shek O Quarry

7.7.1 Construction Phase

This section identifies the potential impacts that may occur as a consequence of the construction of the casting basin and associated operations. Five key impacts have been identified. These may have ecological impacts within one or more of the construction phases, and are described below.

Potential impact 1 : Clearance and/or disturbance of habitats and species

No habitats of wildlife interest have been found within the quarry itself. The habitats of wildlife interest are outside the quarry and include native species-rich tall scrub, semi-natural woodland and streams and their associated vegetation. Impact could be caused to the flora and fauna of these habitats due to clearance and disturbance.

Options for mitigation The contractors should confine their working areas to within the quarry and should avoid clearance or disturbance to specific areas, or features, such as streams outside the quarry.

The quarry should eventually be restored by replanting of vegetation through the planting of appropriate tree, shrub and grass species.

Potential impact 2 : Storage and disposal of excavated materials

It is anticipated that the proposals may require the storage and disposal of some excavated materials. Impact could be caused if this spoil is disposed of within habitats of ecological interest such as native species rich tall scrub or semi-natural woodland through direct damage to plant animal species. Particularly sensitive to the effects of the disposal spoil are streams and coastal areas. In addition to the direct affects on plants and animals, sediment released within streams could cause impact to fauna and flora down stream.

Options for mitigation All excavated material should be stock-piled in a free draining area where no impact can be caused to habitats of ecological interest. No materials should be disposed of in areas surrounding the quarry.

Potential impact 3 : Storage and handling of potential pollutants

Intentional or accidental spillage of potential pollutants such as fuel, oil *etc* may cause impact to habitats of ecological interest and in particular, watercourses. Pollution of watercourses could have a far reaching impact on wildlife due to the contamination of streams and ultimately seawater.

Options for mitigation Watercourses around and adjacent to the working area should be treated with extreme care. They should not be used as repositories for waste materials. Extreme care should be exercised during the transportation, handling and storage of potential pollutants and in the operation of mechanised equipment to avoid spillage.

Potential impact 4 : Hill fires

Hill fires cause tremendous damage to Hong Kong's vegetation and suppress the natural development of habitats into their natural climax vegetation. The vegetation around the quarry is susceptible to hill fires and damage could be caused particularly to the SSSI if the vegetation were to catch fire. Smoking, cooking and the use of stoves and open fires may accidentally cause hill fires.

Options for mitigation The contractor should be made aware of the very high risk of vegetation catching fire within the areas surrounding the quarry and should understand the damage this can cause. If possible, no smoking, cooking or use of open fires should be permitted on the site. Where the use of fires is unavoidable, extreme care should be taken. Some consideration should be made for the provision of green belts and/or fire breaks to protect areas of high ecological value from fire and to enable other less mature low scrub areas to develop naturally by succession into tall scrub and woodland. The contractors should be required to provide and use fire fighting equipment should a hill fire occur in their area of responsibility.

Potential impact 5 : Extraction of water from existing watercourses

It is assumed that large quantities of water will be required in a number of processes for concrete casting and that this will be obtained from the mains supply to the quarry.

The extraction of large quantities of water from existing watercourses must be avoided. Such extraction could significantly diminish downstream flow which could cause impact to stream fauna and flora over a considerable distance.

Options for mitigation Given the large quantities of water required, it is suggested that no water is removed from the local stream courses. The total demand for water could also be reduced through careful recycling of used water or collection of rain water. Used water should be disposed of in a way so as not to damage any vegetation or cause erosion.

7.7.2 Operational Phase

Operational phase impacts are here defined as a specific assessment of the impacts likely to arise when the casting basin is operational. This is understood to be on a temporary basis for three years.

Disturbance to Wildlife

Potential impact. Continuous human presence within the quarry could cause disturbance to wildlife.

Mitigation and amelioration. The level of disturbance is likely to be little different from that which pertains at present and during the previous 20 years of quarry operations due to blasting and general movement of quarry plant and equipment. In fact, the presence of the casting basin in the quarry could have a positive effect through requiring the workings and quarry management to improve in order to accommodate increased activities in the quarry base.

In addition, the level of disturbance can be mitigated to some extent through the incorporation of adequate acoustic and visual screening around the perimeter of the development. Design and management proposals of any landscaping should take into consideration the long-term requirements for the quarry.

7.7.3 Residual impacts

Through careful working practices and the adoption of the recommended mitigation measures, it should be possible for the casting basin to avoid causing any residual ecological impacts. This is the case largely because the quarry site is of very limited ecological interest. Thus, no residual terrestrial ecological impacts are predicted due to the construction of the proposed casting basin in the quarry.

7.8 Possible Cumulative Impacts of Quarry Activities and Restoration

The current proposal to restore and landscape Shek O Quarry, which it is understood are described in Volumes 1-5 of the Shek O Quarry Preliminary Report for Development and Landscape Restoration, would result in the destruction of approximately 9 hectares of land within the Shek O Country Park. No detailed ecological assessment was carried out in 1991 when plans for the restoration of the quarry were drawn up but a detailed description of vegetation in the area was provided. As part of this report, a preliminary ecological survey of this area has now been undertaken and the results documented in Appendix 7A.

It is now clear that in ecological terms, the area to the north of the Shek O Road is of low conservation significance. However, this is not true of the area to the southeast of the quarry face which supports well developed natural tall scrub/woodland immediately adjacent to the D'Aguilar Peninsular SSSI and is part of that area proposed for excission under the rehabilitation contract (see Figure 7.2). This area is of high conservation significance and therefore, it would be detrimental to the ecology of the area if this land was removed as part of the rehabilitation. In view of the rich and potentially sensitive communities of the D'Aguilar Peninsula SSSI and the advantages of retaining the cliff faces, described above, this component of the proposed rehabilitation will, it is judged, have a negative impact on the local ecology. The current plans also challenge the long term viability of the SSSI as there is currently no "buffer" zone proposed between the edge of the quarry face and the SSSI (see Figure 7.2).

It is therefore recommended that the current proposals are reassessed and that alternatives which are most sensitive to the ecology of the area are investigated. The following options should be considered:

- determining and clearly defining the objectives for the restoration proposals through discussion between the Quarry Operators, their Consultants and relevant Government Departments. Levels of control on the types of recreational activities allowed should be considered.
- prohibiting or restricting any further quarrying activities within the Shek O Country Park to the southeast of the existing quarry face. It is understood that a buffer zone has been agreed between AFD and the Quarry Operator and included in the proposal for rehabilitation works.
- encouraging the quarry operators to explore and study the viability of the suggested habitat creation and enhancement measures further.
- including details of the habitat enhancement measures into the contract of the quarry rehabilitation scheme.
- baseline ecological data of the SSSI would benefit by undertaking a more detailed comprehensive flora survey to identify specimens of rare species and making specific recommendation for their future protection, and if considered applicable, undertaking a bird survey in October/November when passage migrants and winter visitors are present.
- ensuring areas surrounding the quarry are protected from fire in particular the D'Aguilar Peninsular SSSI by writing a fire management plan.
- protection of the SSSI from dumping as part of the overall scheme.
- retention and protection of the beach vegetation.
- the erection of a physical barrier or fence along the southeast corner of the quarry extending to the low water mark.

7.9 Opportunities For Wildlife Enhancement

Suggestions for wildlife enhancement relate mainly to the long-term restoration of the quarry and not necessarily to the temporary presence of the casting basin. However, as they relate to the site in question and could have impacts on the casting basin and how the site is vacated, they are briefly mentioned here. Areas of ecological constraints and opportunities are shown in Figure 7.3.

Habitat creation and enhancement opportunities for this quarry include:

- the possibility of creating a habitat for peregrine falcons to nest on a rock face of the quarry. Disused quarry sites can form valuable nesting sites for cliff-dwelling birds. The position of the Shek O Quarry, where such restricted cliff-nesting species as the Peregrine Falcon are known to occur, would seem ideal for this use. It has been suggested (Tom Dahmer, pers. comm.) that this would be feasible in the type of granitic rock found in Shek O Quarry (though sedimentary rock is preferable). He suggested that a near vertical cliff is preferable with ledges being created by jackhammers as nesting platforms. An overhang is important to ensure shelter and to protect the ledge from wind and rain. In fact, it is likely that a pair of raptors would be drawn into the area and that the actual detailed design of the ledge would be less critical than protecting the nest from predation or accidental or deliberate destruction. This is a specialist area of expertise that would require a detailed input to ensure its success, however, providing predation and disturbance can be avoided, the success rate of nest usage is likely to be very high. Design to avoid predation and particularly disturbance will be a key factor; this will need to be carefully considered in the light of access to the site and the potential for long-term recreation use.

- the possibility of creating cliff ledges on the coastline suitable for white-bellied sea eagles to nest. Again, as above, specialist advice should be sought. This suggestion is unlikely to be compatible with the proposed recreational use of the area but could be undertaken off-site within a wider, more remote area in the vicinity.

- increasing the value of the site generally for wildlife by planting of various native species and a mixture of habitat types (an evaluation of a 1991 tree planting trial at Shek O Quarry is given in Appendix 7C),

- the possibility of creating a flooded quarry base which could be suitable for amphibians and reptiles in particular,

- consideration for enhancing the site for large and small mammals by creating thickets of dense undisturbed vegetation,

- the possibility of creating a "cave" habitat as a suitable place for bats providing sufficient insects were available locally for feeding,

7.10 Monitoring And Audit

7.10.1 The Casting Basin

Given the minimal ecological interest of the quarry itself, monitoring the habitats and species within the quarry will not be required. The important issue here is to ensure that the proposed casting basin does not have any impacts on the surrounding areas which are more significant in wildlife terms and therefore some ecological monitoring is recommended.

Before commencement of any works on site, the baseline ecological surveys should be thoroughly checked against final development proposals to ensure minimum damage to the existing features.

Mitigation and management techniques will be monitored in future years to determine the effectiveness of the methods adopted to enable these ideas to be advanced and improved.

The intention of any monitoring programme is to ensure that the scale of impacts is no greater than predicted in this Preliminary Ecological Impact Assessment and that no unforseen impacts occur to areas of importance.

The programme for this proposal will, therefore, concentrate on monitoring the following areas:

- water quality in the stream to the south east of the quarry and close to the SSSI during and on completion of construction.
- monitoring the D'Aguilar Peninsular SSSI to ensure the proposed casting basin is not impacting on the vegetation and rare plants; an annual 5 man-day survey is recommended to repeat the baseline data collected in 1993 of the flora, birds and mammals. The survey for birds should be carried out at various times of the year. The frequency of future surveys would be dependent upon the results obtained in the first two years.

It is suggested that the responsibility for this part of the monitoring programme could fall to the operators of the casting basin and it should be written into the terms of the contract. Details of the actual monitoring to be carried out could be agreed by both parties at the earliest opportunity.

7.10.2 Overall Restoration and Landscape Proposals

To ensure the success of the restoration and landscape proposals, the quarry operator should

- submit detailed proposals to protect the integrity of the SSSI.
- set up a special programme to prevent and report the outbreak of fire and should fire be causing a problem to the establishment of vegetation, then recommendations should be made to alleviate the situation.

- carefully monitor the success of the planting programme during the entire rehabilitation period of the quarry.

In addition to the works set out above, further ecological surveys, independently arranged by Government, are recommended for the overall restoration and landscape proposals on a regular basis (say 3 to 4 years) during the entire rehabilitation period of the quarry, including surveys on rare and protected species, composition of beach vegetation and woodland habitats on the edge of the quarry (Survey area as shown in Figure 7.1).

Should the monitoring carried out reveal any major problems or concerns regarding the ecological interest of the site which are attributable to the operations of the casting basin or the quarry rehabilitation contractor, then there should be a commitment that resources will be made available to rectify the situation.

7.11 Summary Of Key Issues

The only terrestrial ecology issues for the proposed casting basin lie outside the quarry site. They are in the surrounding area where the proximity of the site to the Shek O Country Park and D'Aguilar Site of Special Scientific Interest should be taken into consideration. There are no existing habitats and species of interest in the quarry site.

The proximity of the Country Park and Site of Special Scientific Interest are not seen as major constraints to the casting basin provided careful planning and consideration of these issues is given to the casting basin in general and to the south-eastern boundary of the proposal in particular.

The current overall restoration proposals for the quarry will, however, result in the loss of an area of woodland/tall scrub within the Shek O Country Park and adjacent to the D'Aguilar Peninsular SSSI that is considered to be of high ecological significance. The mature semi-natural native woodland in the SSSI which is rich in wildlife and the three rare and protected species are vulnerable, in particular the *Keteleeria fortunei*. A buffer zone between the quarry restoration and the SSSI boundary will protect the viability and long-term future of the SSSI.

Further, grading the southern face of the quarry will lose the opportunity of using the rock face as a nesting habitat for raptors.

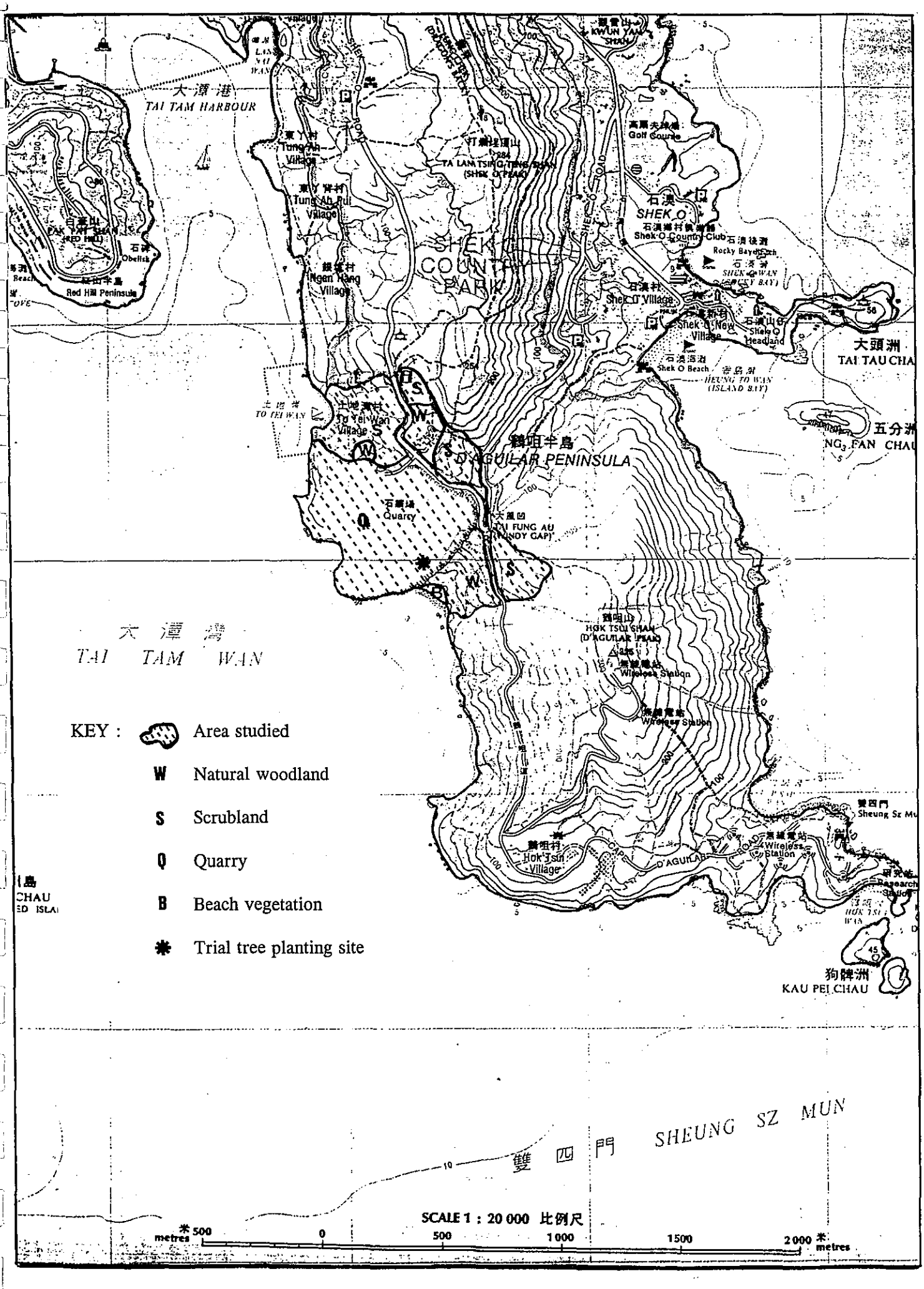


Figure 7.1 Terrestrial Ecology Study Area Boundary

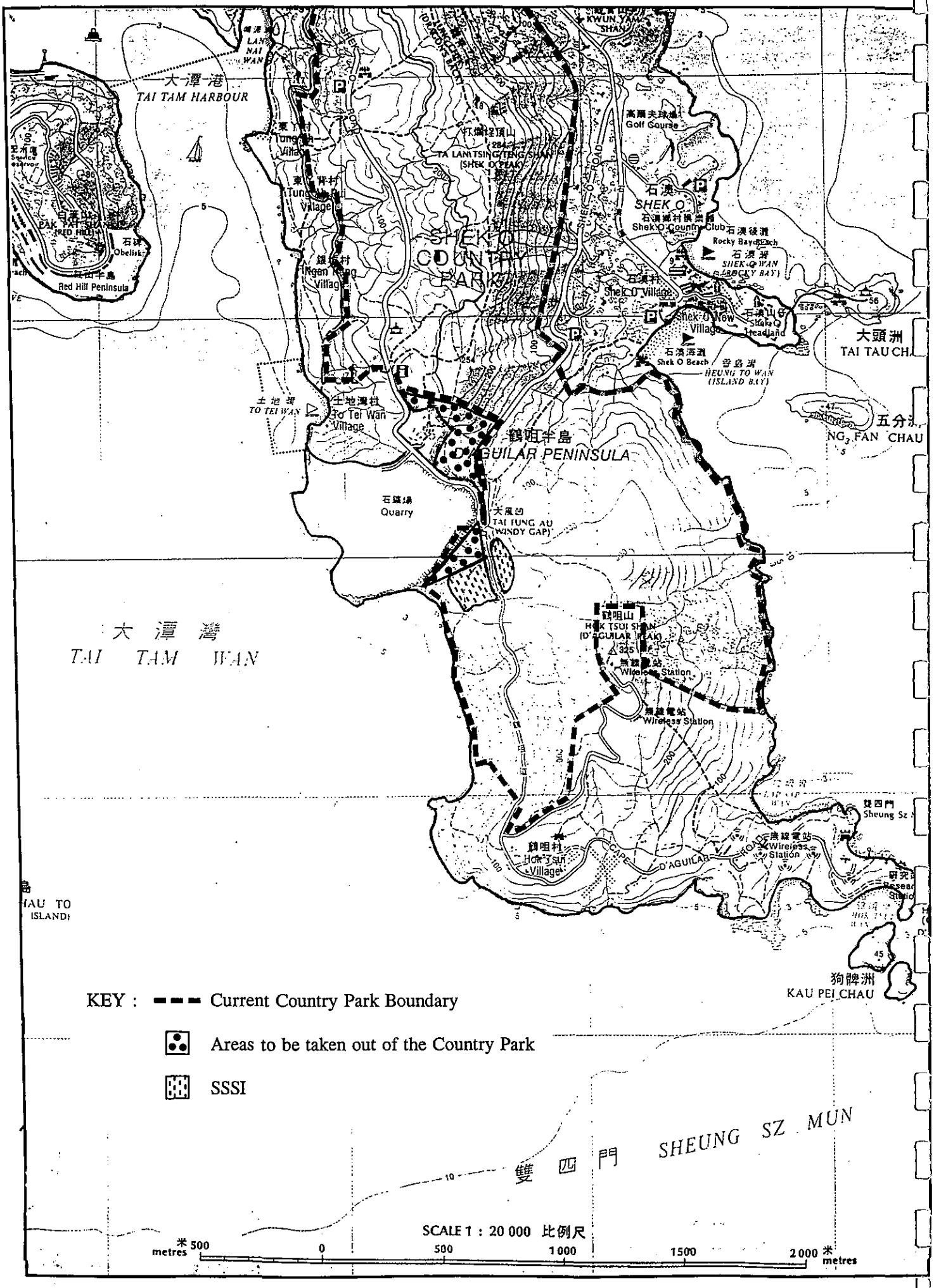


Figure 7.2 **Current and Proposed Future Shek O Country Park Boundaries Boundaries in Relation to D'Aguilar Peninsula SSSI and Existing Quarry Face**

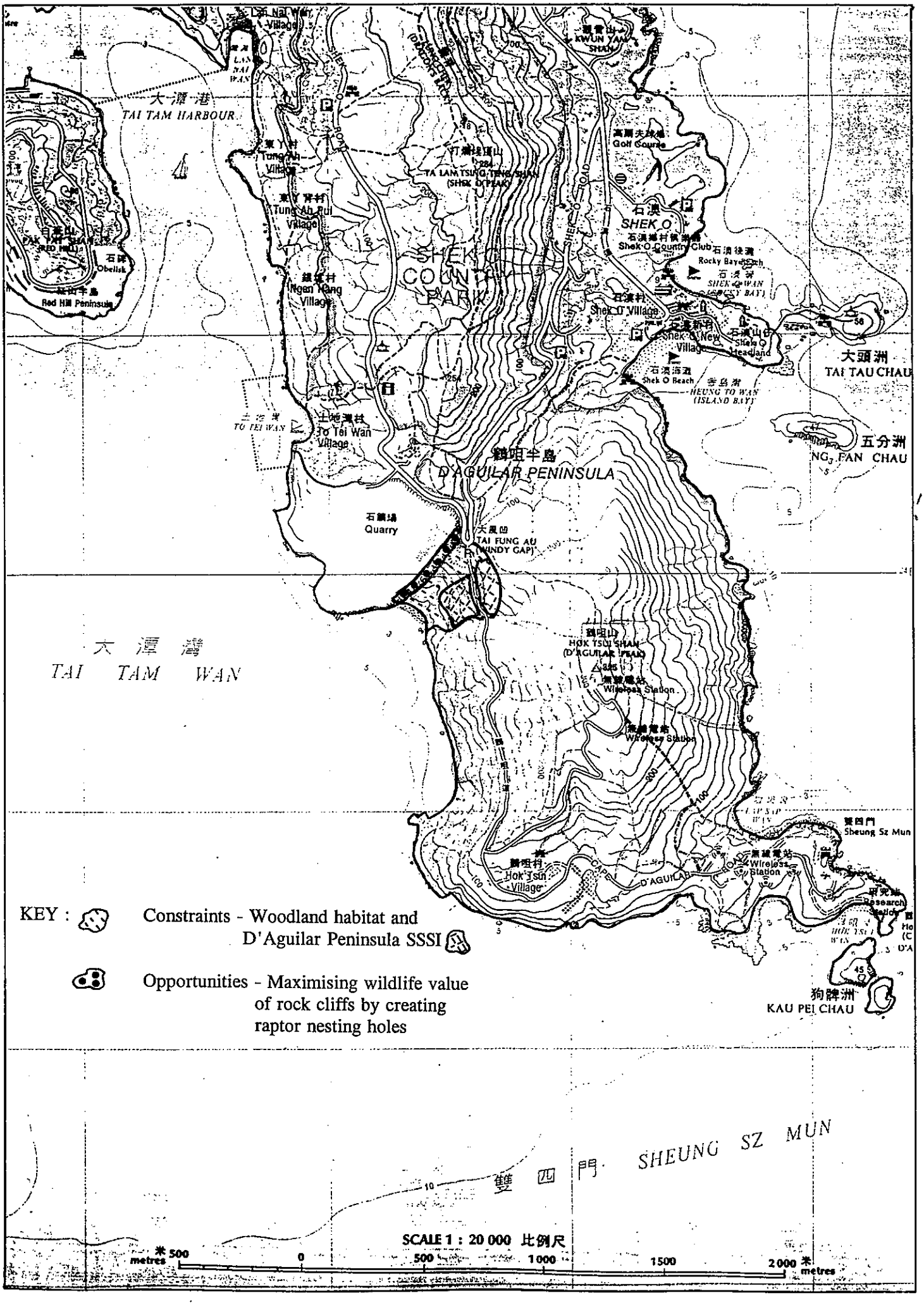


Figure 7.3 Ecological Constraints and Opportunities

8 WASTE ARISINGS

8.1 Introduction

There will be quantities of solid and liquid waste arising as a result of construction and operation of the casting basin site and continued quarrying during casting basin activities. The rate of quarrying will increase over the next few years. At present approximately 1.7 Million tonnes of rock products are being produced per year and this will increase to 2.4 million tonnes by 1998. The original assessment undertaken by Pioneer for the rehabilitation of the quarry identified only minimum waste being produced as part of quarry operation, this being a mechanical process. Therefore increased production rates should not have a significant impact on the present waste arisings. The additional waste production will be from the construction and operation of the casting basin. The possible sources of waste arising during casting of the tunnel units are identified as follows:

- general residual construction materials and spent oil and chemicals.
- dredged marine sediment for creation of marine channel
- additional sewage and wastewater as a result of additional on-site staff
- loss of material during flooding of the casting basin

8.2 Legislation

Waste collection and disposal is contained within the Waste Disposal Ordinance (Cap. 354). This provides a licensing system for the disposal of wastes and for the control of certain prescribed waste by regulation. This classifies construction waste as trade waste and as such the contractor is responsible for disposal.

The procedures to be undertaken in the disposal of marine dredged materials are contained within the Works Branch Technical Circular 2/92, Marine Disposal of Dredged Mud. This lays down the specific procedures which include site investigation (SI) to determine the contamination status of the sediments based on trace metal concentrations. The contamination criteria are contained within the EPD Technical Circular No. 1-1-92. Marine muds classified as contaminated require specific dredging and disposal techniques. Once SI results are known these can be incorporated within the Sediment Quality Report to be submitted to the Fill Management Committee (FMC) who will then, together with EPD, decide the fate of the material.

Any effluent is required to meet standards contained within the Technical Memorandum (TM) Standards for Effluent Discharge, in this case those standards relevant to the Southern Waters Water Control Zone. In addition the TM also applies restrictions regarding the location of such discharges. No new effluent is allowed in the following locations:

- within 200m of the boundaries of a gazetted beach in any direction
- within 200m of the seaward boundary of a marine fish culture zone or an SSSI, and within 100m of the landward boundary
- in any typhoon shelter or marina
- within 100m of a seawater intake point

8.3 Identification of Waste Producing Processes

8.3.1 Continued quarrying and casting basin construction

As quarrying is a mechanical process there will be little waste produced from the activity itself. No overburden is being produced at the moment, although approximately 300,000 tonnes is expected to be produced from 1994 to 1998. This will drop to 100,000 tonnes until 2001 when it will further reduce to 50,000 tonnes until 2005. This material, probably comprising mainly of soil and decomposed granite, will require haulage off site.It is likely that most of this will be utilised as saleable material. Top soil may be stored on site, for use in later rehabilitation. Plans to introduce payment schemes to dispose of construction material in sanitary landfills means that operators will be encouraged to either sell inert construction material or dispose of it at public dump sites.

Waste will continue to be generated from canteen and washroom facilities. Waste produced from casting basin construction will consist mainly of small amounts of used construction material. Some of the basin will be paved for the access road, and small quantities of concrete and other road construction material may require disposal. The marine mud will require disposal in construction of the marine channel, this is discussed below.

8.3.2 Marine Mud

Approximately 15,000 to 30,000m^3 of marine mud will require removal in forming sea channels for transportation of tunnel units from the site. An SI has been undertaken and the samples taken and analysed in accordance with the Works Branch Technical Circular No. 22/92, Marine Disposal of Dredged Mud. The results of the analysis are presented in Table 8.1.

Table 8.1 Results of Marine Sediment Analysis

Station	Heavy Metal Content (mg/kg)						
	Cd	Cr	Cu	Pb	Ni	Zn	Hg
1	<0.05	26	16	29	16	72	0.18
2	0.14	27	20	30	17	73	0.13
3	<0.05	29	20	33	18	80	0.10
4	<0.05	28	20	45	17	83	0.10
5	<0.05	29	20	33	18	80	0.08
6	<0.05	28	20	34	17	83	0.09
7	0.06	28	21	36	17	83	0.10

The EPD Technical Circular (TC) No. 1-1-92, Classification of Dredged Sediments for Marine Disposal, classifies marine sediments in order to establish the contamination status. The classification criteria are shown in Table 8.2. The exceedance of the specified limit of only one metal within a sample is necessary for the material to be classified as contaminated.

Table 8.2 Classification of Marine Sediments by Metal Content (mg/kg dry weight)

	Cd	Cr	Cu	Hg	Ni	Pb	Zn
Class A	0.0-0.9	0-49	0-54	0.0-0.7	0-34	0-64	0-140
Class B	1.0-1.4	50-79	55-64	0.8-0.9	35-39	65-74	150-190
Class C	1.5 or more	80 or more	65 or more	1.0 or more	40 or more	75 or more	200 or more

Class A represents sediments that are uncontaminated and do not require any special removal and disposal methods. Class B sediments are moderately contaminated and require some special collection and disposal techniques. Class C sediments are highly contaminated, special dredging, transportation, and disposal techniques in a specially designated dump site is required.

The results of chemical analysis of the Shek O sediments indicate that the marine muds in this area are of Class A, therefore uncontaminated and requiring no special disposal techniques. However, in accordance with the Works Branch Circular 2/92, a Sediment Quality Report will be required from the operators to be submitted to the Fill Management Committee (FMC) at least 6 weeks prior to dredging work, in order that the allocation of the material can be decided by the FMC and EPD.

8.3.3 Casting operations

It is anticipated that waste generated from tunnel casting will mainly consist of residual material lost during handling and non quarry generated waste such as wood which may be used in part of the forming work for the tunnel units. In addition small quantities of material such as residual concrete and chippings, metallic fines, welding slag and lubricating oils will require disposal. In order to optimise the strength of the concrete, a curing process is required. There are various means of carrying out this operation, generally using curing membranes which cover the concrete or by the use of curing water. It is understood that the latter will be employed on the site, involving large quantities of water flowing over the concrete for up to several weeks. It is likely that this liquid will be contaminated during this process by lime leaching from the surface, elevating the pH levels, and from mould oils remaining on the surface of the casts. This water may require treatment in a settlement tank prior to disposal.

The chemicals used in construction of each tunnel unit will comprise the following:

Form oil	:	9440 litres
Resin	:	small quantities
Concrete surface retard	:	6708 litres

A total of twelve units will be constructed on the site. In addition a small quantity of waste will be produced from the vehicles and plant on the site. This will consist mainly of spent oil, oil filters and broken pieces of machinery.

Wastewater generated from the concrete batching plant will be collected, passed through a settling pit and then re-used for concrete batching.

8.3.4 Casting basin flooding

Tunnel units will need to be transported from the site by flooding the casting basin and floating the units from the site. Three batches of tunnel units will be constructed resulting in the basin being flooded a total of three times during the three years that the site is occupied. This could result in large volumes of solids entering the surrounding waters. It is anticipated that the most problematic waste lost during flooding of the tunnel unit will be of floating refuse in Tai Tam Bay. This type of material is noticeable and likely to be of greatest public concern. The nearest beach, To Tei Wan, is only several hundred meters from the site and although it is not officially gazetted, it is recognised by EPD and monitored by them on a regular basis. As previously noted, it is classified as an inshore recreation area and two water sports clubs hold a lease from the Urban Council for the use of the beach. Strict mitigation measures will be required in controlling potential loss of material to the bay during this activity as described in Section 5.6.4.

8.3.5 Sewage Treatment Facilities

There are no sewage facilities on site to cope with the additional 600 staff required for operation of the casting basin. As this area is presently unsewered, alternative treatment measures will be necessary. Measures to collect the wastewater and tanker it off site have been proposed and this seems the most viable option.

8.4 Mitigation Procedures

8.4.1 Continued quarrying and casting basin construction

It is anticipated that most waste produced can be re-used on site. General refuse will require regular collection and disposal at landfill or public dump depending on the nature of the material.

8.4.2 Marine Mud

Site Investigation has confirmed the non-contaminated status of the marine sediments in the area. A Sediment Quality Report will be required by the FMC and EPD prior to dredging activities in order that the disposal location can be confirmed.

8.4.3 Casting Operations

Waste material such as concrete chippings can be re-used on site. Surface and waste waters should be diverted through oil traps and settlement lagoons prior to discharge. Additional treatment of the curing waters may be required to reduce the pH. Collected oil and grease should be transferred to the chemical waste treatment facility on Tsing Yi. Scrap steel from the reinforcing bars should be sent for recycling.

A U-channel will be constructed around the edge of the casting basin to which sedimentation tanks will be installed at each outlet point. Monitoring of this water will be required to ensure compliance with the Technical Memorandum Standards for Effluent Discharge relevant to Southern Waters WCZ. Collected materials will require disposal at landfill.

Some of the waste produced may not be re-used on site but will, non-the-less, be inert material and could be disposed of at public dump. It is in line with Government policy to dispose of inert construction waste at public dump sites rather than taking up valuable landfill space, the latter requiring extensive leachate and gas control systems. This type of material may include soil, rock, asphalt, concrete, brick, plastic/mortar, inert building debris and aggregate.

The oils and chemicals used on site should be stored, prior to use, in a carefully sealed area to prevent leakage should any spillages occur. This can be done by construction of an impervious concrete floor and a concrete bund around the area. Oil separation facilities will provide separation of runoff prior to disposal. Appropriate marine pollution equipment such as oil skimmers and/or oil sorbant material, as described in Section II of the Code of Practice for Oil Storage Installation 1992, published by the Building Authority, will be provided in the works area for emergency use.

The vehicles used on site should be kept in good working order to reduce petrol/oil leakage and prevent the possible contamination of groundwaters and drainage channels.

8.4.4 Casting basin flooding

Careful clean-up operations of both fines and larger material will be required prior to flooding the casting basin. This will be in addition to normal cleaning practices employed on a daily basis. It is proposed that this is controlled by contract conditions with checks made by the independent monitoring team. Monitoring of flood waters will be required to ensure compliance with water quality standards for discharge into the bay.

The system of flooding requires a section of the cofferdam surrounding the basin to be removed in order to float out the tunnel sections. Once the basin is flooded the surface of this can be skimmed of any floating refuse before the waters move down through the channel of the cofferdam and into open waters. If this cleaning process is undertaken efficiently, no additional measures are considered necessary.

Collected refuse will require disposal at a landfill site.

8.4.5 Sewage Treatment Facilities

Several options have been considered in the treatment of sewage from the site. This included a package treatment plant, a septic tank system and off-site treatment and disposal. The latter is now the most viable option, with all sewage being taken off site by tanker for treatment elsewhere. Shek O Sewage Treatment Works is the nearest site but work constructing this has only just begun. The treatment works at Stanley is not yet completed and will not be commissioned for several months. An alternative is the private treatment works at Redhill, a private development, 8km away by road. Permission would need to be sought from the estate management together with an appropriate fee for service.

8.5 Monitoring and Audit

8.5.1 Monitoring of effluents

Monitoring of key parameters is recommended on a regular basis including BOD, suspended solids and dissolved oxygen. Monitoring of all parameters listed in the Technical Memorandum would be required on a more infrequent basis. This is detailed in the Monitoring and Audit Manual

8.5.2 Collection of floating refuse

An independent consultant shall be employed to monitor the presence of floating refuse. If independent checks reveal unacceptable levels of floating refuse in Tai Tam Bay clearly identifiable with casting basin activities then additional mitigation measures will be required.

8.6 Summary

The continued quarrying will generate little waste, with future arisings unlikely to be significantly more than is produced from existing quarry operations. The potential key impacts have been identified as the loss of material from flooding of the casting basin and the discharge of sewage effluent.

Careful cleaning of material from the basin will be necessary prior to each flooding. Control of this will require specified contract conditions and the presence of an independent checker.

It is proposed to tanker all sewage generated from the site to an off site treatment works.

9 VISUAL IMPACTS

As the casting basin will be predominantly below ground the visual impact of the working area will be minimal. Gross visual impact will therefore remain much as at present for the quarry operations.

The quarry is visually intrusive being open to views from locations throughout Tai Tam Bay, the Stanley Peninsula and Tai Tam Country Park. The steep profile of the natural topography enhances the visibility of the quarry and this is exacerbated by the light colour of the rock faces and quarried material.

The nearest receptors from which the quarry can be viewed are Red Hill and Stanley, 1.3km and 2.2km distant respectively. To Tai Wan, 400m north of the quarry is screened from it by a high ridge. The quarry is visible from To Tei Wan beach only from the low water mark or by crossing the rocks which form a small headland at the south end of the beach. Settlements on the west of the D'Aguilar Peninsula are screened by the ridge of the Peninsula.

Night time operations will require lighting to be provided around the Casting Basin. Such lighting will be directed downwards into the Basin and will not be directed across the Bay towards residential areas. Although the lighting will be visible from the Stanley Peninsula, it is not considered that this will be visually intrusive.

10 SUMMARY OF KEY ISSUES

- Vehicle emissions are not considered to be a key issue.

- With the exception of To Tei Wan, the majority of the dust sensitive receivers are a considerable distance from the site. Model predictions have indicated that there should be compliance with AQO's and Guideline levels arising from the combined Casting Basin and Quarry operations. TSP levels are largely attributable to dust from quarrying; the contribution from the casting basin is small in comparison.

- The monitoring programme has shown that current dust levels are at times in exceedance of the statutory AQO's at the site boundary and To Tei Wan Village. However, dust levels at the village are not necessarily all derived from quarry operations. Modelling predicts that annual TSP levels should be within the AQO. RSP concentrations should also be within the AQO's at the closest inhabited areas.

- The topography of the area provides local villages with shielding from noise from the quarry. The potentially affected receivers are Redhill, American Club and Stanley. The overall operational noise level at Red Hill may exceed the statutory day-time criteria by 1 dB(A). However, the assessment is conservative. Noise levels arising specifically from operational casting activities will be insignificant.

- If night-time working is required this assessment indicates that the criteria may be exceeded at the Red Hill peninsula and at Stanley. There would be a requirement to reduce noise levels by 1 dB(A) to meet criteria. Night-time work would require a Noise Control Permit.

- Water quality in Tai Tam Bay is good but there is potential for nutrient enrichment. Treated sewage effluent and dredged sediments are sources of nutrients. All sewage will be treated off-site, thus removing any potential for nutrient enrichment from this source. The use of a cofferdam will reduce impacts from sediment dredging and available nutrients from this source are expected to be small.

- In view of the use of a cofferdam to allow dry blasting and excavation, and the limited volume of sediments to be dredged for the base of the cofferdam, effects on the marine communities and ecology from these activities are likely to be very small and temporary.

- Marine sediments are uncontaminated and their disposal is not a key issue.

- The only terrestrial ecology issues lie outside the quarry and casting basin sites. The area to the southeast of the quarry face, immediately adjacent to the D'Aguilar Peninsula SSSI is considered to have high conservation significance. This area was addressed in the Shek O Quarry Preliminary Report for Development and Landscape Restoration, where it was concluded that the area would require stabilizing. This has implications for the current rehabilitation proposals which have identified this area as land-take required for grading of the quarry face. It is recommended that the current proposals are re-assessed by Pioneer Quarries, their Consultants and relevant Government Departments and that alternative viable options are investigated so as to

permit the retention of cliff faces in the southern part of the quarry which offer opportunities for wildlife enhancement and protection to the existing SSSI.

- The combined quarry and casting basin operations will generate little waste. Bulk sewage will be treated off-site and washdown of the basin prior to opening the sea gates will ensure that wastes will not be a key issue.

- Visual impacts are not expected to be worse than at present and are not considered to be a key issue.

11 CONCLUSIONS

The construction and operation of a casting basin in Shek O Quarry will result in relatively minor impacts on the environment and will not significantly increase the environmental impact of the existing quarry operations. With suitable mitigation measures and control of site activities based on an Environmental Monitoring and Audit Manual, the impacts of the individual and cumulative activities of the casting basin and quarry should not result in a deterioration in current environmental standards.

Assessments of air and noise impacts have been based on conservative data and therefore represent worst case scenarios. On this basis, the only possible cause for concern would be night working. As the operators propose to work primarily on dayshift with night time working until 1.00 am or 2.00 am only required to finish-off concrete pours, most plant equipment would not be operational at that time and night time noise will be significantly lower than during the day. Night working would only be considered late in the fabrication programme if deadlines were likely to overrun. In such an eventuality, special attention and re-evaluation of requirements would be required. A Construction Noise Permit would be required for night-time work and the Casting Basin operator would have to comply with the conditions of the Permit.

In terms of impacts relating to work outside of the casting basin, the prime concern is the effect of proposed land-take areas in relation to the quarry rehabilitation programme (which were included in the original Pioneer Quarries Ltd Shek O Quarry Preliminary Report for Development and Landscape Restoration, to address concerns with site stability), in particular, land between the present quarry boundary and the D'Aguilar Peninsula SSSI to the south. This area of land, in addition to being of scientific interest in its own right, is important in providing a buffer zone between the quarry and the SSSI. Alternative viable options for the rehabilitation plans and provision of rock for grading the general quarry environs should be considered in discussion with Pioneer Quarries Ltd. At the same time, opportunities for wildlife enhancement by retaining and forming vertical rock faces in the south of the quarry should be considered.

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APPENDIX 3A

PREDICATED DUST EMISSIONS FROM THE CASTING PROCESS AND QUARRY ACTIVITY

Predicted Dust Emissions from the Casting Process and Quarry activity BEFORE upgrading the quarry

Activity	TSP kg/year	RSP kg/year
(A) BATCHING		
1. Dust from unpaved road - batcher to basin	1,800	648
2. Dust from unpaved road - aggregate delivery	1,090	393
3. Dust from unpaved road - cement/PFA delivery	737	265
4. Aggregate dump to hopper	794	286
5. Aggregate to weigh hopper	222	80
6. Dump to ready to mix truck	nil	nil
7. Site erosion	2	1
(B) QUARRY		
1. Drilling	680	68
2. Blasting	25,006	5,001
3. Loading trucks	7,704	2,773
4. Site erosion	149	75
5. Transport to crusher	20,594	7,414
6. Dump at crusher	6,265	2,255
7. Primary crusher	10,710	5,355
8. Secondary crusher	10,710	5,355
9. Tertiary Crusher	10,710	5,355
10. Screening	68,000	51,000
11. Load stock piles	2,941	1,088
12. Reclaim from stockpiles	2,890	187
13. Stock pile erosion	413	206
Total from batching activity	4,644	1,673
Total from quarry activity	166,772	86,132
TOTAL	171,416	87,805

E(54)5

Predicted Dust Emissions from the Casting Process and Quarry activity
AFTER upgrading the quarry

Activity	TSP kg/year	RSP kg/year
(A) CONCRETE BATCHING		
1. Dust from unpaved road - batcher to basin	1,800	648
2. Dust from unpaved road - aggregate delivery	1,090	393
3. Dust from unpaved road - cement/PFA delivery	737	265
4. Aggregate dump to hopper	794	286
5. Aggregate to weigh hopper	222	80
6. Dump to ready to mix truck	nil	nil
7. Site erosion	2	1
(B) QUARRY		
1. Drilling	840	84
2. Blasting	30,917	6,183
3. Loading trucks	9,517	3,426
4. Site erosion	149	75
5. Transport to crusher	25,440	9,158
6. Dump at crusher	3,095	1,114
7. Primary crusher	1,890	945
8. Secondary crusher	1,890	945
9. Tertiary Crusher	1,890	945
10. Screening	33,600	25,200
11. Load stock piles	1,817	672
12. Reclaim from stockpiles	3,570	231
13. Stock pile erosion	413	206
Total from batching activity	4,644	1,673
Total from quarry activity	115,028	49,184
TOTAL	119,672	50,857

Predicted Particulate Emissions

(A) Concrete Batching

1. Dust from unpaved road - butcher to basin

$$E = k\,(1.7)\left(\frac{s}{12}\right)\left(\frac{S}{48}\right)\left(\frac{W'}{2.7}\right)^{0.7}\left(\frac{w}{4}\right)^{0.5}\left(\frac{365 - P}{365}\right) Kg/VKT$$

where k = 0.8

s = 4%

S = 20 Km/hr

W = 19t

w = mean number of wheels = 10 (concrete truck)

p = 140 days

E = 0.72 Kg/VKT

Assume round trip distance be 0.8 Km,

number of trip = 75,000 m^3/year ÷ 6 m^3/trip
= 12,500 trips

"TSP" (uncontrolled) = 7,200 Kg/year

"RSP" (uncontrolled = 0.36 x "TSP"
= 2,592 Kg/year

"TSP" (controlled) = 1,800 Kg/year

"RSP" (controlled) = 648 Kg/year

Note: The emission will be reduced by 75% if frequent watering for the road is carried out.

2. Dust from unpaved road-aggregate delivery.

Use the formula in 1. and assume

W = 52 t

w = 6 wheels

round trip distance = 1.0 Km

number of trips = 75,000 m^3 x 1.8 t/m^3
35 t/truck = 3,857 trips

E = 1.131 Kg/VKT

"TSP" (uncontrolled) = 4,362 Kg/year

"RSP" (uncontrolled) = 0.36 x "TSP"
= 1,570 Kg/year

"TSP" (controlled) = 1,090 Kg/year

"RSP" (controlled) = 393 Kg/year

Note : Same as the note in item "1"

3. Dust from unpaved road - Cement/PFA delivery

Use the same formula as item "1" and assume

$$W = \left(\frac{45 + 22}{2}\right) = 34\,t$$

w = 10 wheels,

round trip distance = 2.0 Km,

number of trips = 75,000 m^3 x 0.4 t/m^3
22t/truck
= 1,364 trips

E = 1.08 Kg/VKT

"TSP" (uncontrolled) = 2,946 Kg/year

"RSP" (uncontrolled) = 0.36 x "TSP"
= 1,060 Kg/year

"TSP" (controlled) = 737 Kg/year

"RSP" (controlled) = 265 Kg/year

Note: Same as the note in item "1".

4. Aggregate dump to hopper

$$E = k(0.00090)\left[\frac{(\frac{s}{5})\ (\frac{U}{2.2})\ (\frac{H}{1.5})}{(\frac{M}{2})^2\ (\frac{Y}{4.6})^{0.33}}\right] Kg/t$$

where s = 4%

U = 3.75 m/s

H = 4 m

Y = 20 m^3

M = 1%

E = 0.0059 Kg/t

"TSP" = E x 75,000 m^3 x 1.8 t/m^3/year = 794 Kg/year

"RSP" = 0.36 x "TSP" = 286 Kg/year

5. Aggregate to weigh hopper

Use the formula in item "4" and assume

H = 2 m

Y = 25 m^3

E = 0.00274 Kg/t

"TSP" (uncontrolled) = E x 75,000 m^3 x 1.8 t/m3
= 370 Kg/year

"RSP" (uncontrolled) = 0.36 x "TSP" = 133 Kg/year

"TSP" (controlled) = 222 Kg/year

"RSP" (controlled) = 80 Kg/year

Note : Emission reduction of 40% will be expected.

6. Dump to ready to mix truck

Emission will be minimal as concrete is wet batched.

7. Site erosion

$$E = 1.9 \left(\frac{s}{1.5}\right) \left(\frac{365 - P}{235}\right) \left(\frac{f}{15}\right) \textit{ Kg/day/hectare}$$

where s = 4%

P = 140 days

f = 7%

E = 2.26 Kg/day/hectare

Assume the area of receiver hopper = 25 m^2

"TSP" = E x 365 x 25 m^3 10,000 hectare
= 2 Kg/year

"RSP" = 0.5 x "TSP" = 1 Kg/year

(B) Shek O Quarry

1. Drilling

$E = 0.4 \times 10^{-3}$ Kg/t (TSP)

(a) For production rate of 1.7 million tons/year,

"TSP" = 0.4 x E Kg/year = 680 Kg/year

"RSP" = 0.1 x "TSP" = 68 Kg/year

(b) For production rate of 2.1 million tons/year,

"TSP" = 840 Kg/year

"RSP" = 84 kg/year

Note : Same amount of dust emission will be anticipated for both new and old plants.

2. Blasting

$$E = \frac{961\ A^{0.8}}{D^{1.8} \times M^{1.9}}\ lb/blast$$

where A = area blasted in ft^2 = 20 x 60 m^2 = 13,147 ft^2

D = depth of blast in ft = 20 m = 66.2 ft

M = mositure content = 1%

E = 454.65 Kg/blast

(a) Assume there will be 55 blasts for 1.7 million tons/year,

"TSP" = 454.65 Kg/blast x 55 blast
= 25,006 Kg/year

"RSP" = 0.2 x "TSP" = 5,001 Kg/year

(b) Assume there will be 68 blasts for 2.1 million tons/year,

"TSP" = 30,917 Kg/year

"RSP" = 6,183 Kg/year

Note : Same amount of dust emission will be anticipated for both new and old plants.

3. Loading Trucks (from front end loaders)

$$E = \frac{k \times 0.0009 \left(\frac{S}{5}\right) \left(\frac{U}{2.2}\right) \left(\frac{H}{1.5}\right)}{\left(\frac{Y}{4.6}\right)^{0.33} \left(\frac{M}{2}\right)^{2}} \; Kg/t$$

where k = 0.73 (for batch drop operation)

s = silt content = 4%

U = mean wind speed = 3.75 m/s

H = drop height = 2.0 m

M = moisture content = 1%

Y = Dumping Capacity = 5.4 m^3

E = 0.004532 Kg/t

(a) For production rate of 1.7 million tons/year,

"TSP" = E x 1.7 x 10^6 Kg/year = 7,704 Kg/year

"RSP" = "TSP" x 0.36 = 2,773 Kg/year

(b) For production rate of 2.1 million tons/year,

"TSP" = 9,517 Kg/year

"RSP" = 3,426 Kg/year

Note : Same amount of dust emission will be anticipated for both new and old plants.

4. Site erosion

$$E = 1.9 \left(\frac{s}{1.5}\right) \left(\frac{365 - P}{235}\right) \left(\frac{f}{15}\right) \textit{ Kg/day/hectare}$$

where s = silt content = 4%

P = number of days with $\geq$ 0.25 mm of precipation/year = 140 days

f = % of time that wind speed > 5.4 m/s = 7%

E = 2.264 Kg/day/hectare

Assume the pile area = 1,800 m^2

"TSP" = 2.264 Kg/day/hectare x 365 days x 1800 x 10^{-1} hectare = 149 Kg/year

"RSP" = 0.5 x "TSP" = 75 Kg/year

Note : Same amount of dust emission will be anticipated for both new and old plants.

5. Transport to Crushers

$$E = k(1.7)\ (\frac{s}{12})\ (\frac{S}{48})\ (\frac{W}{2.7})^{0.7}\ (\frac{w}{4})^{0.5}\ (\frac{365-P}{365})\ Kg/VKT$$

where k = particle size multiplier = 0.8

s = silt content = 4%

S = mean vehicle speed = 15 Km/hr

W = mean vehicle weight = 52 t

w = mean number of vehicle wheels = 6

P = 140 days

E = 0.848 Kg/VKT

Assume round trip distance = 2 Km,

truck capacity = 35 t

(a) For production rate of 1.7 million tons/year,

"TSP" (uncontrolled) = 82,377 Kg/year

"RSP" (uncontrolled) = 0.36 x "TSP"
= 29,656 Kg/year

"TSP" (controlled) = 20,594 Kg/year

"RSP" (controlled) = 7,414 Kg/year

(b) For production rate of 2.1 million tons/year,

"TSP" (uncontrolled) = 101,760 Kg/year

"RSP" (uncontrolled) = 36,633 Kg/year

"TSP" (controlled) = 25,440 Kg/year

"RSP" (controlled) = 9,158 Kg/year

Note : If frequent watering for the concerned road is carried out, the emission will be reduced by 75%.

6. Dump at Crushers

$$E = \frac{0.73 \times 0.0009 \left(\frac{s}{5}\right) \left(\frac{U}{2.2}\right) \left(\frac{H}{1.5}\right)}{\left(\frac{Y}{4.6}\right)^{0.33} \left(\frac{M}{2}\right)^{2}} Kg/t$$

where s = silt content = 4%

U = mean wind speed = 3.75 m/s

H = drop height = 5 m

Y = capacity of dumping device (dump truck) = 20 m^3

M = moisture content = 1%

E = 0.00737 Kg/t

(a) For production rate of 1.7 million tons/year,

"TSP" (uncontrolled) = 12,529 Kg/year

"RSP" (uncontrolled) = 0.36 x "TSP"
= 4,510 Kg/year

"TSP" (controlled) = 6,265 Kg/year

"RSP" (controlled) = 2,255 Kg/year

(b) For production rate of 2.1 million tons/year,

"TSP" (uncontrolled) = 15,477 Kg/year

"RSP" (uncontrolled) = 5,571 Kg/year

"TSP" (controlled) = 3,095 Kg/year

"RSP" (controlled) = 1,114 Kg/year

Note : For the old plant, it is assumed that the emissions can be reduced by 50% by the existing water sprayers. For the new plant, 80% emission reduction will be expected.

7. Primary Crushers

E = 0.009 Kg/t

(a) For production rate of 1.7 million tons/year,

"TSP" (uncontrolled) = 15,300 Kg/year

"RSP" (uncontrolled) = 0.5 x "TSP"
= 7,650 Kg/year

"TSP" (controlled) = 10,710 Kg/year

"RSP" (controlled) = 5,355 Kg/year

(b) For production rate of 2.1 million tons/year,

"TSP" (uncontrolled) = 18,900 Kg/year

"RSP" (uncontrolled) = 9,450 Kg/year

"TSP" (controlled) = 1,890 Kg/year

"RSP" (controlled) = 945 Kg/year

Note : At present, the emission reduction rate is assumed to be 30%. For the modified plant, 90% will be expected.

8. Secondary Crushers
Same as Primary Crushers

9. Tertiary Crushers
Same as Primary Crushers

10. Screening

E = 0.08 Kg/t

(a) For production rate of 1.7 million tons/year,

"TSP" (uncontrolled) = 136,000 Kg/year

"RSP" (uncontrolled) = 0.75 x "TSP"
= 102,000 Kg/year

"TSP" (controlled) = 68,000 Kg/year

"RSP" (controlled) = 51,000 Kg/year

(b) For production rate of 2.1 million tons/year,

"TSP" (uncontrolled) = 168,000 Kg/year

"RSP" (uncontrolled) = 126,000 Kg/year

"TSP" (controlled) = 33,600 Kg/year

"RSP" (controlled) = 25,200 Kg/year

Note : The emission reduction efficiency of the existing screens is assumed to be 50%. For the modified plant, 80% reduction will be expected.

11. Load Stock piles

$$E = \frac{k \times 0.0009 \left(\frac{S}{5}\right) \left(\frac{U}{2.2}\right) \left(\frac{H}{3.0}\right)}{\left(\frac{M}{2}\right)^2} Kg/t$$

where k = 0.77 (for continuous drop)

s = silt content = 4%

U = mean wind speed = 3.75 m/s

H = average drop height = 10 m

M = material moisture content = 2.7%

E = 0.00173 Kg/t

(a) For production rate of 1.7 million tons/year,

"TSP" (uncontrolled) = 2,941 Kg/year

"RSP" (uncontrolled) = 0.37 x "TSP"
= 1,088 Kg/year

(b) For production rate of 2.1 million tons/year

"TSP" (uncontrolled) = 3,633 Kg/year

"RSP" (uncontrolled) = 1,344 Kg/year

"TSP" (controlled) = 1,817 Kg/year

"RSP" (controlled) = 672 Kg/year

Note : At present, there is no emission control facility. For the new plant, 50% dust reduction will be expected.

12. Reclaim from Stockpiles (conveying tunnel belt)

E = 0.0017 Kg/t

(a) For production rate of 1.7 million tons/year,

"TSP" = E x 1.7 x 10^6 t/year = 2,890 Kg/year

"RSP" = 11 170 x "TSP" = 187 Kg/year

(b) For production rate of 2.1 million tons/year,

"TSP" = 3,570 Kg/year

"RSP" = 231 Kg/year

Note : The emission rates for both the old plant and the modified plants will be the same.

13. Stockpile erosion

$$E = 1.9 \left(\frac{s}{1.5}\right) \left(\frac{365 - P}{235}\right) \left(\frac{f}{15}\right) Kg/day/hectare$$

where s = silt content = 4%

P = 140 days

f = 7%

E = 2.2638 Kg/day/hectare

Assume stockpile area be 5,000 m^2 = 0.5 hectare

"TSP" = E x 360 days x 0.5 hectare = 413 Kg/year

"RSP" = 0.5 x "TSP" = 206 Kg/year

Note : The emission rates for both the old and new plants are expected to be the same.

APPENDIX 5A

BASELINE MARINE MONITORING DATA COLLECTED JUNE-JULY 1993

WATER QUALITY AND SEDIMENT MONITORING IN TAI TAM BAY 1993 - METHODOLOGY

1. Water Quality

The water quality monitoring was carried out at four stations on the 22, 30 June and 13, 19 July respectively. Each sampling event covered a 24-hour tidal cycle and was programmed to commence at low or high water. Based on 6-hr continuous monitoring at each of the four stations and a data acquisition frequency of every two minutes, approximately 160-180 data points for each parameter were collected. Profiling of water quality parameters was also conducted. The locations of monitoring stations are provided in Table A (and shown in Section 6, Figure 6.1). Temperature (°C), salinity ($^{o}/_{oo}$), water depth (m), turbidity (NTU) and DO (mgl^{-1}) were recorded on data loggers and down-loaded to a computer using Sea-soft and Excel software. Simultaneous recording of current data was carried out during each monitoring event.

Instruments used for *in-situ* water quality monitoring and current velocity measurements include the SBE-19 Seacat profiler, the OBS-3 particle sensor with YSI multi-probe, and the Valeport BFM 108 direct reading current meter. These instruments were deployed on seabed mooring and subsurface floats but were tethered to the boat to prevent instrument loss or vandalism. During profiling, the instruments were lowered slowly down the water column until reaching the seabed, then raised slowly back to the surface with data acquisition during decent and ascent. Each profile comprised approximately 30 data sets at a sampling interval of 2 data sets per second.

2. Sediment Sampling and Testing

Field Sampling

Sediment sampling was carried out on 14/7/1993 and the sediment samples were collected from 7 stations as indicated in Table B. Positioning of the stations was achieved using a GPS satellite positioning system. Upon station fixing, a marker buoy was dropped into the water to mark the station, and sediment sampling was only carried out when the boat was observed to be less than 10 m from the marker buoy. A Van Veen grab was used for sediment sampling. One sample from each station was collected and sent for trace metal analysis.

Laboratory Analysis

Trace metal analysis of 7 metals were carried out for the sediment samples. For cadmium, chromium, copper, lead, nickel and zinc, the sample was dried at 103-105°C followed by nitric acid and hydrochloric acid digestion and analysed by Atomic Absorption Spectroscopy (AAS) according to Ref. APHA 17th Edition, Method 3111. For mercury, the sample was dried at 103 - 105°C and analysed by AAS according to Ref. APHA 17th Edition, Method 3112B.

Table A Sampling Programme for Tai Tam Bay June-July 1993

Date	Time	Station A 22 12 48 N 114 13 48 E	Station B 22 13 10 N 114 13 48 E	Station C 22 13 31 N 114 13 48 E	Station D 22 13 36 N 114 13 48 E
22-23/6/93	Start Time: End Time:	18:45 01:00	01:15 07:15	07:30 13:30	13:35 18:35
30/6/93 - 1/7/93	Start Time: End Time:	10:48 16:35	04:32 10:07	22:45 04:45	16:30 22:30
13-14/7/93	Start Time: End Time:	11:15 17:15	15:20 21:20	05:30 11:30	21:25 05:25
19-20/7/93	Start Time: End Time:	10:00 15:50	16:00 21:50	22:00 03:50	04:00 09:50

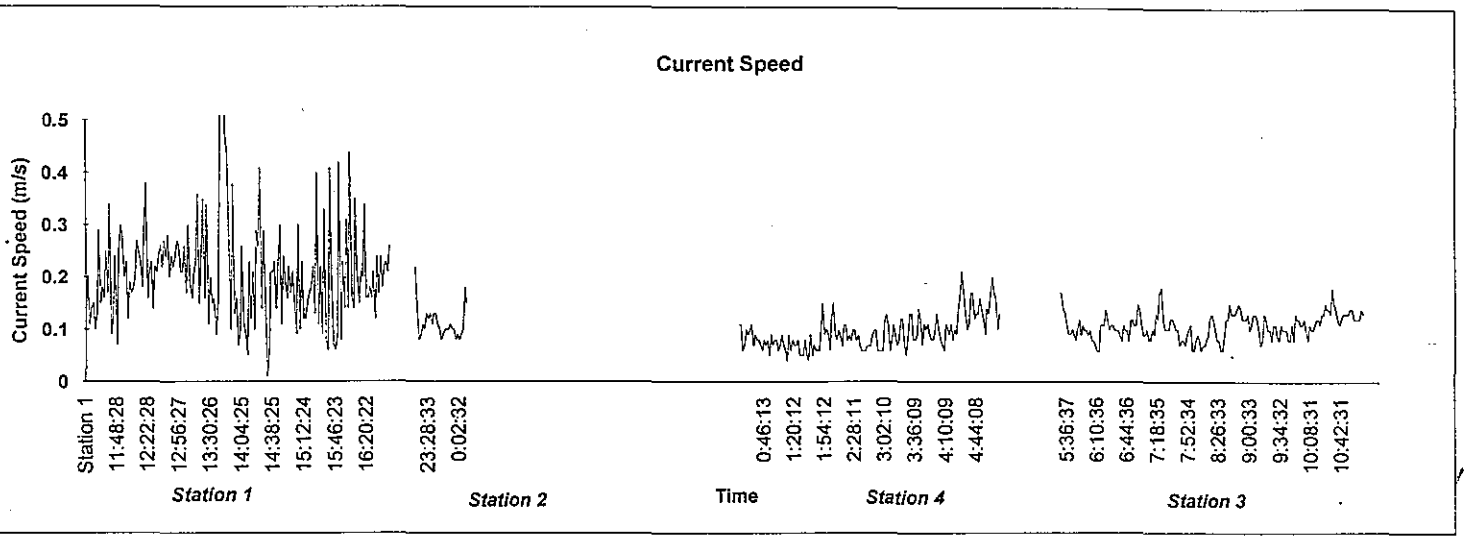
Table B Coordinates of Stations in Tai Tam Bay for Sediment Sampling

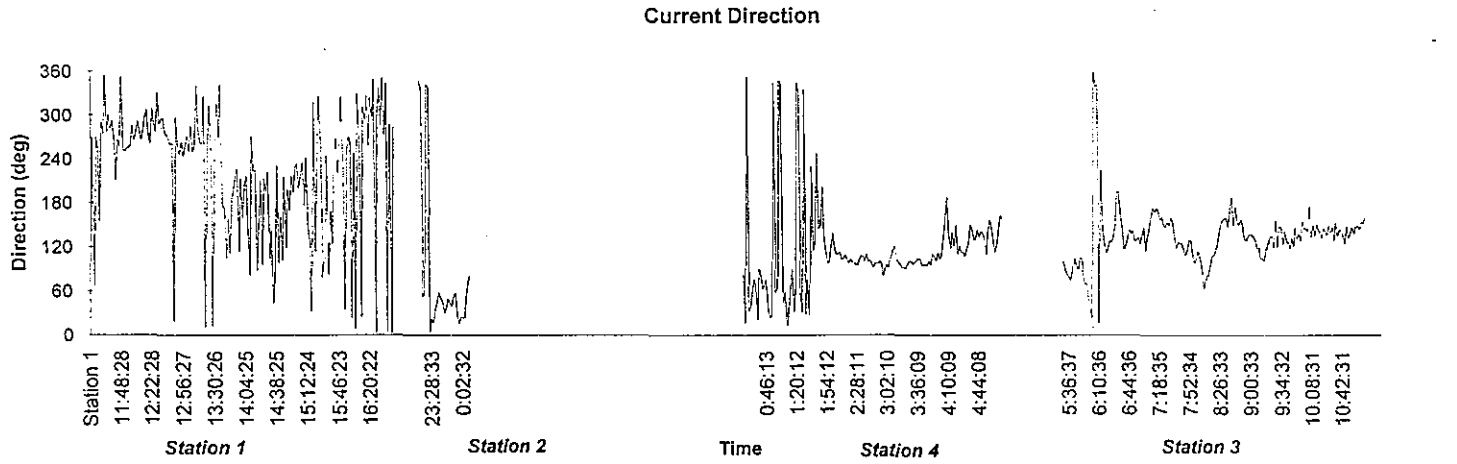
Stations	Coordinates
St1	22 13 27 N 114 13 56 E
St2	22 13 17 N 114 14 02 E
St3	22 13 13 N 114 14 06 E
St4	22 13 11 N 114 14 09 E
St5	22 13 06 N 114 14 13 E
St6	22 13 09 N 114 14 04 E
St7	22 13 02 N 114 13 56 E

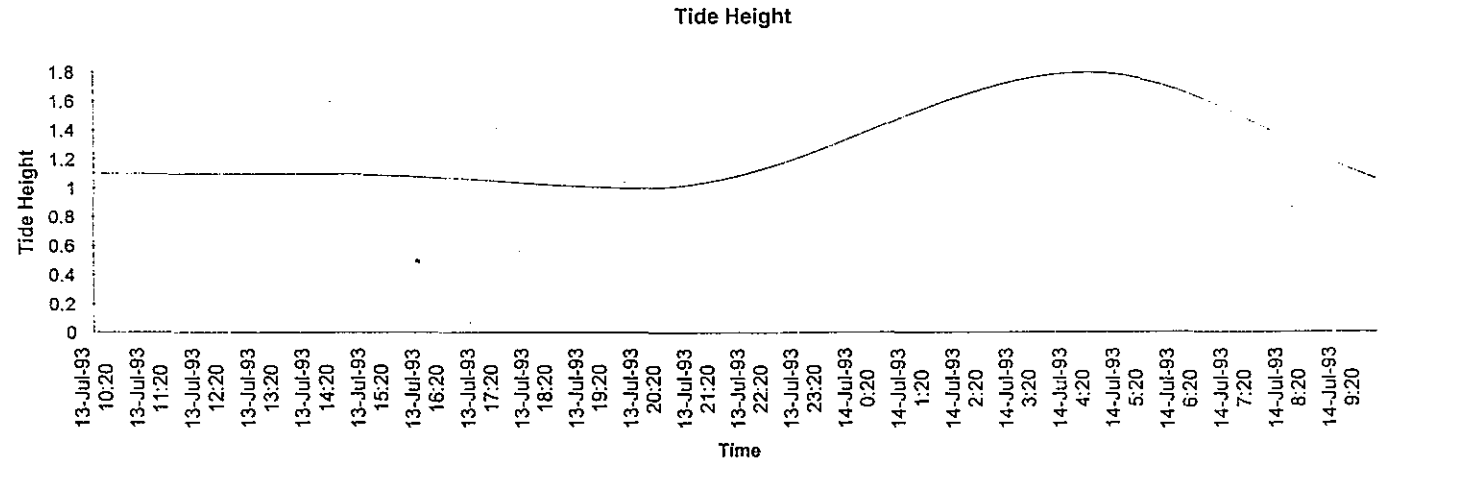
3 July 1993

Current Changes During the Monitoring Period

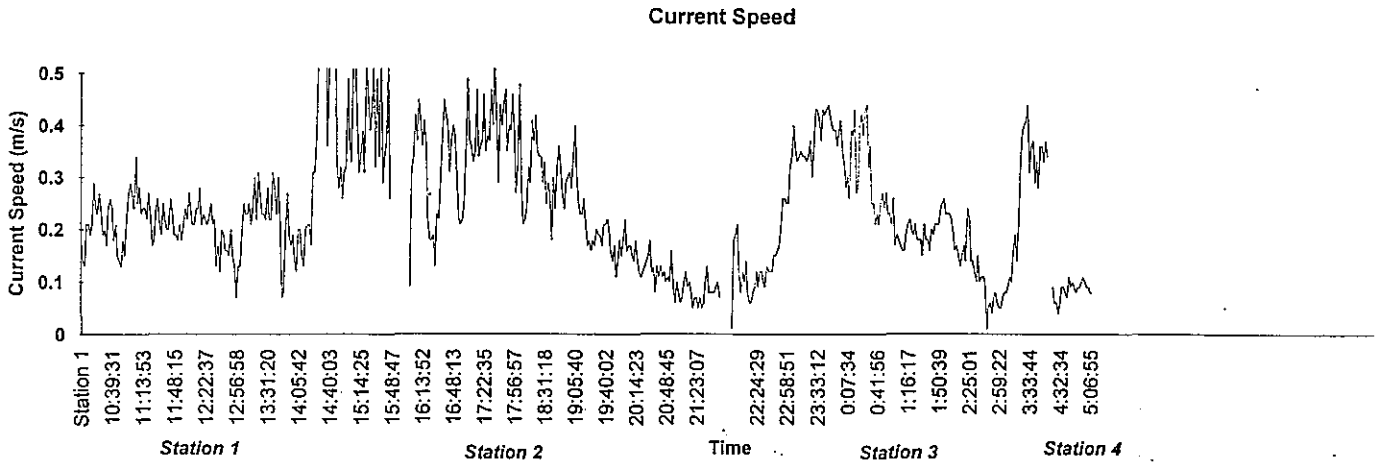
Station 1243

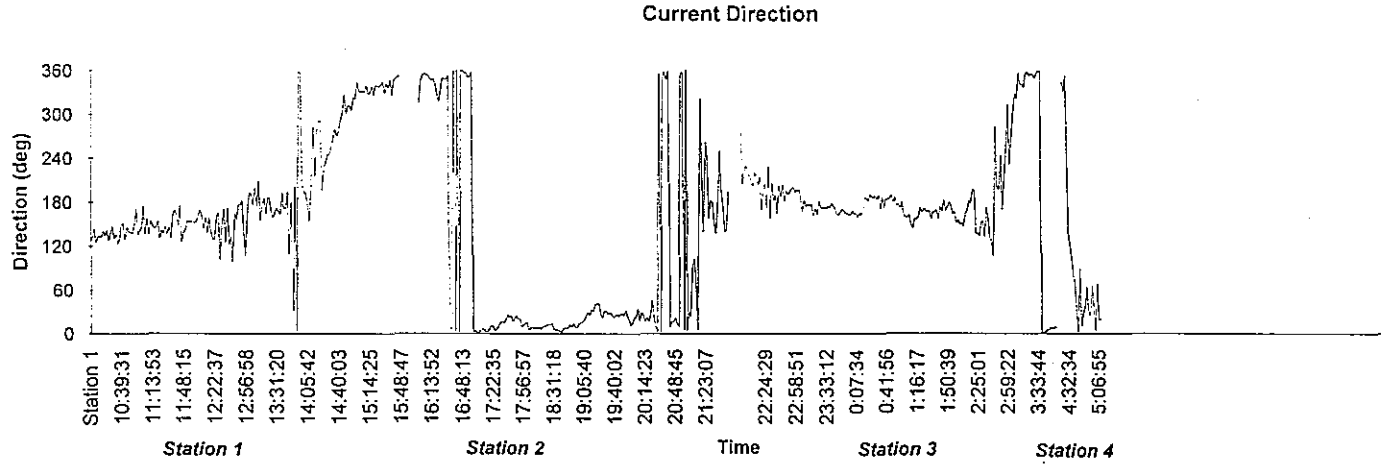


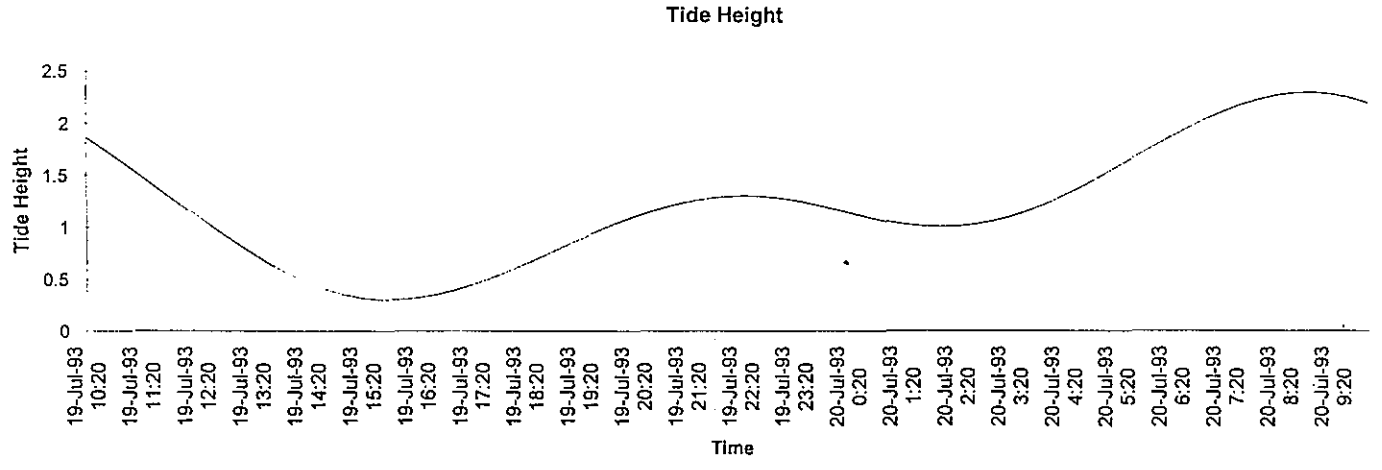




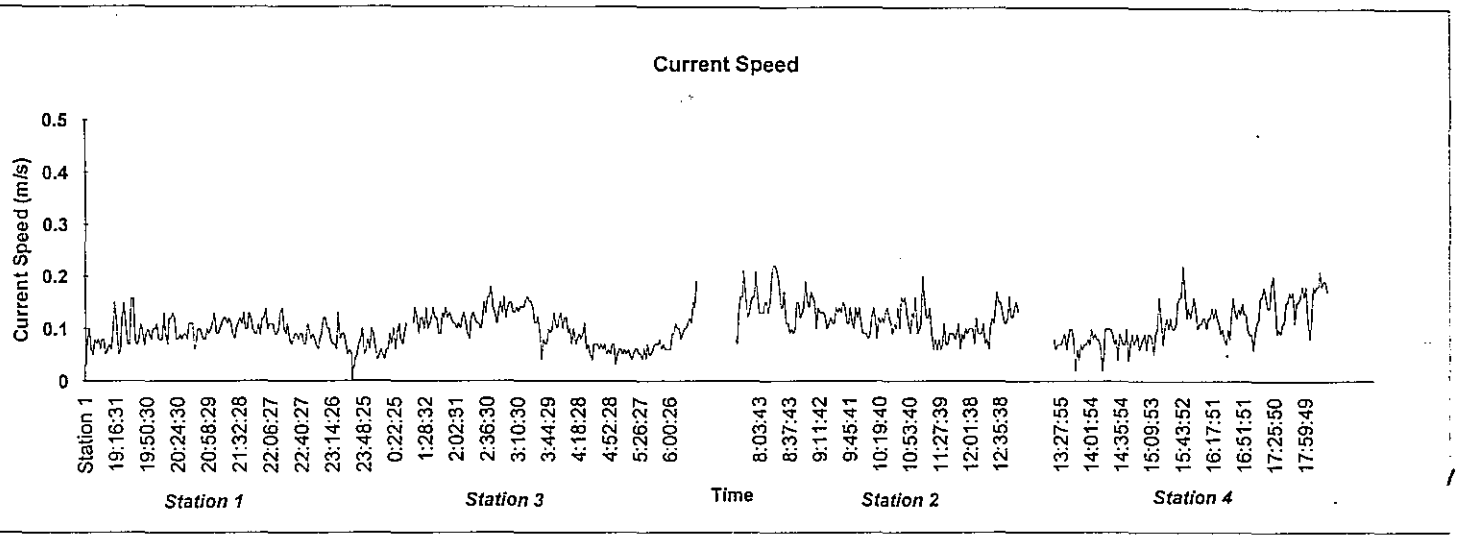
19 July 1993
Current Changes During the Monitoring Period
Station 1234

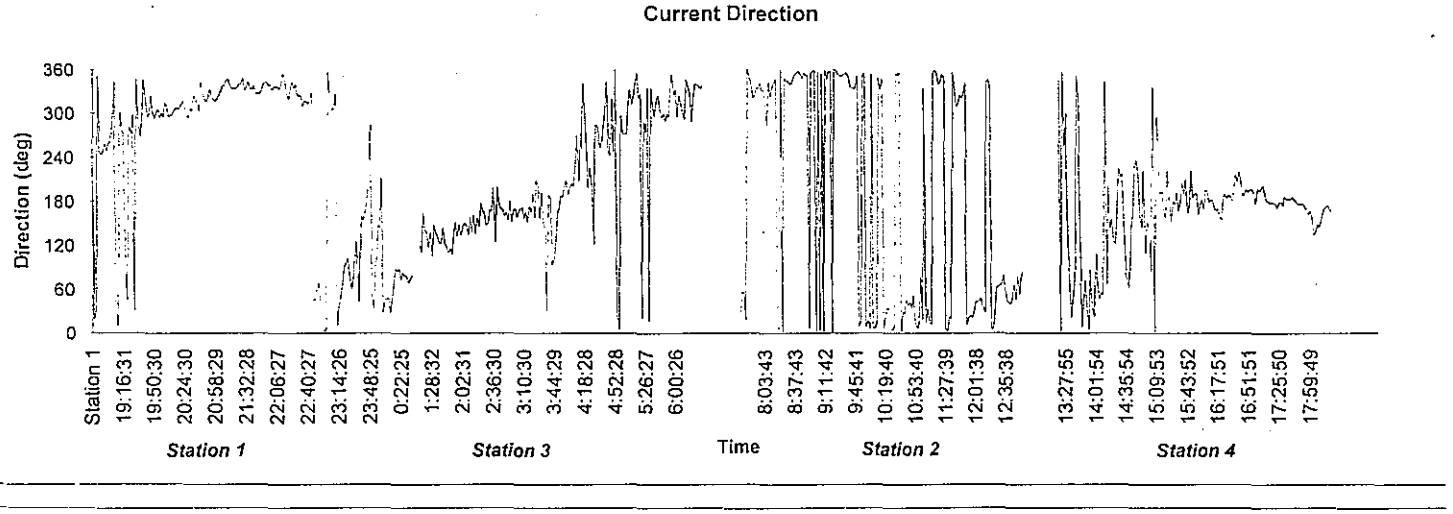


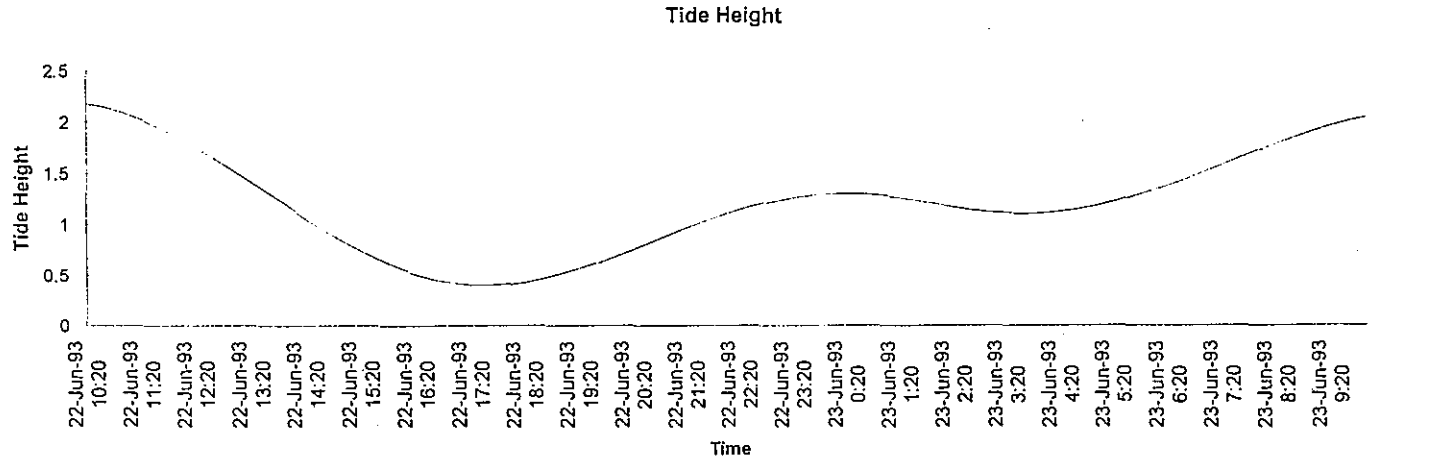




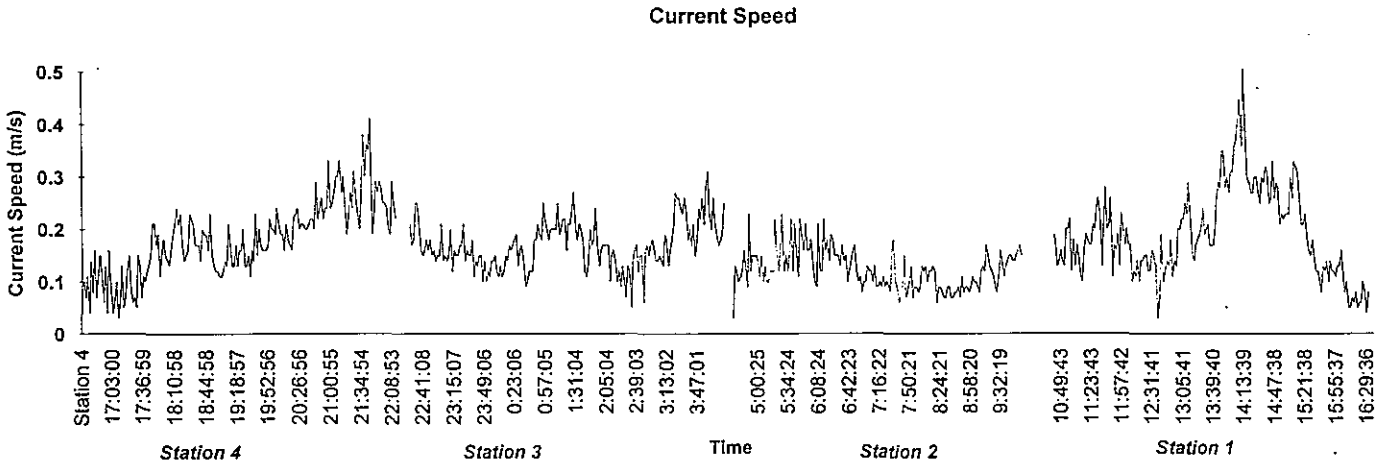
22 June 1993
Current Changes During the Monitoring Period
Station 1324

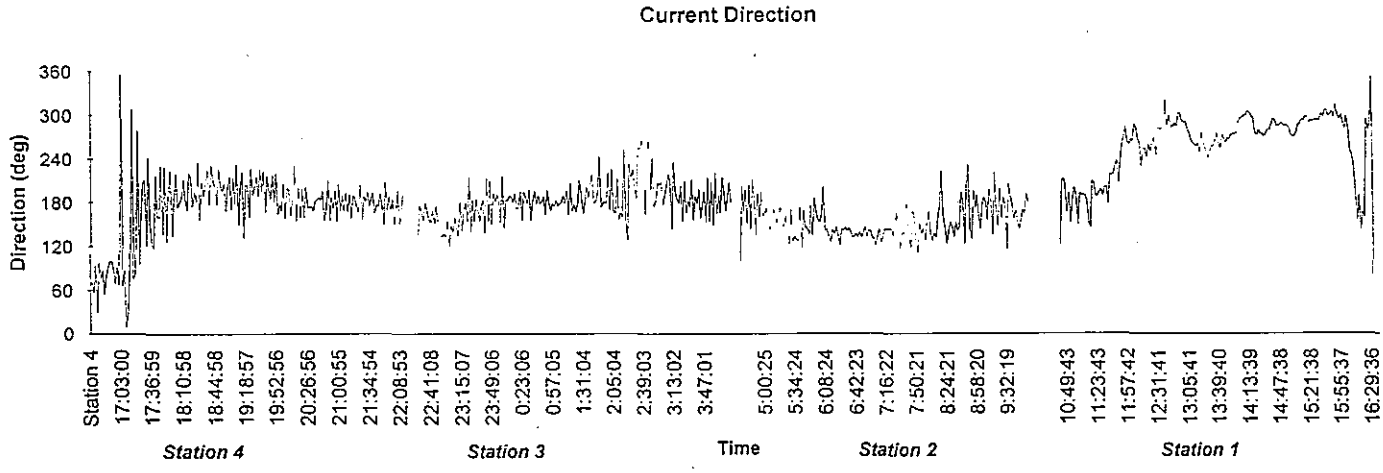


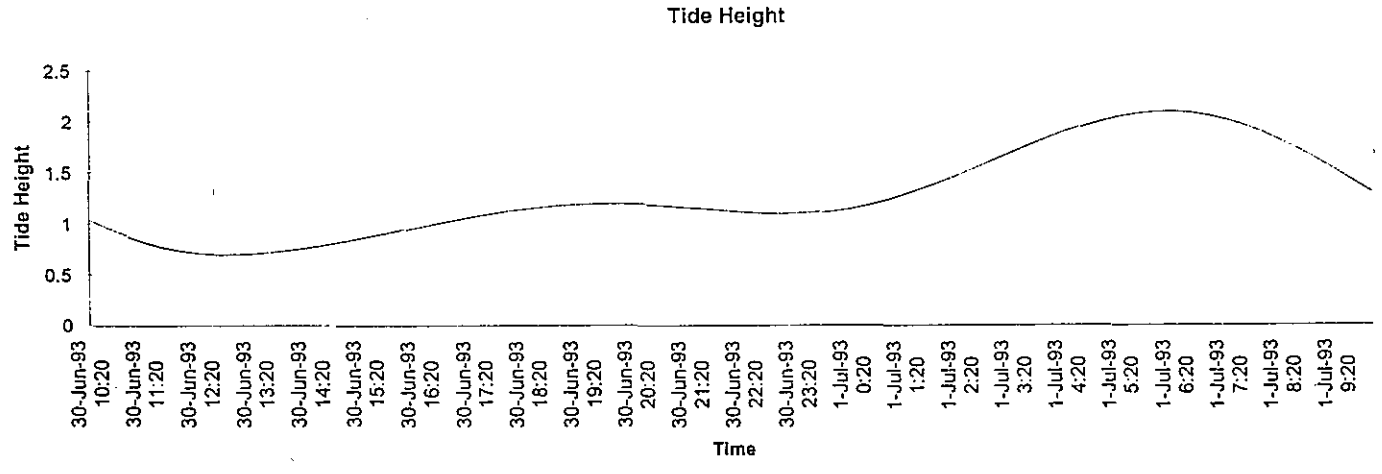




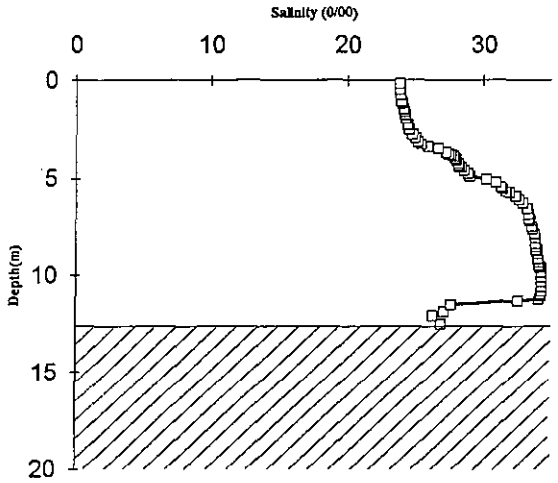
30 June 1993
Current Changes During the Monitoring Period
Station 4321

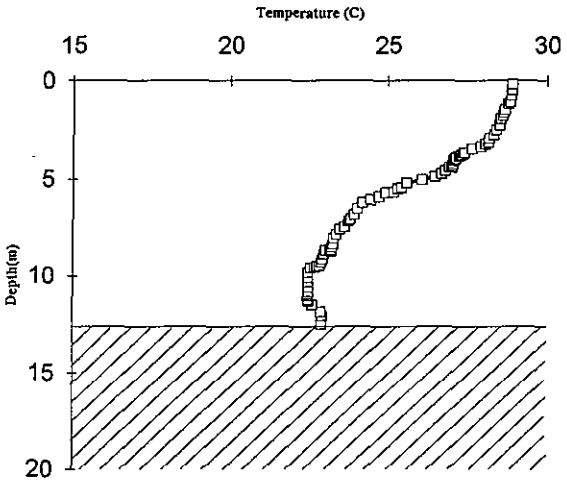


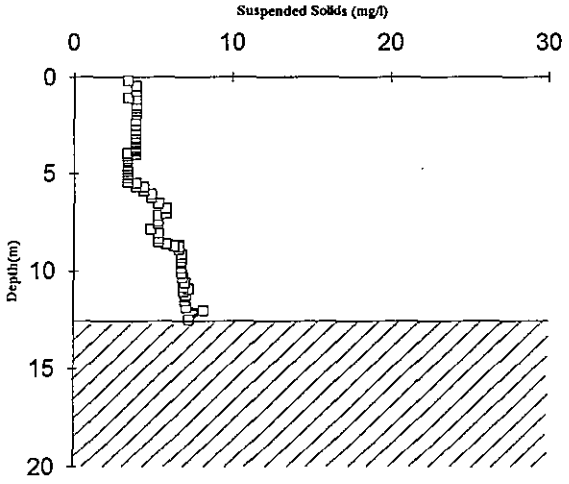


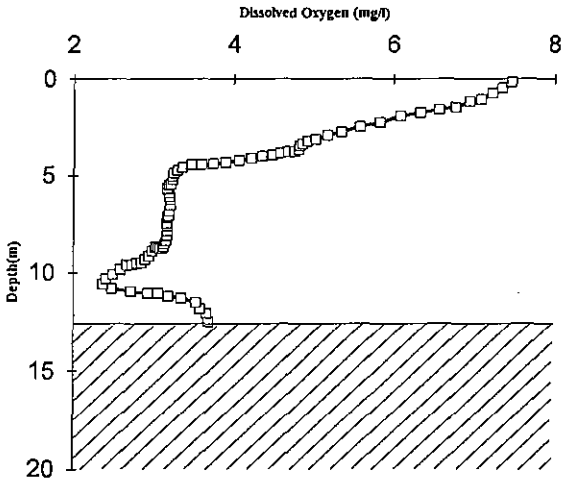


Shek O Quarry
Water Quality Monitoring
Profile : Station 3 (20 July 93, 9:56 - 9:58)

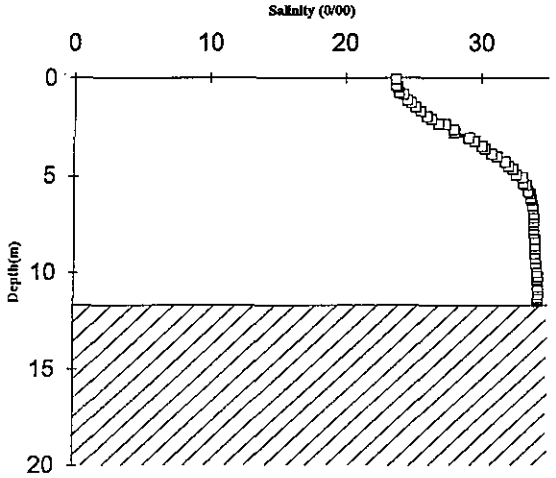


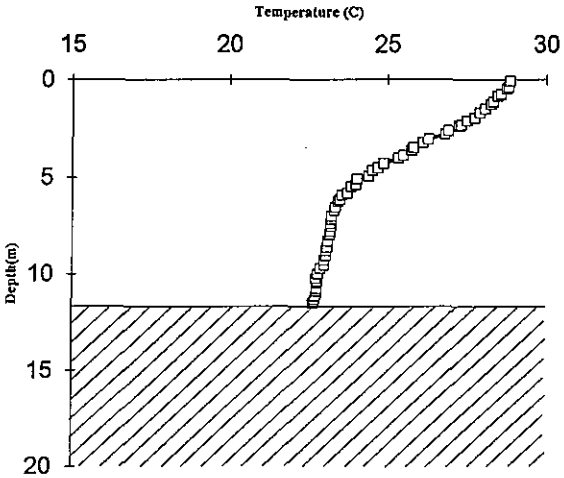


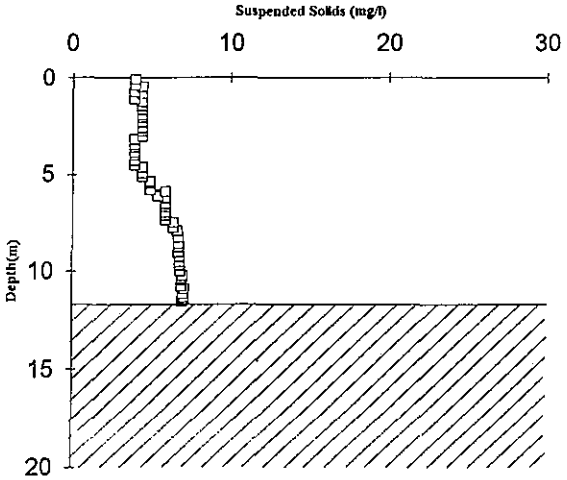


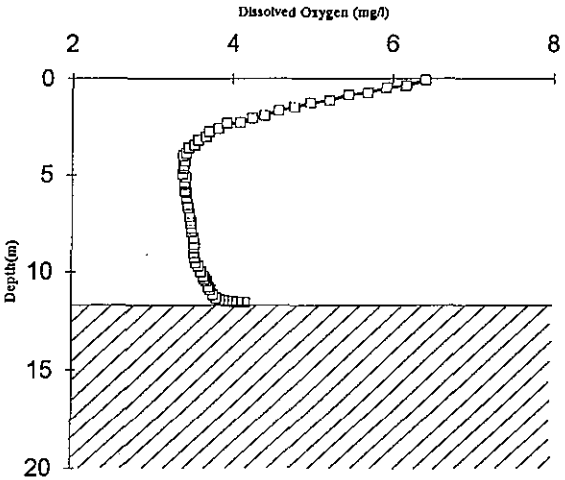


Shek O Quarry
Water Quality Monitoring
Profile : Station 4 (14 July 93, 9:50 - 9:52)

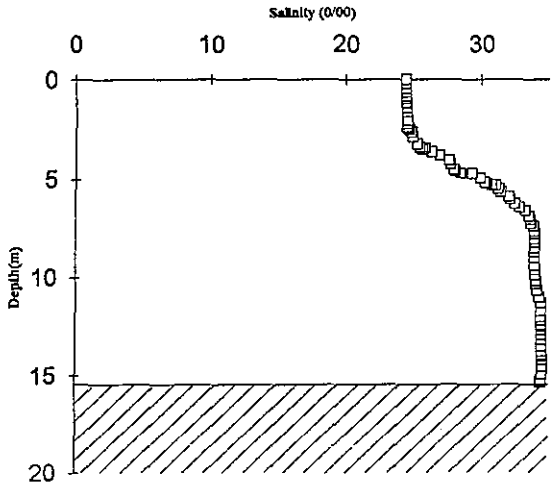


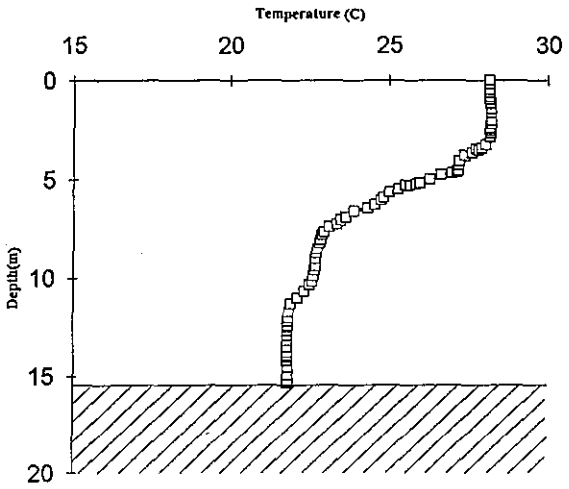


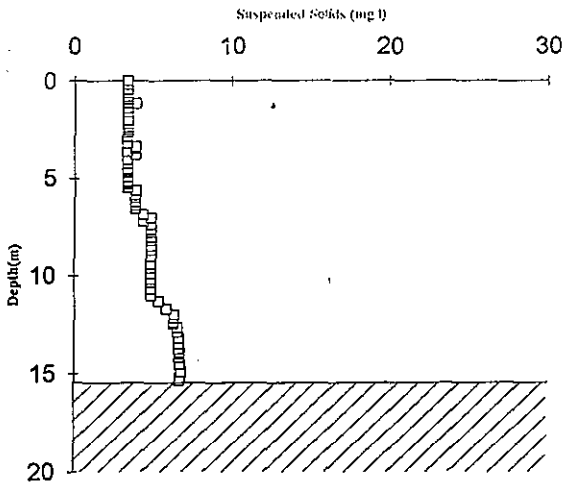


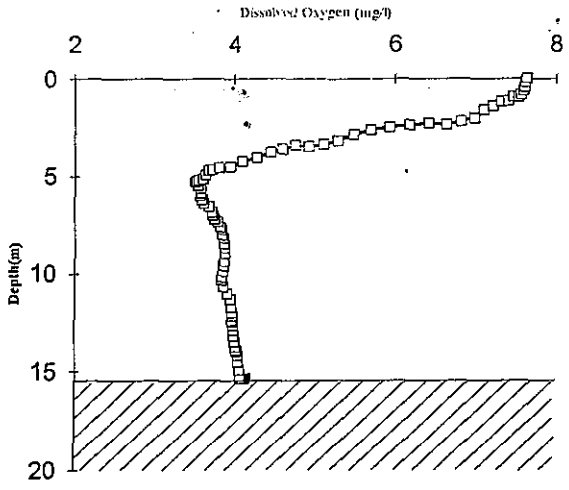


Shek O Quarry
Water Quality Monitoring
Profile : Station 1 (20 July 93, 10:10 - 10:12)

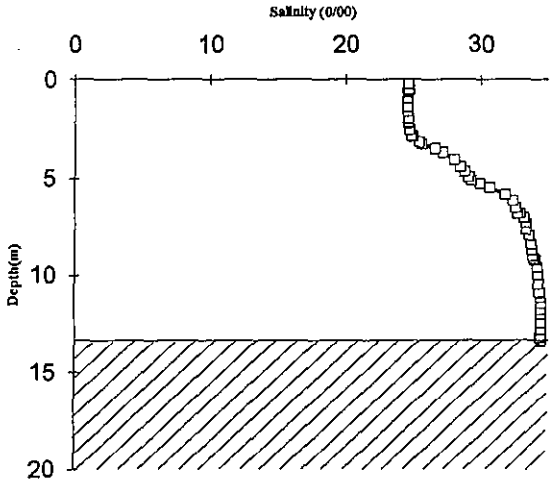


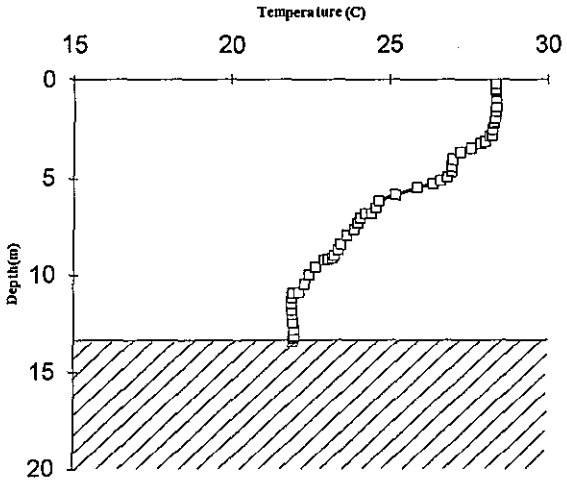


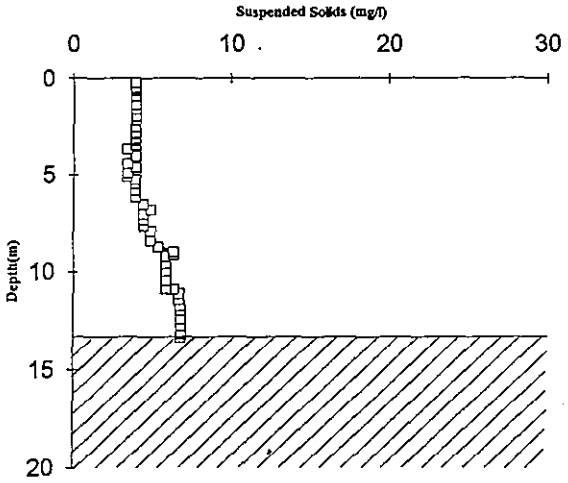


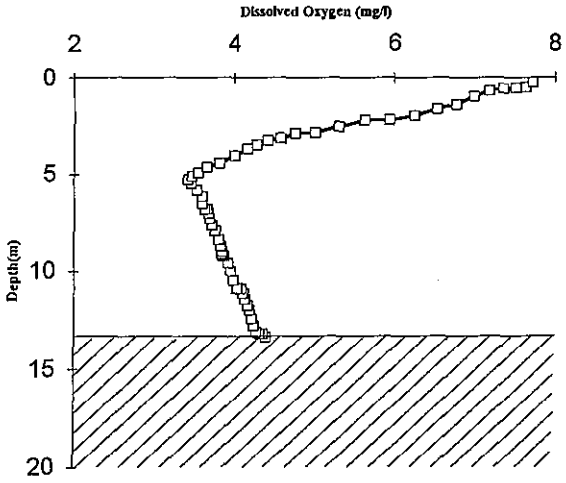


Shek O Quarry
Water Quality Monitoring
Profile : Station 2 (20 July 93, 10:03 - 10:05)









Shek O Quarry
Water Quality Monitoring
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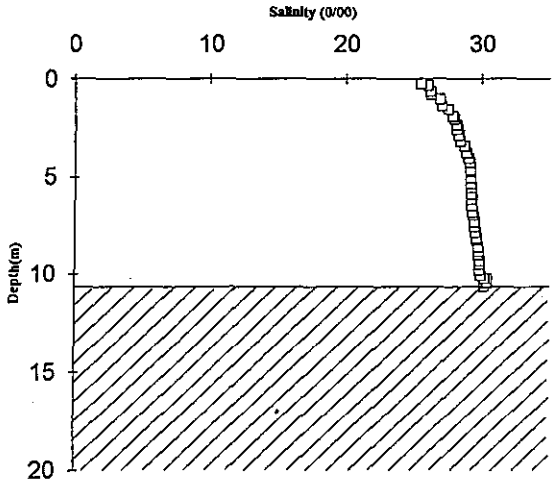

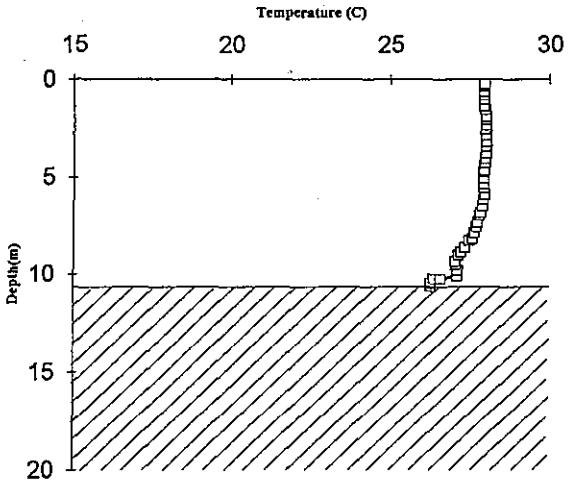

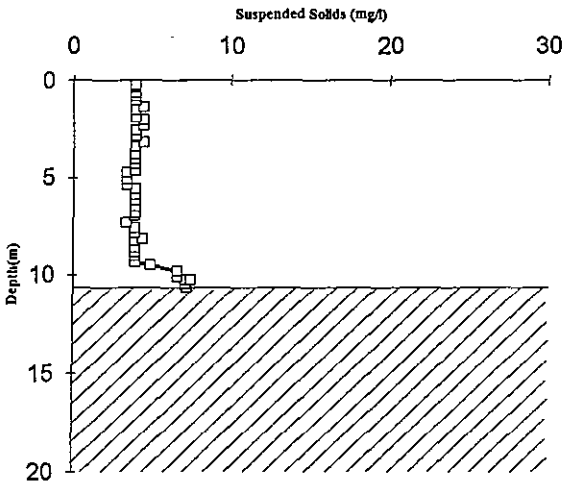

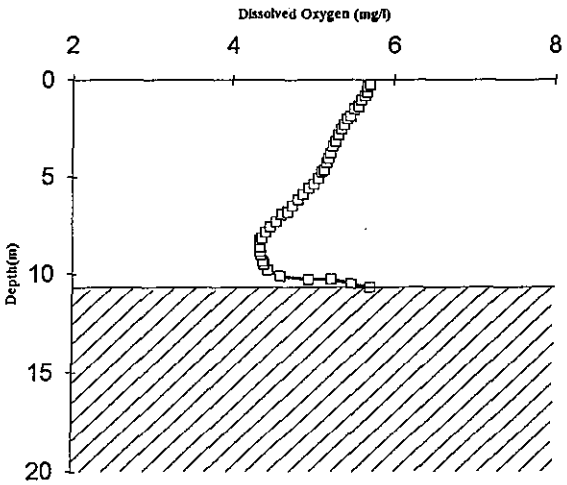

Shek O Quarry
Water Quality Monitoring
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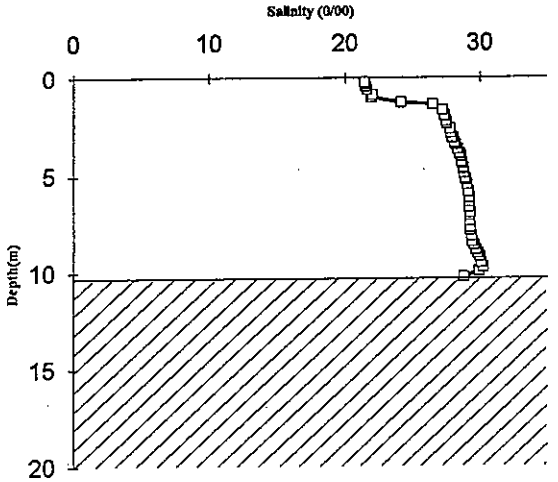

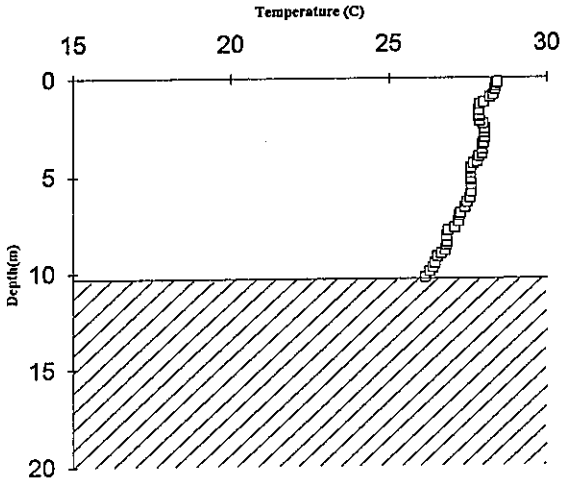

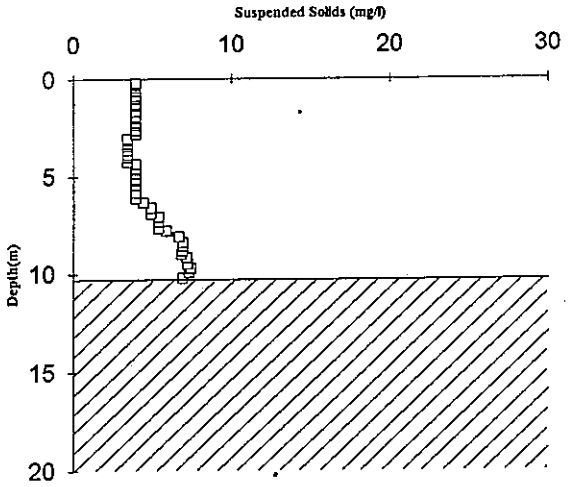

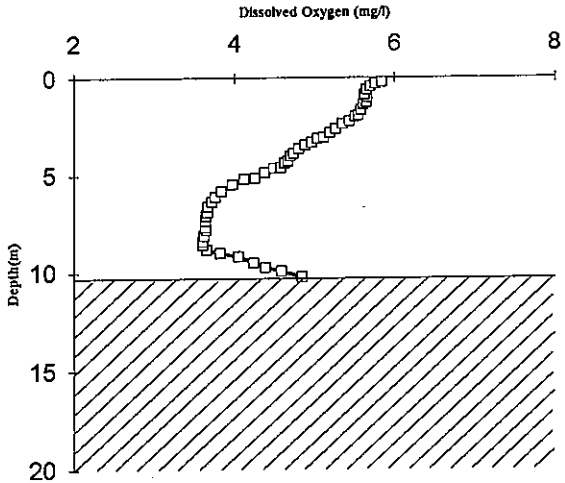

Shek O Quarry
Water Quality Monitoring
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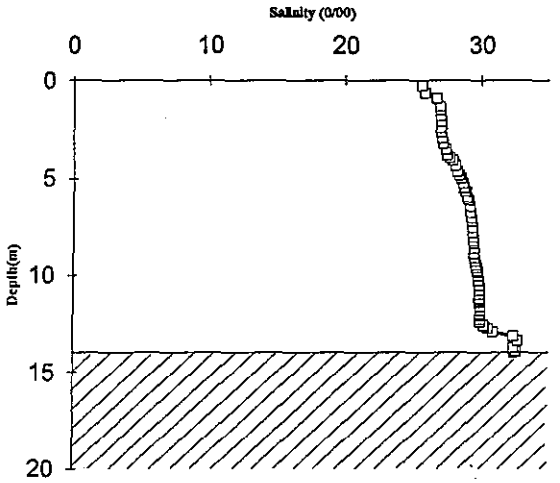
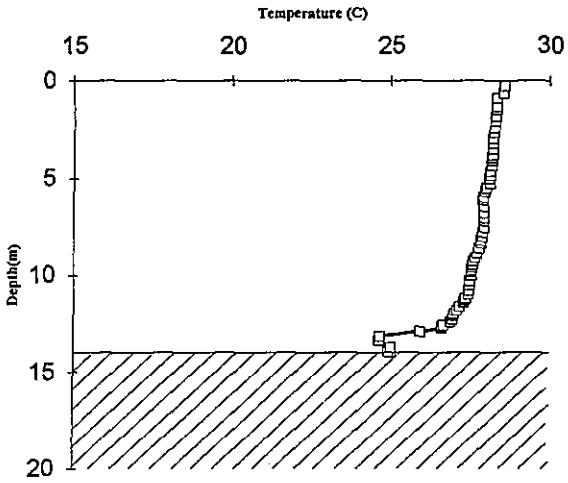
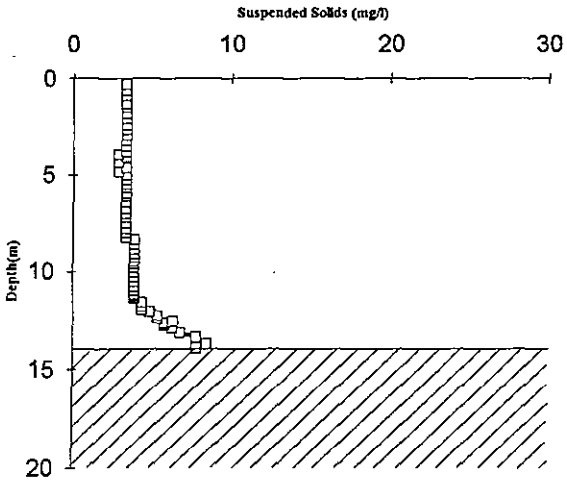
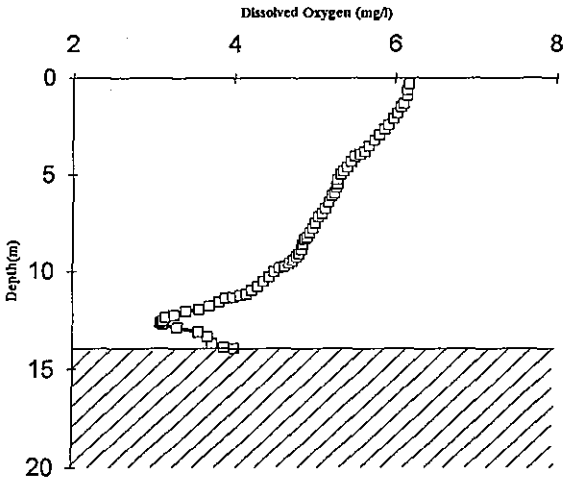
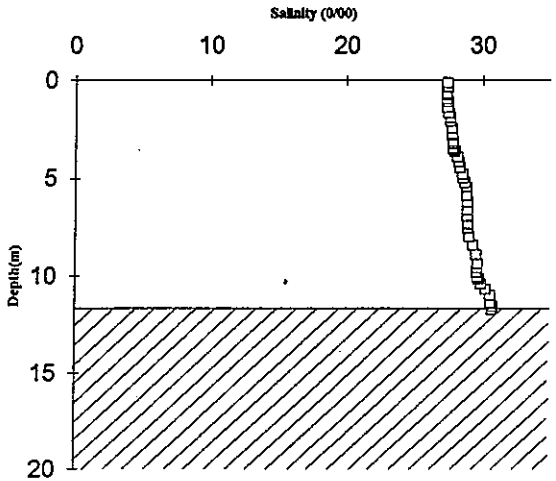


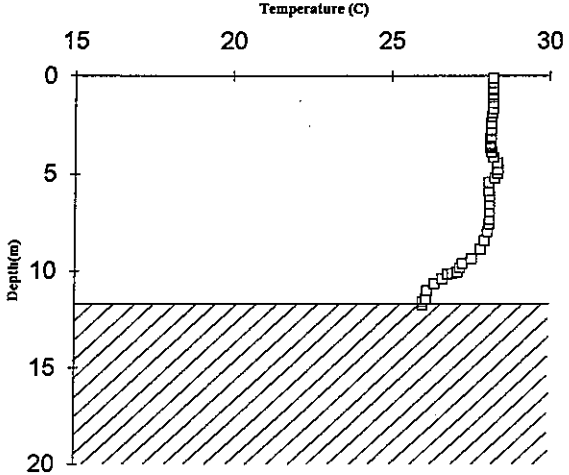


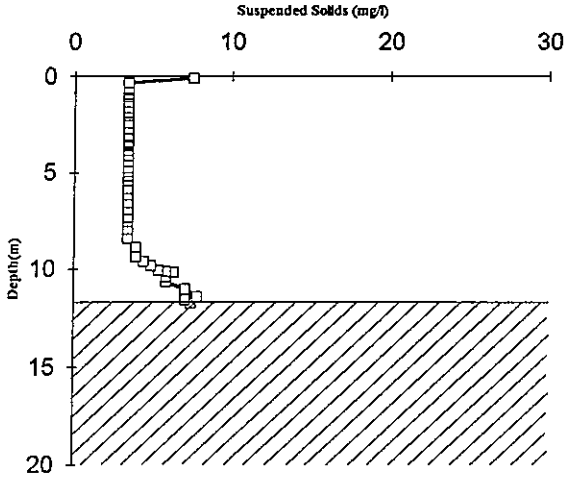


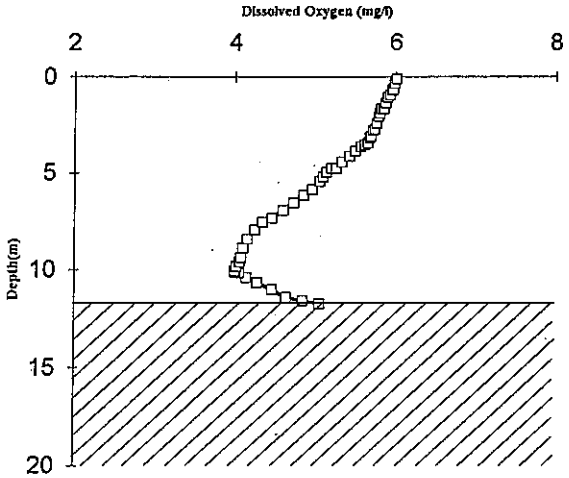


Shek O Quarry
Water Quality Monitoring
Profile : Station 2 (14 July 93, 10:08 - 10:10)

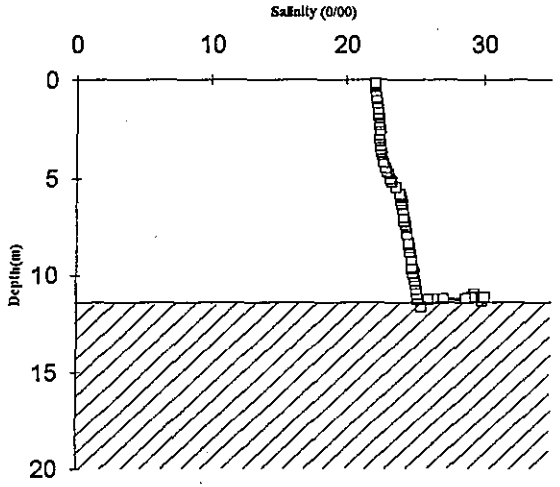


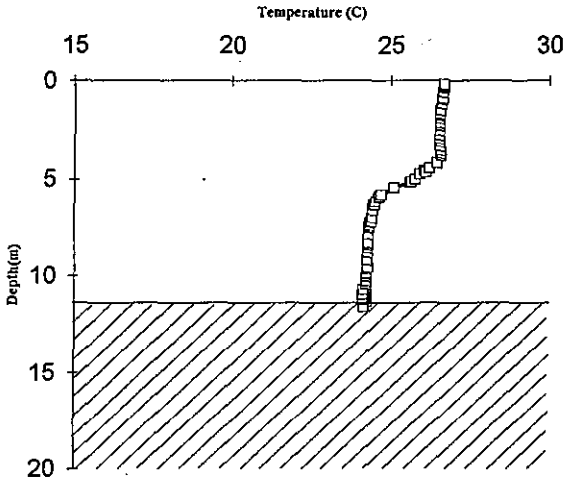


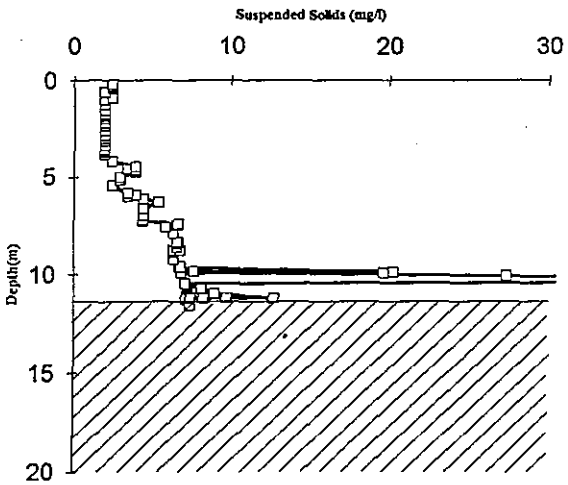


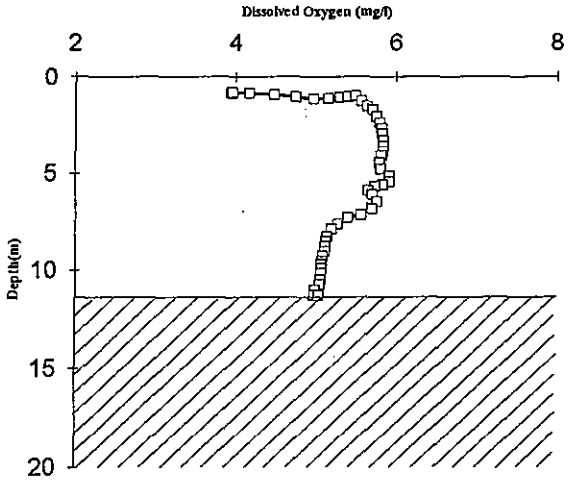


Shek O Quarry
Water Quality Monitoring
Profile : Station 3 (1 July 93, 10:19 - 10:21)

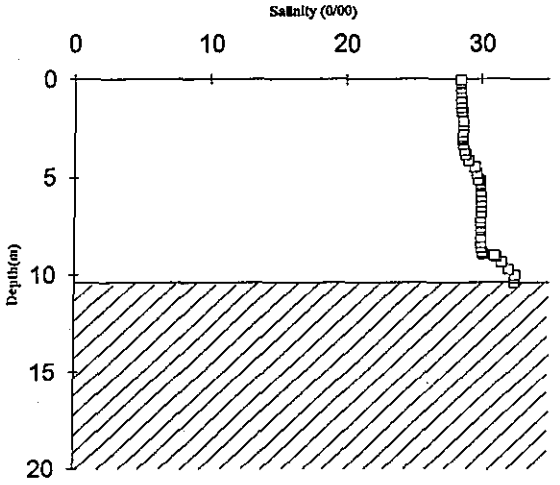


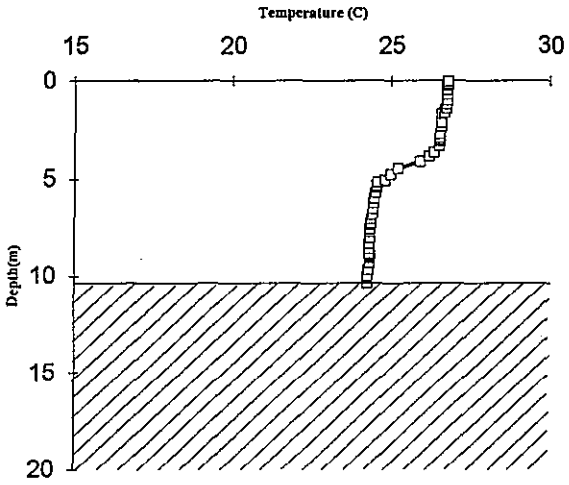


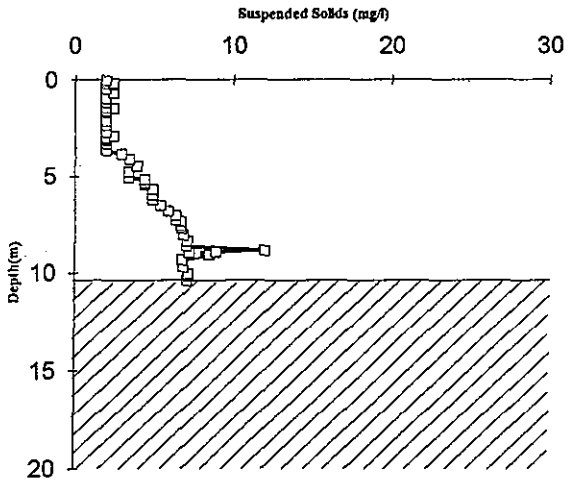


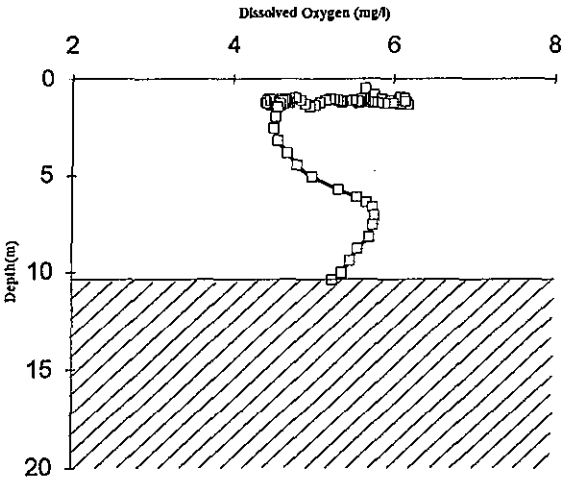


Shek O Quarry
Water Quality Monitoring
Profile : Station 4 (1 July 93, 10:27 - 10:29)

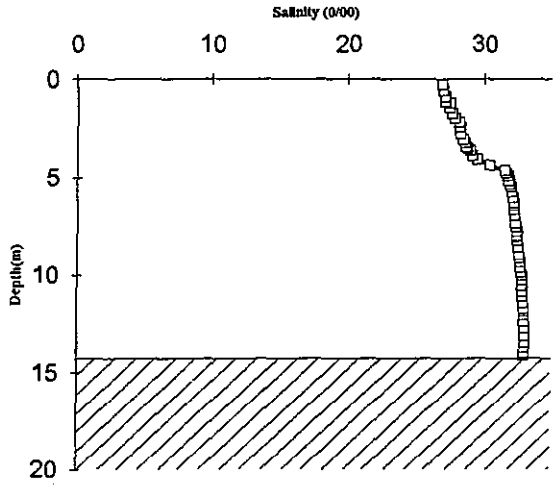


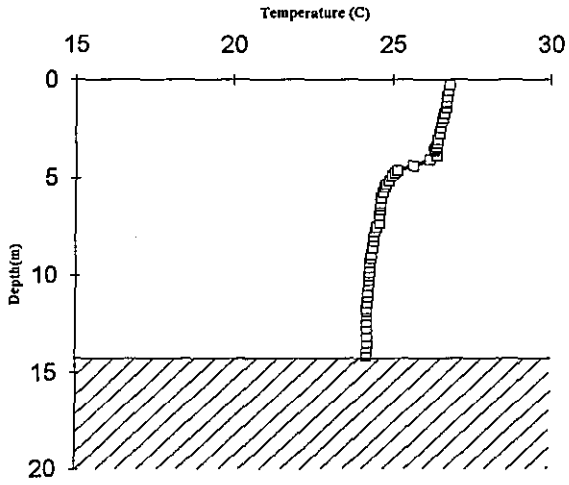


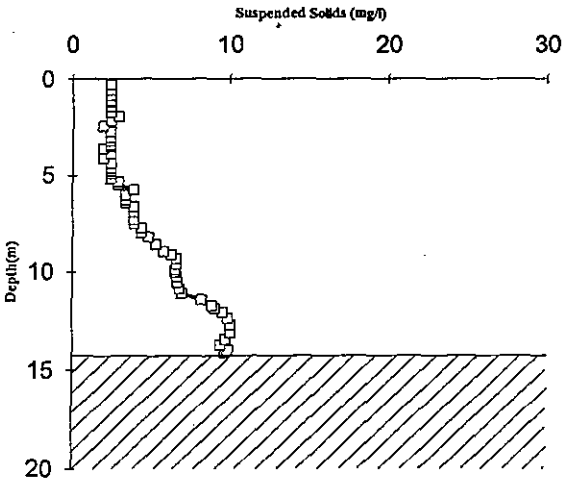


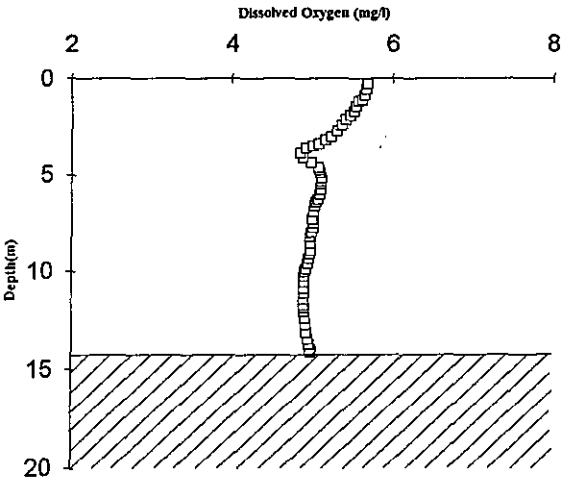


Shek O Quarry
Water Quality Monitoring
Profile : Station 1 (1 July 93, 10:41 - 10:43)

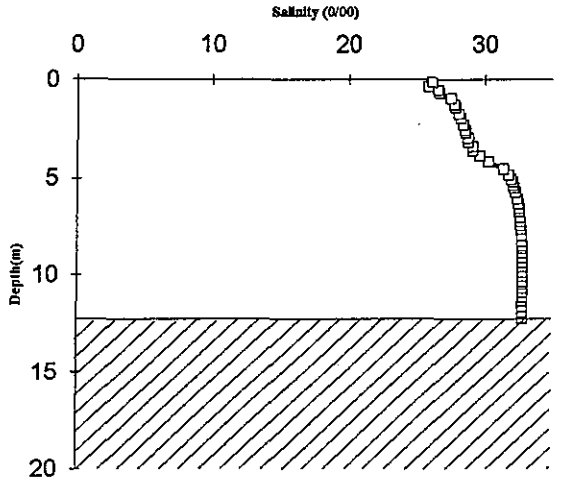


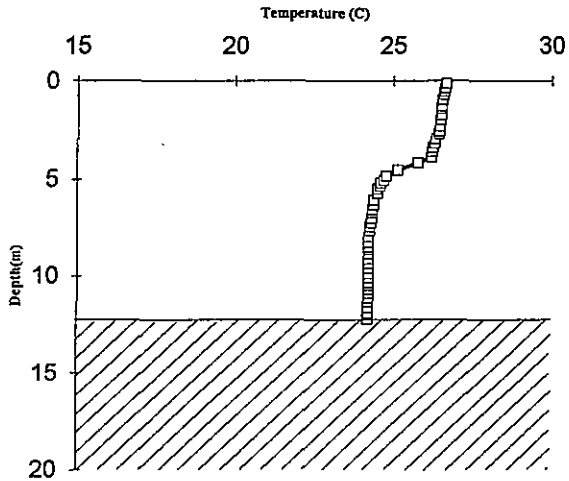


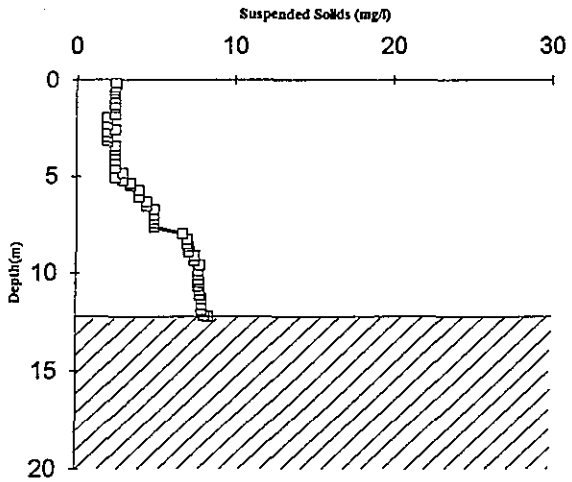


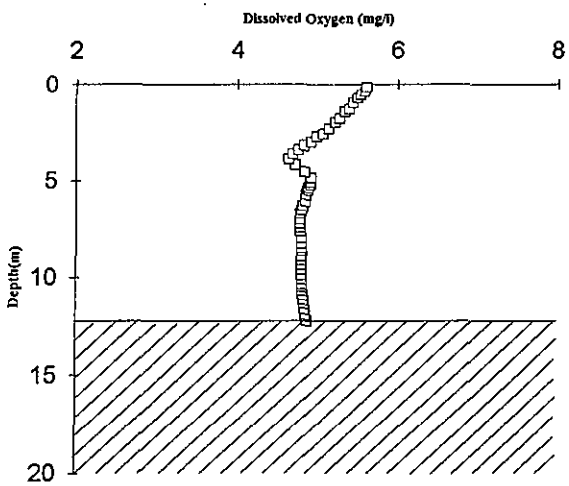


Shek O Quarry
Water Quality Monitoring
Profile : Station 2 (1 July 93, 10:08 - 10:10)

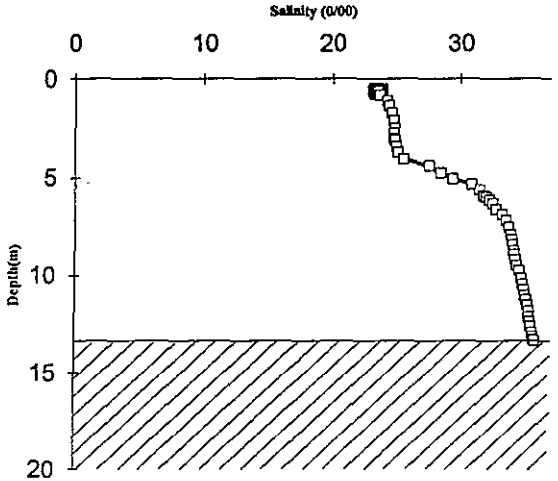


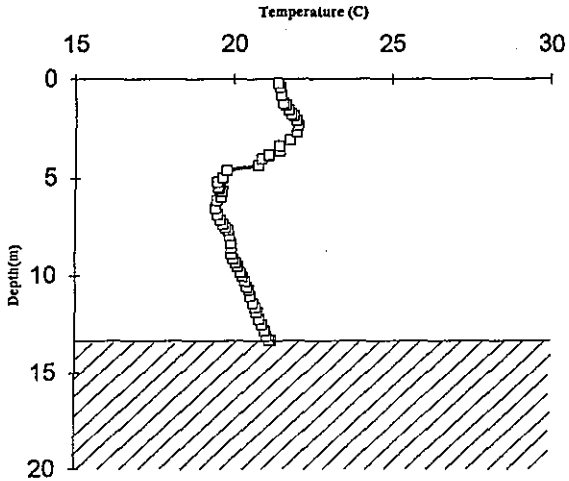


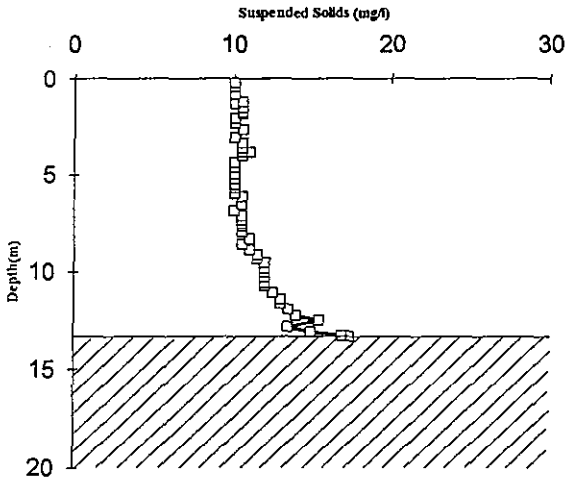


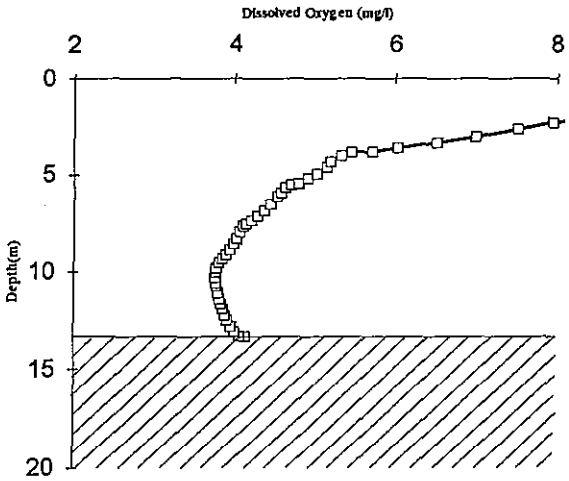


Shek O Quarry
Water Quality Monitoring
Profile : Station 3 (30 June 93, 6:47 - 6:49)

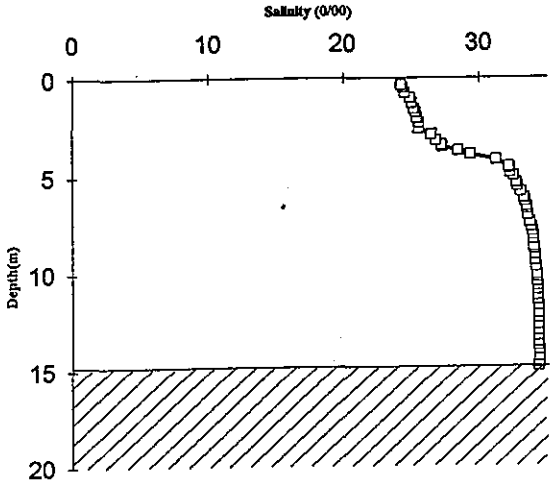


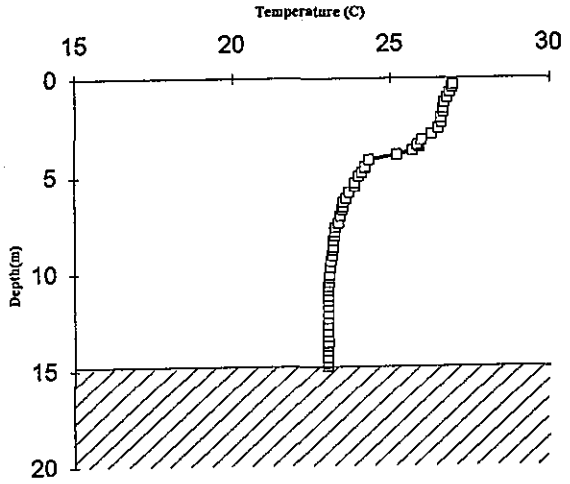


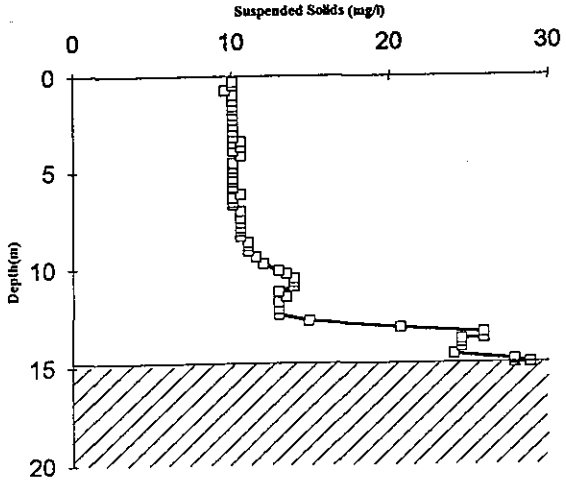


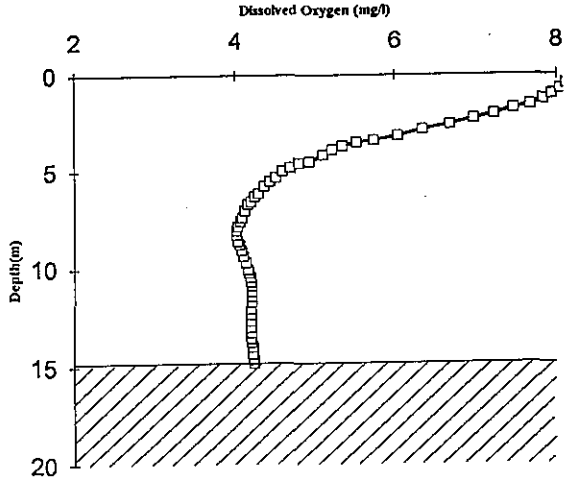


Shek O Quarry
Water Quality Monitoring
Profile : Station 4 (23 June 93, 7:01 - 7:03)

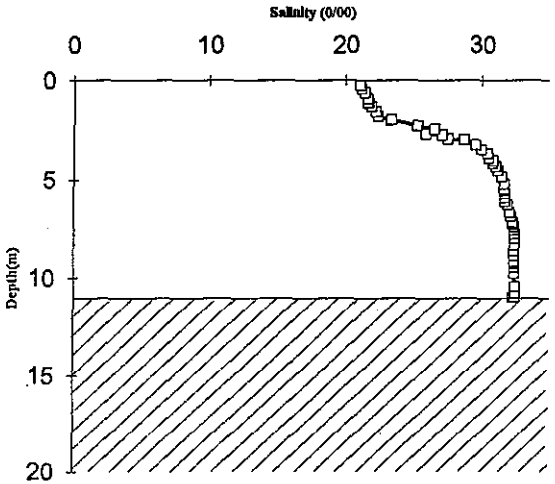


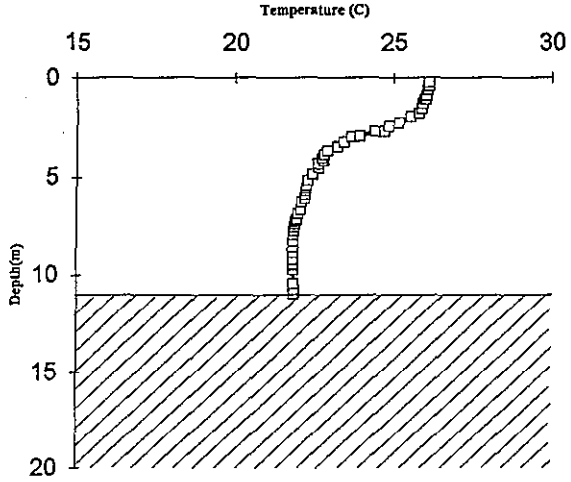


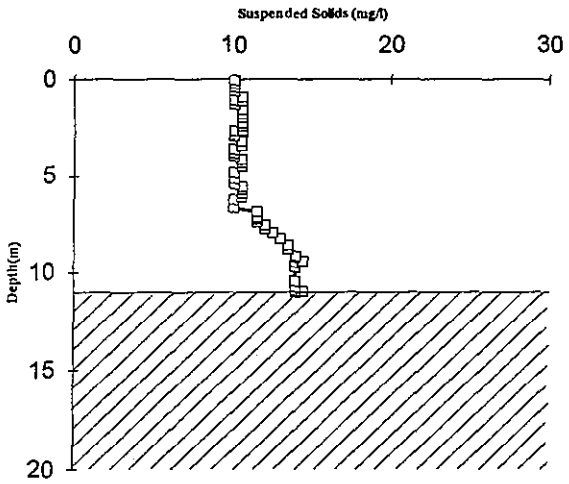


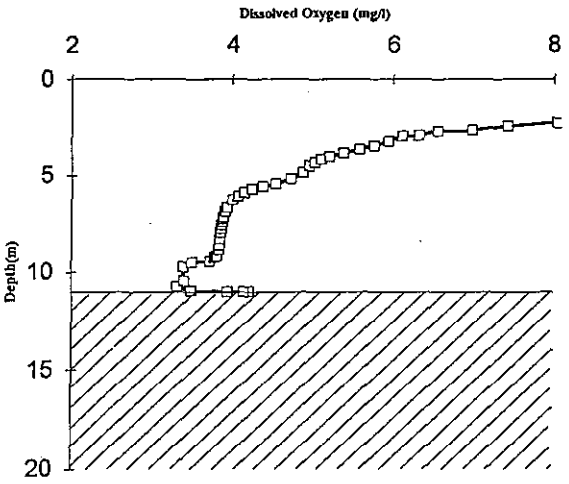


ShekO Quarry
Water Quality Monitoring
Profile : Station 1 (23 June 93, 7:21 - 7:23)

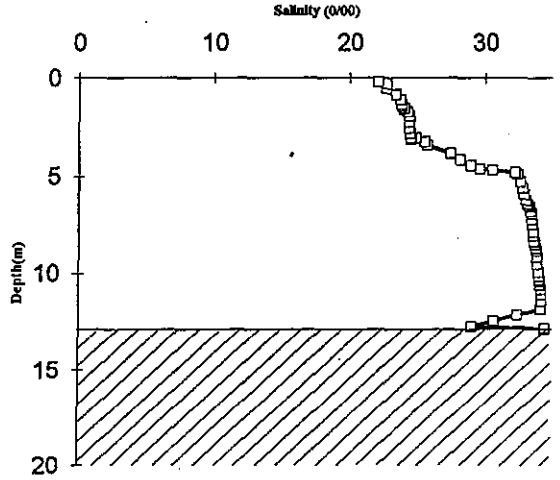


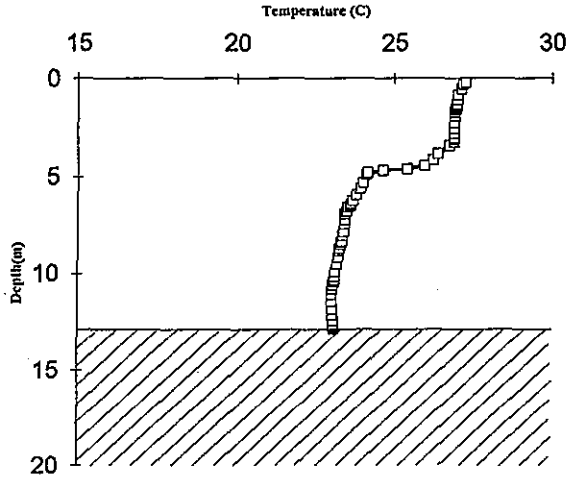


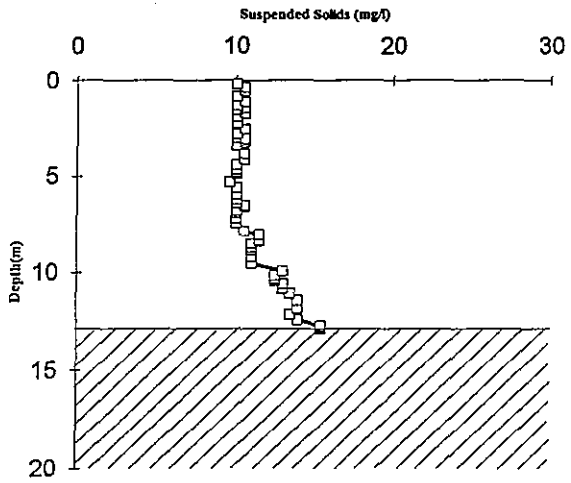


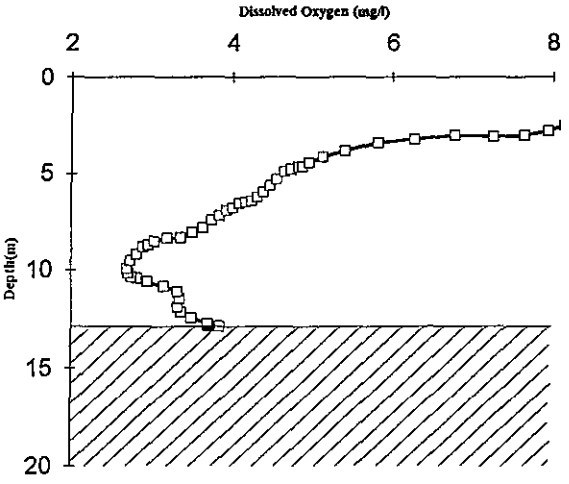


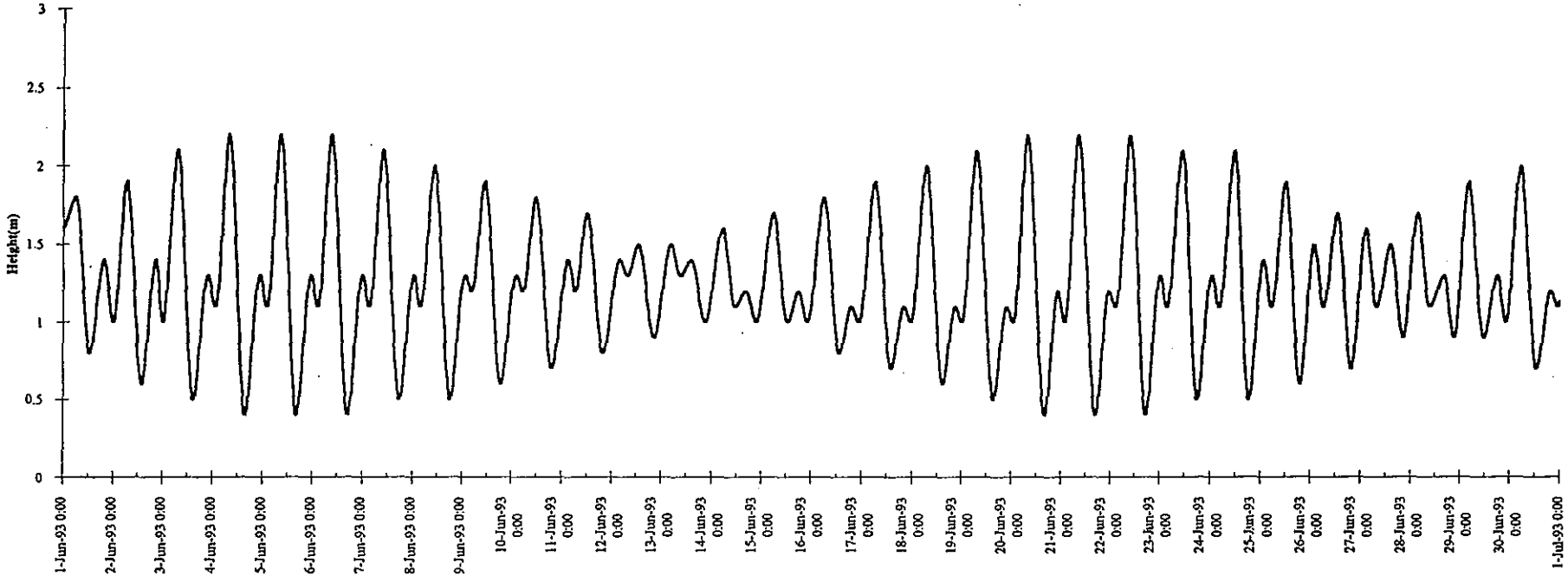
Shek O Quarry
Water Quality Monitoring
Profile : Station 2 (23 June 93, 7:10 - 7:12)



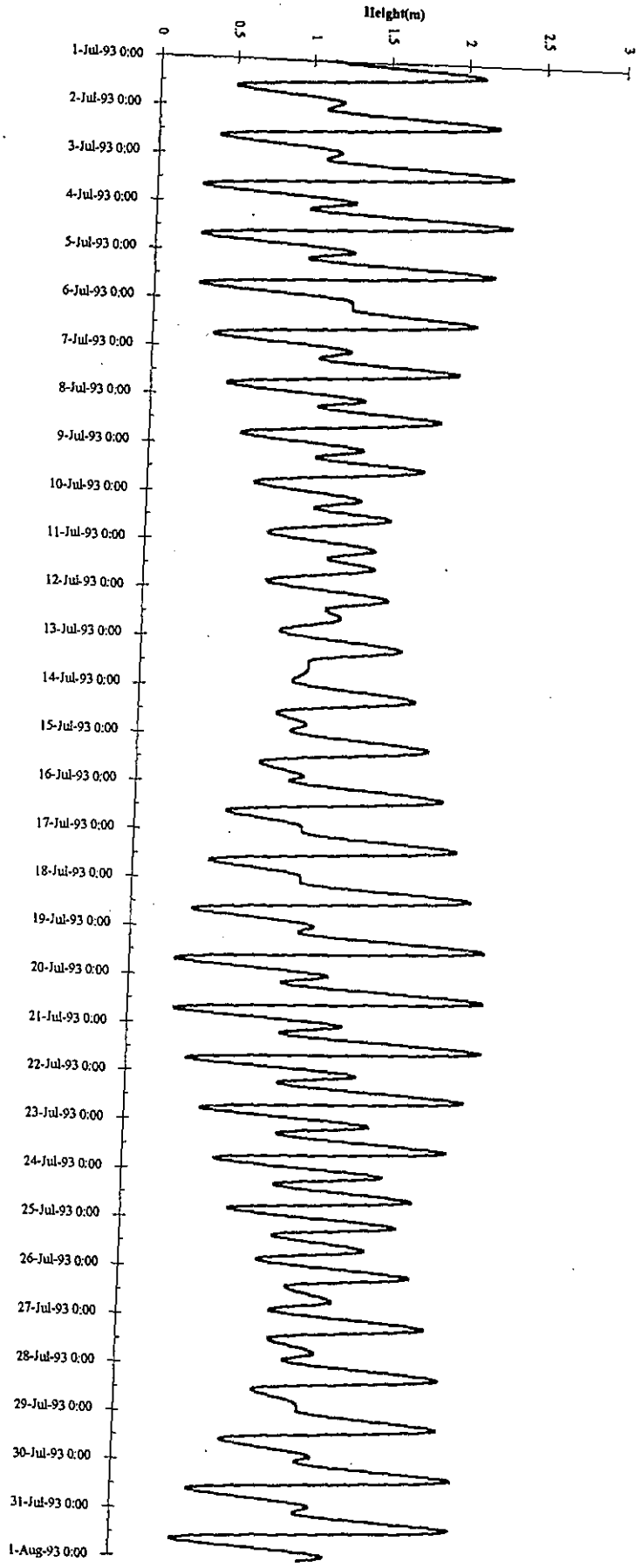








Tidal Heights at Waglan Island for June 1993



Tidal Heights at Waglan Island for July 1993

APPENDIX 5B

EPD MONITORING DATA FOR TAI TAM BAY 1990-1993

APPENDIX 5B : EPD MONITORING DATA FOR 1990 - 1993

SOUTHERN WATER ** Depth Average **

STATION : SM1 TAI TAM BAY

DATE	TIME	BOD5 (MG/L)	COND (UMHO/CM)	DO (MG/L)	DO(SAT) (%)	PH	SALINITY (PPT)	SD (METRE)	TEMP Degree C	TURB (NTU)
27/02/90	1130	0.373	395.727	7.757	86.357	8.36	31.12	4	16.07	4.967
20/04/90	1110	0.987	449.613	6.223	76.277	8.023	32.643	2	19.933	1.867
22/06/90	1255	0.297	509.605	6.323	92.902	8.707	31.549	2.1	27.758	2.7
17/08/90	1255	1.247	513.255	7.088	101.623	8.521	32.868	2.6	26.25	3.167
15/10/90	1315	0.867	507.548	6.755	96.355	8.2	32.132	1.8	26.618	4.333
17/12/90	1300	0.553	459.233	6.693	106.867	8.07	32.937	3	19.367	4.533
26/02/91	1255	0.907	410	7.222	81.595	8.233	31.907	2	16.636	2.133
29/04/91	1314	0.91	493.912	6.508	86.182	8.1	33.626	3.5	23.209	2.267
27/06/91	1245	0.85	496.5	5.49	78.867	8.15	31.937	2.8	23.833	2.567
23/08/91	1300	1.023	495.733	6.517	94.5	8.22	30.837	2.5	24.067	2.2
24/10/91	1250	0.25	516.2	7.22	102.333	8.247	33.203	1.6	23.2	4.867
11/12/91	1305	1.363	462.826	11.562	138.932	8.732	34.514	2	19.034	2.233
28/02/92	1300	1.22	407.433	8.203	100.7	8.067	32.107	2.5	15.833	2.467
01/05/92	1250	1.267	460.333	7.297	101.733	8.227	31.493	3.5	22.333	1.1
25/06/92	1305	1.267	433.757	6.802	97.035	8.366	27.639	2.4	26.281	3.1
10/08/92	1325	1.66	469.767	5.54	83.4	8.273	30.033	3.5	25.967	1.5
07/10/92	1305	0.89	531.4	4.86	73.967	8.237	32.937	1.5	27.8	5.233
15/12/92	1245	1.347	450.067	8.31	110.467	8.193	33.007	1.5	19.7	3.933
24/02/93	1255	0.42	451.467	7.923	91.967	8.273	34.037	1.5	18.193	7.3
30/04/93	1255	1.167	481.025	6.466	82.754	8.223	33.745	3.5	21.742	5.007
18/06/93	1320	1.297	428.533	6.491	88.535	8.304	28.539	2	24.208	4.433

APPENDIX 5B (CONTINUED) : EPD MONITORING DATA FOR 1990 - 1993

SOUTHERN WATER ** Depth Average **

STATION : SM1 TAI TAM BAY

DATE	TIME	CHY (MG/M**3)	FC (NO/100ML)	PHAE (MG/M**3)	SIL (MG/L)	SS (MG/L)	E.COLI (NO/100ML)	TVS (MG/L)
27/02/90	1130	0.333	19.333	0.333	0.873	4.833	16.333	0.833
20/04/90	1110	0.7	16	0.2	0.497	0.667	15	0.5
22/06/90	1255	4.433	27.667	1.033	0.37	0.833	18.667	0.667
17/08/90	1255	2.667	2	0.2	0.623	2	2	0.667
15/10/90	1315	1.5	6.333	0.4	0.553	3.5	5.333	0.833
17/12/90	1300	2.667	1	0.233	0.443	2.5	0.667	1
26/02/91	1255	0.867	35.667	0.6	0.63	3.333	32.667	1
29/04/91	1314	0.867	1	0.5	0.32	1.667	0.667	0.833
27/06/91	1245	3.267	11.333	2.433	0.217	4.5	8	1.5
23/08/91	1300	1.867	15.333	2.3	0.303	2	1	0.5
24/10/91	1250	0.233	17.333	2.567	1.233	3.833	13.333	2
11/12/91	1305	0.3	4.333	0.6	1.133	1.833	4.333	0.5
28/02/92	1300	0.567	0.333	0.867	0.84	2.333	0.333	1
01/05/92	1250	1.067	1	0.2	0.417	1.167	1	0.5
25/06/92	1305	5.167	1	1.167	1.477	4	1	1
10/08/92	1325	1.133	37.333	3.433	1.61	2.167	14	1
07/10/92	1305	2.867	5.667	0.8	0.71	5.667	3.667	1.333
15/12/92	1245	0.2	7.333	0.267	0.733	5.5	6	1.667
24/02/93	1255	0.3	2.667	0.2	0.437	6.167	1.333	1.167
30/04/93	1255		1.667				1.333	
18/06/93	1320		7.333				6.667	

APPENDIX 5B (CONTINUED) : EPD MONITORING DATA FOR 1988 - 1991

Sediment data for Station SS1

Analyses performed on fraction <63um

Date	Station	NH3-N mg/kg	TKN/SP mg/kg	TP/SP g/kg	COD g/kg	%	TVS w/w	%	T S w/w	m	C N g/kg	m	S/SP g/kg	S.G.	pH %	TOC /w	m	As /kg	mg	B /kg	mg	Cd /kg	mg	Cr /kg	mg	Cu /kg
880202		19	870	450	13000		9		59		0.03		0.04			0.74		4.8		11		0.26		27		15
880823		0.38	540	330	12000		7.5		50		0.06		7	2.626	8.7	1.1		4.4		14		0.04		26		21
890623		0.14	860	360	21000		6		68.000 <		0.01		2.5	2.4	8.1	0.88		4.4		9.5		5.3		18		11
910823		3.86	1400	400	27000		8		99.000 <		0.01		0.36	2.201	7.5	1.4		14		61		12		49		37

Date	Station	Fe mg/kg	Hg mg/kg	Mn mg/kg	Ni mg/kg	Pb mg/kg	Zn mg/kg	DWR w/w	PCBs æg/kg	PAHs æg/kg	Al mg/kg	Eh ve	< 63æm %	< 125æm %	250æm %	500æm %	< 1000æm %
880202		21000	0.12	610	14	14	51	0.59	9.7	110							
880823		30000	< 0.050	600	24	44	75	0.5	22	41		-215	64.82	89.28	97.96	99.1	99.5
890623		19000	0.19	490	19	31	61	0.68				-154	74.18	88.01	94.34	96.55	97.84
910823		37000	0.12	980	26	82	130	0.98			30000	-118	97.56	98.91	99.51	99.73	99.85

Date	Station	< 2000æ %	< 4000æm %
880202			
880823		99.86	100
890623		99.18	100
910823		99.92	100

APPENDIX 5B (CONTINUED) : EPD MONITORING DATA FOR 1990 - 1993

SOUTHERN WATER ** Depth Average **

STATION : SM1 TAI TAM BAY

DATE	TIME	NH4-N (MG/L)	NO2-N (MG/L)	NO3-N (MG/L)	PO4-P (MG/L)	TKNS (MG/L)	TPS (MG/L)	TKN(S+P) (MG/L)	TP(S+P) (MG/L)
27/02/90	1130	0.011	0.006	0.046	0.021	0.247	0.03	0.31	0.043
20/04/90	1110	0.046	0.005	0.05	0.003	0.343	0.02	0.403	0.05
22/06/90	1255	0.014	0.01	0.065	0.003	0.353	0.04	0.373	0.053
17/08/90	1255	0.03	0.007	0.025	0.002	0.313	0.037	0.473	0.06
15/10/90	1315	0.008	0.005	0.002	0.004	0.297	0.02	0.52	0.037
17/12/90	1300	0.014	0.002	0.002	0.003			0.453	0.057
26/02/91	1255	0.06	0.003	0.05	0.023			1.467	0.04
29/04/91	1314	0.118	0.002	0.016	0.029			0.477	0.08
27/06/91	1245	0.039	0.014	0.04	0.004			0.867	0.05
23/08/91	1300	0.056	0.008	0.008	0.016			0.28	0.15
24/10/91	1250	0.012	0.017	0.026	3.007			0.333	0.063
11/12/91	1305	0.035	0.034	0.115	0.017			0.23	0.07
28/02/92	1300	0.022	0.019	0.045	0.003			0.19	0.087
01/05/92	1250	0.039	0.003	0.034	0.008			0.197	0.077
25/06/92	1305	0.012	0.011	0.189	0.018	0.09	0.11	0.14	0.09
10/08/92	1325	0.042	0.007	0.063	0.012			0.44	0.13
07/10/92	1305	0.028	0.023	0.028	0.02	0.423	0.23	0.48	0.257
15/12/92	1245	0.037	0.021	0.036	0.052	0.65	0.04	0.61	0.047
24/02/93	1255	0.056	0.006	0.006	0.012	0.55	0.023	0.563	0.037

APPENDIX 6A

SPECIES RECORDED FROM TRAWLS IN TAI TAM BAY JULY 1993

APPENDIX 6A : SPECIES COLLECTED BY TRAWL FROM TAI TAM BAY - JULY 1993

Taxa		Samples - AO												Tot.
		540	541	542	543	544	545	546	547	548	549	550	551	
Phylum	PHYCOPHYTA (Algae)													
Class	Rhodophyceae													
Sub-class	Florideophycidae													
Order	Cryptonerniales													
	Jania sp.					2								2
Phylum	PORIFERA (Sponge)													
Class	Demospongia													
Sub-class	Monaxonida													
	Siphonochalina					1		1						2
Phylum	COELENTERATA													
Class	Anthozoa													
Sub-class	Octocorallia													
Order	Alcyonacea													
	Palythoa sp.					1								1
Order	Pennatulacea													
	Pteroaides sparmanni										1			1
Phylum	ANNELIDA													
Class	Polychaeta													
Sub-class	Sedentaria													
	Siphonosoma cumenense				1	1					2			4
	Siponid sp.					1								1
	Sabellidae sp.					1								1
	Myxicola infundibulum						2							2
	Sipunculus nudus							1				1	1	3

Phylum	MOLLUSCA													
Class	Amphinura													
	Lepidozona coreanica		1											1
Class	Gastropoda													
Order	Caenogastropoda													
Super-fam	Naticacea													
Family	Naticidae													
	Eunatica papilla					1								1
Super-fam	Tonnacea													
Family	Cassicae													
	Phalium bisulcatum											1		1
Super-fam	Cymatiacea													
Family	Bursidae													
	Bursmargaritula									1		1		2
Super-fam	Muricacea													
Family	Muricidae													
	Murex aduncospinosus					1								1
Super-fam	Buccinacea													
Family	Buccinidae													
	Buccinidae sp.				1									1
	Babylonia areolata										1	1		2
Family	Nassariieae													
	Nassarius nodiferus				21	2	12	26		2	1	1	2	67
	Nassarius teretiusculus				2	2	1	1	9					15
Super-fam	Volutacea													
Family	Olividae													
	Oliva oliva										1			1
Class	Bivalvia													
Sub-class	Heterodonta													
Order	Veneroida													
Super-fam	Cardiacea													
Family	Cardiidae													
	Trachycardium sp.										1		1	2
	Placamen tiara						1	1						2
Super-fam	Tellinacea													
Family	Tellinidae													
	Pharoanella perna							1						1
Super-fam	Veneraoea													
Family	Veneridae													
	Gafarium sp.	1	2											3
Class	Cephalopoda													
Sub-class	Coleoidea													
Order	Decapoda													
	Sepia pharaonis	3		1						2	4	1		11
	Euprymna berryi				1	1	2	1		1	1			7
Class	Gastropod													
Sub-class	Opisthobranchia													
	Opisthobranch sp.							1						1

Phylum	ARTHROPODA													
Class	Crustacea													
Sub-class	Malacostraca													
Super Ord	Hopiocarida													
	Oratosquilla oratorio	3	2	4	5	4	1	21	16		14	9	6	85
	Harposquilla Japonica			3				1		6	1		1	12
Super-ord	Eucanda													
Order	Decapoda													
Sub-order	Nalantia													
	Metapenseus ensis	82	67	36	110	7	23	93	125	63	74	57	32	769
Super-ord	Elucarida													
Sub-order	Natantia													
	Alpheus brevicrustatus			1		3	1	9	5	8	4	7	2	40
Order	Anomura													
Super-fam	Galatheoidae													
	Porcelain crab (unid)				1									1
	Porcellana picta												3	3
Sub-order	Reptantia													
	Calcinus sp.	2	1		4		2		1					10
Phylum	ECHINODERMATA													
Class	Horothuroldea													
Order	Aspidoctirota													
	Holothuria sp.						1	1						2
Class	Echinoidea													
Order	Echinoida													
	Temnopleura reevesi							6	1		1			8
	Saimacis sphaeroides					1								1
Order	Spatangoidea													
	Lovenia elongata		1											1
Class	Asteroidea													
Order	Phanerozona													
	Archaster typicus											1		1
Phylum	CHORDATA													
Sub-phyl	Urochordata													
Class	Ascidiacea													
	Styela canopus					2	1							3
Sub-Total: Number of Individuals		91	74	45	146	31	47	164	157	83	106	80	48	1072
Sub-Total: Number of Taxa		5	7	5	9	16	11	14	6	7	13	10	8	

APPENDIX 6A : SPECIES COLLECTED BY TRAWL FROM TAI TAM BAY - JULY 1993

Fish Species in each trawl

Taxon	Samples - AO5												Total
	540	541	542	543	544	545	546	547	548	549	550	551	
Clupanodon panctatus		1											1
Ophichthys cephalozona						1	1	1					3
Saurida elongata		1	8	1				2		3	1		16
Fistularia commersonii								1					1
Micrognathus/Phoxocampus belcheri										1			1
Sebastos marmoratus										2			2
Therapon jarbua	17	6											23
Kuhlia mugil										1			1
Unid Apogen sp.1		1		58	14	1	90	47	49	43	21	29	353
Unid Apogen sp.2						1	2				1	1	5
Apogen endekataenia	20		33										53
Decapterus maruadsi									1				1
Caranx sp.							2	1					3
Leiognathus sp.				3	1	1	39	36	37	20	11	2	150
Lutjanus sp.	7	6	6	13			7	3	3	5		1	51
Gerres fiamentous			2	1		1		1			2		7
Evynnis cardinalis										1			1
Johnius fasciatus										1			1
Agyrosomus argentatus		12	12	21	1	1	9	6	4	5	2	1	74
Upeneus bensasi		1	1	2					5	4	2		15
Polydactyius sp.		23		12		2	5	1	5	2	3		53
Parapercis sp.											1		1
Valenciennea sp.				14		1	20	8	3	3	5	3	57
Amblygobius sp.				2		3	6	1	1	2			15
Siganus fuscescens	49			1	3	48	248	24	64	10	4	2	453
Calliurichthys japonicus				3				1					4
Callionymus richardsoni	1		1										2
Bothidae sp.				1			1				3	1	6
Pseudohombus arsius						1							1
Engyprosopon multisquama									1				1
Laeops kitakarae									1			2	3
Aseraggodes kobensis										2			2
Cynoglossus lineolatus	1												1
Cynoglossus joyheri								1					1
Stephanolepis cirrhifer	7	4	1	1							1		14
Lagecephalus lunaris spadiceus								1			1		2
Sub-Total: Number of Individuals	102	55	64	133	19	61	430	135	174	105	58	42	1378
Sub-Total: Number of Taxa	7	9	8	14	4	11	12	14	12	16	14	9	

APPENDIX 6A (CONTINUED) : SPECIES COLLECTED BY TRAWL FROM TAI TAM BAY- JULY 1993

Diversity and evenness of species in each trawl

Data courtesy of Ecological Research Group and Swire Laboratory

Sample	AO540	AO541	AO542	AO543	AO544	AO545	AO546	AO547	AO548	AO549	AO550	AO551
Diversity Index H'	2.838	2.88	3.13	3.418	4.132	3.483	3.282	3.38	3.283	3.678	3.592	3.322
Eveness	0.694	0.656	0.737	0.684	0.088	0.703	0.63	0.682	0.716	0.711	0.725	0.745
Species Number	17	21	19	32	26	31	37	31	24	36	31	22

The index gives a value for the diversity of the sample ie. a low diversity is where the bulk of the data occurs in a few of the categories and a high diversity where the data is distributed evenly among the categories

H' = 1 = low diversity
H' = 5 = high diversity

Eveness is a ratio of observed diversity to maximum diversity. A value of 0 = sample dominated by one species, and a value of 1 = a sample in which all species are equally abundant.

Assumptions: All species in the community are accounted for in the sample

From this, one can conclude that all the trawl samples have a relatively high diversity as all values are nearer to 5 than 1 and the eveness values are also high, indicating all the species are in more or less equal proportions

APPENDIX 6A (CONTINUED) : SPECIES COLLECTED BY TRAWL FROM TAI TAM BAY - JULY 1993

Summary of Taxa for each Trawl

Data courtesy of Ecological Research Group and Swire Laboratory

	Samples - AO5												Tot.
	40	41	42	43	44	45	46	47	48	49	50	51	
Crabs	25	17	18	49	14	30	77	61	26	24	27	32	400
Fish	102	55	64	133	19	61	430	135	174	105	58	42	1378
Various	91	74	45	146	31	47	164	157	83	106	80	48	1072
Total Number of Individuals	**218**	**146**	**127**	**328**	**64**	**138**	**671**	**353**	**283**	**235**	**165**	**122**	**2850**
Crabs	5	5	6	9	6	9	11	9	5	7	7	5	
Fish	7	9	8	14	4	11	12	14	12	16	14	9	
Various	5	7	5	9	16	11	14	6	7	13	10	8	
Total Number of Taxa	**17**	**21**	**19**	**32**	**26**	**31**	**37**	**29**	**24**	**36**	**31**	**22**	

APPENDIX 6B

SPECIES RECORDED FROM INTERTIDAL ROCKY SHORES IN THE VICINTY OF SHEK O QUARRY JULY 1993

APPENDIX 6B : SHEK O BASELINE SURVEY INTERTIDAL SPECIES LIST - JULY 1993

Species	Station1	Station2	Station3	Station 4	Station 5	Station 5a
Chaetomorpha antennina		X			X	
Corallina spp.		X			X	X
Hildenbrandtia indet.	X	X	X		X	
Kythuthrix indet.			X	X	X	X
Ralfsia sp.		X			X	
Pomatoleios kraussi	X		X		X	
Serpulorbis imbricatus			X		X	X
Spirorbis foraminosus	X		X			
Acanthopleura loochooana						X
Liolophura japonica	X	X	X	X	X	X
Cellana grata	X			X	X	X
Cellana toreuma				X		
Patelloida saccharina				X		X
Nerita albicilla	X		X		X	
Nodilittorina millegrana				X	X	
Nodilittorina pyramidalis	X		X	X	X	X
Planaxis sulcatus	X	X	X		X	
Thais clavigera	X	X	X		X	
Siphonaria japonica	X		X		X	
Siphonaria sirius					X	
Perna viridis		X				
Saccostrea cucullata	X	X	X			
Saccostrea sp		X		X	X	X
Septifer virgatus	X	X	X	X	X	X
Pollicepes mitella	X	X		X		X
Tetraclita squamosa	X	X	X	X	X	X
Ligia exotica			X	X		X
Stegocephalus inflatus	X				X	
Grapsus albolineatus				X		X
Portunus spp.	X	X			X	

APPENDIX 7A

RESULTS OF A PRELIMINARY TERRESTRIAL ECOLOGICAL SURVEY SHEK O CASTING BASIN

1 Introduction

A preliminary ecological survey was undertaken to describe the basic terrestrial faunal and floral assemblages of the areas surrounding the Shek O Quarry on the D'Aguilar peninsula. These areas included the D'Aguilar Peninsula SSSI (within the Shek O Country Park), beach habitats south of the quarry and below the SSSI, areas to the north of and bordering the quarry near To Tei Wan village, and part of the Shek O Country Park to the northeast.

The limited scope of the survey (5 man–days field work) was agreed in discussions with the Project Study Management Group, AFD and WWF. This provided for a focused study of those issues of prime concern, within the timescales set by the Western Harbour Crossing Programme.

2 Flora

The flora of the areas surrounding Shek O Quarry, including part of the Shek O Country Park, falls into three broad habitat categories: beach vegetation, shrubland and woodland. In the time available, only a preliminary survey of the area can be done. Compilation of a complete species list being impossible, only common, unusual, rare and protected species were noted.

2.1 Beach Vegetation

The vegetation behind the beach, at the southern edge of the quarry, follows a continuum from salt–tolerant, seashore vegetation to the woodland behind.

Immediately behind the beach *Zoysia sinica, Vitex rotundifolia, Ipomoea brasiliensis* and *Excoecaria agallocha* form a dwarf vegetation band. This vegetation gradually increases in height as the dominant species are replaced by *Leucaena leucocephala* and *Hibiscus tiliaceous*. Further inland these species are interspersed with other terrestrial species such as *Viburnum odoratissimum* and *Sterculia lanceolata* and merge with the broadleaf woodland.

In recent years such beach vegetation has become reduced in the Territory and many remaining sites are under threat of development. On Hong Kong Island beach vegetation is now quite scarce.

2.2 Shrubland

Three patches of shrubland were found in the north, northeast and the southeast of the study area. Of these the latter two fall within the Shek O Country Park boundary.

2.2.1 Northeastern Low Shrubland

The northeastern low shrubland habitat above Shek O Road is dominated by shrub species such as *Rhodomyrtus tomentosa, Eurya japonica, Rhaphiolepis indica, Litsea rotundifolia* and *Melastoma sanguineum*. Among the shrubs, climbers like *Cassytha filiformis, Morinda umbellata, Gnetum montanum, Millettia nitida,* and *Smilax spp.* are common, along with several grasses such as *Arundinella setosa, Cymbopogon spp.*, and *Eulalia spp.* In addition to these, *Dianella ensifolia, Gardenia jasminoides* and *Helicteres angustifolia* are frequently encountered. This assemblage is typical of shrublands on granitic soils in Hong Kong.

2.2.2 Southeastern Tall Shrubland

The southeastern tall shrubland located above Cape D'Aguilar Road is composed of a mosaic of dense shrubs and exposed granite. Most common shrubland species can be found within this area, such as *Aporusa chinensis, Rhodomyrtus tomentosa, Melastoma sanguineum, Eurya japonica* and *Litsea rotundifolia.* Some tree species, appearing as low bushes, are also very common in the area — these include *Artocarpus hypargyrea, Celtis sinensis, Sterculia lanceolata* and *Schefflera octophylla.* This combination suggests the area has escaped severe disturbance and is undergoing a succession from shrubland to woodland. One species of rattan, *Calamus* sp., has been recorded at this site and is thought to be very restricted locally (Richard Corlett, pers. comm.).

2.2.3 Northern Shrubland

The shrubland on the northern side is located below the Shek O Road and is at the northern edge of the study area. Here the habitat ranges from dense tall shrub to sparse low shrub. In the tall shrub area the plant community is dominated by *Rhodomyrtus tomentosa, Bambusa spp., Eurya japonica, Gordonia axillaris* and *Wikstroemia indica* as well as other climbers such as *Tetracera asiatica, Dalbergia spp.,* and *Gnetum montanum.* Further north, a less dense shrubland community appears, composed of a mosaic of low–growth shrub and exposed granite. The dominant species in the area are *Rhodomyrtus tomentosa, Wikstroemia indica, Rhaphiolepis indica, Ilex spp.* and climbers *Cassytha filiformis* and *Morinda umbellata.*

A study of the D'Aguilar Peninsular by Proud (1977) divided the local shrublands into a number of different communities. Under her classification the area to the north of the quarry, and that within the Country Park to the northeast, were classified as 'Hong Kong Granite Shrubland'. Those adjoining the eastern and southern borders of the quarry and east of the Cape D'Aguilar Road are classified as 'Exposed Granite Shrubland' and a band to the south (apparently falling within the SSSI) as 'Leucaena Shrubland'.

2.3 **Woodland Habitat**

In the study area, two types of woodland can be distinguished. One is located within the Shek O Country Park and D'Aguilar Peninsular SSSI on the southeastern side of the quarry; the other on the northern and northeastern side of the quarry.

2.3.1 Southeastern Woodland

The woodland on the southeastern side of the quarry is situated just below Cape D'Aguilar Road. It is a dense, well–developed and highly diverse native woodland, the dominant tree species being *Artocarpus hypargyrea, Sterculia lanceolata, Garcinia oblongifolia, Mallotus paniculatus, Schefflera octophylla, Litsea spp., Machilus spp.* and *Rhus spp.* In the under–storey, shrubs like *Atalantia buxifolia, Gardenia jasminoides, Psychotria rubra* predominate and are found along with climbers like *Dalbergia spp., Strychnos angustiflora, Smilax spp.* and *Sageretia theezans.*

The most unusual species found in the area are *Keteleeria fortunei* and *Quercus glauca,* which are discussed in Section 2.4. Within the woodland, the large rocky outcrops provide refuge for plants in their early stages and have allowed the succession to the present community. The diverse structural organisation as well as the prevalence of native species in this and surrounding areas produce suitable habitat for many animals (see below).

2.3.2 Northern Woodland

Species frequently recorded in the woodland and shrubland of the north and northeast region, 31 August 1993.

Trees and shrub species

Acacia confusa
Acronychia pedunculata
Albizia corniculata
Antirrhoea chinensis
Aporusa chinensis
Artocarpus hypargyrea
Atalantia buxifolia
Bambusa spp.
Breynia fructicosa
Bridelia monoica
Brucea javanica
Carallia brachiata
Casuarina equisetifolia
Casuarina stricta
Celtis sinensis
Cinnamomum campha
Cratoxylum ligustrinum
Daphniphyllum calycinum
Diospyros vaccinioides
Diploprora dubia
Eurya japonica
Ficus variolosa
Firmiana simplex
Garcinia oblongifolia
Gardenia jasminoides
Glochidion eriocarpus
Gordonia axillaris
Homalium cochinchinensis
Ilex asprella
Ilex pubescens
Lantana camara
Leucaena leucocephala
Litsea cubeba
Litsea glutinosa
Litsea rotundifolia
Mallotus paniculata
Melastoma candidum
Melastoma sanguineum
Mussaenda pubescens
Ormosia emarginata
Pandanus urophyllum
Phoenix hanceana
Phyllanthus emblica
Pinus massoniana
Psychotria rubra
Reevesia thyrsoidea
Rhaphiolepis indica
Rhodomyrtus tomentosa
Rhus succedanea
Sapium discolor
Schefflera octophylla
Scolopia chinensis
Sterculia lanceolata
Styrax suberifolius
Syzygium buxifolia
Wikstroemia indica
Zanthoxyllum avicennae

Climbers and herb species

Adiantum caudatum
Alyxia sinensis
Arundinella setosa
Asparagus cochinchinensis
Cassytha filiformis
Cymbopogon spp.
Dalbergia benthami
Dalbergia hancei
Dendrotrophe frutescens
Dianella ensifolia
Dicranopteris linearis
Embelia laeta
Eremochloa ciliaris
Eulalia spp.
Gahnia tristis
Gnetum montanum
Gymnenma alterniflorus
Helicteres angustifolia
Hydeotis acutagula
Hyserpa nitida
Ischaemum spp.
Liriope spicata
Millettia nitida
Millettia reticulata
Millettia speciosa
Morinda umbellata
Neyraudia reynaudiana
Phyllanthus cochinchiensis
Psychotria serpens
Pteroloma triquetrum
Rhynoscopa rubra
Rourea microphylla
Rubus parvifolius
Sageratia theezans
Smilax china
Smilax glabra
Strophantus divaricatus
Strychnos angustiflora
Tetracera asiatica
Toxocarpus wrightianus
Tylophora ovata

In the northern and northeastern side of the quarry and along both sides of Shek O Road, just outside the Country Park boundary, a woodland comprising of a mixture of native and exotic species occurs. The common native woodland species *Celtis sinensis, Sapium discolor, Bridelia monoica, Pinus massoniana, Schefflera octophylla, Litsea spp.* and *Ficus spp.* coexist with the common exotic species *Casuarina stricta, Casuarina equisetifolia, Acacia confusa* and *Leucaena leucocephala,* forming a secondary woodland. Other species such as *Psychotria rubra, Diploprora dubia, Liriope spicata* and *Alyxia sinensis* are common in the under–storey. This type of mixed woodland may be a result of past plantations and reflects a progression to secondary woodland.

2.4 Significance of the Vegetation

Under the Country Park Ordinance (Ch. 208), the five–hectare native woodland and shrubland area, about one hundred metres from the southeast boundary of the Shek O Quarry, was recognised as a Site of Special Scientific Interest (SSSI) in 1975. The major interest of the "D'Aguilar Peninsula SSSI" is the presence of *Quercus glauca, Keteleeria fortunei* and *Acampe multiflora.*

Quercus glauca belongs to the Family Fagaceae, a family which characterises the physiognomic and floristic type of the forests of Guangdong Province. This species is of considerable scientific interest in the study of plant sociology in Hong Kong. In the SSSI, several large individuals and a patch of low bushes were found in the woodland and the shrubland respectively.

Keteleeria fortunei is another indigenous species in the SSSI, which is confined to coastal lowlands in Fujian, Guangdong and southern Guangxi. As a relict species its presence is of considerable botanical interest. In Hong Kong it is apparently reduced to two individuals, one at each of two locations within the study site. It is protected under the Forestry (Amendment) Regulation 1993, (Cap. 96, section 3). *Keteleeria fortunei* is also listed in China Plant Red Data Book and under protection in China (Fu and Jin 1992).

Acampe multiflora, belonging to the Family Orchidaceae, is protected under the Forestry (Amendment) Regulations 1993, (Cap. 96, section 3). This rare indigenous ground orchid is one of the large group of epiphytic orchids in Hong Kong, usually found clinging to granite boulders. It can be found amongst the rocky outcrops in some patches of grassland within the area.

The shrubland in the vicinity of Shek O Quarry contains some uncommon species, including those characteristic of an advanced stage in succession. One possible explanation is the large bare rocks on the hillside, which probably serve as a barrier to the spread of hillfire (Richard Corlett, pers. comm.).

Species recorded behind the beach

Viburnum odoratissimum
Ipomoea brasiliensis
Vitex rotundifolia
Paederia scandens
Leucaena leucocephala
Hibiscus tiliaceus
Excoecaria agallocha
Zoysia sinica
Lantana camara
Pandanus furcatus
Synostemon bacciformis
Wedelia prostrata

Species frequently recorded in the woodland and shrubland within the SSSI, August 31 1993.

Tree and shrub species

Acronychia pedunculata
Albizia corniculata
Artocarpus hypargyrea
Atalantia buxifolia
Breynia fructicosa
Bridelia monoica
Carallia brachiata
Celtis sinensis
Cratoxylum ligustrinum
Daphniphyllum calycinum
Diospyros vaccinioides
Diploprora dubia
Eurya japonica
Ficus herta
Ficus hispida
Ficus pyriformus
Ficus stenophylla
Ficus variolosa
Firmiana simplex
Garcinia oblongifolia
Gardenia jasminoides
Glochidion eriocarpus
Gordonia axillaris
Hibiscus tiliaceus
Homalium cochinchinensis
Ilex asprella
Keteleeria fortunei
Lantana camara
Leucaena leucocephala
Litsea cubeba
Litsea glutinosa
Litsea rotundifolia
Machilus thunbergii
Mallotus paniculata
Melastoma candidum
Melastoma sanguineum
Mussaenda pubescens
Ormosia emarginata
Pandanus urophyllus
Phoenix hanceana
Phyllanthus emblica
Psychotria rubra
Quercus glauca
Rapanea neriifolia
Reevesia thyrsoidea
Rhaphiolepis indica
Rhodomyrtus tomentosa
Rhus hypoleuca
Rhus succedanea
Sapium discolor
Schefflera octophylla
Scolopia chinensis
Sideroxylon wightianum
Sterculia lanceolata
Styrax suberifolius
Wikstroemia indica
Zanthoxyllum avicennae

Climbers and herb species

Acampe multiflora
Alyxia sinensis
Antirrhoea chinensis
Arundinella setosa
Asparagus cochinchinensis
Cassytha filiformis
Clerodendrum fortunatum
Cymbopogon spp.
Dalbergia benthami
Dalbergia hancei
Dendrotrophe frutescens
Dianella ensifolia
Dicranopteris linearis
Dioscorea bulbifera
Embelia laeta
Eremochloa ciliaris
Eulalia spp.
Gahnia tristis
Gnetum montanum
Helicteres angustifolia
Hydeotis acutagula
Ischaemum spp.
Liriope spicata
Lonicera confusa
Melodinus suaveolens
Millettia nitida
Millettia reticulata
Millettia speciosa
Morinda umbellata
Neyraudia reynaudiana
Phyllanthus cochinchiensis
Psychotria serpens
Rachis excelsa
Rourea microphylla
Rhynoscopa rubra
Sageratia theezans
Scleria chinensis
Smilax china
Smilax glabra
Strophanthus divaricatus
Strychnos angustiflora
Tetracera asiatica
Tylphora ovata
Uraria logopodiodes

3 Amphibians and Reptiles

This report covers the findings of the preliminary amphibian and reptile survey at Shek O. The site was visited on 31 August 1993. Reptiles and amphibians were recorded through direct sighting, active searching and detection of mating calls in the latter group. A dip–net was also used to sample tadpoles in the water. The secretive nature of the study animals and the dense vegetation prevent accurate counting; thus their population density cannot be measured. For similar reasons it is likely that a number of species present were not detected in the current brief survey.

Two species of amphibian and one species of reptile were found during the survey. Their distributions are shown in the following table.

Habitat	Species	Number
Stream in SSSI	*Rana exilispinosa* Lesser Spiny Frog	1
Shrubland east of Quarry	*Bufo melanostictus* Asian Common Toad *Boiga multomaculata* Large–spotted Cat Snake	1 1
Shrubland north of Quarry	*Bufo melanostictus* Asian Common Toad	2

The three species found during the survey are quite common and widespread in Hong Kong and Southern China.

The stream in the SSSI is not well sheltered and it has a steep gradient with bedrock as its main substrate. Besides *R. exilispinosa,* it is unlikely that other stream–dwelling amphibians occur in this stream because of the lack of adjacent forest and the limited hiding places available.

The SSSI consists of a mixture of young trees and tall shrubs on the lower slope and short shrubs on the upper; the hillside is quite steep with only a thin layer of leaf litter. The reptile fauna is expected to be similar to that of the shrubland adjacent to the quarry and other shrub–covered hillsides in Hong Kong. *Lycodon aulicus* (Common Wolf Snake) has been found in the site in the past. In addition, other common species associated with shrubland such as *Hemidactylus bowringi* (Bowring's Gecko), *Calotes versicolor* (Changeable Lizard), *Mabuya longicaudata* (Long–tailed Skink), *Takydromus sexlineatus* (Grass Lizard), *Ramphotyphlops braminus* (Common Blind Snake) and *Trimeresurus albolabris* (Bamboo Snake) may occur.

The shrubland is expected to support very few amphibians due to the low water–retaining capacity. *B. melanostictus* is probably the only amphibian species foraging in this area regularly. Its existence also depends on the availability of suitable wetlands, such as the pool in To Tei Wan, as breeding sites.

In summary, the site is thought to be of very limited significance to amphibians. It probably supports a rather diverse reptile fauna similar to that of other shrub–covered dry hillsides in Hong Kong, but rare species are not expected to inhabit this area.

4 Birds

Birds were recorded as they were seen, foraging or roosting, or heard calling, along a transect line through the study site. The area surveyed incorporated the sandy beach at the southern end of the quarry, the hillside and stream within the SSSI and the Cape D'Aguilar Road through the SSSI, and To Tei Wan at the northern end of the site. From To Tei Wan the shoreline was followed to the main quarry pier, the transect then moving inland through the quarry works itself.

The preliminary survey of the bird fauna took place on 31 August 1993. Sixteen species were recorded during the visit.

Avian Fauna recorded at Shek O Quarry

COMMON NAME (Latin Name)	STATUS
BLACK–EARED KITE *(Milvus migrans)*	R
SPOTTED DOVE *(Streptopelia chinensis)*	R
WHITE–BREASTED KINGFISHER *(Halcyon smyrnensis)*	R
RUFOUS–BACKED SHRIKE *(Lanius schach)*	R
BLACK DRONGO *(Dicrurus macrocercus)*	SV
MAGPIE *(Pica pica)*	R
JUNGLE CROW *(Corvus macrorhynchus)*	R
LESSER COUCAL *(Centropus bengalensis)*	R
BLACK–FACED LAUGHING THRUSH *(Garrulax perspicillatus)*	R
HWAMEI *(Garrulax canorus)*	R
CRESTED BULBUL *(Pycnonotus jocosus)*	R
CHINESE BULBUL *(Pycnonotus sinensis)*	R
TREE SPARROW *(Passer montanus)*	R
LONG–TAILED TAILOR BIRD *(Orthotomus sutorius)*	R
WHITE–EYE *(Zosterops japonica)*	R
GREAT TIT *(Parus major)*	R

Key to symbols : R resident
SV summer visitor

All of the birds recorded during this preliminary survey have a widespread distribution in Hong Kong.

The hillside to the south–east of the quarry provides ideal woodland and shrubland habitats for seasonal visitors such as passage migrants and winter visitors (i.e. warblers and flycatchers), which were not recorded due to the time of year the survey was undertaken. A further study, for example during October or November, would give a more useful indication as to how important this area is to migratory birds.

The area within the quarry is very disturbed and noisy, the activity making the sparse shrub habitat within the site generally unsuitable to birds. However, nesting holes of the White–breasted Kingfisher were discovered at several places in embankments along the main access road inside the works area. A Black–eared Kite was observed hunting along the quarry rock face within the site, possibly searching for lizards or small birds that would be exposed at this location.

Although no birds were seen along the beach south–east of the quarry, the vegetation behind the beach was obviously important — based on the amount of activity observed (mainly Bulbul species). Most of the birds recorded during this preliminary survey were seen or heard in this area. No birds were found nesting due to the time of year of the survey; however, most of the resident birds recorded probably nest in the area.

The hillside north of the quarry above To Tei Wan provided good habitat for shrubland birds such as the Hwamei, Rufous–backed Shrike and Chinese Bulbul — all of which were recorded during the visit. An old Magpie nest was discovered in a conifer tree on this slope. A White–breasted Kingfisher was seen foraging in a small stream on the hillside just north of the village. This stream may also be an important water source for other local birds. A Black Drongo was seen hawking dragonflies close to the stream.

The list below represents some of the birds which have been recorded along the Cape D'Aguilar Road, close to and including, the area surveyed during the last three years (Gary Ades & Michael Lau, pers. observations).

Collared Scops Owl
White–bellied Sea Eagle
Peregrine Falcon
Red–throated Pipit
Blue Rock Thrush
Fork–tailed Sunbird
Magpie Robin
Blue and White Flycatcher
Reef Egret
Common Sandpiper
Rubythroat
Stonechat
Daurian Redstart
Rustic Bunting
Blue Magpie

The birds in this list which have rare or scarce status in Hong Kong are the White–bellied Sea Eagle, Peregrine Falcon, Blue and White Flycatcher, and Rustic Bunting. Those which are very local birds (i.e. not widespread) include Red–throated Pipit, Blue Rock Thrush, Daurian Redstart and Blue Magpie.

5 Mammals

Forty small mammal traps were used over a period of two nights to determine the species present in the study area. Permission was first obtained from the Director of Agriculture and Fisheries.

Twenty traps were placed in the SSSI. This area contains dense shrubland and low woodland habitat and has a small stream running through it along which ten traps were positioned. Ten were placed in the low shrubland above the road on the east side of the quarry. Five traps were placed on the beach adjacent to the southern side of the quarry. These were put amongst the well developed back–of–beach vegetation. The remaining five traps were placed in vegetation on the northern side of the quarry. This area is characterised by low shrubland and is near the village area of To Tei Wan.

Traps were put down on the afternoon of 1 September and checked on the mornings of the 2 and 3 September. Oatmeal was used as bait, this being most commonly employed by mammalogists. Trapped animals were identified and released unharmed. The site was also search for signs of other mammals.

Six small mammals were trapped over eighty trap nights, a success rate of 7.5%, which is considered reasonable in comparison with other studies. The following species were trapped:

- **Chestnut Spiny Rate** *Niviventer fulvescens*:
  Two caught in the SSSI, night of 1/9/93.

- **Sladen's Rat** *Rattus koratensis* (synonyms *R.remotus, R.sladeni, R.sikkimensis*):
  Two trapped in the low shrubland above the quarry, night of 1/9/93.

- **Black Rat** *Rattus rattus flavipectus*
  Two caught in the vegetation at the back of the beach adjacent to the south of the quarry, night of 2/9/93. The sub–species is *R.r flavipectus*, the typical form in Hong Kong.

In addition, droppings of the **Masked Palm Civet** *Paguma larvata* were observed on top of flat rocks within the SSSI. These were identified by their large size and their seed contents.

The species caught are all typical of the habitats they were trapped in. According to Chung (1972), *N.fulvescens* (at that time named *Rattus huang*) and *R.koratensis* (at that time known as *R.sladeni*) are the two common murid species of hillsides and shrubland. The presence of *R.r.flavipectus* on the beach is not unexpected. These rats are found in a variety of habitats and those caught probably scavenge on the beach and around some of the quarry buildings.

Other species of small mammal that might be expected from the study area include **Grey Shrew** *Crocidura attenuata* and **Musk Shrew** *Suncus murinus*. The former is mainly a rural species and may be present within the taller shrub and woodland of the SSSI, whilst the latter is often found close to human habitation and might be found around the quarry site or close to To Tei Wan village. Both species are relatively common in Hong Kong. In addition the **Belly Banded Squirrel** *Callosciurus flavimanus thai* has been sighted in the woodland further to the north (on the western slopes of Mount Collinson) and may be present in the woodland of the SSSI. Once again this species is reasonably common in Hong Kong.

Larger mammals which have been sighted on the D'Aguilar Peninsular recently have been **Chinese Leopard Cat** *Felis bengalenis* (March '93), **Masked Palm Civet** *Paguma larvata* (August '91), and **Porcupine** *Hystrix brachyura* (March '91). **Small Indian Civet** *Viverricula indica* and **Chinese Ferret Badger** *Melogale moschata* have been sighted just to the north in Tai Tam Country Park and may well be present in or near the study area. With the possible exception of the Porcupine, none of these mammals are very common and all are protected under the Wild Animals Protection Ordinance.

The effects on mammal populations of blasting activities at quarries have not been studied in Hong Kong. Further blasting at the southern face of the Shek O Quarry may deter the more timid mammal species from using the area; in view of the apparently high density of civets in the SSSI area the question of noise impacts should be taken into account.

6 Recommendations

6.1 Further Work

It is suggested this preliminary survey be extended, if funding is available, to include : (1) a more comprehensive floral survey to identify specimens of rare species, particularly in the areas to be destroyed by the proposed rehabilitation work (2) a bird survey to be undertaken in October or November when the passage migrants and winter visitors are present.

6.2 Protection from Fire

All steps should be taken to ensure the rich vegetation of the D'Aguilar Peninsular SSSI is protected. At present the inaccessible southern side of the quarry is protected from the likelihood of fire. Maintenance of such protection should be a top priority.

6.3 Protection from Dumping

Another threat to the SSSI at present is the dumping of waste from the Cape D'Aguilar Road, which should be curtailed if possible.

6.4 Utilization of Cliff Faces

Disused quarry sites can form valuable nesting sites for cliff–dwelling birds. The position of the Shek O Quarry, where such restricted cliff–nesting species as the White–bellied Sea Eagle and the Peregrine Falcon are known to occur, would seem ideal for this use. It is recommended the possibility of retaining and enhancing some of the quarry's cliff faces be given full consideration.

6.5 Retention of SSSI Buffer Area

The creation of a buffer area for the SSSI is considered necessary. In view of the advantages of retaining the cliff faces (see 6.4) and the need to protect the rich and potentially sensitive biota of the D'Aguilar Peninsular SSSI, it would be preferable to form a steep cliff face buffer rather than increasing the area impacted on by sloping the Southern face of the quarry back at a lower angle. Ecologically it would be preferable to have a steep faced buffer.

6.6 Woodland Preservation

Any woodland damaged by the proposed works, such as that to the north of the quarry, should be fully restored.

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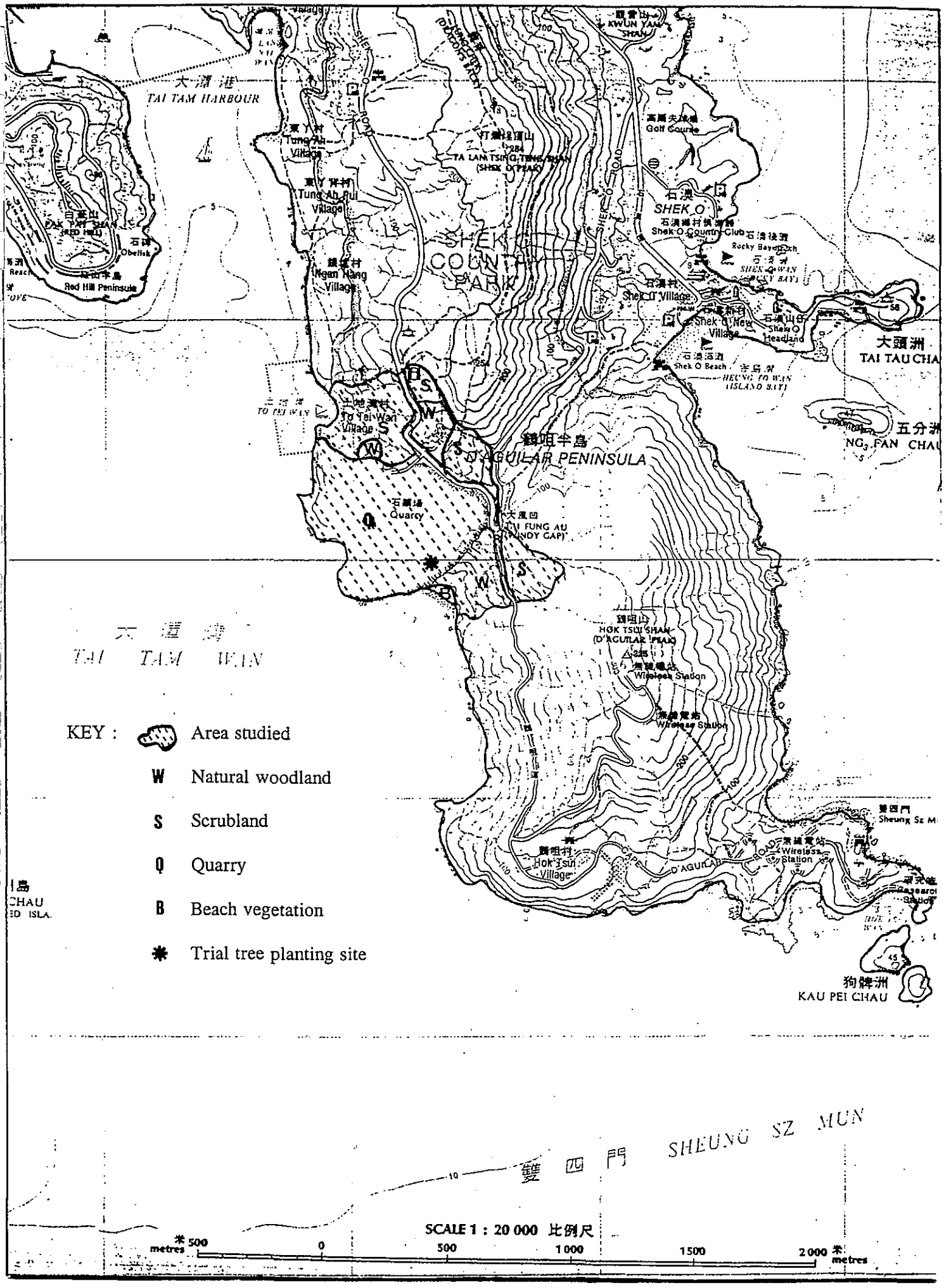


Figure 7.1 Terrestrial Ecology Study Area Boundary

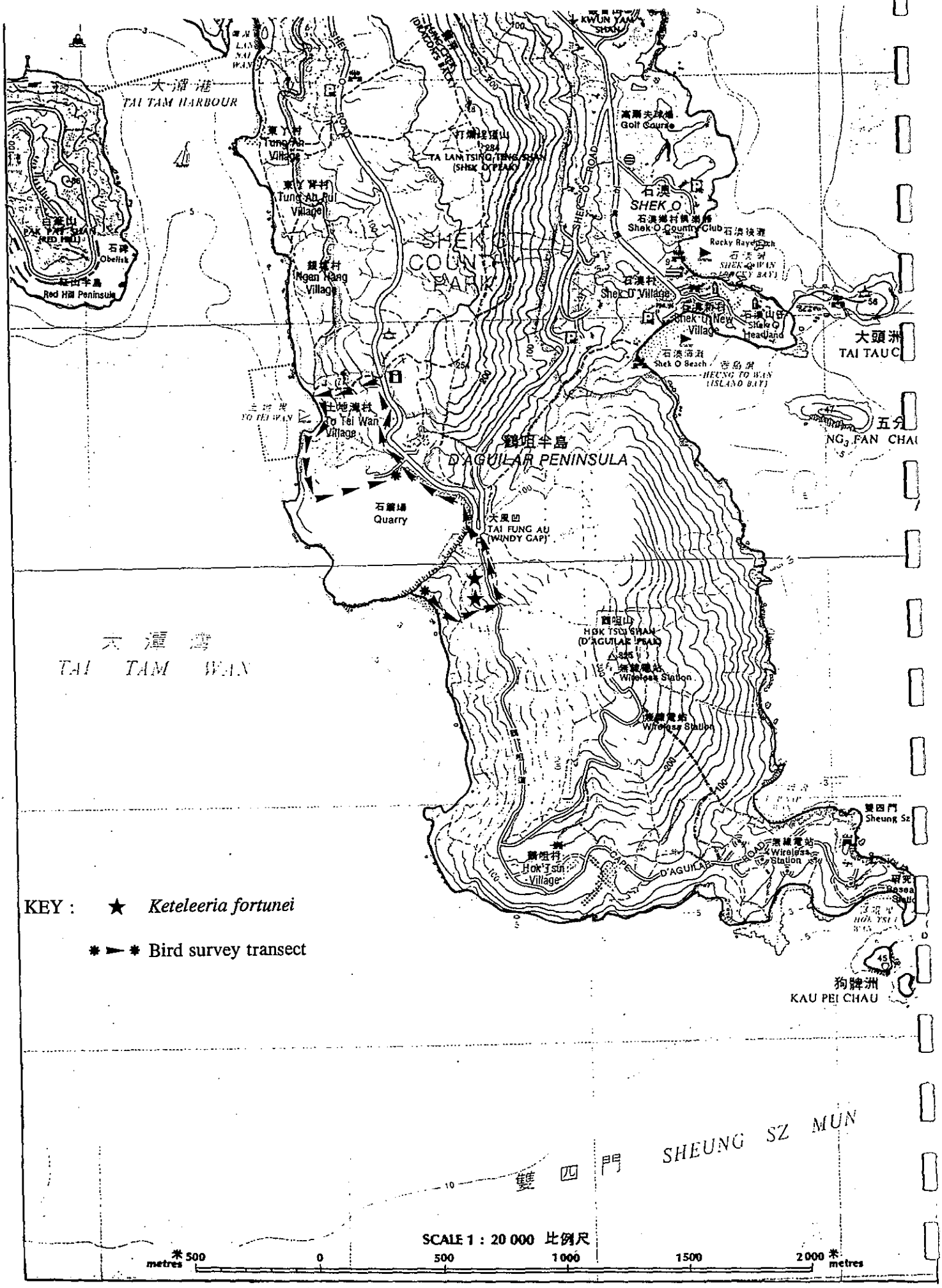


Figure 7A **Supplementary Terrestrial Ecology Study.** Location of *Keteleeria fortunei* and the route walked for the bird survey.

APPENDIX 7B

D'AGUILAR PENINSULA SITE OF SPECIAL SCIENTIFIC INTEREST (SSSI)

APPENDIX 7B : SITE OF SPECIAL SCIENTIFIC INTEREST (S7/75) D'AGUILAR PENINSULA

Site

Growing in this site are two trees and twenty-four low bushes of *Quercus glauca*, two trees of *Keteleeria fortunei* and two orchid plants of *Acampe multiflora*. The area is about five hectares.

Special Scientific Interest

Quercus glauca

Q. glauca is an indigenous species which has never been recorded elsewhere in Hong Kong, except from this site.

Quercus and *Castanopsis* are the two leading genera which give the characteristic physiognomy and floristic type to the forest zone in Northern Kwangtung and at higher elevations everywhere in the province of Kwangtung. Professor Fenzel (1930) named this type of vegetation "Evergreen Querco - Castanetum". He further argued that this "Evergreen Querco - Castanetum" probably did not extend to the lower zones of the coastal regions of Kwangtung (e.g. Hong Kong) before the arrival of man.

An understanding of the ecology of *Quercus* and *Castanopsis* is thus of scientific value to the study of plant sociology in this area which is still little known.

It is equally of practical value in connection with tree planting in this area. Professor Fenzel's argument implies that it might not be practical to plant species composing the "Querco - Castanetum" of the higher and northern zones of Kwangtung, on the barren slopes of coastal Kwangtung, at least not unless they are planted as part of a mixture containing predominantly pioneer species.

Keteleeria fortunei

This is also an indigenous species.

These two trees represent the known remaining wild stock of this species in Hong Kong. A larger group of the same species about 5,000 metres from this site was destroyed within the last few years as a result of quarrying.

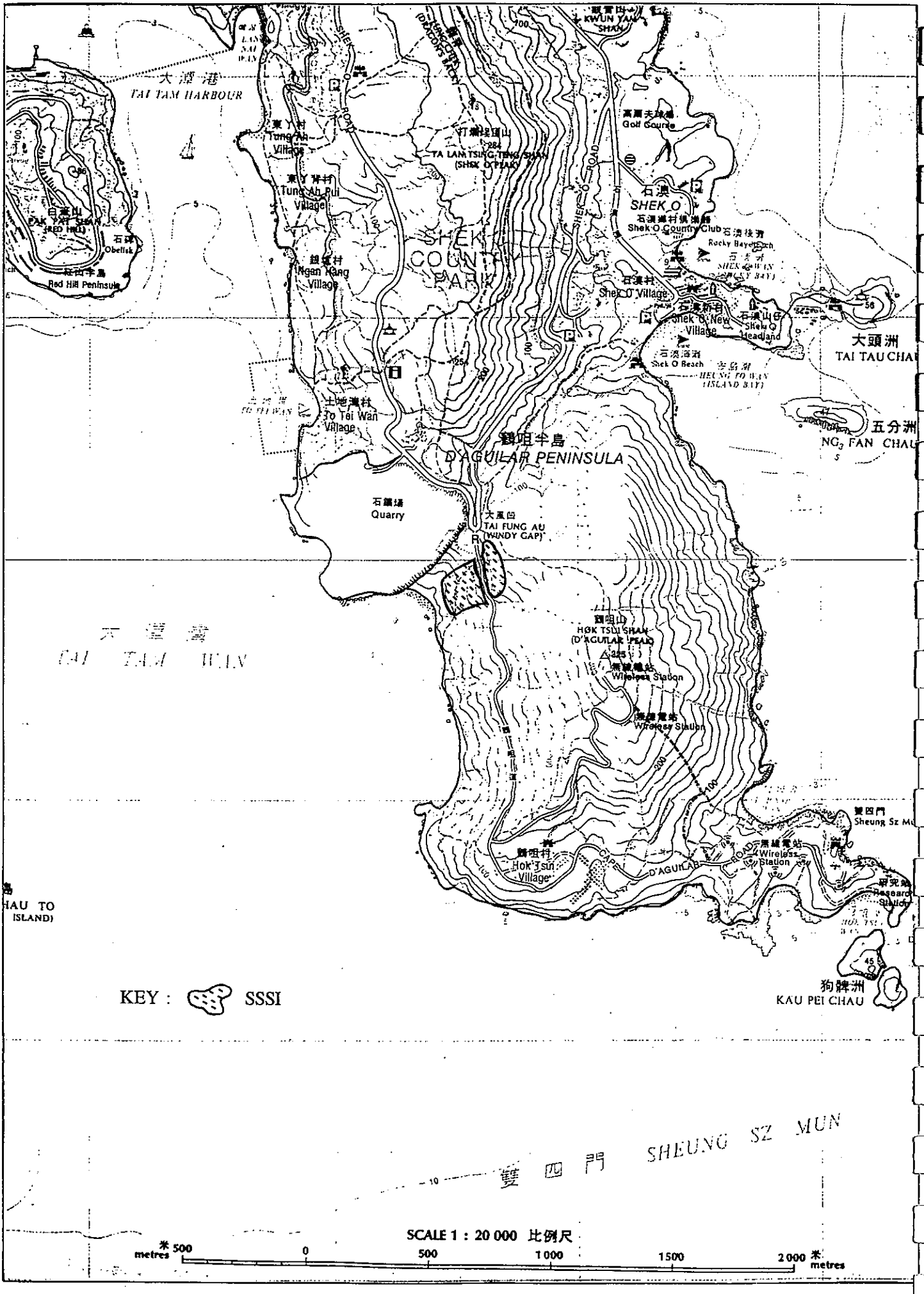
Acampe multiflora

This is an indigenous ground orchid and all digeneous orchids are protected by Law.

Degree of Hazard

The site is within a proposed Conservation Area, but is located by the side of a road and may come under pressure if any road improvement works are carried out.

Branchlets and the beautiful cones of *Keteleeria* are very attractive and likely to be collected by people for the purposes of floral arrangement.



Appendix 7B **Site of Special Scientific Interest (S7/75)**
D'Aguilar Peninsula

APPENDIX 7C

SUMMARY OF A 1991 TREE PLANTING TRIAL AT SHEK O QUARRY - EVALUATED JULY 1993

APPENDIX 7C: BRIEF ASSESSMENT OF THE SHEK O TREE PLANTING TRIAL UNDERTAKEN IN 1991.

A tree planting trial was set up in 1991 to investigate the method of tree planting and to assess the suitability of certain trees planted.

Set out below are the findings of observations made on a site visit during July 1993 aprroximately 2 years after planting.

It is understood that the rock was blasted and a slope of 35° was created. Geotextile netting was placed over the rock to stop the fines going into the rock. 900 mm of overburden and soil was placed on the netting and the trees were planting into this as seedlings. It is estimated that the trees were planted as at spacing of 0.5 - 1.0 m apart, the spacing appears to vary in different parts of the site.

TREE SPECIES	AVERAGE HEIGHT	CONDITION
Acacia confusa	2m	good
Macaranga tanarius	1m	poor
Leucana leucocephala	1.5m	good/moderate
Casuarina equisetifolia	3m	variable
Celtis sinensis	0.5m	good but small
Bombax malibaricum	0.75m	poor, stunted
Acacia mangium	3.5m	good/moderate
Tristania conferta	2.5m	good

APPENDIX I

RESPONSES RECEIVED ON THE SHEK O CASTING BASIN EIA DRAFT KEY ISSUES REPORT

APPENDIX I.1 RESPONSES RECEIVED ON SHEK O CASTING BASIN EIA DRAFT KEY ISSUES REPORT

RESPONDENT	DEPARTMENT	DATE RECEIVED	COMMENTS (Y/N)
K H Chu	Urban Area Dev. Office	5 October 1993	Y
T Williams	GEO, Mines and Quarries	5 October 1993	Y
H T Chan	Planning Dept. HK District Office	5 October 1993	Y
E A Glenville	Highways Dept.	6 October 1993	Y
K Y K Wong (Part 1)	EPD	7 October 1993	Y
D H W Tsang	Port Works C E Office	8 October 1993	N
J K Shaw	NAPCO	9 October 1993	Y
F Y Wong	AFD	11 October 1993	Y
B S Young	Marine Dept.	12 October 1993	N
K Y K Wong (Part 2)	EPD	12 October 1993	Y

KEY Y = Specific comments received

N = No specific comments

APPENDIX 1.2 RESPONSES RECEIVED ON SHEK O CASTING BASIN EIA DRAFT KEY ISSUES REPORT

Item	Respondent	Respondents Comments	Consultants Comments
1	H T Chang District Planning Office	My only comment on the abovenamed Report....is that the site area of 25 ha of the Quarry shown on line 2 of Para 2.1 appears to be incorrect. According to the approved Tai Tam & Shek O OZP (No. S/H18/2) the area set aside for the Quarry is 33.7 ha (zoned 'undetermined' on the OZP). The area is even larger in the rehabilitation proposal. You may wish to clarify with DLO/HKS on the existing licenced area of the Quarry.	DLO/HKS respond that the existing Quarry boundary is 35 ha. The future area will be approximately 46 ha but the boundaries have yet to be finalised.
2	T. Williams CED, Mines & Quarries	<u>Summary - Paras 2 and 3</u> The detailed proposals for the rehabilitation were submitted in a report entitled "Preliminary Report for Development and Landscape Restoration" dated May 1991. This report contained an Environmental Impact Study. It was agreed in June 1993 that the three additional items mentioned were the only extra requirements to the information given in the May 1991 report for completion of the EIA on the rehabilitation scheme. <u>Chapter 1 - page 1</u> See my above comments <u>Chapter 7 - Para 7.8 - pages 54 and 55</u> The extension of the proposed site for the quarry restoration into the SSSI buffer zone is required to stabilise an area within the buffer zone of loose dumped material. This was discussed at some length with various Government Departments during the quarry rehabilitation study. Conditions can be inserted into the contract requiring the contractor to assess the feasibility of incorporating such cliffs into the scheme, subject to detailed design. However, it should be noted that the design of the final landform must also address the long term stability of the slopes finally formed.	The paragraphs will be altered to include these statements. As above. It is agreed that the proper place for these issues is in the design submissions from the Quarry Operator subject to approval by CED and AFD. This was implied in the recommendation that the objectives for the restoration proposals should be clearly determined and defined through discussions between the Quarry Operator, their Consultants and relevant Government Departments.

2 cont.		All these issues will be addressed in the design submissions from the Contractor, which will be subject to approval by AFD as well as CED. To carry out the rehabilitation scheme, some work will be required in the "buffer zone" that is now to be excised from the Country Park, and the designation of "no go" areas at this juncture could compromise the rehabilitation scheme and leave an area of potential instability. I am firmly opposed to the suggestion in the consultant's report of including "no go" conditions in the rehabilitation contract; Government must retain flexibility in approving the final design for the overall benefit of the scheme.	"No Go" areas were suggested as a possible measure to mitigate against the impact of the rehabilitation on the Country Park to the southeast of the existing quarry face. The delineation of actual boundaries of any such "no go" area or buffer zone can only be addressed in the above mentioned consultations between all relevant parties and taking into account the need for slope stability requirements.
		Measures to protect the allocated rehabilitation site from fire, and to restrict fire from spreading from the rehabilitation site to the SSSI or the neighbouring Country Park, will be specified in the contract.	Noted
		I note, with some concern, the consultant's suggestions that periodic ecological studies should be carried out in the vicinity of the rehabilitation site, to be funded by the operator. The quarry rehabilitation contract will be for a period of 10 years with a further 2 year maintenance period. The future monitoring of the ecology outside the site is an issue for the Country Park Authority to address and it would be unfair to impose this burden on the operator. Obviously, as the rehabilitation contract will expire after 12 years, suggestions for conditions to be included in the rehabilitation contract for the operator to fund ecological surveys over a thirty year period, and to be responsible for remedial measures over this period are totally impractical.	Ecological monitoring constitutes part of the Environmental Monitoring and Audit requirements as set out in the Study Brief. Terrestrial ecological impacts arising from rehabilitation projects, are long term effects and monitoring programmes have to take this into consideration. The basis for funding the work is the 'polluter pays' principle. At the end of the rehabilitation contract the operators responsibility for conducting the surveys ceases, but not necessarily their responsibility for funding. The thirty year timescale relates to the establishment of woodland which was suggested by the 'Preliminary Report for Development and Landscape Restoration' (May 1991). Thirty years is the same requirement for landscape maintenance and monitoring that Government stipulated in the NENT Landfill specification. In all probability, the scale of any such monitoring would be minor and would not entail large costs. Judgement from AFD and the Country Park Authority should be sought in this respect.
		<u>Chapter 10 - Summary of Key Issues - page 66</u> The recommendation made in para 9 is noted, and I reiterate that the landform proposed is subject to a detailed design submission after the Design and Build contract has been signed.	Agreed

2 cont.		time, but measures must be taken to ensure the future overall stability of the site. Furthermore, the contractor will be required, at the time, to submit detailed proposals for safe-guarding the SSSI from damage.	
3	K H Chu Project Management Office, Urban Area	My observations are as follows: (i) Since the quarrying activity has been causing high dust level at the quarry boundary and To Tei Wan Village, the dust control clauses to be included in the new quarry cum casting basin contract must aim for an improvement. (ii) In the last paragraph on page 17, the consultants stated that the NSRs near the quarry are likely to be assigned an ASR of A or B. Can this be specific to make known which is which? Otherwise, it makes difficult to fix what the ANLs are and compare them with the figures in Tables 4.7 to 4.9. (iii) I infer from the report that cofferdam construction is a must; but this is not so stipulated in the recommended contract Clause 5.2 in Appendix II. The recommended Clauses 3(vi) & 4(i) require the contractor to prepare Monitoring and Audit Manual(s) for dust and noise control. Clause 5.1(v) also refers to 'the Environmental Monitoring and Audit Manual' which the contractor has to comply with for water quality control; but it is not clear who is responsible for the preparation of this particular manual. The relationship between all these said manuals and the Environmental Monitoring and Audit Manual which the consultants will produce under this study is totally unclear.	Noted EPD has indicated that the ASR will be 'A'. The use of a cofferdam was proposed by the Casting Basin operators from the outset as the most effective means to carry out excavation works. Clause 5.2 relates only to the proposed use of the cofferdam. The Environmental Monitoring and Audit Manual is to be submitted by the Franchisee to the Works Checker and DEP at the commencement of the project. One of the objectives of the EIA was to identify and formulate environmental monitoring and audit requirements for incorporation into the EM&A Manual. These two are essentially the same and the Consultants are preparing the EM&A Manual on behalf of the Franchisee in consultation with EPD.

3 cont.			If the intention is to use the manual produced by the consultants as a basis for formulating the control clauses in the contract and which the contractor has to comply with, there does not appear to be a need for separate manual(s) to be prepared by the contractor. Also, it seems pre-mature for the consultants to recommend contract clauses now before his production of the Environmental Monitoring and Audit Manual.	Draft Clauses were requested by CED to be available for consideration for incorporation into the rehabilitation contract between Government and the Quarry operator by mid September.

4	E A Glenville for Government Engineer Western Harbour Link	I have the following comments:	
		i) Summary para 4 - there is a need to do more than "consider" the cumulative aspects of casting basin operation and quarrying activities. The opening sentence of the EIA Study Brief states that "The purpose of this environmental impact assessment is to provide information on the nature and extent of environmental impacts arising from the formation and operation of the proposed casting basin for the Western Harbour Crossing (WHC) *and from all other activities taking place concurrently at Shek O Quarry.*" This is accepted in later text, paras 1.2.2(d), 1.2.3 and 3.5.2 refer.	'considered' will be changed to 'evaluated'. The exact wording quoted left appears in section 1.2 first para as noted.
		ii) Introduction, para 1.1 - the final sentence may have to be amended in light of comment (i) above.	Noted
		iii) Site Description, para 2.1 - final paragraph. It would be useful to insert a figure for the population of To Tei Wan.	The population of To Tei Wan consists of three families of approximately fifteen people in total.
		iv) Air, para 3.6 - from Table 3.4 it is noted that there is a vast amount of dust predicted to arise from quarrying activities, and less than 1% attributable to casting basin activities. It is noted in para 3.6 that current dust levels are in exceedance of the statutory AQOs at To Tei Wan Village.	Approximately 4% of the dust arises from casting activity on the basis of all quarry and Casting Basin equipment being operational at the same time.

4 cont.			What evidence is there to support the statement that "Annual average TSP levels *should* be within the AQO. RSP concentrations *will* be within the AQOs at the closest inhabited areas."? It is noted from the final paragraph that "...unless the quarry operation is controlled through the necessary contractual, licence and enforcement procedures, dust concentrations in the vicinity of the casting basin *may* not meet the AQOs and guideline requirements." See also Summary, para 6, 3rd bullet.	The statements are based on modelling results. The term *will* should be replaced by *should*. Definitive statements cannot be made regarding any model output as these only represent estimates based on best available data and reasonable assumptions.
			With regard to the present unsatisfactory situation at the quarry, are complaints being received from villagers, and what measures are being taken to reduce dust?	The only complaints that the Consultants are aware of are anecdotal references to dust covering catamarans kept at To Tei Wan. Complaints have not been received by Pioneer.
		v)	Noise, para 4.7 - a realistic assessment of night time noise should be included, utilising actual plant envisaged to be employed. I presume that quarrying operations will not continue through the night, 24 hour water pumping will be necessary, and that 4 concrete vibrators are inadequate for night time pours. See also Summary, para 6, 5th bullet.	Night time operation is controlled through the statutory process of the NCO. A revised assessment of night time operation (based on data from Kumagai Gumi) indicates that noise levels at Red Hill may be 46 dB(A), which is only 1dB(A) above the criterion. A reduction of 1dB(A) should be easily achieved, although this would need to be demonstrated to EPD before a construction noise permit could be issued.
			It is noted in Conclusions, para 11 however, that the operators (casting basin?) intend to work day shift only.	The operators now consider it will be necessary to work until 1 am or 2 am to finish-off concrete pours.
		vi)	Marine Water Quality, para 5.5.1 - third para. There are conflicting comments throughout the Report as to whether, or not, sewage will be removed off site for treatment, see para 5.6.2, 5.8, 8.3.5, 8.6 and Summary para 6, 6th and 10th bullets. A positive statement on this would be helpful.	A decision has now been reached to move all sewage off-site. Previously, the casting basin operator had retained the option of providing a septic tank for the office facility pending enquiries and cost evaluation.
		vii)	Marine Water Quality, para 5.8 - some text is missing here.	As all sewage will now be taken off-site this paragraph can be re-worded.

4 cont.		viii)	Marine Ecology, para 6.7 - 2nd para, 2nd sentence. Is it not the removal of the cofferdam itself that will affect sediment suspension, rather than the controlled flooding? If so, what methods will be used for its removal so as to minimise sediment suspension?	The removal of the cofferdam should not have a great impact on suspended sediments as the bund will be composed of relatively coarse marine sand. The *first* flooding of the area within the dam has the potential to cause suspension of fine sediment from the exposed areas of mud. On completion of flooding, the basin would have to remain closed for approximately 24 hours to allow suspended sediments to settle. In reality the amount of suspended sediment may be small, as the surface of the sediment would have been exposed for up to one year and may become compacted and/or hardenend.
		ix)	Terrestrial Ecology, para 7.8 - 2nd para., 2nd sentence. It is not clear where this natural tall scrub/woodland is, or how it will be affected by the rehabilitation works. It should be useful to include a drawing showing both the proposed rehabilitation works and these affected areas.	The tall scrub/woodland is that area proposed for excission under the rehabilitation contract which lies between the southeast quarry face and the SSSI.
			With regard to the final sentence, is not the proposed rock cliff an effective buffer?	Yes, the cliff face is an effective buffer but is not considered adequate in itself to protect the SSSI.
			Subject to consideration of the above, it may be necessary to amend para 7.11, 3rd and 4th paras.	If all the woodland is lost there will be no buffer zone. Mines and Quarries (CED) have submitted that leaving the cliff and area of tall scrub/woodland could compromise the rehabilitation scheme and leave an area of potential instability. Clearly, the need for a buffer zone and stabilisation are mutually exclusive requirements as they stand and an alternative or compromise needs to be sought.

5	K Y K Wong EPD	We have the following comments ..... <u>Air</u>	
		1 According to the captioned report, it was found that the dust level to To Tei Wan Village may exceed AQO level. As the future dust level of Shek O Quarry may be improved upon inplementation of Best Practicable Means (BPM) for dust suppression, therefore, the Consultant is requested to re-model the dust impact assessment (i.e. producing a residual impact assessment) by taking into account the effect of the BPM and the topographic impact.	The assessment shows that, for the model used, the dust levels from the casting basin account for only 4% of the total, hence this will not present a particular problem. Cumulative impact was based on data provided by pioneer, and the impact was estimated using those data. However, should Pioneer advise of reduced projected dust levels (ie update Table 3.4) these levels can be remodelled.
		2 Section 3.1, 3rd para, page 6 The Consultant should note that since August 1993, any concrete batching plants with cement silo capacity exceeding 50 tonnes are classified as Specified Processes (SP) under the Air Pollution Control Ordinance and are required to operate under licence by EPD.	Noted (see para 3.1)
		<u>Noise</u>	
		3 Summary 4th and 5th bullets in S6: Please refer to the following comments with regard to severity of execssive noise impacts.	
		4 S4.2.2 1st para.; As already mentioned in our comments on the Draft Initial Assessment Report, the 75 dB(A) daytime criterion should be adopted throughout th	The limit is given in the Report, inclusion in contract documentation is an issue between HyD WHL and Kumagai Gumi, and is not related to technical assessment.

5 cont.			requirement is still not reflected in this para.	
			2nd para.; ASR of A would be appropriate for all the NSRs in Table 4.7.	Noted
		5	Table 4.3	
			Descriptor for daytime construction noise should be $L_{Aeq(30min)}$ as in the Draft Initial Assessment Report. Please add "on" between "includes all day" and "Sundays and Public Holidays" in the remark.	Other studies have been required to use $L_{Aeq(5mins)}$ eg Central Kowloon, Central and Wanchai Reclamation. However, the text will be ammended as required. Noted.
		6	S4.3	
			Noise impacts from dredging, vessel mooring and tunnel unit launching on NSRs including To Tei Wan, red Hill and Stanley Town which would not be shielded from the above processes should be assessed in the report.	Dredging impacts at Stanley and Red Hill have been addressed. To Tei Wan is very sheltered and is unlikely to have a sightline over dredging activity. Vessel mooring and tunnel unit launching are not likely to be as noisey as normal construction activity.
		7	Table 4.4	
			We have already pointed out that $L_{Aeq(1min)}$ readings are not considered representative of background noise levels. Should the Consultant wish to make reference to the existing background noise levels, noise measurement for duration of at least 5 minutes should be carried out.	Noted. As previously stated these are quoted from an earlier report.
		8	S4.7	
			In accordance with Table 4.6, limitation of numbers of concrete vibrators and ready mix trucks proposed by the Consultant would reduce the noise impact by only 3 dB(A) which would be insufficient to achieve the	This item is now superceded. Kumagai Gumi have provided a night time equipment inventory which will be assessed and included in the Final Report.

5 cont.			night time criterion of 45 dB(A).	
			Furthermore, quarrying activities and rock crushing would be two major contributors to the cumulative noise impacts according to Table 4.6. It should be checked whether these activities would be carried out outside normal daytime hours. If affirmative, recommendation of mitigation measures for the casting basin should take into account these concurrent activities in the quarry.	It is understood that Pioneer is unlikely to operate at night. The construction Noise Permit procedures will identify if concurrent casting and quarry activity will occur, and the statutory controls can be applied as necessary.
			Nevertheless, the Consultant should take into account the above comments and review the noise assessment including recommended mitigation measures for any excessive noise impacts.	Noted.
		9	p26, Sect. 5.1 3rd para	
			Replace "...semi-diurnal (two tides a day) on spring tides to diurnal (one tide per day) on neap tides." by "...semi-diurnal (two tides per day) on neap tides to diurnal (one tide per day) on spring tides."	The quotation is correct according to Morton and Morton (1983). Verification will be sought from the Author(s).
		10	p33, Sect. 5.5.1 3rd para	
			The sub-soil of the quarry site may not be suitable for septic tank and soakaway system. Also, permission of effluent discharge into Tai Tam Bay sensitive waters (Secondary Contact Recreation Zone) will increase the chances of eutrophication and toxic red tides to occur. Therefore we recommend that all sewage generated in this project should better be contained without treatment and regularly disposed of to the Stanley STP.	The Contractors have now decided to take all sewage off-site for treatment.

5 cont.		11	p34, Sect 5.5.2 1st para Replace "A consequence of dredging relating to the cofferdam construction and removal is the increased suspended particulate load in the water column." by "A consequence of dredging without some form of barrier is the increased suspended particulate load in the water column." 2nd para We suggest that the line of the cofferdam should be selectively piled into the seabed outside the inshore bouldery region. Also the area of enclosure can be minimisd by cofferdaming the navigation channels' perimeter only.	Noted The planned method would involve the minimum amount of piling and afford the greatest level of protection to the environment.
		12	p34, Sect.5.5.3 Please refer to Comment (10) above for our comments on on-site septic tank/soakaway.	Noted
		13	p38. Sect5.5.3 This statement of "The great majority of...." is incompleted.	As all sewage will now be taken off-site this section will be re-written.
		14	p62, Sect 8.3.5 Please refer to Comment (10) above for our comments on septic tank facility.	Noted

5 cont.		15	p64, Sect. 8.4.5 We recommend to use Stanlet STP as a long term sewage disposal place. However, before Stanley STP is commissioned, the private treatment works at Redhill can be utilised as an interim measure.	Noted
		16	p66, para. 6 Replace "...it is proposed that the majority, if not all, sewage will be treated off-site,.." by "..it is proposed that all sewage will be treated off-site,.."	Previous comments apply
		17	App.II, p6, Sect. 5.3(i)(a) Replace "..weatherproof dissolved measuring..." by "..weatherproof dissolved oxygen measuring.."	Noted
		18	p7, Sect 5.3 (i)(b) Replace "A portable..." by "Turbidity of the water shall be measured by the nephelometric method using a portable,.."	Noted
		19	p7, Sect.5.3 (i)(c) Replace "..or Van Doorn type water sampler with a capacity of no less than 1.5 litres or similar approved." by "...or Van Dorn type water sampler that consists of a PVC, glass or stainless steel cylinder with a capacity of no less than 1.5 litres and can be effectively sealed with latex cups at both ends, or similar approved."	Noted

5 cont.		20 App. II. p7 Sect.5.3 (ii) Replace '...shall be made available to DPE verification." by "...shall be made available to DEP for verification."	Noted
		Environmental Monitoring and Auditing	
		21 General Comment The Consultant's responses to my comments on the Draft Initial Assessment report (as provided in P3 of Appendix I) that EM&A issues would be addressed in the Key Issues Report. However, only little information is provided in this present report. As the Consultant defers the discussion of EM&A issues to the coming EM&A Manual, we expect the manual will address the issues with sufficient details.	Currently under discussion with EPD
		22 Appendix II (a) The duties of the Authority mentioned in those recommended clauses should in fact be the duties of the Engineer. Therefore, the word Authority should be replaced by Engineer.	Noted
		(b) It is not acceptable that the Contractor is responsible for the monitoring and audit work and preparation of progress reports. Such work should be carried out by the Franchisee, the Engineer or its directly employed environmental cnsultant.	Noted

5 cont.			(c) The Consultant should make reference to the NAPCO Procedure 312 and associated attachments. These documents contain more comprehensive requirements with respect to noise, air and water quality.	Noted
		23	Section 5.2.1	
			By virtue of the Water Pollution Control (Amendment) Ordinance 1990, there are no more exempted discharges or deposits.	Noted
		24	Section 5.2.2	
			The Water Pollution Control Ordinance is the main piece of legislation for water pollution control. The Water Pollution Control (Southern Water Control Zone) Order (1988) is a legal order for declaring Southern Water Control Zone and designating DEP as control authority.	Noted
		25	Section 5.5	
			The impacts of rain water runoff should also be addressed.	The impacts of rain water runoff will be the same as at present if not somewhat reduced due to the basin trapping some of the run-off which will then pass to the settlement pits.
		26	Section 5.5.2	
			Please justify your claim that the deposition of sand into marine water to form bunds for supporting sheet piling will not result in significant quantities of suspended sediment?	Due to the relatively coarse grain size of marine sand, sediment suspension resulting from the deposition of the sand will be of short duration. The rapid settlement will also limit the transport of the sediment by the weak water currents.

5 cont.		27	Section 5.6.3 i) Form oil if in a relative high concentration is regarded as chemical waste under the Waste Disposal (Chemical Waste) (General) Regulation. Therefore, any excess oil or spillage intercepted in the treatment tank should be properly contained, labelled and stored on site prior to collection by licensed collectors for disposal.	Noted
			ii) last para. - please indicate which types of treatment tanks should be used.	Settlement, oil/water separation. Maximum volume of curing water is estimated to be 10 m^3 per day per section for a limited duration.
		28	Section 5.6.4 i) Since concrete curing water and washdown water would contain large quantities of oil, grease, cement solids, mould-release agents and contaminants, due consideration should be given to the treatment effeciency of the proposed sedimentation tanks and oil traps to see whether they can really meet the TM's standards, in particular suspended solids and oil & grease limits.	Noted
			ii) Has consideration been given to flooding and draining the basin during favourable tide conditions?	Yes. Flooding will be accomplished using pumps, not tidal flow. Draining the basin should not require control relative to tidal movement as the water in the basin will be clean seawater.
		29	Section 5.7 If an on site sewage treatment plant is proposed, monitoring of its effluent quality on a weekly basis is necessary. The test determinants including BOD, SS, *E.coli*, DO, oil and nutrients should be included in the Table 5.3 for the plant effluent.	There will not be an on-site sewage treatment plant.

5 cont.		30	Section 6.6 Mitigation measures and monitoring requirements to reduce and check the water quality impacts during the construction of the cofferdam should also be recommended.	Routine water quality monitoring will be undertaken during the construction of the cofferdam; in particular, suspended sediments and dissolved oxygen. Careful placement of the marine sand will minimise disturbance of in-situ sediments and suspension of fine particulates.
		31	Section 8.3 As pointed out in Section 2.2, a concrete batching plant will be established on site. The Report has neither addressed to any waste water that would likely generate from the concrete batching process eg washdown water from cement-concrete mixers, nor has it mentioned any mitigation or control measures to treat the waste water.	Waste water will be collected, passed through settling pits and then re-used for concrete batching.
		32	Section 8.4.3 i) Any spent oil, grease or other chemical waste should be contained, labelled and stored on site in compliance with the chemical waste legislation.	Noted
			ii) The report has not mentioned any provision to prevent any stormwater infiltration into the oil separation facilities or treatment tanks during heavy rainfall.	The system will be closed which will prevent stormwater infiltration.
			iii) The time for provision of the marine pollution equipment (and any other equipment recommended in the report) should be specified in the report and spelt out in the EM&A Manual.	Noted

5 cont.		33	Section 8.4.5 i) The report proposed that off-site treatment and disposal appears to be the most viable option. However, it does not make any estimation on the total quantity of sewage and sullage generated from the washroom facilities and canteen kitchens in order to assess its cost-effectiveness. ii) I find the propsal of transporting the sewage and waste water to the private sewage treatment plants (STP's) at Redhill for treatment is totally illogical and unacceptable. Firstly, the STP's which were designed with optimal capacity to treat a predetermined quantity of sewage, could certainly not be capable of handling a sudden increase of influent. Doing so would definitely have an adverse effect on their performance. Secondly, the STP's could only provide secondary treatment but not nutrient removal and their effluents are ultimately discharged into Tai Tam Bay. I cannot see this proposal will help to solve the potential elevation of nutrient concentrations in this area as mentioned in Section 5.5.1. iii) If the option of tankering sewage and waste water off site for treatment is adopted, a contingency plan should also be drawn up to handle emergency situations, namely suspension of tankering service due to bad weather or road condition. A storage tank should be built to provide temporary containment of the sewage and waste water.	Viable in the sense that there are no real alternatives. There is insufficient land within the quarry to provide for an adequate sewage treatment works for 600 workers, plus the capital cost of such works for the three years the casting basin will be in use is uneconomical. A long sea oufall is also cost prohibitive. Sullage (32 m^3/day) will go to the settlement pits. Redhill STP is designed to treat a peak flow of 150 m^3/hour and should therefore have sufficient reserve capacity to treat the estimated 20 m^3/day sanitary waste from the Casting Basin during off-peak periods. The additional effluent should not exceed the criteria specified in the discharge licence, as it appears that the design criteria for STP is conservative. This information has been provided by Balfours International (Asia) Consulting Engineers Ltd. A container will have to be provided for storage of effluent pending collection by tanker. This tank can also provide emergency storage capacity.

5 cont.		34	Section 8.5.2 What are the addtional measures?	The additional measures would be dependent upon the identification of the cause of non-compliance.
		35	Section 8.6 Who is the independent checker?	The independent checker will be the Works Checker appointed to the Franchisee. For environmental issues, this is understood to be ERM under the aegis of Scott Wilson Kirkpatrick.
		36	Section 9 The glare impact from lighting during night-works should also be addressed.	Noted
		37	Section 5.1 (i) (i) Please add "no flooding shall commence unless the Engineer gives his written approval."	The Works Checker will be the relevant authority.
		38	Section 8 - Removal of Waste Material i) A clause should be added in this section to require the contractor to comply with the requirements of the Waste Disposal (Chemical Waste) (General) Regulation in respect of packaging, labelling, storing and collecting of chemical waste produced on site.	Noted.

6	F Y Wong AFD	1	Summary	
			The quarry face regrading will not encroach into the SSSI, a belt of buffer zone is suggested to be created in the southern part of the quarry.	Agreed
		2	Site Description	
			Fig. 2.2, it appears that part of the storage basin is to be built on the western edge of the small beach outside the limit of the works area. In order to protect vegetation and the beach itself, it is recommended to rearrange the layout of the Casting Basin without encroaching into the beach. A "no go" area is recommended to be established along the western headland of the beach.	The actual boundary of the works needs to be confirmed by Pioneer and Kumagai in discussion with CED Mines and Quarries Division.
		3	Air	
			Para 3.8. the effect of dust on the SSSI and surrounding vegetation is uncertain, will there be any recommendations to reduce such impact on vegetation?	The general dust suppression methods applied to the Quarry and Casting Basin operations should reduce impact on vegetation.
		4	Noise	
			Para 4.3. What will the noise impact upon visitors to country parks along the Hong Kong Trail which is located to the north and northeast of the site? C.P. visitors have not been considered as sensitive receivers in the study.	Visitors to the trail are already subject to the impact of quarrying operations. Their exposure is limited in duration and is not expected to be worse as a result of Casting Basin operations.
		5	Marine Water Quality	
			Para 5.5.1. Details of off-site disposal of sewage is not given.	

6 cont.			Para. 5.6.1 When the first tunnel sections are ready to be floated out, the cofferdam will be removed, sediment dispersion might occur, what mitigation measures will be taken to minimise the effect of sediment dispersion?	See Item 4 (viii).
			Para 5.8. Are there anything left out at the end of the first paragraph?	Noted
		6	Marine Ecology	
			Para. 6.1 Tai Tam Harbour and Hok Tsui (Cape D'Aguilar) were recognized as SSSI's not gazetted.	Noted
			Para 6.5.2 and 6.6. The Draft EIA implies that all the blasting will be done inside a cofferdam. If this is the case adequate mitigation to blasting effects should be afforded. However, if the need arises for underwater blasting to be done outside the dam then it is likely that adverse effects on fisheries will be reduced if this is done between the months of May and November.	Noted. However, blasting should not occur outside of the cofferdam.
			While it is agreed that the area concerned is relatively small we are not aware of the distance over which blasts from explosives outside the cofferdam may harm fish. Even though the area in question may be small the scale of current major infrastructural works being undertaken throughout Hong Kong is such that mitigatory measures wherever possible are desirable.	Noted. If underwater blasting was necessary, mitigation measures would be proposed.
			It seems that the consultants have done some useful sampling in the area and that is encouraging. It is suggested that the construction of the cofferdam should not affect the beach to the south of the site.	Noted

6 cont.		7	Terrestrial Ecology	
			Para. 7.4.1. Scrubland; 2nd para, the species *Phoenix hanceana* is no longer listed under the Animal and Plants (Protection of Endangered Species) Ordinance since 1990.	Noted
			Para. 7.5. Birds; the suggestion to conduct further study on migratory birds in October and November is desirable but might not be essential in view of the summary given in para. 7.11.	Agreed
			Para. 7.6.1. The new map for replacement was gazetted under Section 9 of the Country Parks Ordinance.	Noted
			Fig. 7.2. Only gives a simplified version of the C.P. boundary.	Noted
			Para. 7.6.2. Appendix 7B is copied from AFD or PD's record, acknowledgement is required. This SSSI is not "designated" rather it is "recognized".	Noted. A sentence to this effect will be added to Appendix 7B.
			Para. 7.6.3. Para. 4; only two trees of *Keteleeria fortunei* are present, not three. Figure A of Appendix 7A cannot be traced. Information on Spiny Date Palm in the last paragraph is incorrect.	The information on the number of *Keteleeria fortunei* trees was obtained from WWF(HK) following the survey. Figure A of Appendix 7A was omitted in error. Re Spiny Date Palm, comment previously noted.
			Para. 7.8. In the preliminary study conducted in 1991 a detailed description of vegetation in the area has been provided.	Agreed
			Creation of a buffer zone between the quarry and the SSSI is supported. In fact, a buffer zone has already been in force for the present quarry operation. This buffer zone is to be maintained or redefined in order to	Noted

6 cnot.			protect the integrity of the SSSI. Detailed proposals for the protection, prevention of dumping and retention of beach vegetation is required. Para. 7.9. Fig. 7.3, detailed proposal on boundary of buffer zone is required. Design of ledge would require specialist advice, this should be agreed as soon as possible in order to enable the operator to include it into the quarry design. Para. 7.10.1 and 7.10.2. If the annual ecological monitoring survey is to be carried out by the operators of the casting basin, then on the completion of the casting basin one or two surveys should be carried out by the quarry operator. Why is it necessary to monitor tree planting for a period of 30 years? In the present practice, after a 2-year initial maintenance period, the government woodland would be managed for a period of 10 years, thus a total of 12 years will be sufficient. It is suggested that some of the recommendations and mitigations in this para. be translated into the quarry and casting basin contracts. Para.7.11. Para 4, last sentence, it is not true that there are only 2 known locations for *Keteleeria fortunei*, AFD has successfully propagated and planted considerable number of this tree in various country parks over the years. This statement contradicts with sub-para 6 of para 7.6.3.	Measures to protect the beach vegetation will be specified in the contract. This is currently under discussion with the relevant parties. It is agreed that the proper place for these issues is in the design submissions from the quarry operator, subject to approval by CED and AFD. The terrestrial ecological surveys should be carried out by the quarry operator as part of the rehabilitation project. Management is a separate consideration to monitoring. Agreed Noted. The sentence should have read "there are only two known locations for natural wild populations of this species in the whole Territory"; sub-para 6 of para 7.6.3 supports this statement.

6 cont.		8	Waste Arisings	
			Para 8.6, the proposal to tanker all sewage is supported and should be applied to both casting basin operator as well as the quarry operator.	Noted
		9	Visual Impacts	
			The possible visual impact by creating vertical cliffs on the southern part of the quarry should be assessed and justified in landscape terms.	This falls within the remit of the quarry rehabilitation project.
		10	Summary of Key Issues	
			The visual impact which has been omitted in this section should be included.	Noted
		11	References	
			Government documents on SSSI's and the Preliminary Study on Shek O Quarry should be included.	Noted
		12	Appendix 6A	
			Some useful data on species have been gathered.	Noted
		13	Appendix 7A	
			Para. 1&2. Further survey is desirable if funding is available	Noted
			Para. 2.2.3. *Phoenix hanceana* is no longer protected under the Animals and Plants (Protection of Endangered Species) Ordinance.	Noted

6 cont.		Para. 2.4. SSSI was not designated under the Country Parks Ordinance (Cap. 208).	Noted
		Sub-para. 3, the 3rd sentence is factually incorrect, para.7.6.3 is relevant.	Noted
		Sub-para. 5, it is doubtful whether the presence of bare rock is really so effective to serve as a fire barrier in this area. From the list given it does not seem to have a high proportion of uncommon species.	Noted
		Para. 6. In general, these recommendations should be considered to be included in the contracts.	Agreed
		Para. 6.1. A more comprehensive survey on flora and fauna can be continued as part of the monitoring process if funding is available.	Noted
		Para. 6.2. Fire preventive measures should be formulated by operators of the casting basin and the quarry.	Agreed
7	J K Shaw NAPCO	<u>General Comments</u>	
		1 No plan for sanitary wastewater.	All sewage to be treated off-site.
		2 Inadequate meteorological data; inappropriate use of ISCST model; inconclusive air meteorological modelling results.	Noted but disagreed. See below.
		3 Lacking assessment of impacts on beach located southeast of the quarry.	Awaiting confirmation of location of quarry/casting basin boundary.
		4 Stipulate whether night time working is proposed or not.	It has recently been decided that night time working until 1 am or 2 am will be necessary to complete concrete pours.

7 cont.		Specific Comments	
		1 Summary Section; para 6, bullet 6: What exact sewage treatment is proposed?	It has recently been decided to remove all sewage from site to a municipal or private sewage treatment works.
		2 Section 2: Figure 2.1 Key points mentioned in text should be shown for reference (i.e. Red Hill, Stanley Village, To Tei Wan and other villages, SSSI, etc.).	Noted
		3 Sec. 2 Figure 2.2: Note that Basin "B" will be used/constructed only if Kumagai are awarded the MTRC IMT contract. Please note the non-gazetted beach presently used for low intensity public recreation to the southeast of the quarry. Why have effects on this resource not been addressed at all?	See Sections 6 and 7
		4 Sec. 3.1, par.3 : Relevance of the statement on "future legislative changes" to the present case is not clear. Will this legislation be in place before the WHC batch plant is erected or not? If not, this is irrelevant, unless the legislation is retroactive. Is it?	The legislation is now enacted and will apply to the casting basin operators.
		5 Sec. 3.2, para. 3 : When in August were the recent amendments promulgated? WHC commenced on 2 August 1993.	The enactment date is not relevant. The legislation will still apply to the casting basin operators.
		6 Sec. 3.3., Table 3.2 : These locations should be shown in Figure 2.1.	Noted
		7 Sec. 3.4, Figure 3.1 : Please add a wind rose to this figure.	Not available

7 cont.		8	Sec. 3.4, Table 3.3 : The appropriateness of using Royal Observatory data needs to be defended. TSP data without local meteorological data is useless for assessment and predictive purposes	The monitoring was undertaken to measure the existing conditions at the quarry boundary and closest sensitive area. These data are presented as such, but are irrelevant to the modelling assessment. Whilst it is of interest to obtain local meteorological statistics during a background monitoring exercise, it is by no means essential. For compliance monitoring, the situation is somewhat different. In case of disputes over the source of dust nuisance (particularly where multiple contracts occur simultaneously), it is necessary to know wind direction to establish responsibility. The only necessary meteorological data for monitoring is air pressure, which would not normally be measured locally.
		9	Sec. 3.5, para 2 : It is not clear how ISCST modelling can be valid in the apparent absence of relevant local meteorological data. How was the model calibrated/verified?	The model is approved by EPD for use in Hong Kong, and is run using regulatory default options. As there are no local batching and casting operations currently being undertaken, further calibration is not possible.
		10	Sec. 3.5.1, para. 2 : What is the basis for the assumption that RSP emission would be 50% of TSP level?	This is an approximation based on monitoring results at other quarries.
		11	Sec. 3.5.1, Table 3.4 : These predictions conflict with measurements in Table 3.3, where mean velocity was 7.08 m/s. Please explain implication.	The modelling is based on three years hourly sequential data obtained from the Hong Kong South station, not the data measured on site.
		12	Sec. 3.5.3, para. 2 : True. This is very rugged terrain. One must question whether the modelling results are more misleading than useful.	Noted. However, modelling is a requirement of the Study Brief.
		13	Sec. 3.5.3, para. 3 : The adjustment made here for the terrain doesn't really solve the problem.	Noted

7 cont.		14	Sec. 3.5.3, Figures 3.2 through 3.3.19 : Please indicate location of Hong Kong South Meteorological Station.	The station is not within the Study area. It is located in Wong Chuk Hang, which is the closest station to the site.
		15	Sec. 4.7, para. 2 : Is night time work planned or not? Do not leave open-ended.	See General Comment 4 above.
		16	Sec. 5.3, para 3 : Reference to the beach to the southeast of the quarry is omitted.	Noted
		17	Sec. 5.5.1, para 3 : Where are wastewater flows from the existing quarry being discharged? A definitive proposal needs to be presented here; there is no agreement with what is stated in the summary.	They are treated off-site. See previous statements re sewage.
		18	Sec. 5.5.2, para 3 : In reference to the bund in the cofferdam, is this bund to be removed upon completion? This bund has its own impacts which are not assessed.	The bund will be removed. The bund material will be marine sand. Impacts are not considered significant as stated in 5.5.2.
		19	Sec. 5.5.3, sentence 4 : (see comment 16)	
		20	Sec. 5.6.3, para. 2, last sentence : There is a reference to treatment tanks, what treatment? Sedimentation/floatation/skimming?	See Item 5.27 above.
		21	Sec. 5.6.4, para. 3 & 4 : How will the debris and contaminants be removed; is this actually planned?	The methods employed will be dependent on the nature and quantity of contaminants present.
		22	Sec. 5.7, Table 5.5 : It is suggested that BOD analysis should be limited to effluent waters, not open waters. Where are the sampling stations located?	Noted. Effluent waters on-site will be sampled at suitable locations prior to discharge eg settlement pits/treatment tanks/casting basin.

7 cont.		23	Sec. 5.7, Figure 5.1 : Please label sampling stations.	Noted
		24	Sec. 5.8, para. 1 : Please finish statement(s).	Noted
		25.	Sec. 6.2.3, para. 2 : Although the beach may not have "marine ecological importance", it does have some recreational public use. This should be addressed.	Noted. Access is only from the sea.
		26	Sec. 7.6.1, Figure 7.2 : In reference to the legend, insert "temporarily" between "Areas to be ...." and " ... taken out of the Country Park".	Agreed
		27	Sec. 8.6, para 3 : This conflicts with earlier statements that on-site versus off-site disposal is still undecided.	See previous comments
		28	Appendix 5B :	
			General comment - numbers should be changed to reflect the accepted precision associated with each measured parameter.	The data are reproduced from EPD files.

APPENDIX I.2 RESPONSES RECEIVED ON SHEK O CASTING BASIN EIA DRAFT FINAL KEY ISSUES REPORT

RESPONDENT	DEPARTMENT	DATE RECEIVED	COMMENTS (Y/N)
P C Y Ho	EPD Water Services	14 December 1993	Y
P Yau	District Office (Southern)	16 December 1993	Y
K H Chu	Urban Area Dev. Office	17 December 1993	Y
T Williams	GEO, Mines and Quarries	17 December 1993	Y
T Tsang	EPD	17 December 1993	Y
W C Lee	AFD	17 December 1993	Y
D H W Tsang	Port Works C E Office	21 December 1993	N
K Anandasiri	CED (FMC)	22 December 1993	N

KEY Y = Specific comments received

N = No specific comments

Comments Received on the Shek O Casting Basin EIA Draft Final Key Issues Report

Item	Respondent	Respondents Comments	Consultants Comments
1	C.Y.Ho Water Services Group	a)p32, Sect.5.6.1, 1st para, line 5. Replace "...closed seabed grab." by "...closed sealed grab."	Corrected
		b)Fig 5.2. The proposed activity no 1 "Excavation" has not been allowed to commence before the EIA Study is endorsed. Therefore it is worthwhile to amend the bar chart to reflect the real timing and to cater for any necessary postponement and/or acceleration of the various activities of the project so as to meet the proposed completion date of December 1996.	"Excavation" refers to the work performed by Pioneer Quarries in preparation for the start of the Casting Basin operations. The latter will begin when the EIA is endorsed. The bar chart has been updated and the revised version will be included in the Final Report.
		c)App.II, p5, Sect.5.1 (i)(e). Since all the on-site sewage is now proposed to be tankered off site for disposal, this statement is recommended to be revised as : "To enable proper containment and delivery of on-site sewage to off-site municipal or private treatment plant, adequate supporting facilities such as vehicular access and storeage capacity shall be provided.	The revision has been made.

Item	Respondent		Respondents Comments	Consultants Comments
2	T. Williams CED, Mines & Quarries	1	I refer to paragraph 7.10.2 (Overall Restoration and Landscape Proposals) and advise that I have commented two times previously on the proposals to make the quarry operator responsible for repeated further studies and surveys of the flora and fauna.	The reports have also suggested previously that this is a matter to be addressed between the quarry operator and the relevant Government Departments. The recommendations on this subject are proposed for consideration and are not binding on any party . However, they remain a relevant part of this report.
		2	I wish to stress that the rehabilitation scheme is a revenue-earning contract. The contractor will pay Government for the contract, but CED does not have the discretion to use such funds for carrying out such surveys as are proposed in the EIA.	See above comment.
		3	Whilst the contractor is responsible for what happens within the site for the period of the contract, he is not responsible for what happens outside the site unless such an event is a result of his operations. The quarry has been there for many years, and the rehabilitation works should improve the situation vis-a-vis flora and fauna, not make it worse. I see little point in carrying out surveys every 2-3 years within the rehabilitation site until the works have ceased and the whole site has been rehabilitated. The responsibility for the surveys, if considered necessary, should then be with the department or authority taking over the site.	It is agreed that the rehabilitation should improve the situation. However, the consideration of areas outside the quarry boundary was a requirement of the Study Brief. Unless some monitoring is done during the rehabilitation period it will not be known whether or not there have been impacts outside the quarry boundary. Again, the previous comments apply regarding decisions concerning such monitoring.
		4	The responsibility for ensuring that the landscaping works within the site are properly effected lies with the contractor and this department, and this will be catered for in the contract.	No Consultant's response required.
		5	Measures for prevention of fires will be stipulated in the contract.	As above.
		6	In conclusion, I am unable to accept any recommendations making the quarry contractor responsible for further surveys of flora or fauna either inside or outside the site boundary. If such surveys are considered necessary they should be implemented and funded through the interested department or authority.	Previous comments apply. This is a matter for Government Departments to decide. However, the making of such decisions is independent of the Consultants Brief and this should not delay endorsement of the report.

Item	Respondent	Respondents Comments	Consultants Comments
3	P.Yau District Office Southern	I attach my previous comments made to EPD for your attention. One further point I want to make is that throughout the period of the casting basin operation, the environmental impact on those sensitive receivers, e.g. To Tei Wan Village, Redhill and Stanley town, should be closely monitored to ensure that no environmental nuisance arises. Any nuisance generated by night-time working, if inevitable, should be mitigated and be kept within acceptable environmental standards.	The Consultants have not previously received these comments, although dated 5 October 1993 and addressed to EPD. It is noted that CES were not on the circulation list.
		1 (i) Since To Tei Wan is only 400m from the Quarry and is susceptible to adverse dust impact from both the quarrying and casting basin activities, mitigating measures should be adopted to the satisfaction of EPD. The proposal made in Para. 3.7 is supported.	Pioneer Quarries are committed to the installation of new plant incorporating dust suppression measures which should result in significant reductions in dust emissions. These have been discussed between Pioneer and Air Policy Group.
		(ii) If noise impact on the Red Hill peninsula and Stanley exceeds the acceptable standard, especially in the night time, measures should be adopted to contain the problem. The Report is not clear onwhether night-time operations are envisaged but obviously they are not advisable. In any emergency situation where works at night are considered necessary, stringent conditions should be imposed for works to proceed.	As stated in Appendix I of the Draft Final Key Issues Report the operators consider it necessary to work until 1 am or 2 am to finish off concrete pours. During this time all unnecessary plant will not be working thus reducing potential noise levels. Noise monitoring of night time operations will be carried out.
		(iii) As stated in Para. 4.6, vehicle flows resulting from the casting basin activities should be limited to the minimum and within normal daytime working hours so that the effect on sensitive receivers along the delivery route would be reduced to the minimum.	The operators are committed to this. It is also practical for reasons of cost and efficiency.
		I shall rely on your (EPD) professional expertise to ensure that the quarrying and casting basin activities would not bring unacceptable environmental nuisance to local residents and visitors to beaches in the area. I am unable to attend the meeting on 8 October but should be grateful for a copy of the minutes and future correspondence for reference.	This comment was addressed to EPD and requires no response from the Consultant.

Item	Respondent	Respondents Comments	Consultants Comments
4	W.C.Lee AFD	1 Para 7.6.2, 1st sentence, as pointed out in my previous comments adted 11.10.93, SSSI are not "designated", please make appropriate amendment.	All other reference to 'designation' had been removed with the exception of the one cited. This has now been corrected.
		2 I am surprised to find that Appendix 7A is an older version rather than the one that you sent to this department on 24.11.93. This must be replaced by the agreed version subject to my comments dated 30.11.93 (attached).	The earlier version was incorporated in error. This has now been replaced by the updated version with comments incorporated.
5	K.H.Chu Project Manager Urban Area	i) The air quality survey has shown that current dust levels (24-hour average TSP and RSP) due to quarrying activities alone are at times in exceedance of the statutory AQO at the quarry site boundary and To Tei Wan Village. However, assuming the same quarry equipment, the modelling predicts that dust levels due to both quarrying and casting activities should be within AQO limits. This does not sound logical. Clarification is required or it would cast doubt about the reliability of the modelling.	Since the time of monitoring at To Tei Wan, Pioneer have proposed mitigation measures which includes the installation of new and enclosed plant. Furthermore, the working pattern in the quarry will change. The modelling has taken some, but not all of these changes, into account. Also, exceedance of AQO's at To Tei Wan may not necessarily be entirely attributable to Quarry activities. These factors have been discussed at length with the Air Policy Group who have agreed to the wording of the report.
		ii) I take it that the cofferdam construction has been accepted by all parties concerned as a must. Therefore, I see the need to include in the list of 'method of working' items under paragraph 5.1(i) of the environmental clauses recommended for inclusion in the casting basin contract 'Cofferdam construction to reduce impacts from sediment dredging, and allow dry blasting and excavation.' With this inclusion, Section 5.2 'Cofferdam Construction' then follows naturally.	The wording in the environmental clauses has been changed to include this statement.

Item	Respondent	Respondents Comments	Consultants Comments
6	T. Tsang EPD	i) Summary. 4th and 5th bullets in S6 : it is considered that predicted noise levels at Redhill slightly above noise criteria identified by the Consultant were results of omission of utilisation factors of equipment and atmospheric absorption in the assessment. I should iterate that the Consultant should take into account these factors to give a more realistic prediction of noise impacts.	The analysis corresponds to a worst case scenario without omitting the utilisation factors of equipment. However, atmospheric absorption can be incorporated in the analysis and will be performed during week beginning 27/12/93 and incorporated into the final report. Conventionally, atmospheric absorption is not a prerequisite of noise assessments.
		ii) S4.5 Table 4.6. Table 4.7 & S4.6 : the Consultant has not yet incorporated our previous comments on the Draft Key Issue Report. For your easy reference, a copy of relevant previous comments is attached (as follows)	The Consultant never received these comments. Please refer to the letter from Mr K Y K Wong of EPD dated 7 October 1993 which refers to that report and lists all comments on Air, Noise, Water Quality and Environmental Monitoring and Audit. You will note that the comments under Air include Sections 2, 3, 4 and 7 but not 5 or 6. These latter sections would appear to have been omitted during transcription.
		f) S4.5. Whilst excessive noise impacts have been identified based on a conservative approach as mentioned by the Consultant, the Consultant should take into account the utilisation factors of the equipment and atmospheric absorption in view of the large distance of the concerned NSRs from the quarry in the assessment to give a more realistic prediction of noise impacts.	Same comment as item 6(i).
		Regarding definition of "construction" processes and "industrial" processes, the Consultant should have received our letter ref EP 40/M2/1 II of 18.9.93. A copy of this letter is attached for your reference. In the captioned assessment, the prime concern of processes in this project should be concrete batching and rock crushing. As clarified in the above letter, these two processes should be considered "industrial" processes if they are simply for the preparation or manufacturing of concrete or aggregates for the purpose of sale to contractors for some construction works. On the other hand, these processes should be considered as "construction" processes if they are directly connected to some "construction works or projects". The above should be useful for the Consultant to review the classification of various processes in the assessment.	Pioneer Quarries will own and operate the batching plant and sell the concrete to Kumagai Gumi. When concrete is not required for the casting basin eg when the basin is flooded, Pioneer will be free to sell concrete to other contractors. The batching plant is not leased to Kumagai. Therefore by the adjacent definitions the concrete batching plant is taken as an industrial process.

Item	Respondent	Respondents Comments	Consultants Comments
6 cont.		g) Table 4.6. For petrol powered water pumps, the sound power level should be 103 dB(A) in accordance with the TM. For the low sound power levels (88dB(A)) quoted in this table, the water pumps should be electrically driven.	Kumagai Gumi have confirmed that electrically driven water pumps will be used.
		In accordance with the TM, sound power level of wheel loaders should be 112 dB(A) instead of 115 dB(A).	Noted. This was a typographic error and will be revised. However, the total SWL will remind the same.
		(h) Table 4.7. Whilst locations of some NSRs can be found in the report by making cross reference to the figures in Chapter 3, location of American Club is not shown in these figure. For easy reference of the readers, a location map showing all the NSRs in this table should be incorporated in Chapter 4.	American Club was shown in Figure 2.1 but it is accepted that it is necessary to reproduce this figure in Chapter 4. This has now been incorporated as Figure 4.1.
		(i) S4.6. 2nd Para. : The Consultant should confirm whether all equipment involved in the casting process would be located within the casting basin whilst a 10 dB(A) noise reduction have been applied for shielding effect of the basin itself in the noise assessment.	It is confirmed that all equipment involved in the casting process will be located within the Casting Basin.
		Last Para. : Limitation of vehicle flow induced by the quarry and the casting basin to normal daytime hours is strongly supported to eliminate noise impacts on the NSRs along the delivery route to the site in view of the low background noise levels at night in the area.	The operators are committed to this.

APPENDIX II

RECOMMENDATIONS FOR ENVIRONMENTAL CLAUSES FOR INCLUSION IN THE QUARRY AND CASTING BASIN OPERATORS CONTRACTS

RECOMMENDATIONS FOR ENVIRONMENTAL CLAUSES TO BE INCLUDED IN THE CASTING BASIN CONTRACT CONDITIONS

1 AVOIDANCE OF NUISANCE

(i) The Contractor shall be responsible for ensuring that no earth, rock or debris is deposited on public or private rights of way as a result of his operations, including any deposits arising from the movement of plant or vehicles. The Contractor shall provide a vehicle cleaning facility at the exits from the works areas where excavated material is hauled, to the approval of the Engineer and to the requirements of the Commissioner of Police.

(ii) The Contractor shall ensure that existing stream courses and drains within and adjacent to works areas are kept safe and free from any debris and any excavated materials arising from the Works. The Contractor shall ensure that chemicals and concrete agitator washings are not deposited in watercourses.

(iii) Water and waste products arising on works areas shall be collected, removed from works areas via a suitable and properly designed temporary drainage system and disposed of at a location and in a manner that will cause neither pollution nor nuisance.

(iv) The Contractor shall construct, maintain, remove and reinstate as necessary temporary drainage works and take all other precautions necessary for the avoidance of damage by flooding and silt washed down from the Works. He shall also provide adequate precautions to ensure that no spill or debris of any kind is allowed to be pushed, washed down, fall or be deposited on land or the seabed adjacent to works areas.

(v) In the event of any spoil or debris from construction works being deposited on adjacent land or seabed or any silt washed down to any area, then such spoil, debris or material and silt shall be immediately removed and the affected land or seabed and areas restored to their natural state by the Contractor to the satisfaction of the Engineer.

2 AIR QUALITY

General Requirements

(i) The Contractor shall undertake measures to prevent dust nuisance as a result of his activities. Any air pollution control system installed shall be operated whenever the plant is in operation.

(ii) The Contractor shall not install any furnace, boiler or other similar plant or equipment using any fuel that may produce air pollutants without the prior written consent of the Director of Environmental Protection (DEP) pursuant to the Air Pollution Control Ordinance.

(iii) The Contractor shall not burn debris or other materials on the works areas.

(iv) The Contractor shall implement dust suppression measures which shall include, but not be limited, to the following:

(a) Stockpiles of sand and aggregate greater than 20 m^3 for use in concrete manufacture shall be enclosed on three sides, with walls extending above the pile and 2 m beyond the front of the pile.

(b) Effective water sprays shall be used during the delivery and handing of all raw sand and aggregate, and other similar materials, when dust is likely to be created and to dampen stored materials during dry and windy weather.

(c) Areas where there is a regular movement of vehicles shall have all-weather surfaces to a standard agreed with the Authority and be kept clear of loose surface material.

(d) If used, conveyor belts shall be fitted with windboards, and conveyor transfer points and hopper discharge areas shall be enclosed to minimise dust emission. Conveyors carrying materials which have the potential to create dust shall be totally enclosed and fitted with belt cleaners.

(e) Cement and other such fine grained material delivered in bulk shall be stored in closed silos fitted with a high level alarm indicator. The high level alarm indicators shall be interlocked with the filling line so that in the event of the hopper approaching an overfull condition, an audible alarm will operate and the pneumatic line to the filling tanker will close.

(f) Air vents on cement silos shall be fitted with suitable fabric filters provided with either shaking or pulse-air cleaning mechanisms.

(g) Weigh hoppers shall be vented to a suitable filter.

(h) The filter bags in the cement silo dust collector must be thoroughly shaken after cement is blown into the silo to ensure adequate dust collection for subsequent loading.

(i) The provision of adequate dust suppression plant including water bowsers with spray bars or means of applying surface chemical treatment.

(j) If formed as part of this Contract, areas of reclamation shall be completed, including final compaction, as quickly as possible consistent with good practice to limit the creation of wind blown dust.

(k) The Contractor shall restrict all motorised vehicles on the work areas to a maximum speed appropriate to the quality of the haul roads and confine haulage and delivery vehicles to designed roadways inside the work areas.

(l) Where dusty materials are being discharged to vehicles from a conveying system at a fixed transfer point, a three-sided roofed enclosure with a flexible curtain across the entry shall be provided. Exhaust fans shall be provided for this enclosure and vented through a suitable fabric filter system.

(m) Any vehicle with an open load carrying area used for moving potentially dust producing materials shall properly fitting side and tail boards. Materials having the potential to create dust shall not be loaded to a level higher than the side and tail boards, and shall be covered by a clean tarpaulin in good condition. The tarpaulin shall be properly secured and shall extend at least 300 mm over the edges of the side and tail boards.

(n) Dry mix batching shall be carried out in a totally enclosed area with exhaust to suitable fabric filters.

3 MONITORING OF DUST (TSP) LEVELS

General Requirements

(i) The Contractor shall carry out the Works in such a manner as to minimise dust emissions during execution of the Works.

(ii) The Engineer may require equipment intended to be used on the Works to be made available for inspection and approval to ensure that it is suitable for the project.

(iii) The Contractor shall devise and arrange methods of working to minimise dust emissions, and shall provide experienced personnel with suitable training to ensure that these methods are implemented.

(iv) After commencement of the Works if the equipment or work methods are believed by the Authority to be causing serious air pollution impacts, remedial proposals shall be drawn up by the Contractor and, once approved by the Engineer, implemented. In developing these remedial measures, the Contractor shall inspect and review all dust sources that may be contributing to the pollution impacts. Where such remedial measures include the use of additional or alternative equipment such equipment shall not be used on the Works until approved by the Engineer. Where remedial measures include maintenance or modification of previously approved equipment such equipment shall not be used on the Works until such maintenance or modification is completed and the adequacy of the maintenance or modification is demonstrated to the satisfaction of the Engineer.

(v) If the Engineer finds that approved remedial measures are not being implemented and that serious impacts persist, he may direct the Contractor to cease related parts of the Works until the measures are implemented. No claims by the Contractor shall be entertained in connection with such a direction.

(vi) The Franchisee shall prepare a Monitoring and Audit Manual to the satisfaction of the Engineer. This will describe the detailed monitoring schedule, trigger and action levels. The Contractor will follow the actions and recommendations in this manual.

4 NOISE POLLUTION CONTROL

General Requirements

(i) The Contractor shall consider noise as an environmental constraint in his planning and execution of the Works.

(ii) The Contractor shall take all necessary measures to ensure that the operation of mechanical equipment and construction processes on or off the works areas will not cause any unnecessary and excessive noise which may disturb any occupant of any nearby dwellings, schools, hospitals, or premises with similar sensitivity to noise.

(iv) The contractor shall use such measures and shall maintain plant and silencing equipment in good condition so as to minimise the noise emission during construction works.

(iv) The Engineer may require equipment intended to be used on the works to be made available for inspection and approval to ensure that it is suitable for the project.

(v) The Contractor shall devise and arrange methods of working to minimise noise impacts, and shall provide experienced personnel with suitable training to ensure that these methods are implemented.

(vi) After commencement of the Works if the equipment or work methods are believed by the Engineer to be causing serious noise pollution impacts, the equipment or work methods shall be inspected and remedial proposals drawn up by the Contractor and, once approved by the Engineer, implemented. In developing these remedial measures, the Contractor shall review all construction noise sources that may be contributing to the pollution impacts, and propose changes to scheduling of activities, installation of plant soundproofing, provision of alternative plant, erection of sound barriers around part of the works areas or the location of construction noise sources, or any other measures that may be effective in reducing noise. Where such remedial measures include the use of additional or alternative equipment, such equipment shall not be used on the Works until approved by the Engineer. Where remedial measures include maintenance or modification of previously approved equipment such equipment shall not be used on the Works until such maintenance or modification is completed and the adequacy of the maintenance or modification is demonstrated to the satisfaction of the Engineer.

(vii) If the Engineer finds that approved remedial measures are not being implemented and that serious impacts persist, he may direct the Contractor to cease related parts of the Works until the measures are implemented. No claims by the Contractor shall be entertained in connection with such a direction.

Noise Monitoring and Compliance Audit Reporting

(i) The Franchisee shall prepare a Monitoring and Audit Manual to the satisfaction of the Engineer. This will describe the detailed monitoring schedule, trigger and action levels. The Contractor will follow the actions and recommendations in this manual.

5 WATER QUALITY

5.1 General Requirements

(i) The Contractor shall carry out the Works in such a manner as to minimise adverse impacts on the water quality during the execution of the Works. In particular he shall arrange his method of working to minimise the effects on the water quality within the works areas, adjacent to the works areas, on the transport routes to and from the works areas and at the loading, and dumping areas. Methods of working shall include, but not be restricted to, the following:

(a) The use of phenolic compounds shall be prohibited.

(b) Water pumped out of the basin shall pass through treatment tanks prior to discharge.

(c) All discharges from site shall comply with the Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters.

(d) All necessary Licences required for discharges shall be obtained prior to commencement of site works.

(e) To enable proper containment and delivery of on-site sewage to off-site municipal or private treatment plant, adequate supporting facilities such as vehicular access and storage capacity shall be provided.

(f) Preparation of the formwork shall, where practicable, be carried out outside the basin, including the cleaning and application of form oil or release agents.

(g) All maintenance of plant equipment shall be performed outside the basin wherever practicable.

(h) Refuelling of plant equipment shall as far as is practicable be performed outside the basin.

(i) A cofferdam shall be constructed to reduce impacts from sediment dredging and allow dry blasting and excavation.

(j) Prior to the basin being flooded the Contractor shall carry out cleaning of the basin to the satisfaction of the Engineer.

(k) No flooding shall commence unless the Engineer gives his written approval.

(ii) If marine plant is used on the Works, it shall be inspected by the Engineer to ensure that the plant is suitable for the project and can be operated to achieve the water quality requirements of this appendix. The Contractor shall provide facilities to the Engineer for inspecting or checking such vessels and shall not use such vessels or plant for the Works without the approval of the Engineer. The Engineer may require the Contractor to carry out trials of any plant or vessels to prove their suitability.

(iii) The Contractor shall devise and arrange methods of working to minimise water pollution and to meet the water quality requirements and shall provide experienced personnel with suitable training to ensure that these methods are implemented.

(iv) Before the commencement of the Works, the Contractor shall submit to the Engineer the proposed methods of working.

(v) After commencement of the Works, if the plant or work methods are believed by the Engineer to be causing serious water pollution impacts, the Contractor shall propose and implement remedial measures as detailed in the Environmental Monitoring and Audit Manual. Where such remedial measures include the use of additional or alternative plant such plant shall be used on the Works until approved by the Engineer. Where remedial measures include maintenance or modification of

previously approved plant, such plant shall not be used on the Works until such maintenance or modification is completed and the adequacy of the maintenance or modification is demonstrated to the satisfaction of the Engineer.

(vi) If the Engineer finds that approved remedial measures are not being implemented and that serious impacts persist, he may direct the Contractor to cease related parts of the Works until the measures are implemented. No claims by the Contractor shall be entertained in connection with such a direction.

(vii) The Contractor shall inform the Agriculture and Fisheries Department, Environmental Protection Department and Marine Department prior to the casting basin being flooded and the seagates opened.

(viii) The Contractor shall adhere to the requirements of the Environmental Monitoring and Audit Manual.

5.2 Cofferdam Construction

(i) The Contractor shall minimise adverse impacts resulting from the dumping operations on water quality. To achieve these requirements the Contractor shall design and implement methods of working that:

(a) minimise loss of material during transport of fill material;

(b) prevent discharge of fill material except at approved locations;

(c) prevent the avoidable reduction, due to the Works, of the dissolved oxygen content of the water adjacent to the Works;

5.3 WATER QUALITY MONITORING EQUIPMENT

The following conditions are to be implemented in conjunction with the requirements of the Environmental Monitoring and Audit Manual.

(i) The Contractor shall provide the following equipment within one week of the commencement of the Contract:

(a) Dissolved oxygen and temperature measuring equipment

The instrument shall be a portable, weatherproof dissolved oxygen measuring instrument complete with cable, sensor, comprehensive operation manuals, and be operable from a DC power source. It shall be capable of measuring:

* a dissolved oxygen level in the range of 0-20 mg/L and 0-200% saturation; and

* a temperature of 0 to 45° Celsius

It shall have a membrane electrode with automatic temperature compensation complete with a cable of not less than 30 m in length. Sufficient stocks of spare electrodes and cable shall be maintained for replacement where necessary. (YSI model 58 or 59 DO meter, YSI 5739 probe, YSI 5795A or similar approved).

(b) Turbidity Measurement instrument

Turbidity of the water shall be measured by the nephelometric method using a portable, weatherproof turbidity-measuring instrument complete with cable, sensor and comprehensive operation manuals. The equipment shall be operable from a DC power source. It shall have a photoelectric sensor capable of measuring turbidity between 0-100 NTU (Hach model 2100p or similar approved).

(c) Suspended Solids Sampling Equipment

A 12 volt DC powered peristaltic pump equipped with a Tygon tubing of at least 30m length, or Van Doorn type water sampler that consists of a PVC, glass or stainless steel cylinder with a capacity of no less than 1.5 litres and can be effectively sealed with latex cups at both ends, or similar approved.

(d) Water Depth Detector

A portable, battery-operated echo sounder. This unit can either be handheld or affixed to the bottom of the work boat if the same vessel is to be used throughout the monitoring programme. (Seafarer 700 or similar approved).

(e) 12V batteries and 200V/12V Battery charger

(ii) Monitoring instruments shall be checked, calibrated and certified by an approved accredited laboratory before use on the Works and subsequently re-calibrated at 3-month intervals throughout all stages of the water quality monitoring. Response of sensors and electrodes should be checked with certified standard solutions before each use. The turbidity meter shall be calibrated to establish the relationship between turbidity readings (in NTU) and levels of suspended solids (in mg/L). All such calibration data shall be made available to DEP for verification.

6 TERRESTRIAL ECOLOGY

(i) The contractors shall confine their working areas to within the quarry and shall avoid clearance or disturbance to specific areas, or features, such as streams outside the quarry.

(ii) All excavated material shall be stock-piled in a free-draining area where no impact can be caused to habitats of ecological interest. Materials shall not be disposed of in areas surrounding the quarry.

(iii) Watercourses around and adjacent to the working area shall be treated with extreme care. They shall not be used as repositories for waste materials.

(iv) Extreme care shall be exercised during the transportation, handling and storage of potential pollutants and in the operation of mechanised equipment to avoid spillage.

(v) If possible, no smoking, cooking or use of open fires should be permitted on the site. Where the use of fires is unavoidable, extreme care shall be taken. Some consideration shall be made for the provision of green belts and/or fire breaks to protect areas of high ecological value from fire and to enable other less mature low scrub areas to develop naturally by succession into tall scrub and woodland. The

contractors shall be required to provide and use fire fighting equipment should a hill fire occur in their area of responsibility.

(vi) Water shall not be removed from local stream courses.

(vii) The total demand for water shall be reduced through careful recycling of used water.

(viii) Used water should be disposed of in a way so as not to damage any vegetation or cause erosion.

7 GENERAL PROCEDURES FOR THE AVOIDANCE OF POLLUTION DURING TRANSPORTING, AND DUMPING

(i) The Contractors' equipment shall be designed and maintained to minimise the risk of silt and other contaminants being released into the water column or deposited in other than designated locations.

(ii) Pollution avoidance measures shall include but are not limited to the following:

(a) mechanical grabs shall be designed and maintained to avoid spillage and shall seal tightly while being lifted;

(b) vessels shall be sized so that adequate clearance is maintained between vessels and the sea bed at all states of the tide to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash;

(c) pipe leakages are to be repaired promptly and plant is not to be operated with leaking pipes;

(d) the marine works shall cause no visible foam, oil, grease, scum, litter or other objectionable matter to be present on the water within the work areas or dumping grounds;

(e) barges shall be fitted with tight fitting seals to their bottom openings to prevent leakage of material;

(f) excess material shall be cleaned from the decks and exposed fittings of barges before the vessel is moved;

(g) loading of barges shall be controlled to prevent splashing of dredged material to the surrounding water and barges shall not be filled to a level which will cause overflowing of material or water during loading and transportation.

(iii) The engineer may monitor vessels transporting material to ensure that no dumping outside the approved location takes place and that loss of material does not take place during transportation. The Contractor shall provided all reasonable assistance to the Engineer for these purposes.

(iv) The Contractor shall ensure that material is disposed of at the approved locations. He will be required to ensure accurate positioning of vessels before discharge and will be required to submit and agree proposals with the Engineer for positional control at disposal sites. Disposal in designated marine dumping grounds shall be in accordance with conditions of a licence issued by the DEP under the Dumping at Sea Act

(Overseas Territories) Order 1975. Floatable and certain contaminated material (as defined by DEP) will not be acceptable at marine dumping grounds and will require other method of disposal.

8 REMOVAL OF WASTE MATERIAL

(i) Notwithstanding the provisions of the GCC the Contractor shall not permit any sewage, waste water or effluent containing sand, cement, silt or any other suspended or dissolved material to flow from the works areas onto any adjoining land or allow any waste matter or refuse to be deposited anywhere within the works areas or onto any adjoining land and shall have all such matter removed from the works areas.

(ii) The Contractor shall be responsible for temporary training, diverting or conducting of open streams or drains intercepted by any works and for reinstating these to their original courses on completion of the Works.

(iii) The Contractor shall submit any proposed stream course and nullah temporary diversions to the Engineer for agreement one month prior to such diversion works being commenced. Diversions shall be constructed to allow the water flow to discharge without overflow, erosion or washout. The area through which the temporary diversion runs is to be reinstated to its original condition when the temporary diversion is no longer required.

(iv) The Contractor shall segregate inert construction waste material suitable for reclamation or land formation and shall dispose of such material at a public dumping area(s).

(v) Non-inert construction waste material deemed unsuitable for reclamation or land formation and other waste material shall be disposed of at a public landfill.

(vi) The Contractor's attention is drawn to the Waste Disposal Ordinance, the Public Health and Municipal Services Ordinance and the Water Pollution Control Ordinance.

(vii) The Contractor shall comply with the requirements of the Waste Disposal (Chemical Waste) (General) Regulation in respect of packaging, labelling, storing and collection of chemical waste produced on site.

9 COLLECTION OF FLOATING DEBRRIS

(i) The Contractor shall provide adequate services, which may include water-witch or similar type vessels, to operate within and around the quarry area for the purposes of collecting all floating debris and rubbish generated by or entrapped in or by the works to the satisfaction of the Waste Disposal Authorities.

(ii) The Contractor is required to collect and to keep the area within the quarry area free of floating debris. Should the Engineer consider that the performance of collection operations to be inadequate or ineffective, he will inform the Contractor who shall make proposals for improvement within one week. Should it be necessary to increase these operations then this shall be the responsibility of the Contractor after approval of the proposals by the Engineer.

(iii) The materials so collected shall be delivered by the Contractor to an approved Government landfill site.

(iv) Collection of floating debris and their disposal shall commence not later than the first flooding of the casting basin site and shall continue on a continuous or non-continuous basis, as required, until the casting operations cease.

10 DISCHARGE INTO SEWERS AND DRAINS

(i) The Contractor shall not discharge directly or indirectly (by runoff) or cause or permit or suffer to be discharged into any public sewer, storm-water drain, channel, stream-course or sea, any effluent or foul or contaminated water or cooling or hot water without the prior consent of the Engineer and relevant Authorities who may require the Contractor to provide, operate and maintain at the Contractor's own expense, within the premises or otherwise, suitable works for the treatment and disposal of such effluent or foul or contaminated or cooling or hot water.

(ii) If any office, site canteen or toilet facilities are erected, foul water effluent shall, subject to paragraph (i) above, be directed to a foul sewer or to a sewage treatment facility.

(iii) The Contractor's attention is drawn to the Buildings Ordinance, the Water Pollution Control Ordinance and the Technical Memorandum "Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters."

SHEK O QUARRY CASTING BASIN

ENVIRONMENTAL IMPACT ASSESSMENT

FINAL KEY ISSUES REPORT

ADDENDA

Item	Comments
Page 52, sub-point 2.	Replace "Quarry Operator" with "CED" on the third line.
Page 55, line 3.	Add "monitoring" between "ecological surveys".
Appendix 7B.	For paragraph under *Acampe multiflora* amend "all digenous" to "all indigenous".
Appendix II, Section 5.1(v), second sentence.	"not" should be included after..."such plant shall..."
Appendix II, general.	Reference should be made to Works Branch Technical Circular 32/92 "The Use of Hardwood in Construction Sites" when reviewing General Contract Clauses.