

4 ENVIRONMENTAL FRAMEWORK

4.1 Introduction

Before the impacts from the construction and operation phases of the project can be accurately quantified a concise assessment of the ambient conditions currently prevailing in the area is required.

Baseline environmental data for the study area have been collated from the environmental baseline study that was conducted as part of the LAPH study and other sources as described below. Population data have been obtained from the District Office and Census and Statistics Department and landuse data have been obtained from the Planning Department.

The background levels in the study area have been quantified for noise and air quality, water quality and hydrodynamics, sediment, land uses and population. It should be noted that since some of the data have been collated from areas in the vicinity of the study area some extrapolation of data is required in order to provide an assessment of the conditions within the study area. Most of the baseline monitoring was undertaken as part of the LAPH Study. The present assessment has been carried out using existing sources of data and no additional survey or monitoring work has been conducted.

The following data has been collected and analysed :

- (a) LAPH Study, Final Report/Executive Summary;
- (b) Master Layout Plan;
- (c) Phase 1 - planning and reclamation programme;
- (d) traffic data for 2001, 2011;
- (e) LAPH Air Quality Data, 1991;
- (f) original EIA baseline data from LAPH Study;
- (g) EPD Water Quality Data 1991;
- (h) emission factors of vehicles supplied by EPD;
- (i) schedules of construction activities;
- (j) plant and equipment and noise values;
- (k) Tung Chung CO data, 1991 (MMHK); and
- (l) Royal Observatory Meteorological Data 1992.

The existing data and their evaluation in terms of existing noise, air and water quality are discussed in subsequent chapters. The discussion in this chapter will therefore concentrate on an analysis of the population and landuses in the vicinity of the proposed study areas and an identification of areas containing sensitive receivers that could be affected by the project.

4.2 Areas Containing Sensitive Receivers

4.2.1 Sensitive Receivers for Air and Noise

The environmental framework discussed above has been analysed to identify the areas containing sensitive receivers that could be affected by the construction or operation of the port development. Any committed developments (e.g. Penny's Bay Power Station) which could be similarly affected, were also established at this stage. The sensitive receivers are shown on Figures 4.1, 4.2 and 4.3 and are discussed below.

The LAPH study concluded that residents of Discovery Bay and central Peng Chau would be the most severely affected Noise Sensitive Receivers (NSRs) during port operation.

Source-receiver distances range from one to nine kms. It is therefore not appropriate in most cases to select individual sensitive receivers. Sensitive uses to the west and south west may be more acutely affected by changes in noise and air quality from container terminals CT10 and 11 construction and operation due to the prevailing northeasterly winds.

Discovery Bay

Discovery Bay is a major residential development on Lantau Island lying over 3.5km west of the CT10 and CT11 site. Access to Discovery Bay is by boat; there is no vehicular access to other areas on Lantau Island and only limited vehicle usage within the community. The development is a mix of high, medium and low rise housing with associated commercial development. Closest sensitive receivers to the port development are sited on a promontory south of the ferry terminal, called Peninsula Village. The closest sensitive receivers are located in Cherish Court on Capeland Drive, a 17 storey high rise block at the eastern end of this promontory. In addition there are new medium rise blocks being constructed north of Cherish Court at the eastern end of Caperland Drive. At this point there is no topographic shielding between the port and the sensitive receivers.

Peninsula Village represents the southern boundary of the Discovery Bay residential development; other development occupies the bays and lower slopes of the hillsides to the north. In the future there is further development planned at Yi Pak on the northern side of Discovery Bay. The Sz Pak Tsui headland, immediately to the west of Penny's Bay provides some topographic shielding of the port to the planned development at Yi Pak. However there is no topographic shielding to the established areas of Discovery Bay.

Peng Chau

Peng Chau is an island off the east coast of Lantau. The population is concentrated in low rise residential areas on the western side of the island, though there are isolated SRs on the headland which forms the northern area of the island. This headland offers significant topographic protection to the main residential areas.

Fa Peng and Tso Wan

These small villages represent the closest sensitive development to the port. The villages are located in two river valleys on the east side of the Tsing Chau Tsai Peninsula. There is topographic shielding of the villages from parts of the port but there is limited shielding to the eastern end of Terminal CT10.

Lantau Port

The port development itself will be a sensitive receiver for air pollution. The only sensitive receiver for noise within the development will be a health centre which is proposed in the commercial area.

4.2.2 Sensitive Receivers for Water Quality

Sensitive receivers for water quality have been subdivided into :

- (a) livelihood : commercial, local and subsistence fishing industries or communities, fish culture areas;
- (b) recreation : gazetted and ungazetted beaches;
- (c) ecology : marine species of ecological importance (including the green sea turtles and Chinese White Dolphins);
- (d) other sensitive receivers include the seawater intake at Lamma Power Station, the main embayment at Tung Wan and specifically Discovery Bay.

The sensitive receivers which have been identified are illustrated on Figure 4.1.

4.3 Baseline Noise Levels

Data on the ambient noise levels around the study area were collated by the LAPH Study team in October and December 1991 and documented in the Background Noise Survey for the LAPH Study (1993). The survey was conducted over a 24 hour period to measure the background noise levels in terms of hourly L_{eq} , L_{10} , L_{50} and L_{90} .

The results for L_{90} are summarised in Table 4.1.

Table 4.1 Measured L_{90} Background Noise Levels

Location	Daytime L_{90} Noise Level (dBA)	Night-time L_{90} Noise Level (dBA)
Penny's Bay	40.2 - 48.4	35.2 - 51.8
Discovery Bay (north)	45.0 - 49.8	39.8 - 44.8
Discovery Bay (south)	50.4 - 58.0	35.2 - 48.0
Peng Chau (north)	50.1 - 54.9	42.8 - 49.0
Peng Chau (south)	52.3 - 56.7	43.1 - 50.8

The tranquil nature of the study area is confirmed by the baseline surveys.

4.4 Baseline Air Quality

Baseline air quality measurements have been taken at two sites within the study area, Cheung Chau and Discovery Bay, as part of the LAPH, Environmental Baseline, Working Paper 12A. The mean measured pollutant concentrations taken at the Discovery Bay site are shown in Table 4.2 below. It was noted that all the measured pollutant concentrations met the relevant AQO's. As CO data were not collected in the LAPH study and it has been agreed with EPD that ambient CO levels, as monitored at Tung Chung by MMHK in 1991, would be adopted as the background CO level in the study area (mean concentration = $296 \mu\text{g}/\text{m}^3$).

Table 4.2 Mean Measured Pollutant Concentrations at Discovery Bay

Pollutant	Arithmetic Mean $\mu\text{g}/\text{m}^3$	Geometric Mean $\mu\text{g}/\text{m}^3$	Standard Deviation
SO ₂	10		12.9
NO	3		10.5
NO ₂	41		28.9
TSP		90.6	
RSP		75	

4.5 Water Quality

Marine water quality is routinely monitored by the Environmental Protection Department (EPD). Monitoring stations selected for use in this Study are illustrated on Figure 4.4. Of specific interest is monitoring station SM10 which is located within Discovery Bay. A summary of water quality monitoring data collected by EPD in 1991 and 1992 which are relevant for this Project is presented in Table 4.3.

Marine water quality in the Study Area has been routinely monitored by Government since 1972. Data collected in this area reflects the estuarine conditions and the seasonal variation in water quality which prevail in the Western Waters and to the south east of Hong Kong Island. During the wet season the freshwater inflows from the Pearl River are predominant in the surface layers of the water column with oceanic waters forming the bottom layer. A well defined mixing zone for the two layered flows extends from the Western Harbour into the Study Area. During the dry season the extent of this vertical stratification is considerably reduced or even absent due to the reduction outflow from the Pearl Delta.

These seasonal variations in water quality are marked by the ranges of salinities obtained throughout the year and which vary considerably in different locations. Measured levels of inorganic nitrogen in the Study Area range from 0.13mg/l in the south of the East Lamma Channel to 0.31 mg/l in Discovery Bay. Total nitrogen values appear to be increasing in all parts of the Study Area except SM18 (south of the East Lamma Channel) and are of the order of 0.7mg/l. Despite this the ranges of chlorophylla-a which were recorded declined in 1992 compared with 1991 except at Station SM18 where supersaturation of the water column was also identified at some stage during the year. E.coli counts in Discovery Bay were higher than in other parts of the Study Area which could be due in part to the stormwater flows into the Bay and in part to the effluent discharges from the Peng Chau and Discovery Bay outfalls which discharge into the Tai Lei Channel.

From the summary of data given in Table 4.3 it may be observed that at station SM10, in Discovery Bay, E.coli counts were higher than at stations within the Lamma Channel. The source of pollution was probably domestic effluent discharged from the Discovery Bay sewage outfall. At the same location, dissolved oxygen levels varied considerably throughout the year, and nutrient loads were relatively high. Comparison of data over the two year period shows that dissolved oxygen levels have declined with a commensurate increase in turbidity, suspended solids and total nitrogen loadings in Discovery Bay.

Table 4.3
Summary of Existing Water Quality Monitoring Data

Parameters	SM9		SM10		SM11		SM18		
	1991	1992	1991	1992	1991	1992	1991	1992	
Temperature (deg C)	Surface	33.4 (18.0 - 92.9)	21.7 (15.3 - 28.0)	21.8 (16.5 - 24.9)	22 (15.4 - 29.2)	22 (15.8 - 25.3)	21.9 (17.2 - 26.5)	23.1 (15.4 - 28.2)	
	Bottom	21.7 (17.6 - 24.6)	21.1 (15.2 - 26.2)	21.5 (16.2 - 24.8)	19.9 (15.4 - 24.3)	21.6 (15.6 - 24.8)	21.6 (15.3 - 28.9)	20.7 (17.0 - 22.8)	21.5 (15.0 - 24.6)
Salinity (ppt)	Surface	30.3 (24.0 - 32.6)	30.2 (24.6 - 33.1)	30.9 (29.0 - 32.5)	31.3 (28.4 - 33.1)	30.9 (28.0 - 32.5)	30.8 (22.7 - 33.6)	29.1 (23.2 - 33.2)	
	Bottom	31.6 (30.2 - 32.6)	31.5 (29.6 - 33.1)	31.4 (29.3 - 32.5)	31.6 (28.8 - 33.1)	31.7 (29.5 - 32.5)	31.5 (29.8 - 33.1)	33.1 (31.8 - 34.1)	33.1 (32.2 - 33.8)
D.O. (% saturation)	Surface	91 (69 - 115)	83 (65 - 103)	94 (68 - 115)	91 (82 - 110)	98 (81 - 126)	116 (94 - 140)	111 (93 - 128)	
	Bottom	71 (49 - 81)	70 (51 - 86)	83 (57 - 105)	87 (81 - 98)	83 (50 - 107)	92 (40 - 188)	98 (59 - 180)	
pH value		8.1 (7.9 - 8.2)	8 (7.8 - 8.0)	8.2 (8.1 - 8.3)	8 (8.0 - 8.1)	8.2 (8.1 - 8.3)	8.2 (8.1 - 8.3)	8 (7.9 - 8.2)	
		1.6 (1.0 - 2.0)	1.3 (1.0 - 2.0)	1.3 (0.8 - 2.4)	1.2 (1.0 - 1.4)	1.4 (0.8 - 2.0)	1.4 (1.0 - 2.0)	2.3 (1.5 - 3.0)	2 (1.5 - 2.5)
Secchi Disc (m)		6.6 (3.7 - 12.4)	6.9 (3.1 - 10.0)	6.3 (3.4 - 10.5)	6.6 (4.9 - 10.8)	6.6 (3.7 - 12.3)	6.5 (4.0 - 11.8)	3 (1.2 - 4.5)	3.7 (2.1 - 5.1)
		6.8 (1.7 - 15.0)	9.3 (2.8 - 18.7)	8.2 (3.8 - 16.3)	8.9 (4.7 - 13.0)	8.2 (2.3 - 18.2)	10 (3.5 - 14.3)	5.3 (2.2 - 16.3)	4.6 (2.3 - 8.5)
BOD5 (mg/L)		1 (<1 - 1)	1.1 (0.7 - 1.5)	1 (<1 - 2)	1 (0.2 - 1.5)	1 (<1 - 3)	1 (0.2 - 1.9)	1 (<1 - 1)	1.4 (0.6 - 2.2)
		0.31 (0.08 - 0.49)	0.3 (0.15 - 0.46)	0.25 (0.14 - 0.36)	0.31 (0.12 - 0.54)	0.25 (0.12 - 0.37)	0.31 (0.15 - 0.53)	0.13 (0.02 - 0.22)	0.13 (0.03 - 0.26)
Total N (mg/L)		0.66 (0.58 - 0.78)	0.67 (0.28 - 0.90)	0.58 (0.41 - 0.95)	0.71 (0.41 - 1.07)	0.62 (0.45 - 0.96)	0.72 (0.41 - 1.11)	0.51 (0.31 - 1.09)	0.43 (0.14 - 0.72)
		0.03 (0.02 - 0.05)	0.03 (0.02 - 0.05)	0.03 (0.01 - 0.04)	0.04 (0.01 - 0.05)	0.03 (<0.01 - 0.04)	0.03 (0.01 - 0.05)	0.02 (0.01 - 0.03)	0.02 (0.01 - 0.03)
TP (mg/L)		0.09 (0.05 - 0.18)	0.14 (0.07 - 0.21)	0.1 (0.05 - 0.23)	0.1 (0.07 - 0.16)	0.1 (0.05 - 0.15)	0.1 (0.06 - 0.14)	0.08 (0.02 - 0.21)	0.11 (0.02 - 0.23)
		1.99 (0.20 - 6.90)	0.45 (0.30 - 0.67)	3.21 (0.33 - 8.00)	0.95 (0.47 - 1.47)	2.64 (0.27 - 7.33)	0.77 (0.37 - 1.10)	1.06 (0.23 - 2.77)	1.74 (0.33 - 6.07)
E.coli (no./100mL)		9 (3 - 22)	31 (13 - 42)	55 (34 - 110)	48 (7 - 187)	20 (5 - 110)	18 (7 - 47)	1 (0 - 4)	1 (0 - 1)

4.6 Marine Sediments

Routine monitoring of sediment quality is also undertaken as part of EPD's marine data collection programme. Sediment quality has been quantified using data collected under the Contaminated Spoil Management Study, which observed that sediments in this area are considered to be relatively uncontaminated. Sediment samples collected from within Penny's Bay did reveal elevated levels of mercury, indicating a moderate degree of contamination.

Sediment data collected at the mouth of Penny's Bay (site 126) and within the area to be reclaimed (site 127) are summarised in Table 4.4.

Table 4.4 Sediment Quality Data

Station	Sediment Quality Data Within and Adjacent to the Port Peninsula (mg/kg)						
	Cu	Cr	Cd	Pb	Zn	Ni	Hg
126	21	21	0.5	47	88	22	0.5
127	17	18	0.7	41	84	22	0.8

Reference : Lantau Port Development - Stage 1 Geotechnical Review, September 1993.

Data obtained from sediment samples collected within and at the mouth of Penny's Bay were generally defined as Class "A", indicating a relative lack of contamination. At station 127 however, levels of mercury reveal a moderate degree of contamination in the samples obtained.

The Geotechnical Review, issued in September 1993, included a proposal for further site investigations, including sediment sampling. Detailed vibrocore sampling surveys were subsequently carried out in accordance with the requirements of the Works Branch Technical Circular No. 22/92. Sediment samples were classified according to the definitions given in the EPD Technical Circular TC 1-1-92. This Technical Circular defines both the level of contamination and the method of disposal for sediments, depending upon the degree of contamination.

Details of the sampling and laboratory testing programmes are included in Appendix D. In summary the results of the laboratory analyses for the Serviced Area indicated that the sediments were class "A" with the exception of the vibrocore VB1, (refer to Appendix D for details), which was assigned to class "B" on account of the chromium content (62mg/kg cf the upper limit of 49 mg/kg for Class "A"). Further sediment sampling is currently being carried out in Penny's Bay in the areas where the proposal has been made to consider dredged reclamation rather than a drained land formation strategy. These additional analyses aim to define the quality of sediments in Penny's Bay and shall be used to determine the dredging and disposal techniques which should be adopted if this proposal is implemented.

Contaminated mud was revealed in the area to be dredged for the local breakwater through laboratory analyses of sediment samples which were collected in that area. EPD have advised in principle that the top 0.5m of the marine muds over the area to be dredged will be treated as contaminated, thus requiring special conditions to be applied during dredging and disposal operations. Details of the sediment testing programme and

the results are also provided in Appendix D. Some contamination was also related in the area to be dredged for the approach channel. Further detailed vibrocore testing is presently being carried out to determine the extent of this contamination so that appropriate dredging and disposal methodologies requirements can be defined.

4.7 Waste

Whilst no specific surveys have been undertaken, existing solid waste arisings within the study area principally relate to the domestic wastes generated by the resident population and a small contribution from industries within Penny's Bay.

Solid wastes arisings during construction will be mostly construction wastes, marine deposits and domestic wastes all of which can be estimated without requiring any supplementary data collection.

4.8 Land Contamination

A survey of the land uses in the study area has been carried out to determine likely sources of land contamination. This survey has included a review of land uses which exist at present and a physical inspection. Areas within Penny's Bay have been used for some years for industrial uses associated with the Cheoy Lee Shipyard. These uses have included a small foundry, oil, fuel and chemical storage together with other activities associated with boat and yacht building.

As a result of the contaminated mud found in Penny's Bay and the open dumping area in Cheoy Lee Shipyard it was originally proposed that a sampling survey be conducted to assess the possible extent of contamination on land. However we are now of the opinion that a sampling strategy would not be necessary, as this area will be covered with 5 - 6m of fill as part of the reclamation process. Should the site have been found to have been contaminated, the most appropriate method for dealing with the contaminated land would have been to cap it with 1 - 2m of fill. Therefore a sampling survey would not be required.

Figure 4.1
Sensitive Receivers

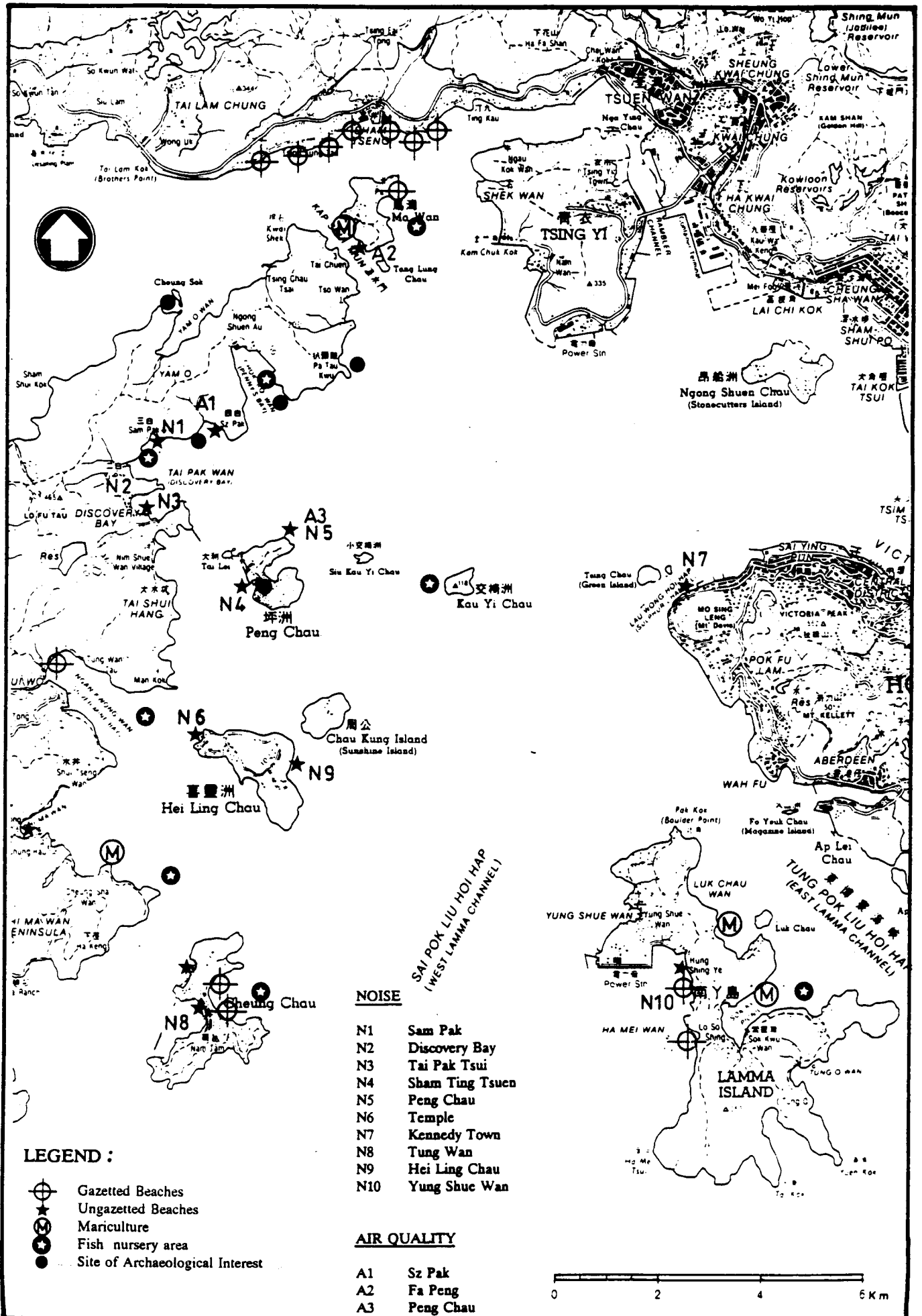


Figure 4.2
Noise Sensitive Receivers

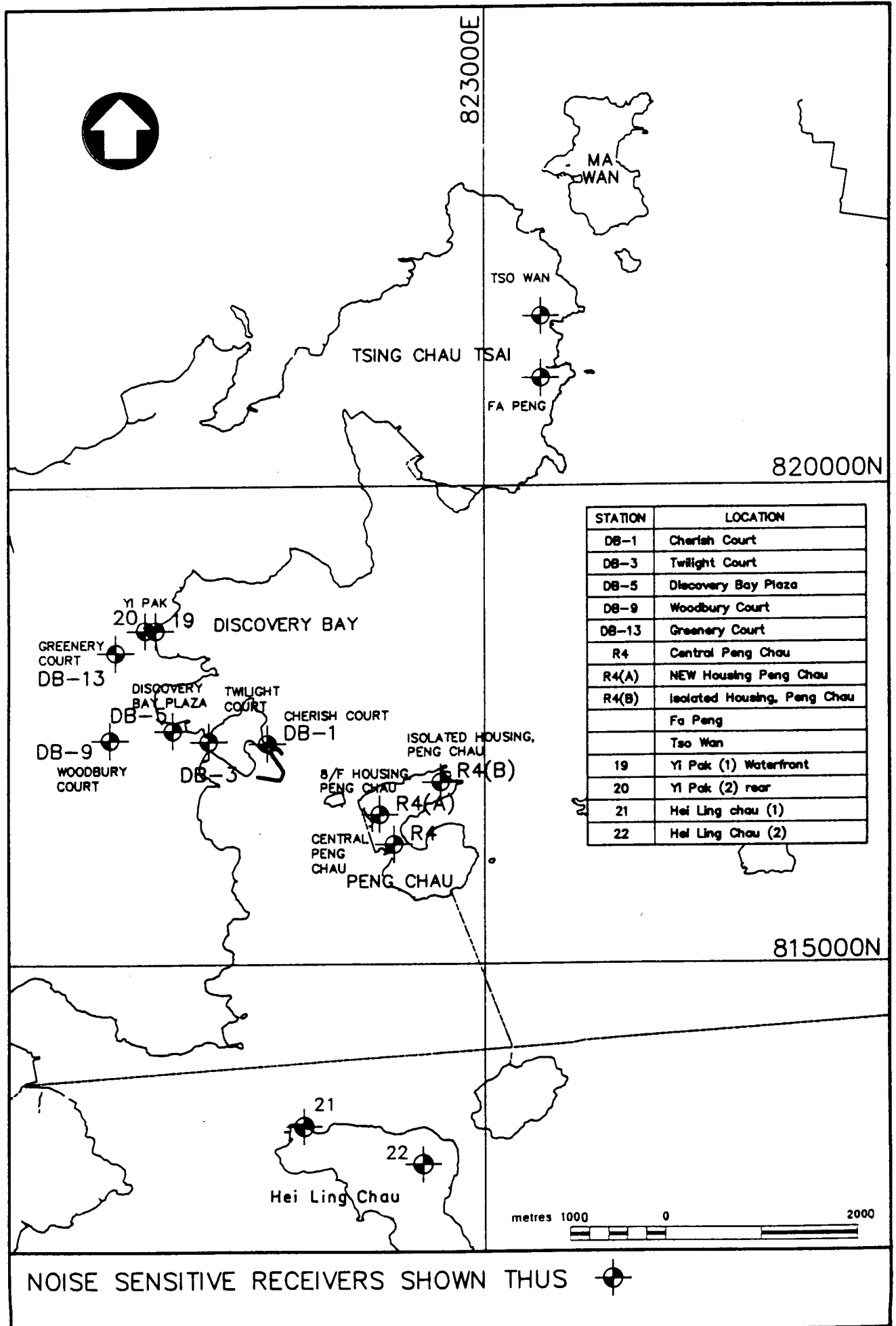


Figure 4.3
Air Sensitive Receivers

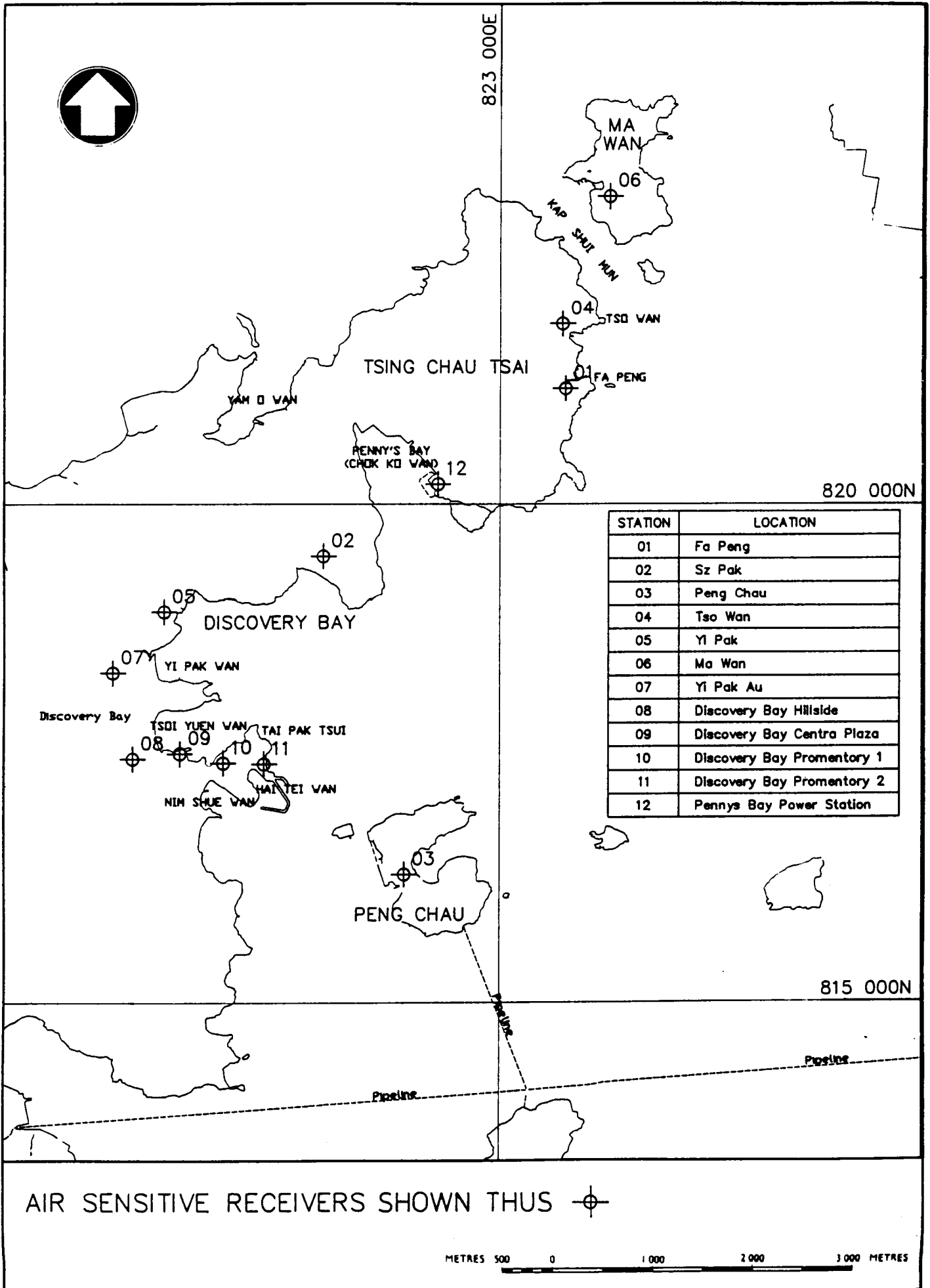


Figure 4.4
Water Quality Monitoring Stations

