Ting Kau and Sham Tseng Sewerage Scheme

Environmental Impact Assessment Study

Executive Summary

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Mott Connell Limited

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ENVIRONMENTAL IMPACT ASSESSMENT STUDY

EXECUTIVE SUMMARY

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Introduction

E.1 Hong Kong Government is proposing to implement the Ting Kau and Sham Tseng Sewerage Scheme as recommended under the Tsuen Wan, Kwai Chung and Tsing Yi Sewerage Master Plan (SMP) Study commissioned in 1989. The project comprises two Public Works Programme Items, namely 52DS - Ting Kau Sewerage and Pumping Stations and 126DS - Sham Tseng Sewerage, Sewage Treatment Works and Disposal Facilities. The Study Area is shown on Figure 1.

Scope of Work and Key Objectives

E.2 The main objective of this Environmental Impact Assessment (EIA) Study was to identify and evaluate, through detailed modelling studies, the level of treatment that should be achieved by the proposed Sewage Treatment Works (STW) and the optimum location and length of outfall and diffuser in order to achieve the Water Quality Objectives, particularly at the bathing beaches. Following this specification of the proposed level of treatment an EIA was to be carried out to assess the potential environmental impacts from the construction and operation of such a scheme. The key objectives of the environmental assessment were:

(a) to describe the proposed Project and associated works together with the requirements for carrying out the proposed STW and outfall as a design-and-build package;

(b) to review the proposed sewage treatment scheme of the Project, identify, evaluate and agree with the Director's Representative suitable sewage treatment options conforming with the specified effluent standards and the available site area for further study;

(c) to identify and describe the elements of the community and environment likely to be affected by the proposed Project, and/or likely to cause adverse impacts upon the proposed Project, including both the natural and the man-made environment;

(d) to identify and quantify emission sources and determine the significance of impacts on sensitive receivers and potential affected uses;

(e) to propose the provision of infrastructure or mitigation measures so as to minimise pollution, environmental disturbance and nuisance during construction and operation of the Project;

(f) to identify, predict and evaluate the residual impacts (i.e. after practicable mitigation measures) so as to minimize pollution, environmental disturbance and nuisance during construction and operation of the Project;

(g) to identify, assess and specify methods, measures and standards, to be included in the detailed design, construction and operation of the Project which are necessary to mitigate these impacts and reduce them to acceptable levels;

(h) to design and specify the environmental monitoring and audit requirements necessary for monitoring the effectiveness of the environmental protection and pollution control measures adopted;

(i) to investigate the extent of side-effects of proposed mitigation measures that may lead to other forms of impacts;

(j) to identify constraints associated with the mitigation measures recommended in the study; and

(k) to identify any additional studies necessary to fulfil the objectives to the requirements of this study or for the completion of the Project.

E.3 The Study comprised the assessment of water quality, air quality, noise, solid waste, risks and hazards, traffic impacts, landscape and visual impacts, and included a cost benefit analysis of the proposed treatment options and environmental and audit requirements.

The Proposed Development

E.4 The proposed site for the new sewage treatment works will be on newly formed land immediately west of the Garden Bakery Site. The sewer reticulation system will be laid under Castle Peak Road from Tsing Lung Tau in the west and Ting Kau on the east. The total length of the trunk sewer will be approximately 5.4 km and there will be a total of seven pumping stations the locations of which are indicated on Figure 1. Pollution prevention methods detailed in this report are proposed to be incorporated in the design-and-build package. This is particularly important because it is much more difficult (not to say costly) to retrofit pollution control measures after the facilities have been commissioned. Construction of the STW is scheduled to take place between 1996 and 1999 with an anticipated commissioning date at the end of 1999.

E.5 Effluent will be treated at the sewage treatment works and discharged to the marine waters via an outfall. The point of discharge and the optimum length of the diffuser section, which is the section that the effluent exits from, was a main component of this assessment. The length of the outfall and its orientation are constrained by engineering difficulties at this site. The length of the outfall cannot exceed 350m due to the fact that the seabed slopes sharply from about -20mPD to -40mPD at this point, thus giving rise to significant engineering problems in constructing a longer outfall. The currents are extremely fast in this location and provide a high level of dispersion. The diffuser section which comprises the last 50m of the outfall contains the discharge ports through which the treated sewage will enter the marine waters. The actual performance of the outfall in the operation phase should be determined following commissioning.Details of the Environmental Monitoring and Audit Programme should be agreed with EPD prior to commissioning of the outfall.

Environmental Framework

General Characteristics

E.6 The study area extends approximately 5.4 km along the coast by Castle Peak Road between Ting Lung Tsuen and Approach Beach.

E.7 Developments which have taken place in this area include low rise village dwellings between the Castle Peak and Tuen Mun Roads, which along with the high rise residential properties reflect the development trend for this area. A number of new low level residential dwellings have recently been built along the coast and on the Castle Peak Road in a style which reflects the fact that the area is becoming more affluent.

E.8 The six beaches (Gemini, Hoi Mei Wan, Casam, Lido, Ting Kau and Approach Beaches) situated on the north shores of the Ma Wan Channel are extensively used encouraged by the fact there are footpaths leading to these beaches from many of the residential developments in the area.

E.9 Government Projects which have been considered during the course of this Study include:

(a) The Ma Wan Channel Improvement Study, which comprises the widening and deepening of the Channel to benefit the navigation of ships through the channel thus reducing the probability of accidents;

(b) Castle Peak Road Improvement Study which comprises the widening and straightening of the Castle Peak Road; and

(c) Route 3 Country Park Section Project, which comprises a conveyor system and a barging jetty located to the east of the reclamation site.

E.10 The new configuration of the Ma Wan Channel has been incorporated as a fundamental assumption for the water quality assessment. It should be noted that as the Castle Peak Road Improvement Study will not be completed within the timeframe for this Project it is therefore recommended that the findings from both this EIA and the Castle Peak Road Improvement Study report are reviewed at the detailed design stage.

Future Land Uses

E.11 The San Miguel Brewery, Garden Bakery and the Union Carbide Depot will all be relocated outwith the sewage catchment area and these sites are zoned to become large, high rise, residential development areas. The Union Carbide site is due to be relocated outwith the Study Area by mid 1996 with construction on this site due to start in early 1997. A population increase in the Study Area has been estimated by the Planning Department and these will comprise largely quality private high rise developments located in the aforementioned industrial sites and also on specially formed land south of the Lido Garden.

E.12 Based on the projected population figures provided by the Planning Department and the Local Control Office of the Environmental Protection Department an estimate of the current and future flows and loads was prepared which subsequent input data for the bacterial dispersion model simulations were based on. For the design horizon of 2011, the effluent flow rate will be 13,367m^3/d with a BOD loading of 2.3 t/day. An estimated 2×10^{15} E.coli/day will be generated by the mainly residential and commercial population within the sewage catchment area.

Background Environmental Conditions

Water Quality

E.13 Water movements in the Study Area are dominated by the complex tidal regime which varies considerably between the wet and the dry seasons. The tidal regime in the wet season is strongly influenced by inflows from the Pearl River which give rise to marked variations in the local flows and stratification over depth. In the dry season the reduced freshwater runoff from the Pearl River is reflected by a relatively well mixed water column. In the intervening period between the wet and dry season there is a further complication with a degree of stratification in the water column when the predominantly dry season flow pattern prevails.

E.14 It has been concluded that once the reclamation has been formed the reduction in cross sectional flow of the whole channel will be less than 2% with the maximum reduction in bulk flows calculated to be less than 0.5% (during the wet season on a spring tide). It must be stressed that the land to be formed for the provision of the sewage treatment works, although in deep water (up to 20m) is located outwith the main tidal flow as illustrated on Figure 2. It was thus concluded that once formed the reclamation will have no far field impact on the tidal regime. Predicted changes in peak velocities (but not tidal phase) during both the wet and dry seasons are very small both in magnitude and duration and will be more than adequately compensated for by the reduction in pollution loadings to the coastal water.

Air Quality and Noise

E.15 The Study Area is a semi rural, predominantly residential area which is becoming more developed and at present the environment can be described as relatively tranquil. As outlined in the foregoing there are a number of large development planned for the Sham Tseng area and this will increase the existing ambient conditions. At present the noise sources include ferries, shipping, road traffic, community noise and various construction site noise (Ting Kau Bridge, Route 3 and Lantau Fixed Crossing Contracts). Dust emissions in the Study Area is likely to be affected by the numerous construction projects in the area.

Sensitive Receivers

Water Quality

E.16 Water quality sensitive receivers have been identified to include, bathing beaches (Dragon, Anglers, Gemini, Hoi Mei Wan, Casam, Lido, Ting Kau and Approach Beaches), seawater intakes, the fish culture zone which is divided into three areas located to the west of Tam Shui Wan, Shek Tsai Wan and Kung Tsai Wan and the marine ecology which includes the Chinese White Dolphins. These sensitive receivers are shown on Figure 3.

Air and Noise Sensitive Receivers

E.17 Ten sensitive receivers were identified by deciding those which will be most affected by the construction and/or operation of the proposed Sewerage Scheme. These receivers are located in close proximity to the proposed pumping stations, proposed truck sewer, reclamation or STW and are shown on Figure 4.

Level of Treatment and optimum length of Outfall and Diffuser

E.18 The design concept was to optimise the length of the outfall and the level of treatment applied in order to achieve the marine water quality objectives and the required water quality standards at the bathing beaches.

E.19 An initial indication of the optimum length of the outfall was determined using dispersion modelling. This modelling technique also indicates the level of treatment needed to achieve the water quality objectives. Confirmation of the acceptability of the optimum treatment level and outfall length was undertaken using a water quality model from the WAHMO suite, which was also carried out to define the cumulative effects on water quality in the Western Buffer Water Control Zone.

E.20 The cumulative effect of this Improvement Scheme on marine water quality, has been demonstrated to be minimal by the fact that there are very minor variations between the baseline and the predicted scenario. Improvements have been demonstrated in the immediate study area through the collection of the many diffuse sources of pollution and the subsequent discharge via the long outfall into the mainstream flow. Figures 5(a) and (b) show the plume movement of the plume during the wet (bathing) and dry seasons.

E.21 The results of the bacterial dispersion model indicate that the water quality at the sensitive receivers will be improved as a result of the scheme implementation.

E.22 The water quality model results indicate that the dissolved oxygen levels achieve the water quality objectives (>4mg/l) at the periphery of the mixing zone and at the fish culture zones and also confirm that inorganic nitrogen levels will also achieve the WQO's and especially those applicable to the ecological sensitive receivers.

E.23 The cumulative impacts of all discharges made to the receiving waters were addressed through the application of the water quality model incorporating the input of all known future pollution loads (SSDS Stage I, Siu Ho Wan, Urmston Road, Area 38, Pillar Point).

E.24 The prediction shows that the minimum level of primary treatment with the long outfall should achieve the WQOs at the sensitive receivers, at least in the context of the discharges from this Sewerage Scheme. However, caution should be applied to placing total reliance on the predictions because:

(i) The long outfall is still discharging very close to the shore (less than 350m).

(ii) The current regime at the discharge location is highly variable.

(iii) The background pollution loads is already high.

(iv) The configuration of the coastline is changing rapidly and new reclamation may have an as yet unquantifiable impact on the dilution and dispersion characteristics at the discharge location.

(v) The hinterland is developing rapidly and there are risks that pollution loads generated in the catchment area of the Sewerage Scheme could increase at a faster rate than currently envisaged.

E.25 Taking account of the modelling assumptions and the location factors specific to the discharge environment, it is prudent to assume that in order to ensure compliance with the WQOs, that a degree of treatment greater than primary be considered in order to provide higher removals of pollution constituents prior to discharge through the long outfall.

E.26 The exact treatment processes to be provided will be determined as a part of the design/construct contract, but it is envisaged that chemically enhanced primary or a similar process capable of meeting the discharge standards will be provided.

E.27 It may be concluded that on the basis of the results obtained and the interpretation of the data especially with respect to the compliance with the WQO's the objectives of this Study can be achieved through the implementation of the strategy in which effluent is treated to better than primary standard and discharged via a long outfall. It should also be stressed that the level of E.coli predicted by the modelling scenarios are due to background levels. It follows, therefore, that the effluent discharge standard can thus be defined as:

Minimum dilution	50 times
BOD	90 mg/L
SS	50 mg/L
NH_3N	23 mg/L
E.Coli	4,000 per 100 mL with flexibility for future upgrading to 1,000 per 100mL
Residual chlorine	0.5 mg/L
Oil and Grease	50 mg/L
pH	6-10 with pH of the receiving water not to exceed the range of 6.5-8.5 after initial dilution.

Environmental Benefits of the Scheme

E.28 The Study has concluded that with the implementation of the recommended treatment option plus the 350m long outfall the following benefits can be realised:

(a) Removal of the majority of the pollution from the adjacent coastal waters. The current pollution loading includes effluent from industrial and commercial sources, the majority of which will be relocated outwith the Study Area, and a domestic population of approximately 30,000 people. Therefore with the commissioning of the plant the resultant E.coli counts at the beaches will improve.
(b) improved sanitation to the local villages;
(c) removal of the public health danger and odour nuisance at present arising from the nullahs;

(d) water quality at the local beaches in the Tsuen Wan area will improve and as a result more people may be able to enjoy these recreational facilities than at present;
(e) increase in tourism and hence revenue into the area;
(f) additional local recreational area for resident thus reducing the need to travel in search of good bathing beaches and hence a potential for a reduction in road traffic and congestion; and
(g) ecologically better environment.

Environmental Impacts and Mitigation Measures

Water Quality

E.29 Potential water quality impacts arising during construction relate to the placing of fill (off-site transport) and the preparation of a trench for laying the pipeline. Measures to reduce the impact of construction include the recommendation that the southern and part of the western seawalls are constructed first, followed by placing of fill within a semi-enclosed basin. The Contractor will be required to monitor the marine works and to provide silt curtains around the seawater intakes (due west of the worksite) and refuse booms should the need arise.

E.30 The requirement to blast rock for the trench in which to lay the outfall will need to be established through, detailed survey work. If blasting is necessary it should be carried out by a diver during the winter months when conditions are less hostile than in the wet season. Because of the difficulties of underwater blasting in the location the size of the charges will have to be placed by hand and will be small, thereby minimising the risk to dolphins which may frequent these waters.

E.31 All of the potential impacts arising from the construction of the land based facilities will be minimised through the installation of appropriate pollution control measures and are considered relatively minor.

Air Pollution

E.32 The assessment has considered the impacts of dust from the reclamation, filling and surcharging and has concluded that the dust levels at all sensitive receivers will achieve the Air Quality Objectives with the inclusion of mitigation measures which include dousing water on any unpaved area and hydroseeding critical exposed surfaces. Furthermore, it is recommended that marine fill is used to complete the whole reclamation, since general fill has a much lower moisture content and is susceptible to a greater degree of erosion. The contractor will be required to monitor dust levels and implement dust suppression methods.

E.33 Potential odour impact during the operation phase was assessed and considered a key issue. For the purpose of this study it was assumed that the works would include the housing of the preliminary treatment and sludge treatment facilities in purpose built structures. The emission rate of hydrogen sulphide, which is the dominant malodorous gas likely to cause nuisance, was modelled. Based on the odour removal efficiency of proprietary equipment which has been proved in practice and proposed for other sewerage schemes in Hong Kong a reduction of 99.9% can be achieved and will reduce the odour levels at the sensitive receivers to as low as 0.2 - 1.3 odour units, which would achieve the criteria specified by EPD. Residual impacts associated with these facilities are minimal, being confined to the regeneration or replacement of activated carbon.

E.34 Activated carbon can be regenerated on-site. It has been proven that regenerated carbon has an adsorptive capacity similar to new carbon. In off-site regeneration spent carbon is usually transferred directly by hydraulic means from the adsorbers into a waiting truck or other containment vehicle. The resultant odour impacts are minimal as the regeneration furnace can be fitted with deodorisation plant and any containment systems will be enclosed. Residual odour impacts associated with the regeneration and replacement of activated carbon will therefore comply with the odour criteria specified by EPD. Although activated carbon has been evaluated as a suitable treatment system alternative processes should be evaluated at the detail design stage to define the optimum.

E.35 This odour assessment has been based on primary treatment. In order to take cognizance of the assumptions used in the water quality modelling and the reliability of the predictions, it is considered prudent to adopt chemically enhanced primary treatment or similar. The odour impacts from this level of treatment will not be worse than those from conventional primary treatment hence the conclusions in this section remain valid.

Noise Pollution

E.36 The construction phase noise impacts have been assessed to be mainly due to the construction of the trunk sewers. Predicted day time noise levels are between 77 and 87 dB(A) compared to 53 dB(A) at present. The assessment has shown that the noise levels from this activity are likely to be high but these can be mitigated by reducing the number of noisy plant such as pneumatic drills, excavators and vibrators. Furthermore, it has been recommended that the Contractor should review and revise his construction programme, method of working and mobilisation of equipment until the acceptable noise levels are achieved. The cumulative noise impacts from the construction of all other works including the reclamation, pumping stations and STW have been predicted to be within criteria set in the Noise Control Ordinance and the established guidelines. The Contractor will be required to monitor noise levels and implement noise reduction methods in working practices.

E.37 The operation phase noise impacts have been identified to emanate mainly from ventilation fans and plant pumps and motors and it is recommended that acoustic treatment is applied to the equipment that have the potential of causing nuisance. It has been concluded that with the implementation of the mitigation measures noise arising from the plant will be below the existing background level and therefore minimal.

Solid Waste

E.38 Solid waste arisings during construction will be confined to domestic wastes, spent construction materials, including bentonite, grouts, formwork, and similar materials. Reuse and recycling of these materials is recommended although all putrescible wastes will need to be disposed of on a daily basis.

E.39 The quantity of waste arisings during operation will be dependant on the actual sewage treatment process adopted. It is anticipated that the quantities will be relatively small and procedures for the collection, storage and disposal of the grit, screenings and sludge will be incorporated within the operations manual. Disposal of these materials will be to landfill and the primary sludge will need to be conditioned and dewatered to achieve 30% dry solids content by weight before removal from site.

Landscape and Visual Impacts

E.40 During construction the visual impacts can be reduced at the STW site by the use of hoardings to eliminate the works from ground level view. Visual impacts perceived by road users will be linked to diversion of traffic.

E.41 Because the surrounding landscape is an attractive shoreline, the seawall which will be constructed in accordance with engineering requirements should be sensitively detailed and co-ordinated with both the natural coastline and the future redevelopment proposals at the San Miguel Brewery, Union Carbide Depot and Garden Bakery sites. The ultimate location of the STW within the proposed area of reclamation is a critical element within the overall design of the landscape. In order to provide adequate screening of the STW a buffer zone between the edge of the reclamation and built form should be established. The design of the STW, whilst complying with all engineering requirements should be sensitively designed as an architectural element within the landscape, this includes refining elements of engineering criteria with architectural detailing for elevations such as appropriate cladding material and co-ordinated colour scheme.

E.42 It should be noted that in the future the Garden Bakery, San Miguel Brewery and the Union Carbide Depot will be redeveloped into high rise residential flats therefore sensitive design of the plant taking into consideration the view from these flats should be a key issue addressed at the detailed design stage. With careful plant layout and blending of colours and materials the scheme should not be intrusive.

Traffic Impacts

E.43 During the construction phase it is anticipated that disruption to traffic will result from the laying of the sewers along Castle Peak Road. It has been recommended in this Study that one-way traffic operations should not exceed 50m and the Contractors will be required to work to this constraint. To minimise disruption of traffic in the long term it is recommended that the roadwork associated with the Castle Peak Road Improvement Project be combined with the laying of the sewers. It is also recommended that materials are brought onto and exported from site by marine transport to minimise the congestion on already heavily used roads.

E.44 In terms of marine traffic impacts, this study has shown that due to the small scale of the reclamation and the relatively short length of outfall there will be few vessels required to complete the contract. Therefore, with the implementation of measures discussed in this Report impacts from marine traffic can be managed so as to prevent accidents or disruption to marine traffic. However, it is recommended that a more comprehensive Marine Traffic Impact Assessment for the proposed outfall be carried out at the detail design stage and that the final design, contract documents, contractors' method statements, etc. be agreed with Marine Department and other relevant bodies.

Risk and Hazard Evaluation

E.45 The main risk associated with this scheme is the possible build up of H_2S and/or explosive gases in confined spaces. Monitoring, maintenance and checking procedures have been outlined and it has been recommended that the operators follow standard procedures for monitoring and routine maintenance so that risks and hazards will be minimal.

Environmental Monitoring and Audit Requirements

E.46 Environmental Monitoring and Audit of both the construction and operation phase of the scheme will be necessary to ensure that mitigation measures are adopted, are shown to be effective, and procedures set out to detail the responsibilities of the Engineer and Contractor/Operator should there be any unacceptable deterioration in the environmental conditions management. An Environmental Monitoring and Audit Manual, prepared by the Engineers should be issued at the commencement of each Works Contract including the detailed technical procedures that the Contractor and Engineer should be contractually bound to comply with. Thus a system will be set up to ensure that all reasonable steps are taken to maintain acceptable environmental conditions which comply with Government standards, regulations and guidelines.

E.47 Actual performance of the outfall following commissioning will be determined by Environmental Monitoring and Audit of the operational phase, the details of which should be agreed with EPD prior to operation of the outfall and in sufficient time to enable a suitable baseline to be determined.

Summary of Mitigation Measures

E.48 A summary of mitigation measures discussed in this Study is presented in Table 1. These should be implemented and/or procedures formulated at the detailed design stage of the project.

Table 1 Summary of Mitigation Measures during Construction and Operation

Issue/Impact	Mitigation Measure
WATER QUALITY IMPACTS - CONSTRUCTION PHASE	
Release of sediments during dredging/ Excavation	If contaminated mud is identified in the area to be dredged for the trench then • dredging will need to be carried out in accordance with the requirements of the EPD and Fill Management Committee (FMC), using inter alia closed grabs; • no material will be allowed to overflow while being lifted; • the Contractor will be required to apply for a licence to dispose of the marine mud at East Shau Chau and will need to provide details of timing of wastes arisings, volumes, levels of contamination to the FMC in his application; and • restricting the daily dredging rate will reduce the release rate of pollutants to the water column. • if mud or dredged material is uncontaminated mitigation measures to reduce suspended solids are required. Once this activity is complete there will be no impact in terms of water quality in the Study Area.
Blasting Rock and the effect on Marine Ecology	Define need to remove rock via a bathymetric survey. Place charges by divers, use small charges which have minimum impact on receiving water and marine ecology.
Release of fines and offsite transport when placing of fill	Forming the southern and western seawalls before the reclamation or place fill behind bunds with lagoons for settlement of suspended solids before the tailwaters discharge to the sea.
Uncontrolled runoff from worksites discharging into water courses and ultimately marine waters	• provide drainage channels at the seaward edge of the reclamation to prevent overflow of surface drainage. Stormwater should be channelled through silt traps or settlement lagoons to reduce the silt load before discharge. • reduce water consumption in site, and recycle/ reuse water wherever possible. • treat according to provision of TM and Practice Note ProPECC PN 1/94.
Spillages of materials used directly or indirectly during construction	• preparation of a spill response plan.
Disposal of domestic effluent	A package treatment plant should be provided for construction effluents until such time as the sewerage connection. The facilities must be suitable to accommodate the maximum number of personnel who may be engaged on-site at a given time, and, the discharge point must not be into any embayment or sheltered water or to bathing beach. An effluent disposal method which results in no discharge is preferred unless it can be demonstrated that such a measure is not feasible for this site.
Release of sediment crossing the Sham Tseng Nullahs with the sewer	• quantification and classification of sediment quality. • define need to dredge nullahs, avoid disturbance to these materials if possible/practical • consider installation of silt screens/curtains at the entrance to the nullah to prevent off site transport of dredged materials

Table 1 Summary of Mitigation Measures during Construction and Operation (Cont'd).

Issue/Impact	Mitigation Measure
WATER QUALITY IMPACTS - OPERATION PHASE	
discharge of treated effluent into the Ma Wan Channel	A 350m long outfall with two caps 50m apart and 3 ports in each cap should be provided. The design and construction should be carried out only after prior approval by Marine Department, Agriculture and Fisheries Department, and Civil Engineering (Port Works).
raw sewage collected from the catchment area requiring treatment	Provision of a Sewage Treatment Works which complies with the effluent discharge standard as stated in this Report.
possible hydraulic performance problems associated with the outfall	Monitoring of the hydraulic performance of the outfall which may be undertaken by regularly recording the water levels in the outlet chamber and correcting this data with the discharge rate through the outfall. A control system should be installed which should be programmed to trigger an alarm if predetermined criteria are exceeded.
possible reduction in diffuser efficiency	Water quality monitoring of the receiving waters to confirm that the water quality standards to which the diffusers are designed are being achieved.
possible disposition around the diffusers	Monitoring of sediment disposition rates around the diffusers to determine accretion rates and to define any maintenance dredging requirements
AIR QUALITY - CONSTRUCTION PHASE DUST IMPACTS	
dust from reclamation fill material	Marine fill material should be used as this has a much higher moisture content and therefore greatly reduces the emission of fugitive dust
erosion of the reclamation surface layer	hydroseeding all unpaved areas 80m from the northern boundary of the reclamation immediately adjacent to the Garden Bakery Site using material such as decomposed granite.
construction site activities including dust impacts from the use of unpathed haul roads	Enforcement of Contract Conditions which will require Contractors to implement mitigation measures such as, provision of wheel washing bays, watering of haul roads, phasing of works such that no two activities likely to cause high dust levels coincide and implementation of Environmental Monitoring and Audit procedures which should include detailed action plans required of the Engineer and Contractor.
AIR QUALITY - OPERATION PHASE ODOUR IMPACTS	
potential odour impacts from pumping station wet wells, ventilation outlets of enclosures and sedimentation tanks	Provision of deodorisation equipment which will be capable of reducing the odour levels to EPDs recommended odour level (predicted 5 odour units averaged over 5 seconds measured at odour sensitive receivers). Odour monitoring to ensure that the all deodorisers are in good working order. This should include a routine odour patrol. The Operators should be contractually bound to demonstrate that all operations meets the odour standard of 2 odour units measured at the site boundary. Compliance with a monitoring/action plan procedure is essential.

Table 1 Summary of Mitigation Measures during Construction and Operation (Cont'd).

Issue/Impact	Mitigation Measure
NOISE - CONSTRUCTION PHASE IMPACTS	

noise impacts from powered mechanical equipment	• all equipment should be silenced where possible
	• portable screens should be installed where necessary and especially if the sensitive receiver is in close proximity
	• predictive noise assessments should be carried out based on the likely construction programme so that parallel noisy activities can be avoided. the following should be reviewed at the detailed design stage:
	  • construction programme
	  • scheduling of noisy works
	  • siting of noisy equipment
	  • reduction in the number of noisy equipment where possible

piling noise	The predicted noise level arising from piling activities should be calculated so that the period allowed from piling can be assessed. Licensing conditions must also be strictly followed.
NOISE - OPERATION PHASE IMPACTS	
potential noise from M&E equipment such as motors, ventilation fans, and pumps.	installation of acoustic enclosure wherever feasible and equipment specific acoustic silencers.
SOLID WASTE - CONSTRUCTION PHASE	
residual construction material	Inert material could be incorporated into the reclamation fill material BUT not organic matter. This should be taken to the closest landfill.
waste from vehicles, plant equipment, repair facilities, concrete or asphalt batching plant if required	Installation of bunds at concrete or asphalt batching plants to contain any materials which may be spilled during construction (the liquid fraction should be discharged via the foul sewer). An accident response plan should be provided by the Contractor. Waste oil, grease, lubricants and batteries to the Chemical Waste Treatment Centre in Tsing Yi and controlled according to the Waste Disposal (Chemical Waste (General)) Regulations.
SOLID WASTE - OPERATION PHASE	
generation of grit and screenings from the sewage treatment works	This should be taken to the closest landfill in a closed skip or container on a daily basis.
generation of sludge from the sedimentation process	This should be transported to landfill in a closed container on a daily basis. Sludge will be required to be conditioned and dewatered to achieve a 30% dry solids content by weight.
generation of waste, from packaging and containers used for the delivery of, for example polyelectrolyte if this is to be used to assist in the sludge dewatering process	This should be taken to landfill on a daily basis.

Table 1 Summary of Mitigation Measures during Construction and Operation (Cont'd).

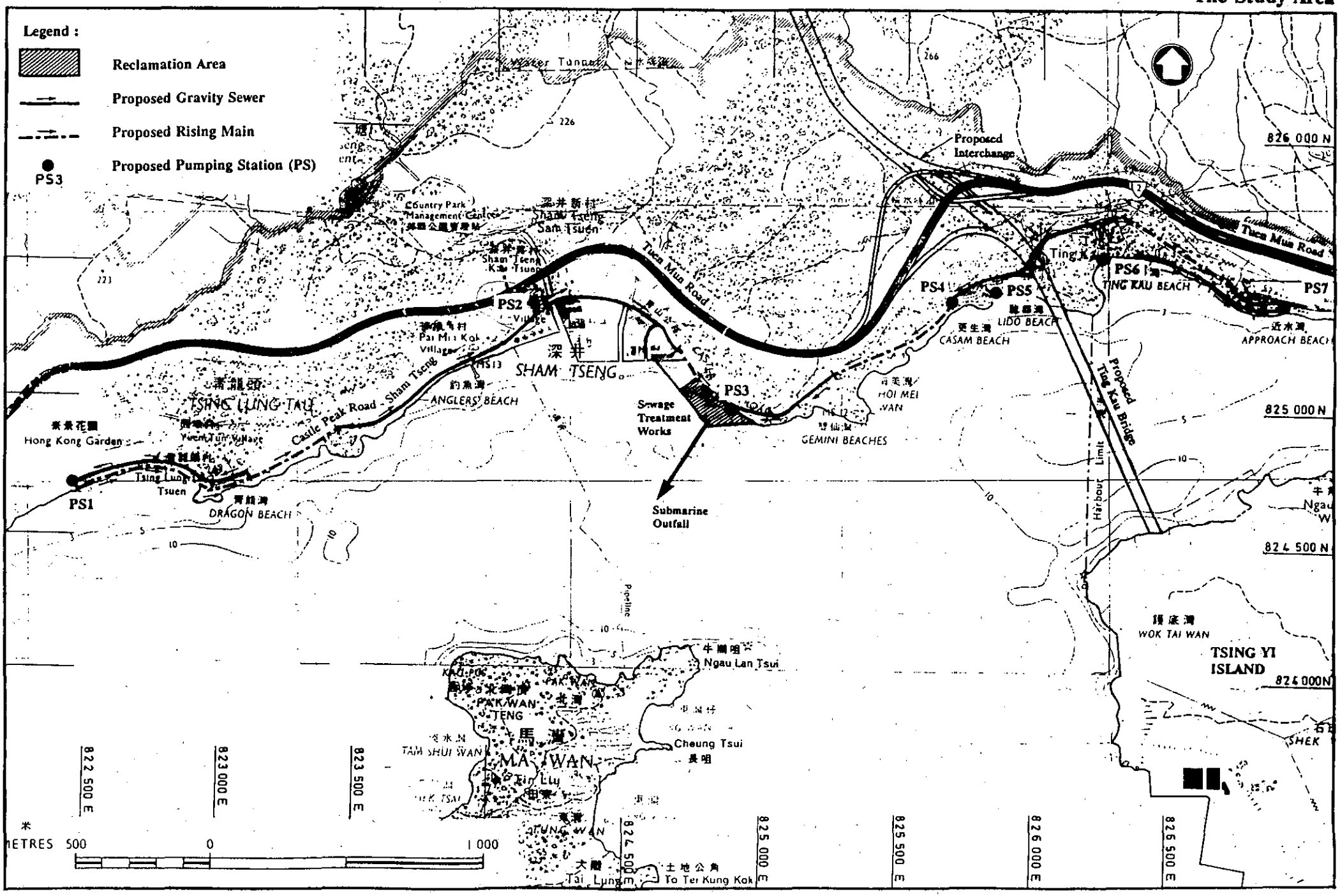
Issue/Impact	Mitigation Measure
RISKS AND HAZARDS - OPERATION PHASE	
possible build up of toxic and/or explosive gases in confined spaces, primarily H_2S gases. Explosive compounds include gases released from volatile substances which may be illegal or accidentally discharged into the sewers (e.g. petrol, kerosene, and methane gas produced from the sewage.	Installation of gas detection systems and monitoring procedures is essential. An effective permit to work system should be implemented for times when access to enclosed spaces is required. Provision of portable ventilation fans and explosion proof lighting, gas detection equipment and breathing apparatus, all of which must be maintained in a good working order throughout the working life of the treatment plant.
risk of failure or malfunction at the plant causing overflow of untreated (screened only) effluent.	Minimal risk but an emergency discharge should be installed which should be below the water mark to minimise nuisance and the emergency overflows should be discharged at least 100m away from the boundaries of a gazetted beach and 100m away from any seawater intake point. During such an event sludge should be temporarily stored in the sedimentation tanks with partially treated and untreated effluent being discharged to the Western Buffer Water Control Zone for the duration of the breakdown.
failure of pumping station motors or pumps	Provide standby motor and pumps at all pumping stations incorporating fail safe systems. Implement routine maintenance of equipment to prevent this occurrence.
TRAFFIC IMPACTS	
possible disruption to traffic in the Ma Wan Channel	Marine traffic watchmen/guards should be stationed by the marine waters within the vicinity of the construction activities to provide the necessary monitoring of the busy shipping route in order to prevent shipping accidents and to minimise disruption to traffic.
traffic congestion caused by the laying of the trunk sewer	The length of the of the works area should be no more a maximum of 50 m. Shorter lengths are preferable to ensure that queues and delays do not occur.
VISUAL IMPACTS	
location of pumping stations close to sensitive receivers and beaches	Implementation of the design guidelines which recommends the following: • sensitive landscaping • concentration of all buildings in one area • sensitive design of buildings • low elevation of buildings • co-ordination of planning with the other uses on the reclamation • landscape reinstatement
locating the STW where it can be seen from the high rise residential block, the buffer/recreational area, and the Ma Wan Channel	

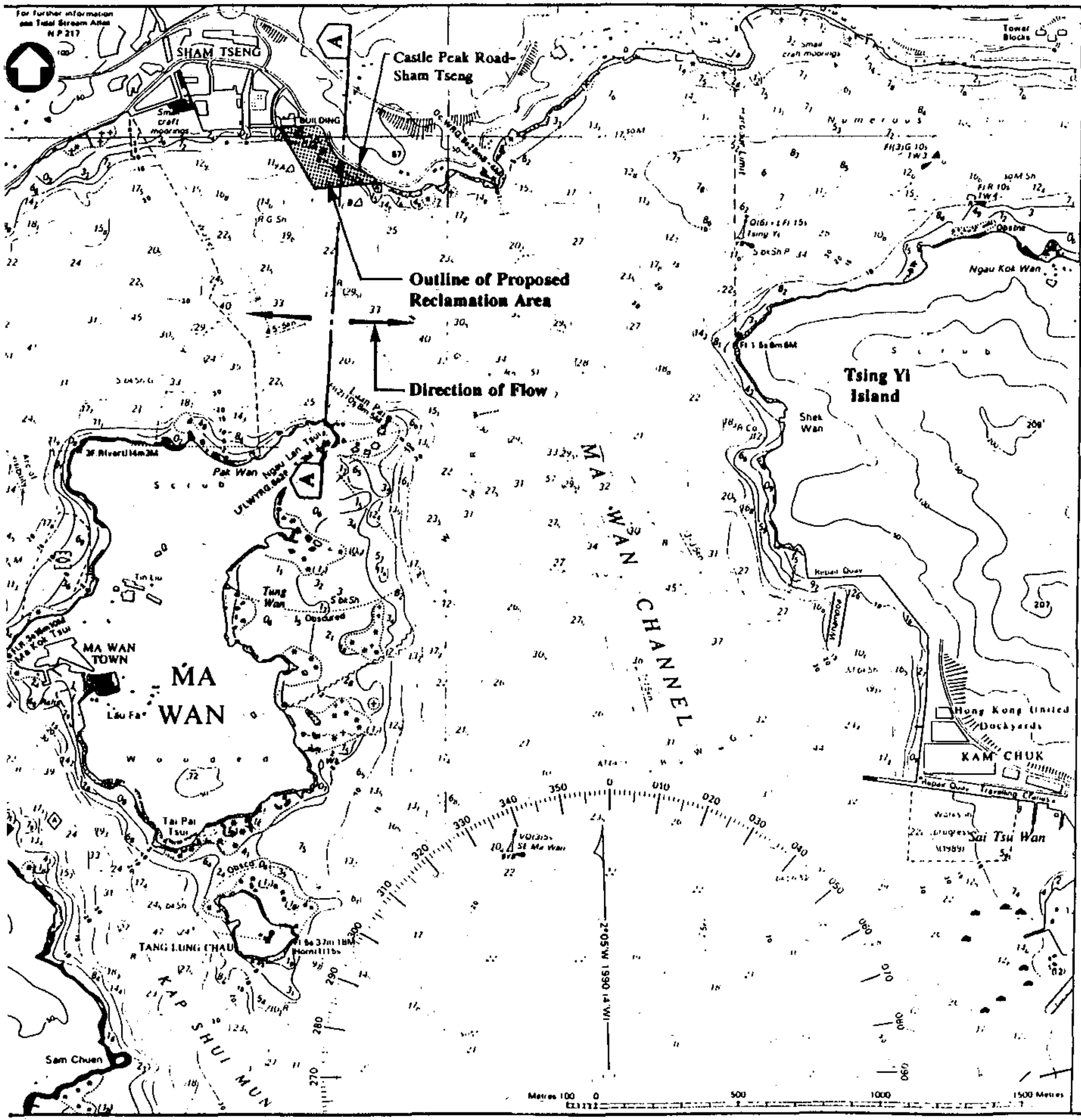
Conclusions

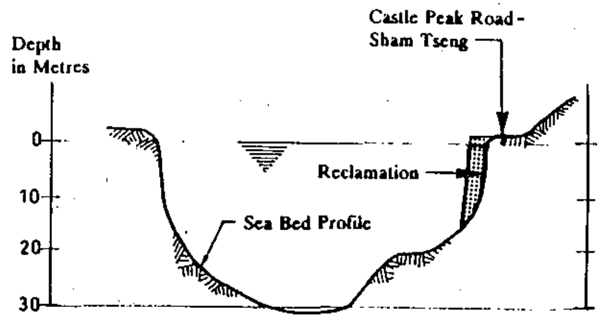
E.49 The Study has shown that an environmental improvement will result from the implementation of this Scheme and also that it will be possible to construct and operate the scheme within the guidelines set for acceptable environmental conditions provided that careful note is taken of environmental impacts throughout the design.

E.50 The primary conclusion is that the proposed Environmental Improvement Scheme is able to be constructed and operated with minimal impact on its surroundings. Furthermore the scheme is capable of being extended or upgraded without undue environmental impact should actual population and wastewater loads exceed the current projections. The proposed land formation has adequate capacity to accommodate such expansion.

Figure 1
The Study Area







Section at A-A

Scale : Horiz = 1:15000
Vert. = 1:1000 N.B.70% FROM ORIGINAL

Total Area = 20752.5m²
Reclamation Area = 450m²

Figure 2
Reduction in Cross Sectional Area as a result of Reclamation

Figure 3
Location of Water Sensitive Receivers

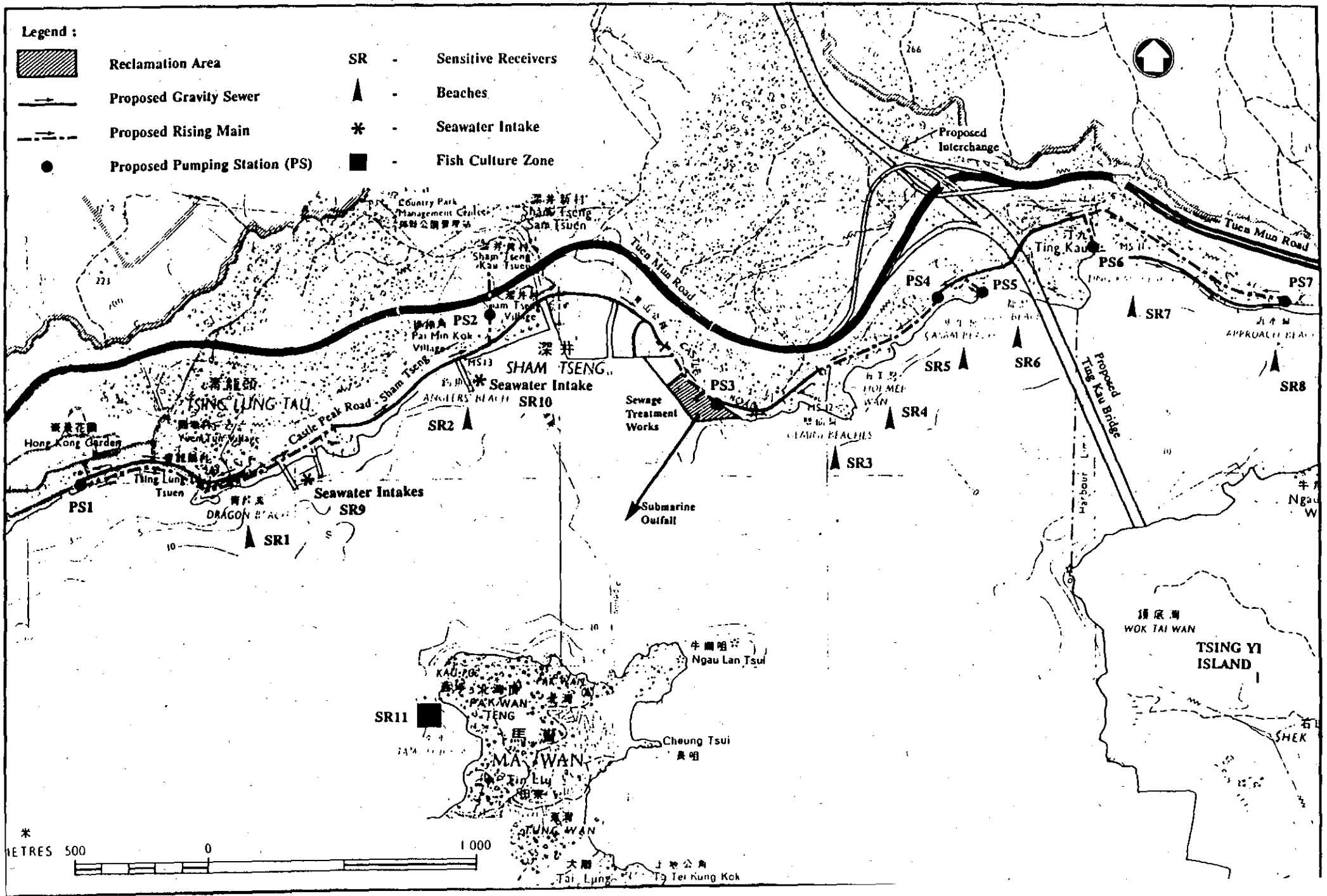


Figure 4
Location of Air and Noise Sensitive Receivers
(Sheet 1 of 2)

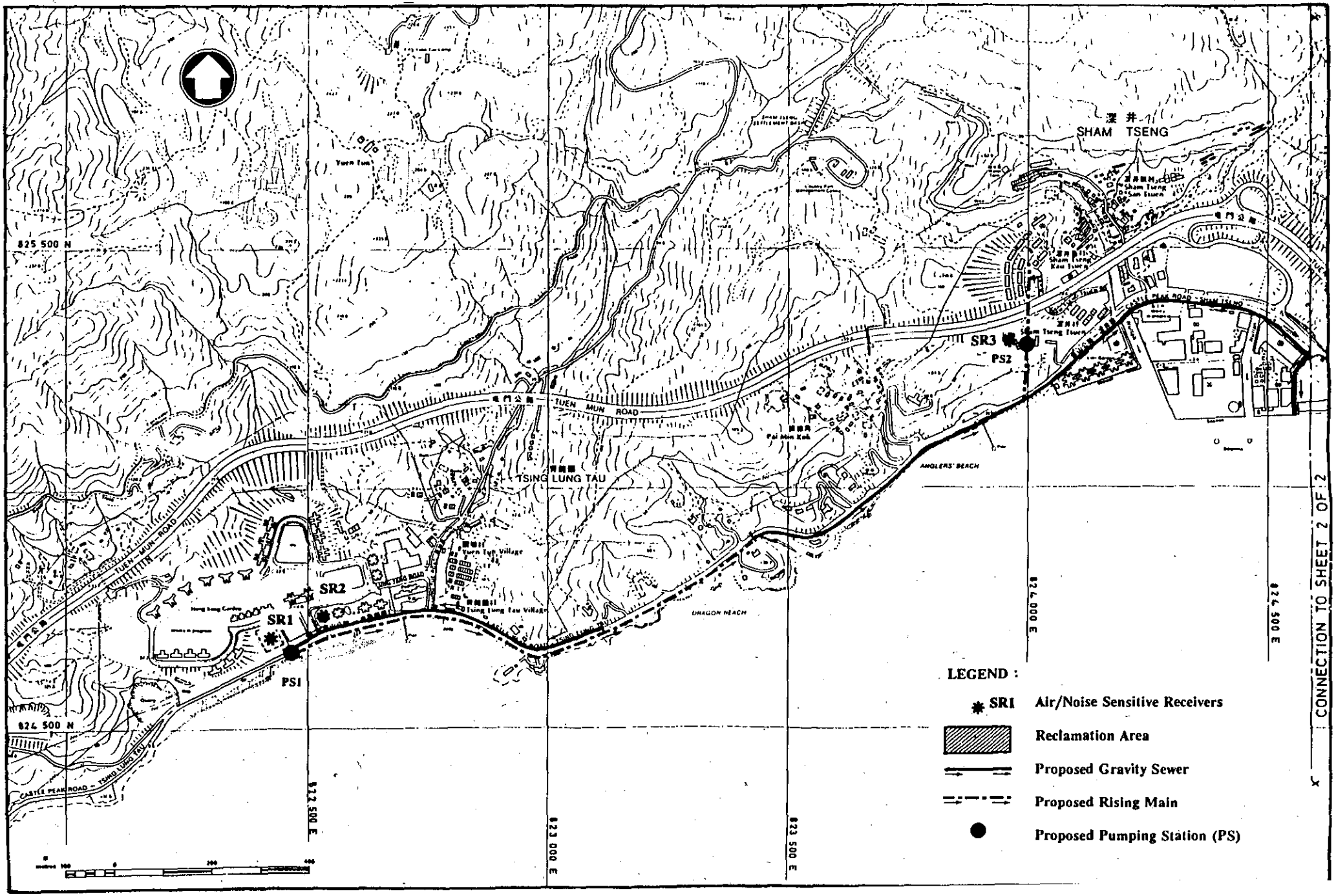
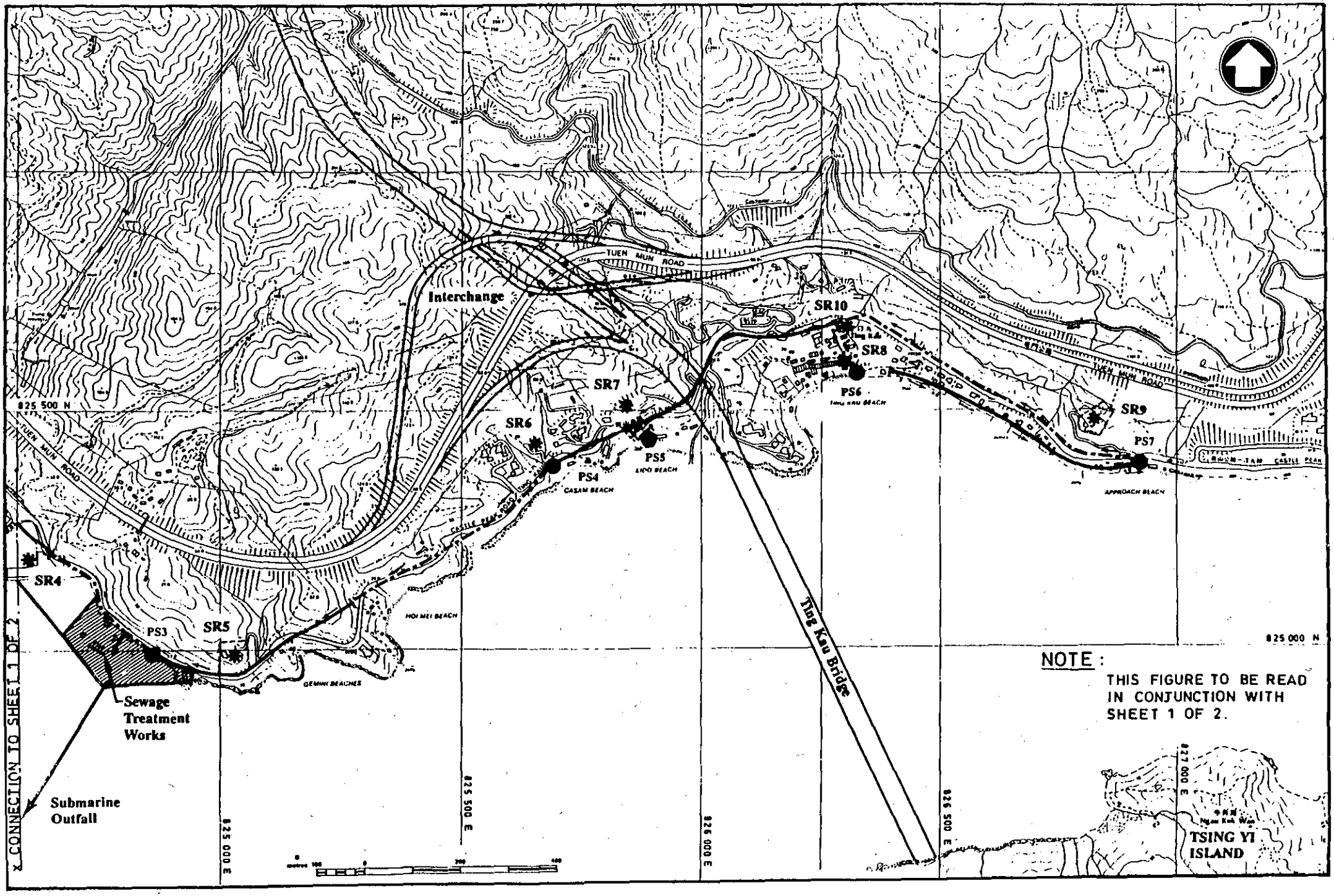
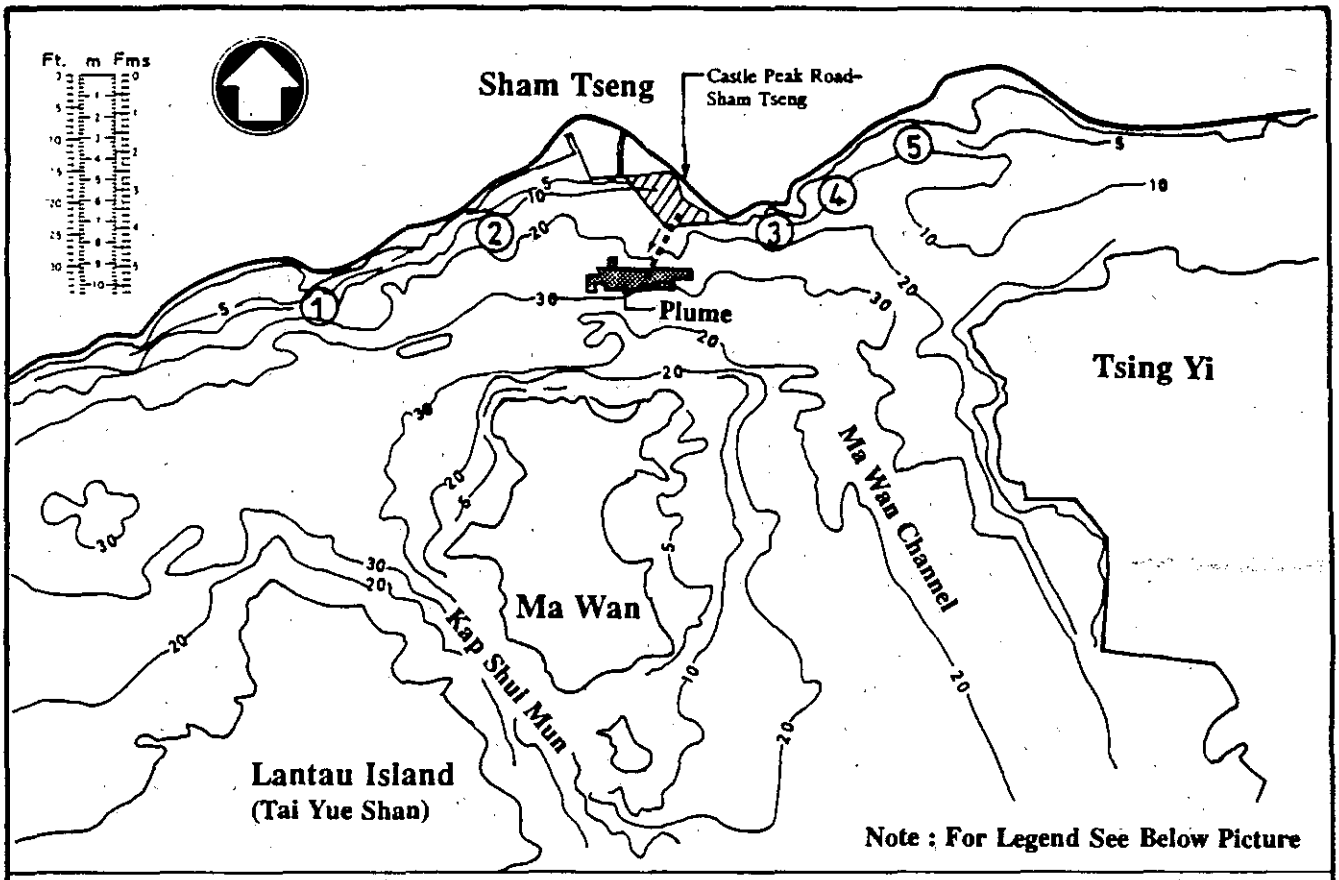


Figure 4
Location of Air and Noise Sensitive Receivers
(Sheet 2 of 2)

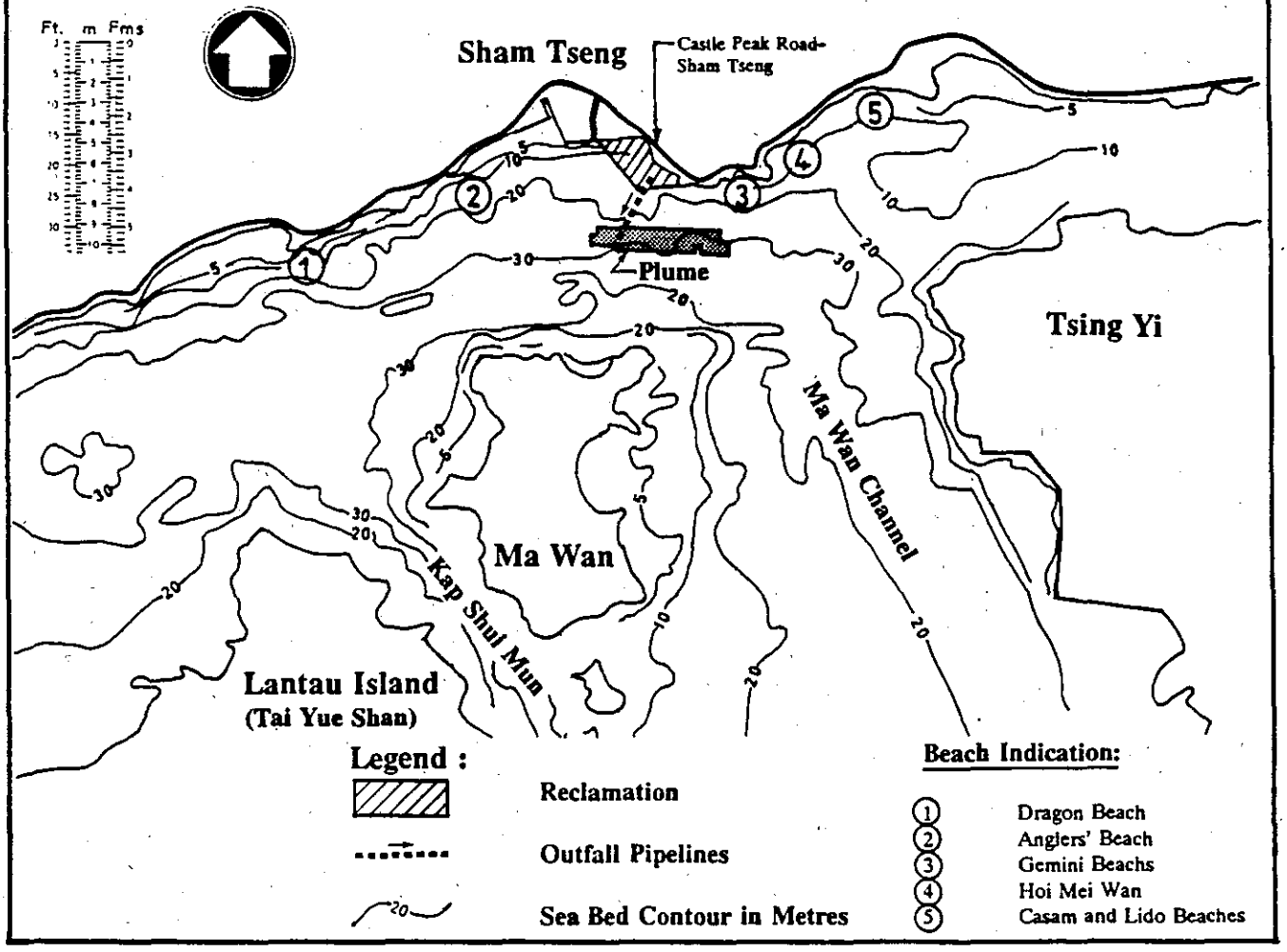


Top Layer
Dry Season, Spring Tide, Long Outfall

Figure 5(a)
Plume Movements in Ma Wan Channel

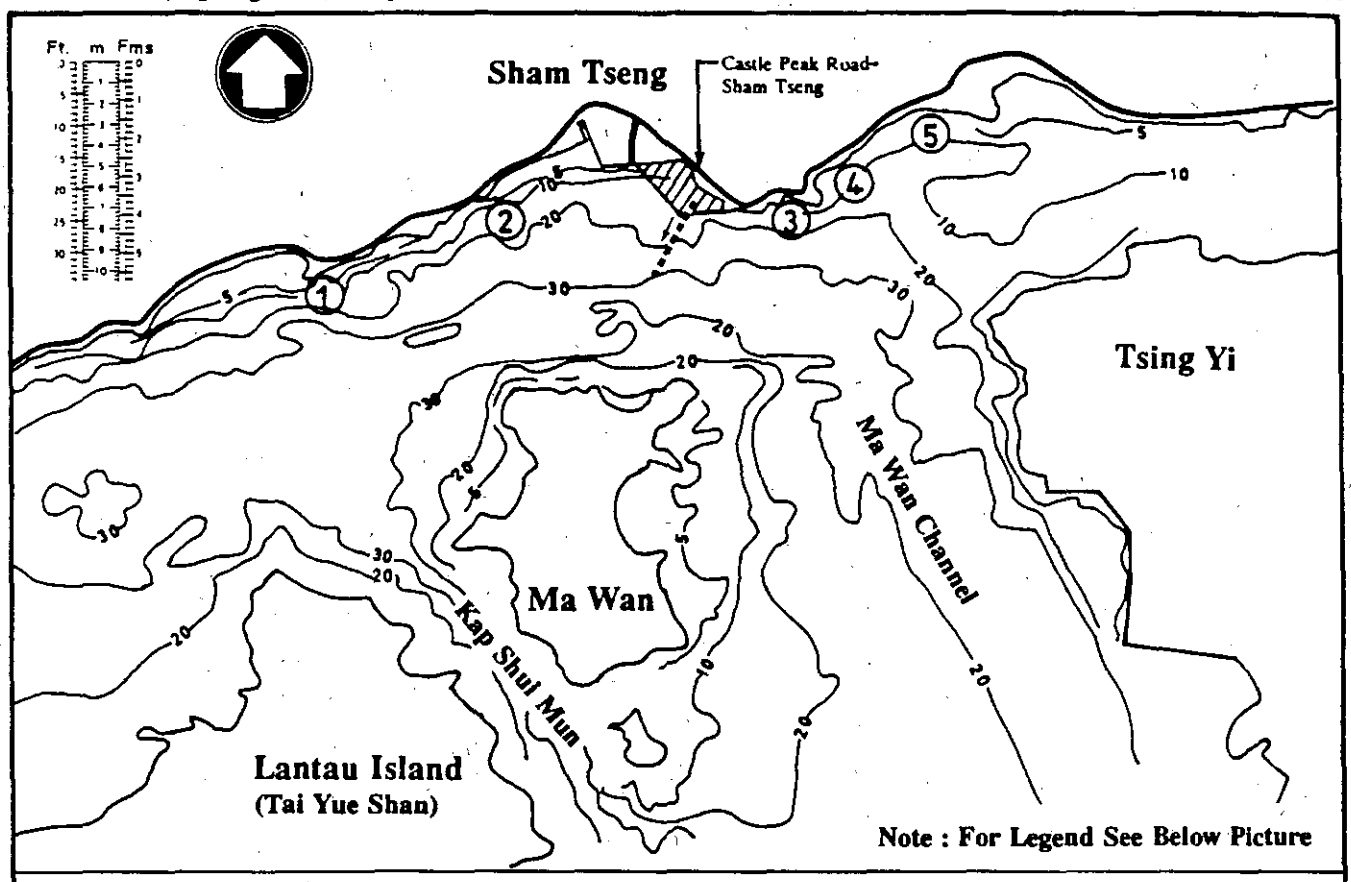


Top Layer
Dry Season, Neap Tide, Long Outfall



Top Layer
Wet Season, Spring Tide, Long Outfall

Figure 5(b)
Plume Movements in Ma Wan Channel



Top Layer
Wet Season, Neap Tide, Long Outfall