DRAINAGE SERVICES DEPARTMENT
LAND DRAINAGE DIVISION

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TERRITORIAL LAND DRAINAGE & FLOOD CONTROL STRATEGY STUDY - PHASE III

SEDIMENTATION STUDY

FINAL REPORT - TASK 6
ENVIRONMENTAL IMPACT ASSESSMENT
(VOLUME B)

May 1997

Hyder Consulting

Hyder Consulting Limited

in association with
Delft Hydraulics • Dredging Research Limited
University of Strathclyde • Hyder Environmental Limited

FINAL REPORT - TASK 6 ENVIRONMENTAL IMPACT ASSESSMENT (VOLUME B)

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SECTION 10

EIA OF DREDGING WORKS IN RIVER SILVER

10. EIA OF DREDGING WORKS IN RIVER SILVER

10.1 Introduction

The River Silver drains a catchment of 3.5 km^2 and flows into Silver Mine Bay on the east coast of Lantau Island. The catchment area and dredging locations with associated sensitive receivers are presented in Figure 10.1. The main channel of the river is approximately 500m long and is fed by three tributary streams slightly west of Mui Wo village. In its upper reaches, the main channel banks are natural while the banks downstream are generally comprised of vertical concrete walls with rip-rap slopes angled at 45°. The water depth in the main channel is approximately 1m, even during Spring high tide. The channel bed is natural throughout the entire length of the river.

10.2 Existing Environment

10.2.1 Existing and Future Land Uses

The majority of the catchment is agricultural but village type development is permitted in designated areas, notably Tai Tei Tong, Luk Tei Tong and Mui Wo Kau Tsuen. The channel catchment is bordered by South Lantau Country Park.

In the lower reaches of the channel, construction work has been ongoing to provide government/institution/community facilities. The surrounding land use is predominantly residential and commercial, with large areas of neglected farmland interspersed with some active small holdings and orchards. Paved walkways and cycle-ways traverse the river edge. The lower reaches of the channel are used for passive recreation. There is a gazetted beach to the north of the channel mouth and a small typhoon shelter parallel to the main river. The only road of note extends from the ferry pier past the lower reaches of the channel.

According to Task 4, Working Paper No 8, future land use is unlikely to radically affect run off and is therefore unlikely to increase storm water flows in the river.

10.2.2 Air Quality

Air quality is not routinely monitored in the vicinity of the channel by the EPD. However, during initial field observations the air quality was noted as being good with no apparent major pollution sources in the immediate surroundings.

A detailed assessment of baseline air quality was undertaken in November / December 1996 for seven consecutive days. The High Volume Air Sampler used for monitoring was located on the bank of the Main Channel adjacent to Ling Tsui Tau village, as shown in Figure 10.1. The 24-hour TSP levels which were calculated each day are summarised in Table 10.1. The methodology is described in Appendix A4, and the full results are in Appendix A7.

TABLE 10.1 SUMMARY OF BASELINE AIR QUALITY MONITORING RESULTS

Monitoring Date	TSP Level (μg / std.m^3)
29/11/96	133
30/11/96	121
01/12/96	103
02/12/96	95
03/12/96	53
04/12/96	146
05/12/96	160

NB: The Air Quality Objective for 24 hr. TSP measurements is 260 μg/m^3.

The baseline TSP level for the monitoring period is variable, ranging from 53 - 160 μg/m^3 with an average of 115.8μg/m^3. The reason for the variation is not clear, but is likely to be due to a naturally fluctuating wind speed and direction. The wind was generally from the north and north-east, thus TSP levels may have been influenced by construction works on the north Lantau coast. Regardless of external influences, the TSP levels are still considered to be low.

An olfactory assessment of the channel was undertaken during the River Corridor Survey and no significant odour was detected. This is consistent with the fact that there are no major polluting sources in the catchment that might contribute to odour.

10.2.3 Noise

A noise baseline survey was undertaken over seven consecutive days during November / December 1996 from the front of the property at No. 1, Ling Tsui Tau village (Figure 10.1). Four 30-minute measurements of L_{eq}, L_{10} and L_{90} were taken, and the average values and range during the period are summarised in Table 10.2. The methodology is described in Appendix A4, with the full results presented in Appendix A6.

TABLE 10.2 SUMMARY OF BASELINE NOISE MONITORING RESULTS

Noise Measurement	$L_{eq\,(30min)}$ dB(A)	L_{10} dB(A)	L_{90} dB(A)
Average	61.7	64.1	55.4
Range	58.2 - 64.4	62.0 - 66.0	53.5 - 58.0

The baseline results show from the L_{90} results that the noise environment in this location is generally quiet in the range of 53.5 - 58.0 dB(A), with vehicle traffic and the noise of villagers predominating. However, the L_{eq} and the L_{10} results indicate that the area is influenced by noise peaks. The noise peaks are likely to be the result of traffic, although road maintenance works was also highlighted as a noise source.

10.2.4 Hydrology and Water Quality

Flood History and Predicted Flooding

Flooding predictions were modelled in Task 4 under two different scenarios for the existing River Silver channel: Case 1 represents a 10 years storm and 50 years tide; and Case 2 represents a 50 years storm and 10 years tide.

No flooding is predicted along the Main Channel under either Case, but will occur in each of the three tributaries to varying degrees for both cases. The northern tributary will flood moderately (0.5 - 1.0m) between Chainages 0-310m under Case 1, and as far as Chainage 350m for Case 2. The western and southern tributaries are predicted to flood severely (>1.0m) under each Case; between Ch. 220 - 400 m, and Ch. 70 - 480m respectively.

Pollutant Loads

Pollution sources in the catchment have been identified as village housing, agricultural run off and sludge from the water treatment works. The Biochemical Oxygen Demand (BOD) of the major sludge discharge into the channel is 80 mg/l while domestic discharge from village households results in a BOD loading of 8 kg/day. (EPD, 1994 letter Ref. EP 860/C8/34). Correspondence with the EPD Local Control Office has revealed that BOD loadings were 1 kg/day as at the end of 1994 (EPD, 1995).

Water Quality

The River Silver is a priority channel routinely monitored by EPD. The general trend over the past few years has been one of improvement since the implementation of the livestock waste control scheme. Data collected by the EPD in 1995 indicates that water continues to be 'excellent' (Appendix B1). Under the Rural Planning and Improvement Strategy programme (RPIS), the foul sewage systems at Mui Wo are being extended to cover a larger area and this is expected to lead to further improvement in water quality.

A water quality survey was specifically undertaken for this study over a 12 tidal hour period during April 1996. Two locations were chosen; one upstream (A7) and one by the river mouth (A10), as displayed in Appendix B2. The results are represented graphically in Figure 10.2 and are summarised in Table 10.3. The monitoring methodology and full results are presented in Appendices A3 and A1 respectively.

TABLE 10.3 SUMMARY OF WATER QUALITY MONITORING RESULTS

Location	Salinity (ppt)	D.O. (mg/l)	D.O. (%)	S.S. (mg/l)	B.O.D. (mg/l)
A7	27.70 (19.30 - 31.60)	6.49 (5.62 - 6.91)	72.5 (60.9 - 79.1)	17.6 (13.0 - 23.0)	<3
A10	32.36 (32.20 - 32.70)	6.68 (6.40 - 7.00)	73.7 (69.8 - 79.6)	19.2 (12.0 - 26.0)	<3

The River Silver is one of the cleanest channels in the Territory, with no significant pollution sources affecting water quality. The channel shows characteristic trends expected from a clean river, with slightly higher salinity, dissolved oxygen and suspended solid levels at the channel mouth due to the tidal influence. The whole of the channel has no significant inputs of organic material, and hence the BOD_5 was below the level of detection (LOD).

10.2.5 Sediment

A total of nine surface grab samples were taken from the bed of the River Silver during July / August 1995. Due to the lack of a soft sediment layer it was not possible to take samples for grain size analysis. The sampling locations and results are presented graphically in Figure 10.3. The full results for grab sampling are presented in Appendix B3.

Characteristics

Site observations indicated that the channel substrate is heterogeneous, varying from banks of sand and gravel to rocks and boulders. In the main stretch the sediment predominantly consists of coarse granular material with muddy patches, whilst in the tributaries there is an increasing presence of cobbles and small boulders.

Quality

Grab sampling indicated that the channel sediment was not contaminated with metals or PCBs and PAHs and was therefore classified as Class 'A'. The organic carbon content was low, as were concentrations of nutrients such as nitrogen and phosphorus. This indicates the absence of any significant polluting source.

10.2.6 Ecology

Riparian Fauna and Flora

A scattered mangrove community exists where the channel divides into three streams, each approximately 3-4m wide, which radiate north, west and south over the River Silver flood plain. The three main mangrove species found here are *Aegiceras corniculatum*, *Kandelia candel* and *Acanthus ilicifolius*, and are probably the remnants of a much larger stand which would have existed prior to development of the area.

The tidal portions of the three channels within the study area are similar in character, the nature of the riparian zone varying from clumps of mature trees, grasses and dense weeds to concrete retaining walls connected to stream-side residential properties. Mature trees and tall stands of grass provide foraging and shelter for bird populations, while trailing vegetation and marshy areas are likely to support large numbers of insects and amphibians.

Aquatic Fauna

The water quality of the River Silver has improved since the implementation of a livestock waste control scheme, and the lower portion of the river contains many small estuarine and marine fish. The three tributary streams have been historically disturbed through the construction of weirs for irrigation purposes. These however, were found to be largely in a state of disrepair following the decline of local agriculture in favour of residential development. The upper portions of the three streams within the study area do not seem to support abundant or diverse freshwater fish populations, probably due to past pollution and continuing organic inputs. However, some fish were observed during preliminary surveys, as were freshwater crabs.

10.3 Proposed Works

10.3.1 Dredging Requirements

An increase of 0.5m or more in the bed levels of the main channel above base conditions (1.0m above present levels), will result in additional flooding around the confluence of the tributaries at Chainage 480m, (i.e. for rainfall with a return period of 1 in 50 years).

Dredging each of the three tributaries to +0.8m reduces the predicted flooding evident under base conditions, but does not alleviate flooding fully. Dredging the entire channel has a greater effect, although flooding still occurs along the western and southern tributaries. The northern tributary does not flood when the channel is dredged to this extent, but some embankment raising would still be necessary to provide sufficient freeboard.

Survey and modelling work concludes that there is no accumulation of marine sediment in the channel. The sediment input from construction works is also negligible. The sediments in the Main Channel are entirely catchment derived and therefore predominately coarse in nature. Accumulation of this material can lead to an increased flood risk. Since accumulation is most likely to occur immediately above or below the confluence, this location is considered the key monitoring area. The anticipated rate of fluviatile sedimentation near the confluence is 200 mm/year, which equates to an approximate total volume of 650 m^3/year.

Task 4 and 5 *Recommendation:* Monitoring of the bed levels along the three tributaries is recommended to ensure subsequent sedimentation does not raise the levels by 0.5m above base conditions (1.0m above present conditions). Task 4 predicts that dredging is required at the confluence of the tributaries every two years, yielding a dredging volume of approximately 1,300m^3.

10.3.2 Dredging Strategy

Task 5 has recommended a dredging strategy for each of the channels based on a consideration of both the physical and key environmental constraints to dredging. The preferred strategy is summarised below:

i. **Access:** Land based plant equipment would be required to dredge the full length of the River with the exception of the mouth. Work would therefore generally be restricted to low tide. Access to the tributaries is hindered by vegetation in places, thus, if dredging is required in the future, then clearance may be necessary in some locations. The existing road along the north bank of the Main Channel should prove sufficient for land access to the confluence of the tributaries but not to areas further upstream.

ii. **Dredging:** At the proposed dredging location, small bulldozers could be used along the Main Channel bed to push material into a temporary stockpile. A crane situated on the north bank could immediately grab loads from the pile for transfer into a skip or directly into a truck. For the purposes of potential future dredging, mini excavators and manual methods could be employed along the restricted regions of the tributaries. A floating grab or backhoe dredger could operate at the River mouth.

iii. **Transport:** At the River confluence dredging location, it is recommended that material be loaded into trucks for transfer off site. Given the potential air quality impacts, the use of covered skips is preferable to a central stockpile. Should dredging be necessary at the River mouth, then marine based dredging plant could be operated in conjunction with a small barge.

iv. **Disposal Strategy:** Disposal options were considered in detail in Task 5 and in the Key Issues Report for Task 6. The optimum solution for sediment disposal would be to use it beneficially and locally if possible, such as application to agricultural land. In the longer term, there may be an option to dispose of the material to the North Lantau Port Development should this work be commissioned.

10.4 Key Issues

Key Issues and Sensitive Receivers were identified in earlier reports. Based on the dredging and disposal strategy, these have been reviewed.

<u>Water Quality</u>

- Silver Mine Bay gazetted beach and bathing water;
- Local fishing interests;

<u>Ecology</u>

- Damage to the banks, vegetation and stream bed in upstream areas of the catchment;
- Disturbance of natural habitats (riffles, pools, marginal and aquatic vegetation) along upper stream courses.

<u>Community Impacts</u>

- Noise during dredging works;
- Use of footpaths etc. along channel, (nuisance).
- Potential dust from temporary stockpiles adjacent to the dredging area.

10.5 Impact Assessment

10.5.1 Noise Impact Assessment

Works Area

There is only one proposed recurrent dredging location for the River Silver as shown in Figure 10.1.

Noise Sensitive Receivers

The most affected NSRs around the works area have been identified as those falling within a 300m buffer of the likely works area. The locations of the NSRs are shown in Figure 10.1 and described in Table 10.4:

TABLE 10.4 DESCRIPTION OF NOISE SENSITIVE RECEIVERS

NSR	Description
A1	Dwellings to the north of Ngan Shu Street
A2	Dwellings to the west of old Watch Tower
A3	Ngan Wan Estate.
A4	Dwellings adjacent to Nga Kwong Road Ngan Shek Street

Assessment Criteria

Noise level are limited by the *Noise Control Ordinance (Cap 400) including its subsidiary regulations and the Technical Memoranda.* (TM).

In addition to the requirements imposed by the Noise Control Ordinance, the following requirements or interpretations will also be used as a standard in order to calculate noise generated from equipment and activities for the purpose of carrying out any construction work other than percussive piling during the time period from 0700 to 1900 hours on any day not being a general holiday:

i) The noise level measured at 1 m from the most affected external facade of the nearby NSRs during any 30-minute period during normal weekly daytime periods between 0700 to 1900 hours will not exceed an equivalent sound level (LAeq) of 75 dB(A) or 70 dB(A) (or 65 dB(A) during examination) for schools.

ii) Construction should not be undertaken during any other period, the restricted period, without the existence of the relevant Construction Noise Permit (CNP).

iii) In accordance with TM, the area around the proposed dredging location has an Area Sensitivity Rating (ASR) of 'A' and as the work is unlikely to take longer than 14 days, a positive correction of 3 dB(A) shall be applied to the Acceptable Noise Levels (ANLs). Therefore the daytime assessment criteria for establishing noise mitigation measures are 63 dB(A) from 1900 to 2300 hours plus all day Sundays and general holidays and 48 dB(A) between 2300 and 0700 hours.

Assessment Methodology

Since marine access to the dredging location is not feasible, the dredging works will be undertaken by employing a bulldozer and a excavator. The dredged material will then be transported by trucks. The trucks only transport the dredged material off the site once they are full. The engine of the truck is assumed to be switched off during idle time. The noise impact generated from the truck is therefore considered insignificant and has not been taken into account in this assessment. The likely equipment for dredging is shown in Table 10.5.

TABLE 10.5 TYPICAL MIX OF EQUIPMENT FOR DREDGING OPERATIONS

Identification Code	Description	Sound Power Level dB(A)
CNP 030	Bulldozer	115
CNP 081	Excavator	112

The sound power levels of the equipment used in this assessment are derived from the TM. The equipment were considered to be grouped equidistant from the approximate geographical centre of the dredging area and the boundary of the nearest NSR. In the case of an oblong area, having a length to width ratio of 5:1 or more, then only the closest portion to the NSR has been considered, as defined in the TM.

A total sound power level of the dredging operation is obtained by summing all the individual sound power levels of the associated equipment.

The noise levels at each NSR are predicted by the following equation:

Predicted noise level = Total sound power level - $20 \log_{10} D$ - 8 dB(A)

where D is distance between the NSR and the notional noise source

A positive correction of 3 dB(A) is made to each predicted noise level due to all concurring activities to account for the facade reflection at the NSR. The predicted unmitigated noise levels are presented in Table 10.6. A detailed calculation spreadsheet is attached in Appendix A5.

TABLE 10.6 UNMITIGATED NOISE LEVELS AT NSRS

NSR	Predicted Noise Level dB(A)
A1	77[3]
A2	77[3]
A3	67[2]
A4	67[2]

Note:

3 *The PNL exceeds the daytime assessment criteria of 75 dB(A) and the ANL of 63 dB(A) from 1900 to 2300 hours, plus all day Sundays and general holidays; and exceeds 48 dB(A) between 2300 and 0700 hours for all days.*

2 *The PNL exceeds the ANL of 63 dB(A) from 1900 to 2300 hours, plus all day Sundays and general holidays; and exceeds 48 dB(A) between 2300 and 0700 hours for all days.*

The calculation indicates that the unmitigated predicted noise levels at all chosen NSRs will exceed the ANLs for the restricted periods. As a result, work during the restricted periods is not recommended. However, the dredging work may also exceed guideline noise levels by 2 dB(A) at A1 and A2 respectively during normal working hours if mitigation is not implemented.

<u>Suggested Mitigation Measures</u>

Appropriate mitigation measures should be incorporated into the dredging manuals to bring reduce the noise level to or below the 75 dB(A) daytime assessment criteria.

Appropriate phasing of works can avoid cumulative noise impacts and is considered the most cost effective way to control the excessive noise generated from dredging operations. For example, a reduction of 2 - 5 dB(A) may be achieved if the bulldozer and the excavator are arranged so that they are not operating at the same time, normally, the bulldozer is used to dredge the mud from the river bed to the bank, then the excavator will transfer it to a truck. The predicted mitigated noise levels at NSRs are presented in the Table 10.7.

TABLE 10.7 MITIGATED NOISE LEVELS AT NSRS

NSR	Predicted Noise Level dB(A)
A1	72 - 75[2]
A2	72 - 75[2]
A3	62 - 65[2]
A4	62 - 65[2]

Note:

2 *The PNL exceeds the ANL of 63 dB(A) from 1900 to 2300 hours, plus all day Sundays and general holidays; and exceeds 48 dB(A) between 2300 and 0700 hours for all days.*

All mitigated noise levels fall within the daytime guideline assessment criteria noise levels, so provided works do not extend into the evening, there will be no residual noise impacts

10.5.2 Air Quality Impacts

There will be no significant dust emissions as dredging work will not require the construction of access roads along the Main Channel. The small volume of material to be dredged (650 m^3/year) will be kept in a stockpile before it is removed from the works area. The stockpile will be kept moist to avoid releases of dust, and all material will be removed immediately after the works are complete.

Dredging will not result in odour emissions given the excellent quality of river water and bed sediment. Thus, provided that the standard specifications recommended in Section 8 are enforced, no air quality impacts are anticipated.

10.5.3 Water Quality Impacts

The water quality of the River Silver is classed by the EPD as 'excellent' (EPD, 1995). Bathers at Silvermine Bay, where there is a gazetted beach, are sensitive to the short term impacts caused by dredging on water quality. Statistics indicate that the beach has a peak attendance in August with most people visiting at the weekend or public holiday, therefore impact can be minimised through dredging in the dry season. This will make the dredging operations less complicated and will coincide with the time when the beaches are officially closed.

Observations indicate that the mouth of the channel operates as a natural fish nursery. The channel is also used for fishing by the general public. Thus, dredging operations have the potential to harm local fisheries and fishing interests. The sediment quality is Class 'A', therefore no significant release of pollutants is expected. Water quality monitoring is only required when removing 7,000m^3 or more which is unlikely to occur for this channel.

10.5.4 Ecological Impacts

The three tributary streams have been historically disturbed through the construction of weirs for irrigation purposes, although these are now mostly in a state of disrepair following the decline of local agriculture in favour of residential development. The upper portions of the three streams within the study area do not seem to support abundant or diverse freshwater fish populations, probably due to past pollution. However, some fish were observed during preliminary surveys, as were freshwater crabs. Dense clumps of aquatic and trailing vegetation along the stream margins provide good habitats for a variety of freshwater organisms. In the lower reaches of the channel many small estuarine fish have been observed in the channel. Disturbance to the estuarine fauna of the river and increased sediment inputs to Silvermine Bay itself may cause temporary decreases in primary production and fish abundance and impacts may occur to the few fish-holding cages moored in the area.

Dredging may also result in damage to the natural habitats within the streams such as the pools and riffles, and the habitat provided by marginal vegetation such as the scattered mangroves (*Aegiceras corniculatum, Kandelia candel* and *Acanthus ilicifolius*). Dredging has the potential to affect water quality through the release of material increasing suspended solids, turbidity and potentially reducing dissolved oxygen levels. Very high levels of sedimentation could lead to temporary smothering of benthic invertebrates, although any effects are expected to be localised and not severe.

The proposed strategy for dredging states that removal of bank-side vegetation is unavoidable for access. Whereas none of the species are endangered, there are only a limited number of streams and channels in the Territory where there is any riparian vegetation of note. The vegetation provides an important habitat for insects, birds and small mammals and also provides a degree of shade in the water, important for fish.

10.6 Mitigation Measures

It is recommended that the following mitigation measures are incorporated into the dredging manual for the River Silver over and above the standard specifications detailed in Section 8 of this report. The objective is to ensure that the predicted environmental impacts are kept to a minimum.

10.6.1 Ecology

As access to the upper reaches of the smaller streams is very difficult with large equipment, sediment should be removed manually to minimise sediment suspension and bank-side disturbance.

10.6.2 Water Quality

It is recommended that the Contractor confines dredging works to outside of the bathing season, May to October. Otherwise the standard specifications outlined in Section 8 are considered sufficient to reduce impacts to acceptable levels.

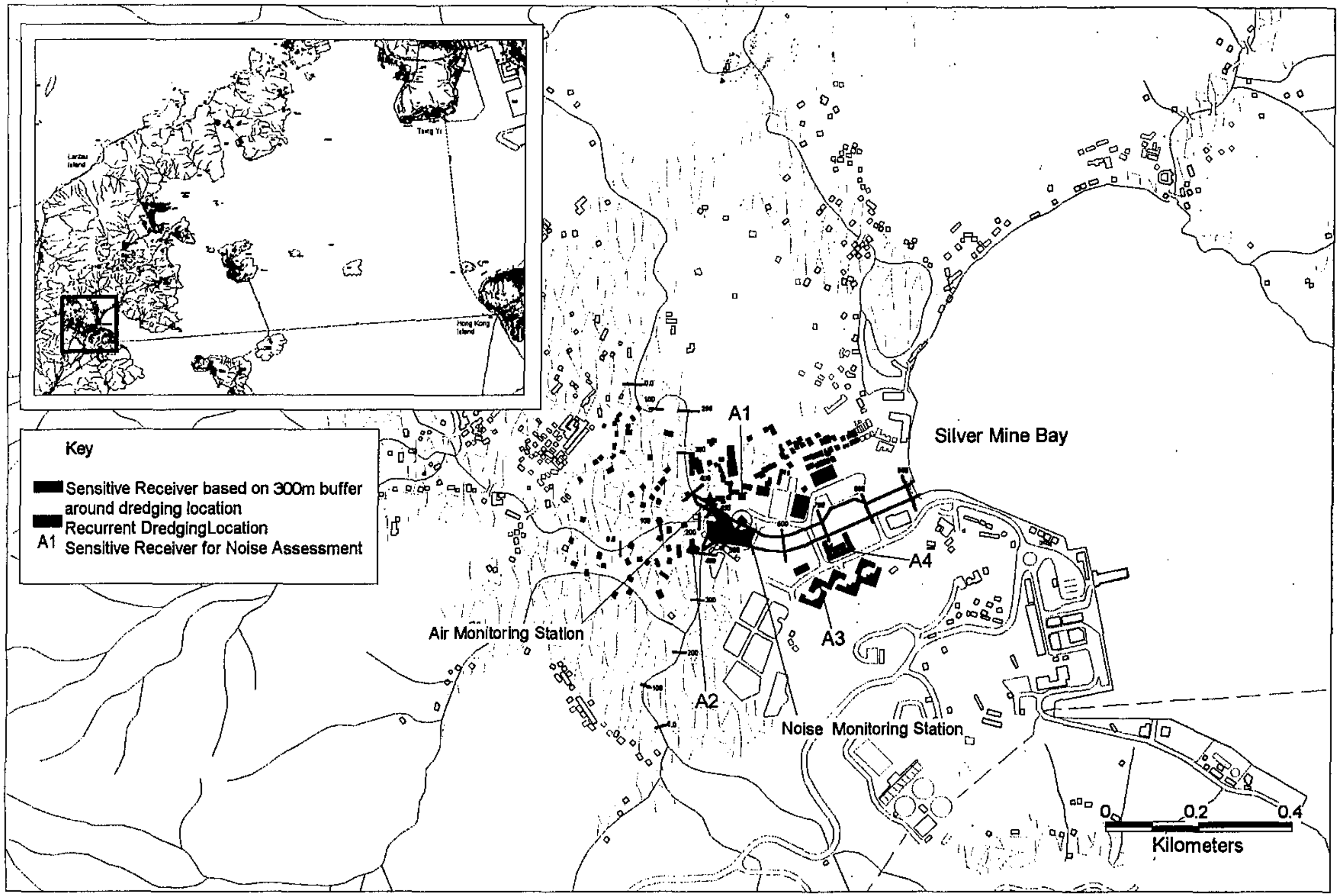

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Figure 10.1 Potential Noise and Air Sensitive Receivers Near Proposed Dredging Locations River Silver

Source: Lands Department
OZP

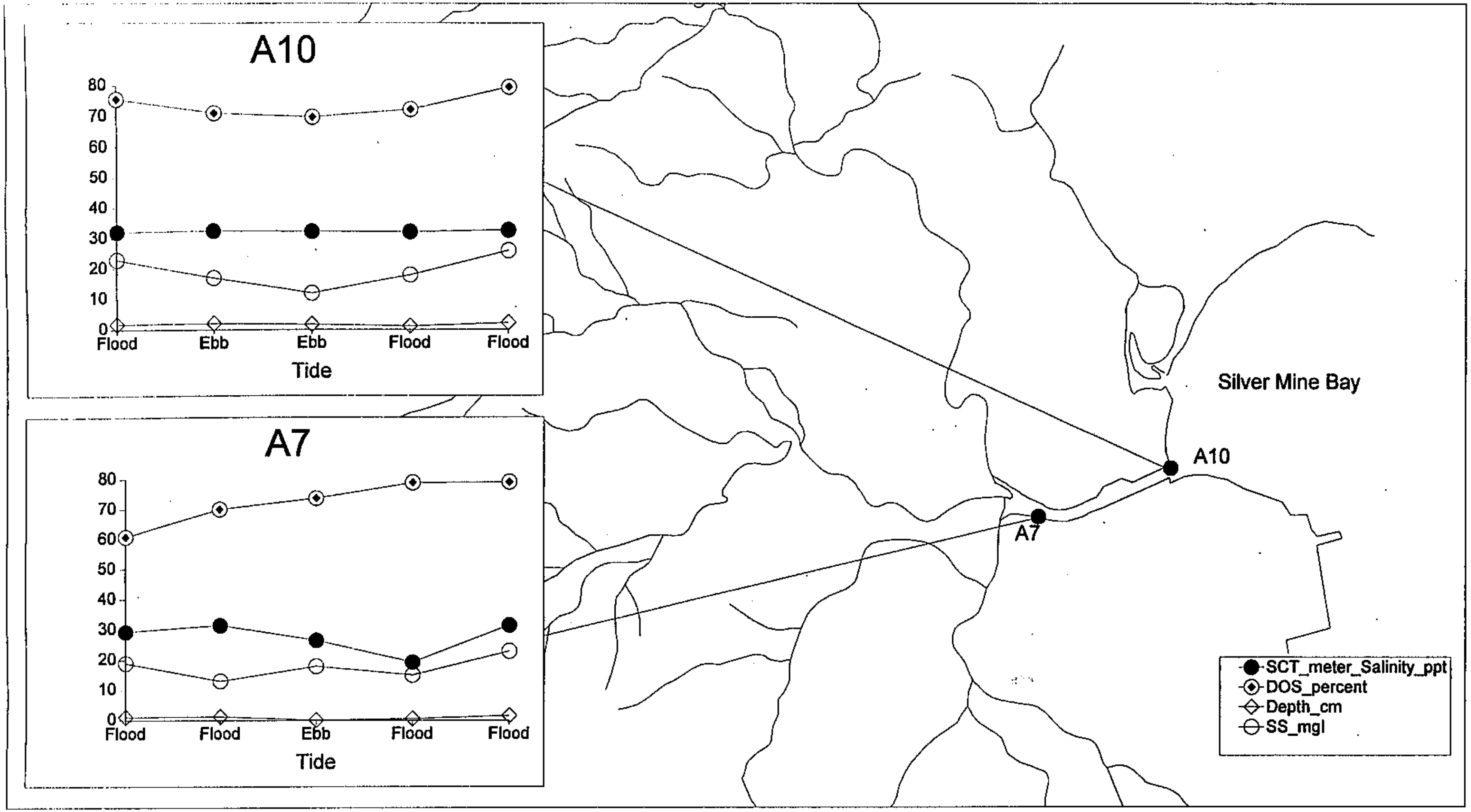

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Figure 10.2 Water Quality Monitoring Results from 15/04/1996
River Silver

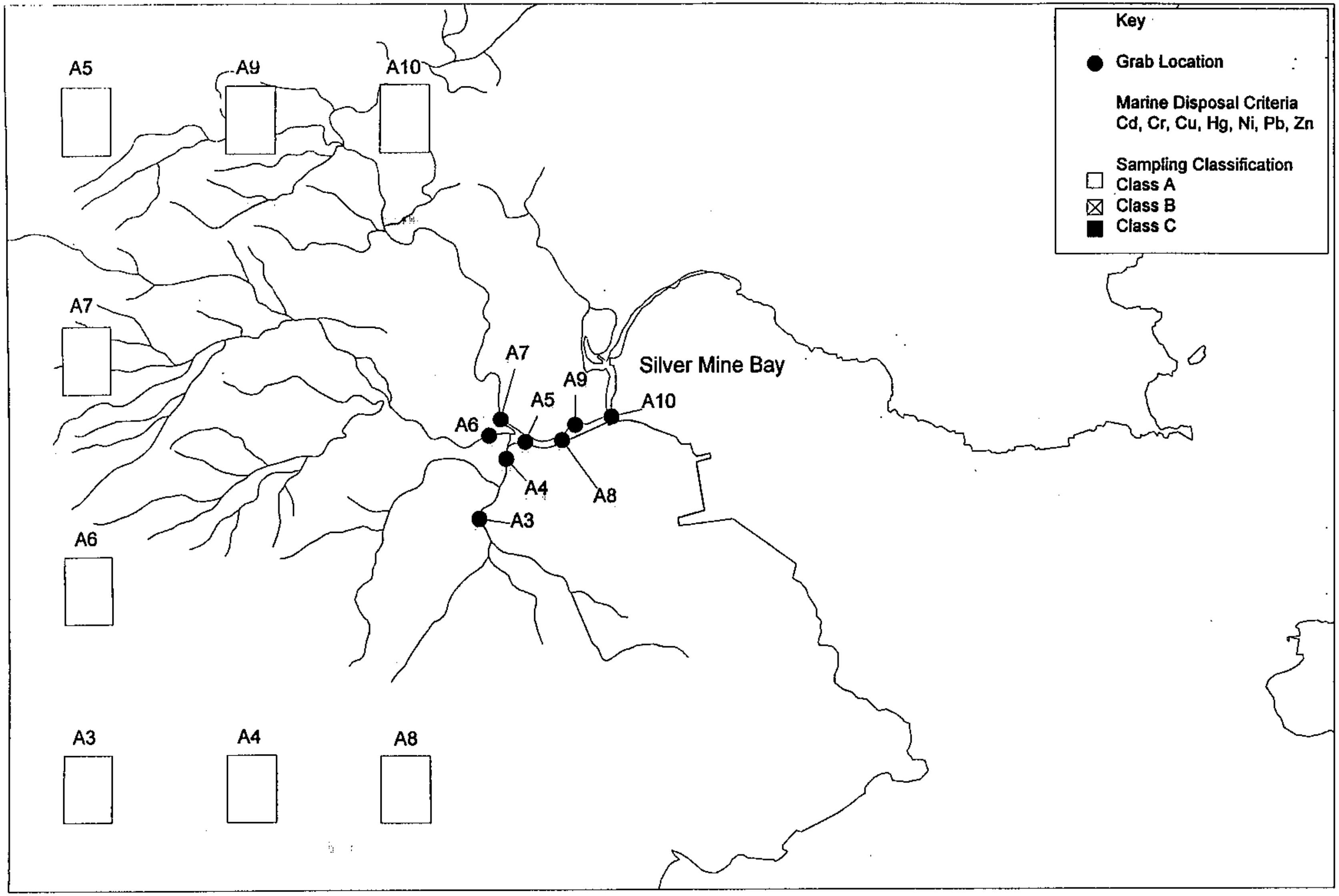

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Figure 10.3 Sediment Grab Analysis Results
River Silver

SECTION 11

EIA OF DREDGING WORKS IN STAUNTON CREEK NULLAH

11. EIA OF DREDGING WORKS IN STAUNTON CREEK NULLAH

11.1 Introduction

Staunton Creek Nullah is an engineered channel, fully lined with concrete and with vertical sides. The channel is 1.5 km long and a maximum of 25m wide. It drains the Southwest side of Hong Kong Island into the East Lamma Channel. The total area of the catchment is slightly greater than 6 km^2 which includes the Aberdeen reservoirs. A catchwater which traverses an adjacent hillside diverts runoff and sediment to the reservoirs, thereby effectively reducing the catchment area. Figure 11.1 shows the location of the channel and the identified dredging sites, as well as sensitive receivers.

11.2 Existing Environment

11.2.1 Existing and Future Land Uses

The land use in the area is mainly urban, with residential development, a Police Training School and a sports ground in proximity to the creek. Woodland covers most of the adjacent hill sides. The construction of the Aberdeen Tunnel initially acted as a source of sediment erosion although this is now under control.

11.2.2 Air Quality and Noise

No data was obtained from existing sources. General observations of air quality were, however, made during a site visit. The proximity of roads and industrial areas appeared to be affecting the ambient air quality. The channel itself and the exhaust fumes from nearby traffic were also found to be causing an odour within the study area, particularly towards the mouth of the channel. Oily discharges upstream may generate an odour problem and dredging has been carried out for this reason in the past.

Noise measurements ($L_{eq\ 5\ mins}$) were measured and found to be in the range of 61 - 71.5 dB(A). Major noise sources were noted as being road and marine harbour traffic.

11.2.3 Hydrology and Water Quality

<u>Flood History and Predicted Flooding</u>

There is no history of flooding in this channel. Flooding is possible close to the mouth of the creek, down from Ap Lei Chau Bridge, where fluviatile sediment and construction-derived material accumulates. Flooding upstream of the Bridge could only occur if substantial sedimentation was allowed. Siltation in the nullah has caused public concern due to the pollution / nuisance impacts on the local environment and is currently under regular maintenance by DSD.

Flooding predictions were modelled in Task 4 under two scenarios for the existing Staunton Creek Nullah channel:

Case 1 - 10 years storm and 200 years tide;

Minor flooding (<0.5m) is predicted between chainages 1375 and 1425m

Case 2 - 200 years storm and 10 years tide;

No flooding is predicted, although an approximately 100m long section of the channel is close to flooding.

Pollutant Loads

Raw sewage and trade effluent is discharged directly into Staunton Creek nullah (EPD Local Control Office South, 1995). According to an EPD consultants report in 1993 the estimated flow for Staunton Creek Nullah is 4,180 m^3/d excluding bare flows and known foul sewer discharges. The estimated BOD load was 3,350 kg BOD/day.

Data provided by the local EPD control office indicated that BOD_5 loading to the channel have since been reduced to an estimated 1,670 kg/day . Sources of pollutants are given as nearby industrial developments and a temporary diversion of a public sewer to storm drains, (EPD, 1995 letter, Ref. EP 860/C8/34).

Water Quality

Staunton Creek Nullah is not routinely monitored by the EPD and no existing data has been obtained relating to water quality to date. Field observations have indicated that the water quality in the channel is poor, influenced by industrial discharges and exacerbated by the naturally poor dispersal capacity of Aberdeen Typhoon Shelter. Thus, flood tides to Staunton Creek are poorly oxygenated. The water was observed to be a green/grey colour in the lower reaches with little flushing.

11.2.4 Sediment

Sediment in the channel was last removed in January/ February 1995 by dry excavation techniques in an attempt to alleviate odour emissions from the channel. No sediment data was available for this recent excavation work.

For the purposes of this Study grab samples were taken from the channel in July 1995. Two core samples were taken during December 1995 where bed depths permitted. The locations and results of core sampling are presented graphically in Figure 11.2. Full core results are presented in Appendix B4.

Characteristics

Initial field observations indicated high sedimentation rates in the channel. The channel is not thought to contain a high degree of fine sediment of marine origin due to a steep gradient in the bed level at the mouth where such sediment is typically deposited. Furthermore, the sheltered nature of the channel mouth is unlikely to encourage sediment dispersion and consequently it can be assumed that soft sediment does not play a significant part in the sediment transport from the channel.

The results of core sample analysis undertaken indicate that the sediment in the tidal stretch of the channel ranges from a silty mud at the mouth to gravel / coarse sand further upstream. It is considered that the sediment is unlikely to be free draining.

Quality

The results from both grab and core sampling indicate that the sediments are highly contaminated and justify a classification of Class 'C' under TC 1-1-92. Persistent contaminants in each of the cores were the heavy metals copper, lead and zinc. The organic carbon content of the channel was relatively high (4.5%) compared to the results from other channels, but can still be regarded as low. Nutrient concentrations were also high. The presence of PAH's was detected in grab samples - the only positive detection in the entire grab sampling programme, as displayed in Appendix B3. As yet we are not aware of the source of this contamination.

11.2.5 Ecology

Riparian Flora and Fauna

No riparian flora or fauna of note have been recorded as a consequence of the urbanised / industrialised nature of the surrounding area.

Aquatic Fauna

Staunton Creek nullah is a concrete faced channel with poor water and sediment quality. It flows into Aberdeen Typhoon Shelter, where levels of organic pollution are high, with *E. coli* concentrations of up to 6,273 counts/100 ml and dissolved oxygen concentrations at the bottom of the water column as low as 61% (EPD 1994a). As a consequence aquatic communities are unlikely to be of ecological conservation value.

11.3 Proposed Works

11.3.1 Dredging Requirements

Task 4 states that sediment accumulates along Staunton Creek Nullah in two distinct areas: the naturally lined mouth and the upstream concrete-lined region.

Inputs of both coarse, construction-derived sediment and fluviatile sediment originate upstream and are expected to accumulate downstream at Chainages 1300 - 1450m. The volume of construction material is anticipated to be in the order of 90m^3 per year, with fluviatile sedimentation contributing 240m^3 annually.

Sedimentation to a level of 0.5 mPD in the non-concreted section of the Nullah will cause flooding during a 1 in 200 year rainfall in the area at Chainages 550 - 720m. Survey data does not indicate on-going sedimentation in this area. However, a soft sediment layer of variable depth was indicated by the surveys and as such monitoring is suggested.

The second area of accumulation is along the concrete lined section. Sediment cannot accumulate on the concrete bed in great volumes due to the high bed shear stress. However, the Drainage Services Department have stated that the concrete section of the channel has to be de-silted regularly as sedimentation has caused public concern with respect to odour generation.

Sedimentation of 0.5m or more above present levels in the concrete lined section of the channel will cause additional flooding for both a tide and rainfall with 1 in 200 year return periods. Additional flooding occurs at Ch. 450 - 850m, and between Ch. 1,050 and the Nullah mouth.

Task 4 and 5 Recommendations: Bed levels should be monitored to ensure that subsequent sedimentation does not raise the level of the bed;

- by +0.5 mPD in the unlined section of the Nullah downstream of Ch. 1330m; and
- by +0.5 m above present levels along the concreted section of the nullah.

Should it be decided that dredging is to be undertaken in the downstream section of the Nullah, then Task 4 calculates that a total of approximately 5,000m^3 of sediment could be removed by dredging on a 15 year cycle.

11.3.2 Dredging Strategy

Task 5 recommended a preferential dredging strategy for the Nullah based on a consideration of physical and environmental constraints.

i. **Access:** Marine access is possible down from the low bridge under Ap Lei Chau Bridge. Access upstream is feasible via a ramp at the eastern end of the creek, or by crane from Heung Yip Road.

ii. **Dredging:** The lined section of the Nullah should be dredged using tyred mini-excavators which scrape the sediment off the concrete bed and load into skips. It is vital that this operation occurs under dry conditions in order to prevent downstream transport of sediment. The creation of bunds may aid this process. Should dredging occur down from the low bridge, then small pontoon-mounted grabs or backhoes could be used, loading into small barges.

iii. **Transport:** Marine and road transport are both feasible options, but all land disposal sites are off Hong Kong Island and the impacts of overland haulage must be considered. Sediment from the mouth will be transported by barge. If it is considered feasible, then the barge will be covered to minimise the effect of odour on sensitive receivers.

iv. **Disposal Strategy:** Sediment dredged from the creek mouth could be transferred to East Sha Chau. Material excavated upstream would ideally be transferred from skip to a marine barge. However, this option requires double handling and the small volume of sediment involved is likely to preclude marine disposal as an option. Thus, the sediment should be permitted for on-shore disposal at a strategic landfill, most logistically SENT.

11.4 Key Issues

The key issues relating to dredging in Staunton Creek generally concern community and nuisance impacts due to the proximity of sensitive receivers to the works site.

Community Impacts

- Dredging operations in the Nullah have a past history of odour problems from accumulated sediment.
- The potential for a short-term community impact exists from the requirement to use a crane to lower floating-plant resulting in the need for traffic diversion and pavement closure. A longer-term impact could arise from the anchoring of a barge at the busy channel mouth.

11.5 Impact Assessment

11.5.1 Noise Impact Assessment

Works Area

There is only one proposed recurrent dredging location for Staunton Creek Nullah and this is shown in Figure 11.1.

Noise Sensitive Receivers

The most affected NSRs around the works area have been identified as those falling within a 300m buffer of the likely works area. The locations of the NSRs are also shown in Figure 11.1 and are described in Table 11.1.

TABLE 11.1 DESCRIPTION OF NOISE SENSITIVE RECEIVERS

NSR	Description
B1	Regional Seminary
B2	Rehabilitation Centre

Noise Impact Assessment Criteria

Noise levels are limited by the *Noise Control Ordinance (Cap 400) including its subsidiary regulations and the Technical Memoranda.* (TM).

In addition to the requirements imposed by the Noise Control Ordinance, the following requirements or interpretations will also be used as a standard in order to control noise generated from equipment and activities for the purpose of carrying out any construction work other than percussive piling during the time period from 0700 to 1900 hours on any day not being a general holiday:

i) The noise level measured at 1 m from the most affected external facade of the nearby NSRs during any 30-minute period during normal weekly daytime periods between 0700 to 1900 hours will not exceed an equivalent sound level (L_{Aeq}) of 75 dB(A) or 70 dB(A) (or 65 dB(A) during examination) for schools.

ii) Construction should not be undertaken during any other period, the restricted period, without the existence of the relevant Construction Noise Permit (CNP).

iii) In accordance with TM, the area around the proposed dredging location has an Area Sensitivity Rating (ASR) of 'C'. The noise environment is dominated by the traffic noise from Ap Lei Chau Bridge which is considered as a relevant Influencing Factor (IF) in this assessment. Therefore day time assessment criteria for establishing noise mitigation measures under the current regulation are 70 dB(A) from 1900 to 2300 hours plus all day Sundays and general holidays and 55 dB(A) between 2300 and 0700 hours.

Assessment Methodology

Since marine access to the dredging location is feasible, the dredging works will be undertaken using a pontoon mounted excavator and the dredged material will be transferred into small barges which will be moved by a tug boat to an area near to the mouth of Nullah where unloading of dredged material to a larger derrick barge will take place. Likely equipment for dredging is shown in Table 11.2.

TABLE 11.2 TYPICAL MIX OF EQUIPMENT FOR DREDGING OPERATIONS

Identification Code	Description	Sound Power Level dB(A)
CNP 081	Excavator	112
CNP 221	Tug Boat	110
CNP 061	Derrick Barge	104

The sound power levels of the equipment used in this assessment were derived from the TM.

The excavator and tug boat were considered to be grouped at a position mid-way between the approximate geographical centre of the dredging area and its boundary closest to the NSR. In the case of an oblong area, having a length to width ratio of 5:1 or more, then only the closest portion to the NSR has been considered, as defined in the TM. It was assumed in the calculations that the derrick barge would be located near the mouth of the channel for transfer of material to ESC.

A total sound power level (SPL) of the dredging operation is obtained by the summation of all the individual SPLs of the associated equipment.

The noise levels at each NSR were predicted by the following equation:

Predicted noise level = Total sound power level - 20 $\log_{10}D$ - 8 dB(A)

where D is distance between the NSR and the noise source

A positive 3 dB(A) correction was made for each predicted noise level due to all concurring activities to account for the facade reflection at the NSR. The predicted unmitigated noise levels are presented in Table 11.3.

A detailed calculation spreadsheet is attached in Appendix A5.

TABLE 11.3 UNMITIGATED NOISE LEVELS AT NSRS

NSR	Predicted Noise Level dB(A)
B1	68[1]
B2	60[1]

Note: 1 The PNL exceeds the ANL of 55 dB(A) from 2300 to 0700 hours for all days.

The calculation indicates that the unmitigated predicted noise levels at both chosen NSRs are below the daytime guideline of 75 dB(A) and the ANL of 70 dB(A) for the restricted hours from 1900- 2300 for normal day and 0700-1900 for general holidays including Sundays. Therefore, no adverse noise impact is anticipated to arise from proposed works during these hours . Should dredging be undertaken at night then predicted noise levels at NSRs will exceed the ANL of 55 dB(A); it is recommended that such works are avoided during night time hours.

11.5.2 Air Quality Assessment

The main issue as regards air quality impacts pertains to odour emissions. There is a history of odour problems in the upper section of the Creek and dredging has recently been carried out in response to public complaints. Thus, as dredging for odour alleviation is considered necessary, the exposure of the local community to odour must be minimised and prevented where possible. Practical mitigation measures are therefore necessary to minimise odour and should be undertaken in conjunction with the dredging and disposal strategy in Section 11.3.2.

The results of channel echo-sounding and sediment sampling revealed that the lined section of the Nullah does not contain a significant layer of soft material. This is thought to be mainly due to the high shear stresses of the concrete bed Furthermore, the construction of access roads is not necessary so truck movements will not disperse dust from new road tracks. Therefore no significant dust impacts are anticipated.

11.6 Mitigation Measures

Mitigation measures over and above the standard specifications detailed in Section 8 are only considered necessary for odour:

- The dredging works will involve the removal of odorous material from the concrete section of the Creek which should be undertaken under dry and cool conditions, and give due consideration to the prevailing wind direction. There should be no spraying down of concrete areas as this disperses contaminants and can generate odour;
- In the long-term, the fugitive discharges into the Nullah should be identified at source and controlled to prevent odour problems in the future. This approach will prevent the need for continual dredging, and will ultimately reduce the volume of sediment accumulating in the lined section of the Nullah.
- For the regular desilting works within the Creek, the works branch or department responsible should keep the EPD informed of the cleaning schedule and

programme. It is also recommended that the water quality in the channel be routinely monitored by EPD.

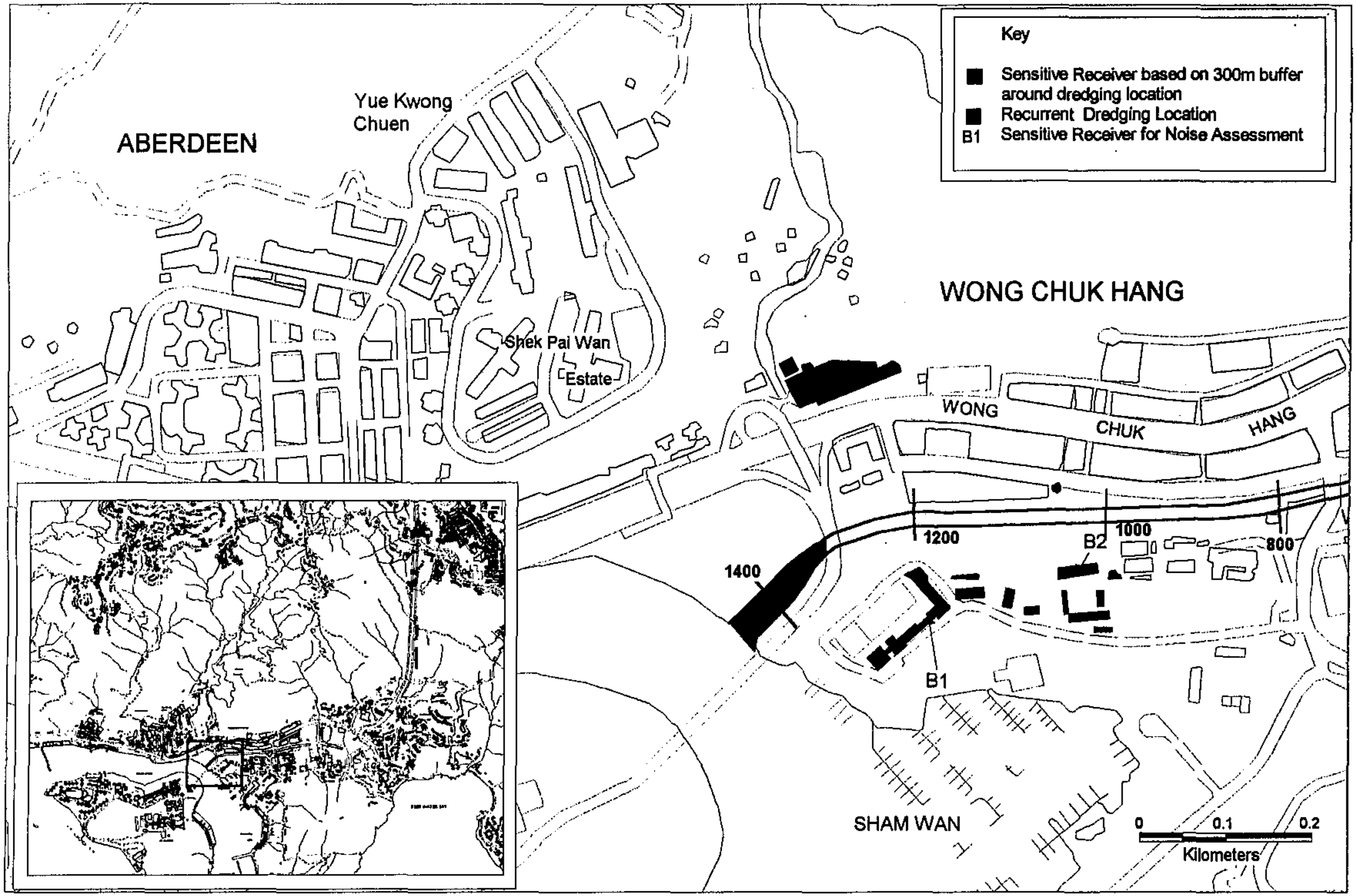

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Figure 11.1 Potential Noise and Air Sensitive Receivers Near Proposed Dredging Location Staunton Creek Nullah

Source: Lands Department OZP

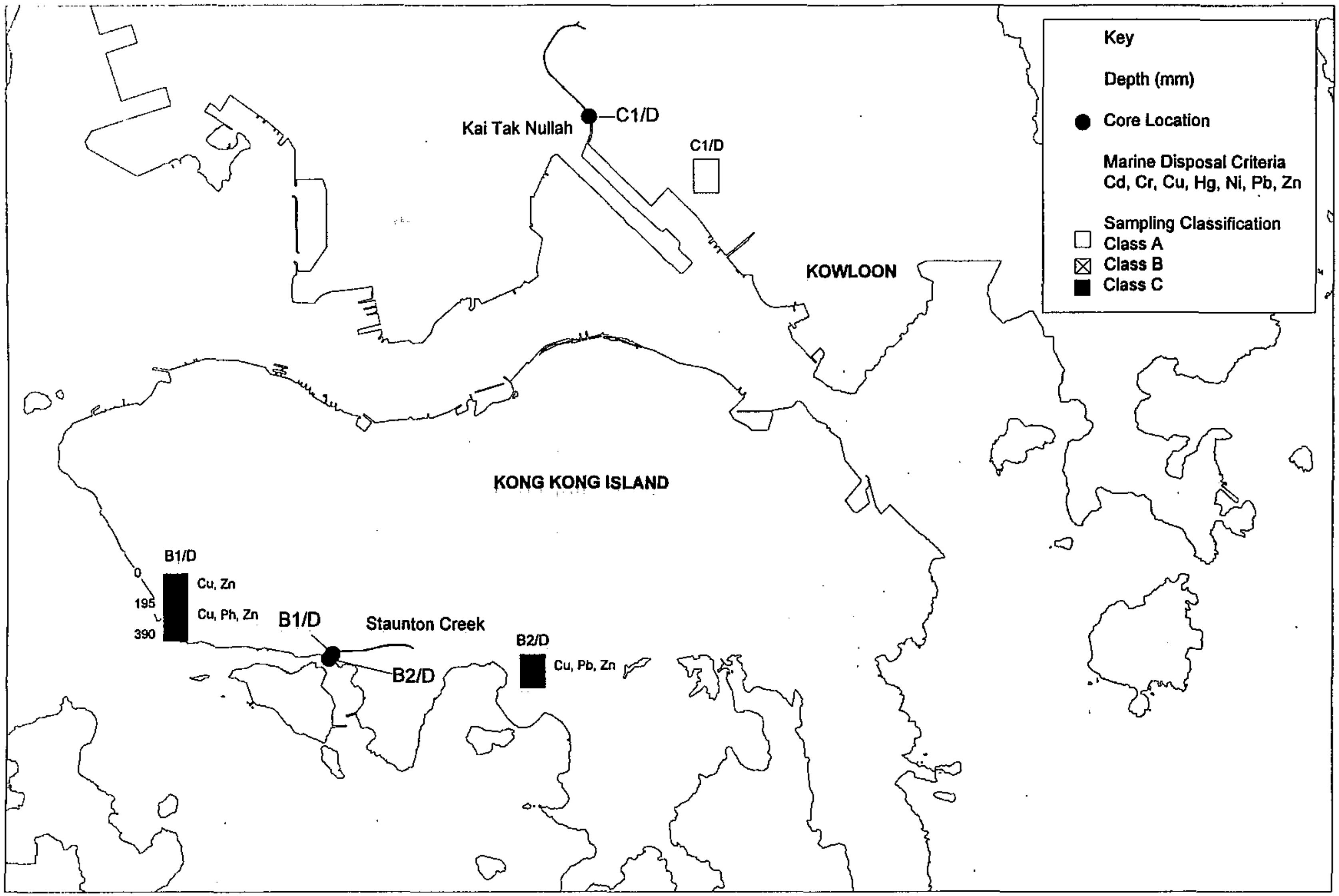

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Figure 11.2 Sediment Core Analysis Results
Staunton Creek Nullah and Kai Tak Nullah

SECTION 12

EIA OF DREDGING WORKS IN KAI TAK NULLAH

12. EIA OF DREDGING WORKS IN KAI TAK NULLAH

12.1 Introduction

Kai Tak Nullah drains from a 11 km^2 catchment through east Kowloon. The nullah passes through Wong Tai Sin, Kowloon City before discharging into Kwun Tong Typhoon Shelter, alongside Kai Tak International Airport. Along its 2 km length the nullah which is engineered and concrete lined, varies in width between 10 and 30 metres. The nullah has a tidal limit in the range of 900m and has no history of extensive sediment removal.

12.2 Existing Environment

12.2.1 Existing and Future Land Uses

The existing area around Kai Tak nullah is 64% urban with an additional 4% of the catchment currently occupied by quarries / construction sites. Southeast Kowloon has been proposed as a reclamation area to provide a new development site comprising the existing Kai Tak airport site and adjacent land for housing 285,000 people. An outline development plan for the area has been produced in Section 3 of Task 8.

12.2.2 Air and Noise Quality

No data was available on existing air quality. The channel emits a strong chemical odour and it is thought that a variety of noxious and corrosive gases are released from the channel. Newspaper reports have stated that gases released from the nullah are responsible for eye irritations, fatigue, sleepiness, nausea and dizziness, amongst other symptoms seen in people living or working in the vicinity of the channel (SCMP, 5th May 1995).

If there is a future requirement for dredging in this channel noise monitoring during the day is not proposed due to the dominance of air traffic noise from Kai Tak International airport. However, in the unlikely event that dredging is recommended during night-time, noise monitoring should be undertaken in accordance with the EM&A manual.

12.2.3 Hydrology and Water Quality

Flood History and Predicted Flooding

It has been noted that severe flooding can occur along the length of the nullah. This has been attributed to obstructions in the nullah and low bank levels, rather than sedimentation. Tasks 4 and 5 have concluded that the entire system is most probably at, or close to, dynamic equilibrium.

Flooding predictions were modelled by Task 4 under two different scenarios for the existing Kai Tak Nullah channel:

Case 1 - 10 years storm and 200 years tide;

Minor flooding is predicted between chainages 0 - 500m, with severe flooding between chainages 800 - 1600m.

Case 2 - 200 years storm and 10 years tide;

Severe flooding occurs between chainages 0 - 1800m.

Pollutant Loadings

According to the EPD 1995 River Water Quality Report, there are 304 chemical waste producers within the Kai Tak catchment, of which just 5 contribute about 70% of the total chemical waste. Heavy organic pollution is reflected by a low mean dissolved oxygen concentration (1.2 mg/l) and a high median annual BOD_5 (>80 mg/l). Annual median concentrations of several heavy metals in water were also elevated (>100 μg/l).

EPD states that pollution problems in Kai Tak nullah are caused by sewage and trade effluent from numerous illegal connections, including: effluent from squatter areas; temporary housing areas; public housing estates; restaurants and factories. The poor dispersive capacity of Kwun Tong Typhoon Shelter aggravates the pollution problem.

Water Quality

Water monitoring undertaken by EPD during 1995 classed the water quality in all but the upper reaches of Kai Tak as 'bad' to 'very bad', whilst the quality in the upper section had improved from 'fair' to 'good' (Appendix B1).

Under Stage I of The Tolo Harbour Effluent Export Scheme (THEES) effluents treated at the Sha Tin Sewage Treatment Works (STW) have been discharged into the upper stretch of Kai Tak Nullah since April 1995. The flushing has improved the water quality and reduced the odour problem at this part of the nullah. On completion of Stage II of THEES treated effluent from the Tai Po STW will also be discharged into Kai Tak Nullah. This additional flow is anticipated to further enhance water quality and alleviate the odour problem (EPD, 1996).

12.2.4 Sediment

Sediment reaching the mouth of Kai Tak nullah typically has a long retention time due to the dispersive limitations of the water in the typhoon shelter. Consequently there is an accumulation of contaminated soft sediment which acts as a continual pollutant source (EPD, 1995).

For the purpose of this survey a total of four grab samples were collected from the middle stretch of the nullah during July / August 1995. A single core sample was collected during December 1995. The locations and results from grab and core sampling are presented in Figures 12.2 and 12.3 respectively. The full data set for the core sample are presented in Appendix B4.

Characteristics

Task 8 revealed that approximately 72% of the sediment yield in the Kai Tak catchment is attributed to erosion on building and quarry sites. Consequently, the grab sample results indicate that much of the sediment within the nullah is granular, probably derived from construction activities. However, as bathymetric surveys revealed that the downstream section of the nullah contains a 0.5m layer of soft sediment of marine origin there is the possibility that a proportion of the fines were lost from each of the grabs.

Quality

Sediment which has been in the nullah for some time is likely to have become contaminated, whereas more recently deposited construction-derived material may still be uncontaminated. The results from grab sampling revealed copper concentrations at three of the locations meeting Class 'C' contamination criteria (Appendix B3). In contrast to the grab results, the result for the core sample displayed no presence of contaminants. This is probably due to the difficulty in obtaining a representative core because of the lack of sediment depth. Core analysis revealed elevated nutrient levels and organic carbon levels at less than 1%. This might be explained by the impact by high pH discharges from local building sites and quarries.

12.2.5 Ecology

Riparian Flora and Fauna

The concrete lined channel contains no riparian flora or fauna.

Aquatic Fauna

Given the nature of the channel and the sparse sedimentation the aquatic fauna of the Kai Tak nullah is expected to be impoverished consisting of only a small number of pollution tolerant species.

12.3 Proposed Works

12.3.1 Dredging Requirements

Hydraulic modelling in Task 4 concluded that lowering the Nullah bed through dredging would not alleviate natural flooding. The existing channel is almost entirely self-cleansing, and so it may be concluded that it is effectively in dynamic equilibrium.

The contribution of marine sediment to the annual dredging requirements is probably nil. Furthermore, fluviatile sedimentation does not occur within the channel due to high bed shear stress. Thus, neither restoration nor maintenance dredging are required.

Task 4 and 5 Recommendation: The precautionary recurrent dredging of approximately 2,000m^3 per year of predominantly construction-derived material should continue from the city section of the nullah, upstream of chainage 1200. This figure is based upon the estimated volume of material removed annually by Mainland South Division of DSD.

As the material removed by DSD is construction-derived, measures should be taken to avoid the illegal dumping / tipping of this material at source. Ultimately, this is best measure for reducing the volume of material requirement removal, and hence for reducing the frequency of dredging.

12.3.2 Dredging Strategy

i. **Access:** The upper stretch of the nullah is characterised by pipelines and bridges which restrict the clearance area for vehicular access. Consequently manual methods of clearance may be necessary in places in conjunction with land-based plant. Three ramps in the upper reaches of the nullah provide good vehicular access. In the section down from the airport there is also little vertical and horizontal clearance, with some stretches of the nullah entirely culverted. Long reach crane will be used to deploy dredging plant elsewhere. Marine access to the nullah is impossible for all areas other than the mouth beside the typhoon shelter.

ii. **Dredging:** Maintenance in the upstream section of the nullah will be undertaken through the use of mini excavators and manual clearance methods which may be deployed from the nullah sides. In the event that dredging is required downstream within the airport in the future, then land-based excavators or crane grabs will be used operating from the apron of the airport runway. Dredging could be undertaken at night when the airport is closed. Where the nullah is decked, tyred mini-excavators and manual methods could be used during low tide conditions.

iii. **Transport:** Due to the absence of suitable areas for stockpiling, all excavated materials will be immediately transferred to road vehicles, close to the access ramps upstream or on the airport runway apron downstream, for transport to a land-based disposal facility.

iv. **Disposal Strategy:** Due to the proximity of land-based disposal facilities and the contaminated nature of the nullah sediment, disposal will be to a strategic landfill. The predominantly granular nature of the sediment is conducive to free draining, thus ensuring the material will be suitably dry for landfill disposal.

12.4 Key Issues

As Kai Tak Nullah passes through a crowded urban area it is in close proximity to many potential Sensitive Receivers. Those receivers nearest to the Nullah with respect to noise and air impacts are indicated in Figure 12.1.

<u>Odour</u>

Odour is considered a key issue because of the history of odour generation in the lower reaches of Kai Tak Nullah, even though works are to be undertaken upstream of the Airport.

- The proximity of ASRs to upstream works requires that potential odour impacts are considered.

- Personnel involved in manual sediment clearance may be exposed to potential health risks from chemical/biological contaminants. Thus, a consideration of health and safety issues is necessary as recommended by Task 5.

12.5 Impact Assessment

12.5.1 Noise Impact Assessment

Due to the location of the nullah and the proposed use of mainly manual excavation methods, noise is not considered as a key issue. Consequently a detailed assessment was not deemed necessary. The upper reaches of Kai Tak nullah flow through the highly urbanised area of east Kowloon, often alongside noisy roads, whilst the lower stretch passes through Kai Tak Airport. If it is decided that mechanical methods of clearance are necessary then their operation will be limited to daytime hours to avoid any potential community impacts during restricted hours. During daytime hours noise guidelines for schools will be exceeded therefore it is recommended that manual excavations techniques continue to be used for works on this channel.

12.5.2 Air Quality Assessment

Odour

The results from grab analysis of the bed sediment revealed heavy metal contamination to Class 'C' and the presence of high nutrient levels, most likely originating from construction site waste waters.

Odour problems in the upper reaches of the nullah are potentially of great significance due to the proximity of residential areas within the 300m works buffer zone, as displayed in Figure 12.1. However, the volume of sediment to be removed is small, granular in nature and present in only a thin layer. Consequently it is probable that the sediment is well aerated and is not suitable for adsorption by odour emanating organic contaminants. Thus, there should be no significant odour problems if appropriate mitigation is followed.

Dust

The small volume of sediment in the nullah and its granular nature, dust emissions from the works are not anticipated to be of significance. Furthermore, any material which is removed from the channel will be transported from the site rapidly as there are no suitable areas for local storage. Adherence to standard dust mitigation measures, as set out in Section 8, is recommended.

12.6 Mitigation Measures

Mitigation measures in addition to the standard specifications in Section 8 include the following:

- Work overalls, gloves and face protection must be used during manual clearance as a precaution against skin-contact or inhalation related health impacts.
- Sediment should not be sprayed down in dried areas as this disperses contaminants and contributes to odour generation.

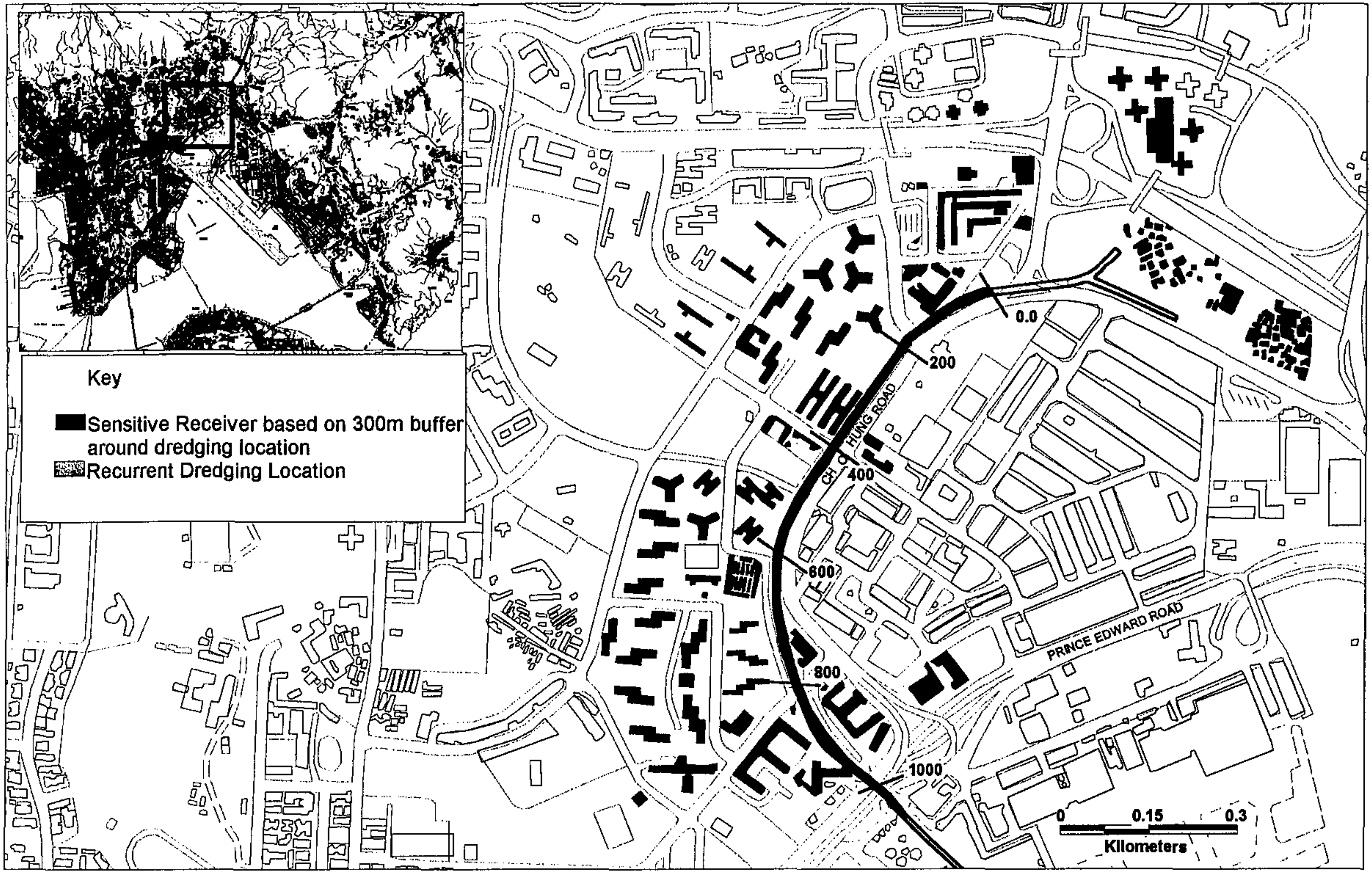

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Figure 12.1 Potential Noise and Air Sensitive Receivers Near Proposed Dredging Location Kai Tak Nullah

Source: Lands Department OZP

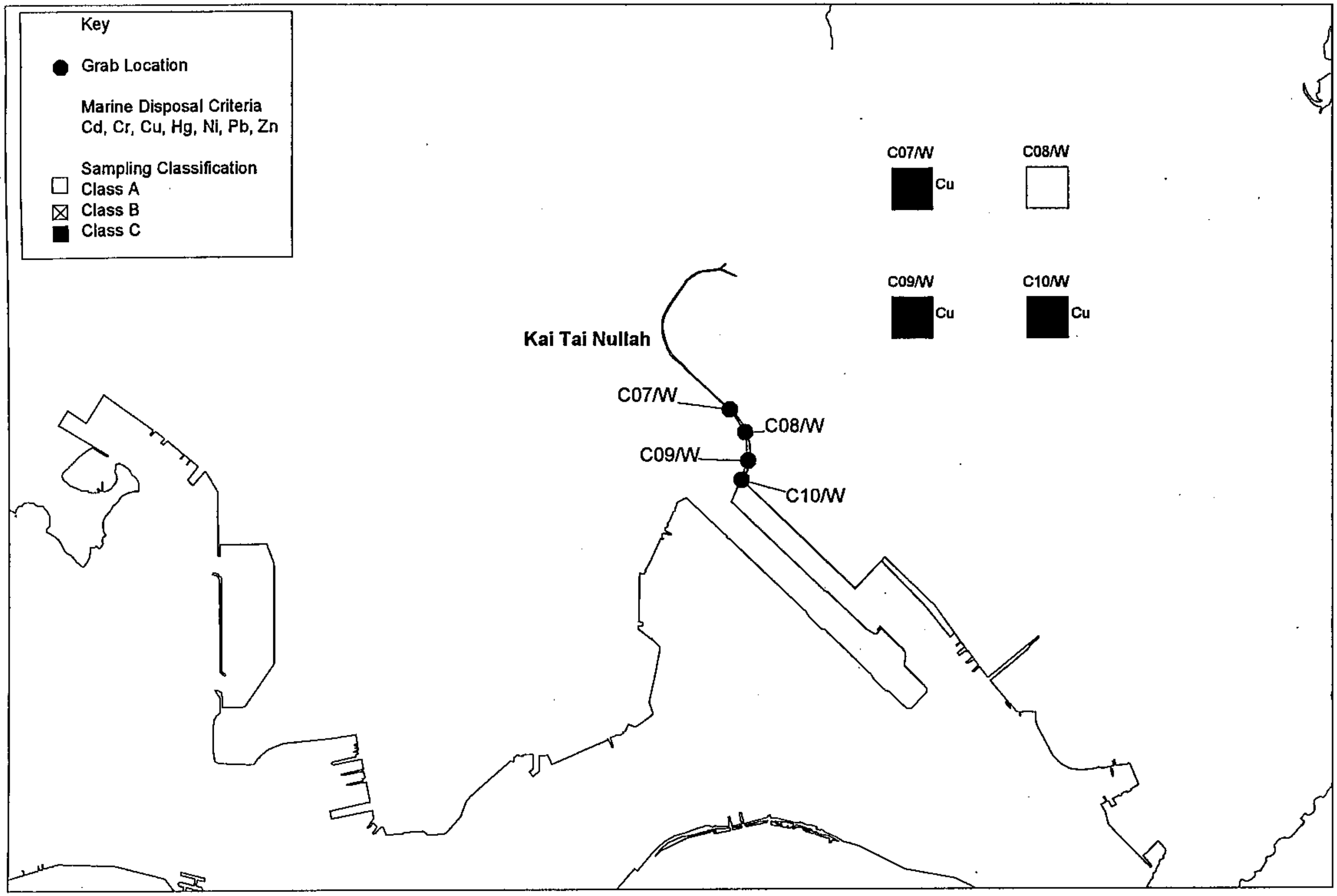

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Figure 12.2 Sediment Grab Analysis Results
Kai Tak Nullah

SECTION 13

EIA OF DREDGING WORKS IN SHING MUN RIVER CHANNEL

13. EIA OF DREDGING WORKS IN SHING MUN RIVER CHANNEL

13.1 Introduction

The Shing Mun River is a major channel some 50 km long located in the East New Territories. Much of the channel is engineered and was formed when a large area of land was reclaimed to create Sha Tin new town. The River is fed by a catchment of approximately 70 km^2 which includes Jubilee Reservoir and the Lower Shing Mun Reservoir. However, as the reservoirs are effective sediment traps the actual catchment area contributing to increased fluviatile sediment loads is approximately 50 km^2.

The most significant stretch of the River runs for 7 km from Tai Wai to the channel mouth at inner Tolo Harbour. The channel is tidal as far as 200m upstream of the Tai Wai KCR bridge. The channel is 50m wide at Tai Wai, whilst at its mouth the channel is close to 200m wide. The bed of the whole length of the River, from its mouth to Tai Wai, is naturally unlined, with no rubble. Figure 13.1 displays the location of proposed maintenance dredging and the Sensitive Receivers to both noise and air quality impacts.

The Shing Mun River is fed by several tributaries, of which three are of greatest significance for this project: Fo Tan Nullah, Siu Lek Yuen Nullah and Tai Shui Hang Stream. Fo Tan Nullah flows in a south-easterly direction for approximately 1,500m passing through an industrial area. All but 250m of the channel is concrete lined. Siu Lek Yuen Nullah is fed by several streams which drain the northern fringes of Tate's Cairn and Buffalo Hill. The tidal stretch of Siu Lek Yuen Nullah flows in a north-westerly direction for about 1,200m until it discharges into the Shing Mun River opposite the mouth of Fo Tan Nullah. Tai Shui Hang Stream also flows in a north-westerly direction and drains the northern slope of Buffalo Hill. Its tidal stretch covers a total of 750m from its confluence close to the mouth of the Shing Mun River.

13.2 Existing Environment

13.2.1 Existing and Future Land Uses

The major land uses in terms of percentage cover are urban areas and grassland. According to EPD (1995), of all premises discharging into the Shing Mun catchment during 1994, 250 were of industrial origin, 450 from commercial premises, 10 from sewage treatment plants, 80 from institutions and 2 from livestock farms. Over 2 percent of the catchment is bare earth which is exposed to erosion, whilst an additional 1% of the area is undergoing construction activity.

Significant housing developments are taking place at Ma On Shan to the north east of the channel mouth and to the northwest of the channel mouth there will be a public dump site at Pak Shek Kok providing reclaimed land for future development.

13.2.2 Air Quality

Sha Tin is situated within an airshed whereby the topography prevents the natural dispersion of pollutants by wind currents. Consequently the valley was designated as a fuel restriction zone under S.43 (i)(j) of the Air Pollution Control Ordinance Cap. 311. There are no major polluting industries found within the valley (Binnie Consultants, 1993a). Thus, the air quality along the Shing Mun valley is generally good. Field observations have indicated that air quality in the vicinity of the channel is adversely affected by road traffic and channel odour.

For the purposes of this Study a baseline air quality survey was conducted at the Jockey Club T.I. College, close to Fo Tan Nullah, and at KCBC Hay Nien Primary School, close to Tai Shui Hang Nullah. Monitoring was undertaken over seven consecutive days during November 1996. The results are summarised in Table 13.1, and presented fully in Appendix A7. Field notes and methodologies are included as Appendix A4.

TABLE 13.1 SUMMARY OF BASELINE AIR QUALITY MONITORING RESULTS

Date of Sampling	Total Suspended Particulate TSP value ug/Std. m^3	
	Hay Nien Primary School	Jockey Club T.I. College
08.11.96	89	98
09.11.96	105	103
10.11.96	115	94
11.11.96	70	74
12.11.96	83	86
13.11.96	71	87
14.11.96	73	92

NB: The Air Quality Objective for 24 hr. TSP measurements is 260 ug/m^3

The results show that the TSP levels were consistently good over the monitoring period, with averages of 86.6 ug/Std. m^3 at the Primary School and 90.3 ug/Std.m^3 at the T. I. College

Odour

The inherent design of the protective berm along the Shing Mun River exposes bed sediment, and hence odour, during low tide and occasionally during mid-tides on hot days. The odour problem is exacerbated in the River's upstream area near Man Lai Court, where the riverbed is raised to match the concrete apron at Tai Wai. Odour emanates from the sediment as a result of persistent discharges of untreated effluent. In terms of existing odour, the Environmental Improvement of Shing Mun River Study for EPD has found that odours detected in the vicinity of the channel are a result of hydrogen sulphide gas generation within the channel. Investigations of rate of gas generation are ongoing (Aspinwall Clouston, 1997)

13.2.3 Noise

A noise baseline survey was also undertaken during November 1996 at the Jockey Club T.I. College and KCBC Hay Nien Primary School. The monitoring locations are presented in Figure 13.1. The results are summarised in Table 13.2. and are presented in full in Appendix A6. Methodology is included as Appendix A4.

TABLE 13.2 SUMMARY OF BASELINE NOISE MONITORING RESULTS

Location	$L_{eq30min}$ dB(A)		L_{10} dB(A)		L_{90} dB(A)	
	Average	Range	Average	Range	Average	Range
Jockey Club College	63.0	59.8 - 67.5	64.6	62.0 - 69.0	59.2	55.5 - 60.5
KCBC Hay Nien Primary School	60.7	58.7 - 64.2	62.8	61.0 - 66.5	56.4	54.5 - 60.0

The baseline L_{90} results indicate that noise levels typically fall between 55 - 60 dB(A). However, there are noise peaks in the range of 60 - 70 dB(A) as a consequence of road traffic noise. The average L_{eq} noise values are greater than 60 dB(A).

13.2.4 Hydrology and Water Quality

Predicted Flooding

Flooding predictions were made in Task 4 under two different environmental scenarios for the existing Shing Mun River channel and its tributaries:

Case 1 - 10 years storm and 200 years tide;

No flooding is predicted in either the Main Channel or along Siu Lek Yuen Nullah. Minor flooding is predicted between chainages 700-1000m in Fo Tan Nullah, with moderate flooding between chainages 0 - 300m in Tai Shui Hang Nullah.

Case 2 - 200 years storm and 10 years tide

Flooding is predicted to be minor in the Main Channel between chainages 0 - 5300m. Moderate flooding is predicted between chainages 500 - 1000m in Fo Tan Nullah, with severe flooding predicted along Tai Shui Hang Nullah between chainages 0 - 450m. Flooding is not anticipated along the Siu Lek Yuen Nullah.

Pollutant Loads

Several studies of the marine fauna of Tolo Harbour have indicated a deteriorating ecological environment, with evidence of eutrophication due to anthropogenic inputs of nutrients and pollution stressed communities (Taylor and Shin 1990; Shin 1990; Lam 1990; Leung, A. W. Y. 1992; Lam 1992; Davie 1992; Leung, S. F. 1992; Chan and Wong 1993). This is mainly due to the highly enclosed nature of the harbour and previous increases in anthropogenic organic inputs. However, since 1988, the incidence of red tides has declined following the implementation of the Tolo Harbour Action Plan, which limited nutrient loading by improving sewage treatment and reducing the input of livestock waste and industrial effluents.

In the past the catchment has been subject to livestock waste pollution, particularly from the Siu Lek Yuen Nullah (EPD, 1994c). After the implementation of the Waste Disposal (Livestock Waste) Regulations in 1988, the pollution load from livestock waste discharges has been largely eliminated. Industrial pollution has had a more significant influence over water quality in Fo Tan Nullah but the unauthorized discharge of industrial effluent has generally been controlled under the WPCO and WDO.

Data regarding pollutant loadings from the Storm Drainage Surveillance Report (Local Control Office Territory North, EPD), conducted in the Summer of 1993, provides relevant background information for this study concerned with the tidal portions of the channel. The organic pollution loading to the river at this time was estimated to be 3,600 kg BOD/day. By the end of 1994 the estimated loading had been reduced to 1,840 kg BOD/day, most of which was domestic in origin (1,520 kg/day). Livestock waste had a BOD of just 10 kg/day due to the implementation of the WDO. Other improvements in pollutant loadings have been due to the provision of public foul sewerage systems; rectification of sewerage cross connections; diversion of wastewater, and the installation of waste water treatment systems.

Water Quality

EPD's routine monitoring has indicated that the water quality of the Shing Mun River has improved as a result of measures taken in recent years to control livestock waste and due to the redirection of sewage from stormwater drains into designated treatment sewers. EPD's routine monitoring data from 1995 indicates that water quality within the Shing Mun River ranges from 'fair' to 'excellent', with the Main Channel containing 'good' water quality (Appendix B1). Suspended solid concentrations were generally low and within acceptable levels. The river water is not contaminated with detectable levels of metals other than very low concentrations of zinc (max. 0.33 mg/l) and mercury (max. 1.0μg/l).

Analysis of water quality for the Shing Mun River and its tributaries was conducted specifically as part of this study during April 1996. The survey was undertaken over a twelve hour tidal cycle at four locations (Appendix B2), using the methodology as described in Appendix A3. The results are presented graphically in Figure 13.2 and are summarised in Table 13.3. The full results are presented in Appendix A1.

TABLE 13.3 SUMMARY OF WATER QUALITY MONITORING RESULTS

Location	Salinity (ppt)	D.O. (mg/l)	D.O. (%)	S.S. (mg/l)	B.O.D. (mg/l)
D1	28.54 (20.3 - 32.5)	0.89 (0.50 - 1.21)	9.5 (5.2 - 12.9)	10.2 (7.0 - 17.0)	6.2 (5.0 - 7.5)
D2	31.32 (30.7 - 33.2)	1.61 (0.61 - 2.77)	17.5 (6.50 - 30.1)	14.0 (12.0 - 15.0)	7.6 (5.5 - 9.5)
D3	31.68 (31.1 - 32.3)	3.81 (2.46 - 4.28)	42.1 (27.6 - 47.9)	8.4 (6.0 - 10.0)	9.4 (8.5 - 10.5)
D4	32.04 (31.3 - 32.7)	6.46 (5.02 - 8.70)	73.2 (56.3 - 95.8)	9.6 (9.0 - 10.0)	9.4 (8.0 - 11.0)

The data shows typical trends in the water's physical parameters which would be expected along any tidal stretch of river. Salinity levels display consistency at the mouth of the river (D3 and D4) where the conditions are representative of marine water, regardless of tidal state, but fluctuate widely at D1 upstream. Dissolved oxygen (D.O.) concentrations decrease from the channel mouth upstream. Downstream the D.O. ranged from 2.46 mg/l (27.6%) to 8.70 mg/l (95.8%) whilst the upstream concentrations ranged from 0.50 mg/l (5.20%) to 2.77 mg/l (30.1%).

Further upstream (D1 and D2), within the intertidal range, suspended solid concentrations increase due to the twin factors of a low water depth and bed material dispersion. The magnitude of changes in the physio-chemical conditions of the river water are greatest upstream due to the proximity of the tidal limit. Downstream the suspended solids ranged from 6 - 10 mg/l, whilst upstream suspended solids concentrations are in the range 7 - 17 mg/l.

The BOD_5 concentrations along the whole of the Shing Mun were in the range 5-11 mg/l. The highest concentrations were recorded downstream during flood tide indicating the input of organic matter from the channel mouth.

13.2.5 Sediment

A total of fifteen grab samples were collected from the Siu Lek Yuen Nullah in July 1995 prior to the commencement of maintenance / repair works. The locations and analytical results are shown in Figure 13.3.

Surface grab samples were collected of Shing Mun River bed sediment specifically for this Study during July / August 1995. Sufficient bed depths subsequently enabled a total of nine core samples to be collected from the River during December 1995. The locations and results of core sampling are presented in Figure 13.4. The full core analysis results are presented in Appendix B4.

<u>Characteristics</u>

The analysis of core samples indicates that the particle size distribution of the bed sediment along the Shing Mun River is dominated by the silt / clay fraction, with some fine to very fine sand present at the mid to lower depths. This is the case for all core samples along the main channel, except for core D2 from the upper section of the channel which had a high content of very coarse sand below its middle depth. The sediment in Fo Tan Nullah was classed as silty clay, whilst the sediment at the mouth of the Tai Shui Hang Nullah was silty at the surface with accumulations of very coarse sand below 0.2m.

<u>Quality</u>

Grab sample results from Siu Lek Yuen Nullah showed the sediment to be contaminated to Class 'B' and Class 'C' criteria in all locations except the channel head. Zinc was present in every contaminated sample and may well be a legacy from historic inputs of Livestock Waste.

Analysis of the core samples revealed that the Main Channel is seriously contaminated with heavy metals, particularly zinc, lead, and copper. The upstream areas of the Main Channel were found to be considerably more contaminated than the mouth of the River, where only lead was present in concentrations high enough to qualify the sediment as Class 'C'. Examinations of core depth profiles against contamination does not reveal any obvious pattern.

The single core sample collected from Fo Tan Nullah was contaminated with copper twenty times greater than the minimum value for Class 'C' criteria under TC 1-1-92. This tributary also contains chromium up to three times greater than the minimum value for Class 'C' classification, and nickel, lead and zinc two times the Class 'C' value. This channel passes through an industrial area and therefore it can be concluded that this contamination is a result of unauthorized discharge of industrial effluent. The contamination is possibly historic as a survey by the Local Control Office found no significant industrial pollution sources in 1993 due to enforcement actions under the WPCO. A review of past water quality data for Fo Tan Nullah indicates that copper contamination has been a persistent pollution problem.

Due to the present contamination levels in Fo Tan Nullah, it is possible that some material may be sufficiently polluted to warrant its inclusion as 'Class 3' sediment. Thus, Tier III and IV testing may be required as recommended under the new EVS guidelines.

Results from EPD sampling show that the sediments in inner Tolo Harbour contain high levels of total organic carbon and generally low to medium levels of nitrogen and phosphorous. Concentrations of metals were also generally low to medium, with the exception of relatively high levels of lead (>75 mg/kg dry solids).

In addition to sampling undertaken for this study, more recently results of sediment tests for the Environmental Improvement of Shing Mun River Main Channel and Associated Nullahs Study (EPD/Aspinwall Clouston,1997) have indicated that sediments have adverse biological effects on some marine organisms. Tests recommended by EVS Consultants for investigating the ecotoxicological effects of sediments on amphipod and polychaete survival and growth were undertaken and found to significantly reduce amphipod survival, polychaete dry weight and bivalve survival by over 25%. Under the proposed EVS guidelines the sediment would be classified as class 3 but would first be subject to Tier IV testing as it is thought likely that the presence of high concentrations of ammonia and sulphides could be causing the toxic effects. Such contaminants can be removed relatively simply, thus reducing toxicity. The sediment is therefore likely to be limiting the development of a robust ecological community within the river (Aspinwall Clouston, 1997)

13.2.6 Ecology

Riparian Flora and Fauna

Limited riparian flora and fauna exists around the Shing Mun River due to the highly industrialised nature of the land and the concrete river bank. Adjacent land on both banks is used for high density commercial and residential developments thus limiting the conservation value of the area.

Aquatic Fauna

Previously, the channel was highly polluted by organic waste from chicken and pig farms and by toxic wastes from adjacent industries. However, the water quality of the Shing Mun River is now improving due to measures including control of livestock waste entering the river and the redirection of sewage from commercial, industrial and residential buildings and from stormwater drains into the foul sewers for treatment.

As a consequence increased numbers of shrimp, fish and shellfish have been reported in the Main Channel (EPD 1994a).

Deposits of mud high in sulphides remain on the river bed, as evidenced by odour problems during periods of low tide. This problem continues due to further pollution sources, namely unsewered villages and discharge of untreated wastewater into the stormwater system. As stated in the previous section, the apparent sediment toxicity is likely to prevent the development of a diverse ecosystem within the channel.

Tolo Harbour, into which the channel drains is considered to be an ecologically important area since it supports one of the few remaining coral communities in Hong Kong and contains or borders nine designated SSSIs (Figure 4.2).

13.3 Proposed Works

13.3.1 Dredging Requirements

Task 4 concluded that the predicted flooding events which occur under base conditions cannot be completely alleviated by dredging. Even dredging of the Tai Shui Hang Nullah to as-built levels would not prevent severe flooding under a Case 2 scenario, as described in Section 13.2.4.

<u>Shing Mun River Main Channel</u>

Tasks 4 and 5 estimated that fluviatile inputs to the Main Channel are distributed throughout its length, mainly between Ch. 2300-3700 and Ch. 4600-6000. These inputs contribute approximately 20,000 m^3 / year for recurrent dredging and represent almost one third of the total anticipated maintenance dredging volume for all the channels in this Study. However, the Main Channel is currently predicted to be at or very close to dynamic equilibrium with respect to sediment fluxes, and its overall rate of material accumulation is negligible.

Task 4 estimated that around 148,000m^3 of sediment requires restoration dredging from the Main Channel between Ch. 1400 - 3300 and Ch. 4700 - 5000. This is in order to comply with flood trigger and side channel / culvert clearance levels.

<u>Fo Tan Nullah</u>

Task 4 estimated that the annual input of sediment to Fo Tan Nullah is approximately 320m^3, which accumulates at Ch. 700 - 800. Echo-sounding and sediment sampling revealed that this material is coarse grained and of fluviatile origin, and also contains a large proportion of soft marine material from the Main Channel.

<u>Tai Shui Hang Stream</u>

Modelling indicates that approximately 460m^3 / year of sediment accumulates along Tai Shui Hang Stream at Ch. 650 - 1050. This is also likely to contain a substantial proportion of marine muds, in addition to fluviatile sediment, given the proximity of the Stream to the mouth of the Main Channel.

Siu Lek Yuen Nullah

Based on Task 4 modelling and CED records, the predicted volume of sediment which accumulates annually in Siu Lek Yuen Nullah is around 7,000m^3. Of this volume, 4,000m^3 accumulates upstream (Ch. 500 - 700). As the bed (a rubble lining overlying a layer of geotextile on a natural bed)of the Nullah does not rise significantly along its entire length, it is likely that this material is carried by the tide from the Main Channel - hence its fine nature and Class 'C' contamination. The remaining 3,000m^3 of material is construction-derived and accumulates at the confluence with the Main Channel (Ch. 1500 - 1600).

Task 4 and 5 Recommendations: Monitoring of marine sedimentation in the Main Channel is recommended with a view to assessing future development. Restoration dredging of the Main Channel is also suggested. It is recommended that all sediment inputs to Fo Tan Nullah, the upstream area of Tai Shui Hang Stream and Siu Lek Yuen Nullah should be regularly dredged.

13.3.2 Dredging Strategy

i. **Access:** Marine access is possible from the mouth of the Main Channel to just beyond Lion Bridge due to sufficient channel depth and width. With the exception of the Tate's Cairn Road Bridge, most other bridges across the Main Channel have a vertical clearance of 3-4m above low tide. The lower reaches of the tributaries are sufficiently deep to allow access by barge/floating pontoon from the main channel.

   Lion Bridge represents the marine access limit for all but the smallest of vessels due to a vertical clearance of less than 3m during low tide. Any plant not small enough to be brought by marine going vessel may be lowered into the inter-tidal channel from Che Kung Miu Road which runs parallel to the River as it bends to the north west. Access to the upstream tidal limit and beyond may be achieved in conjunction with cranes or temporary ramps via the access ramp to the west of the channel next to Mei Lam Estate.

   Marine access is possible for all of Siu Lek Yuen Nullah and the lower reaches of Tai Shui Hang Stream and Fo Tan Nullah. Access to upper Tai Shui Hang Stream requires land-based plant, whilst access to the upper reaches of Fo Tan Nullah will be down the ramp beside Yuen Wo Road.

ii. **Dredging:** Where water depths are sufficient grab dredgers / backhoes mounted on floating pontoons will be used to remove sediment from the Main Channel. In the stretch of Channel furthest upstream rubber-tyred excavators will be used, supplemented by manual methods. Above Lion Bridge, marine plant such as pontoon mounted grabs or excavators loading into small barges will be used. Downstream of Lion Bridge to the River mouth dredging can be undertaken by marine plant as there are no access restrictions. Mechanical dredgers, such as floating grabs, are most likely to be used in order to minimise material volumes and to avoid problems with floating debris.

   Where dredging is required along Tai Shui Hang Stream backhoes and excavators with hydraulic buckets will be used where access allows. Materials from the more confined areas of Tai Shui Hang Stream will be excavated using land plant or manual methods.

Siu Lek Yuen Nullah and the downstream region of Fo Tan Nullah can be worked using pontoon-mounted grabs and backhoes which load into small barges. Tyred mini-excavators and manual methods can be employed in the upper section of Fo Tan Nullah, loading into skips.

iii. **Transport:** Material from the upper reaches of the Main Channel will be placed into skips or trucks for land transportation. Material from the middle section of the Channel, above Lion Bridge, could be transferred either into larger barges further downstream or could be loaded into trucks at the banks for overland transport. Material dredged from the downstream section of the Main Channel, where there are no access limitations, could be initially transported using shallow draft barges. However, transfer to larger barges would be necessary for disposal at East Sha Chau.

Dredged materials from Siu Lek Yuen Nullah and the downstream section of Fo Tan Nullah will initially be loaded into small barges prior to transfer to larger barges for marine transfer. Excavated materials from the upper section of Fo Tan Nullah will be placed into skips at the channel banks and loaded onto trucks for road transport. Material from Tai Shui Hang Stream will be transported by road for land-based disposal, or by barge if marine disposal is required.

iv. **Disposal Strategy:** Should recurrent dredging of the Main Channel occur, then disposal to the Public Dump at Pak Shek Kok is recommended for class B material. Further study is recommended for this option and if it is decided that it is unacceptable then open sea disposal is recommended. Class C material will be disposed of to East Sha Chau contaminated mud pits.

Uncontaminated coarse material from the upstream section of the Main Channel is suitable for land based disposal, such as the Public Dump at Pak Shek Kok provided it is free of rubbish. The soft material from the intertidal reaches between Lion Bridge to the mouth of the Main Channel is suitable for disposal to the East Sha Chau contaminated mud pits.

There are numerous free-draining obstructions in Tai Shui Hang Stream, mainly opposite Chevalier Gardens Footbridge, which should be removed and disposed of to Pak Shek Kok. The disposal option for material dredged from Ch. 650 - 1050 depends upon the results of contamination tests: clean material should be used for a beneficial use if an opportunity arises; class B material should be suitable for disposal to Pak Shek Kok subject to further study; whilst heavily contaminated material, although not expected here, will be suitable for landfill disposal. Material from the upper reaches of the Stream is expected to be reasonably free-draining and could be taken to Pak Shek Kok.

In Fo Tan Nullah, sediment dredged from the downstream region and cleared from the upstream areas will be disposed of at landfill or East Sha Chau.

Class B material dredged from Siu Lek Yuen Nullah will be disposed of to Pak Shek Kok or alternatively open sea disposal if disposal to the public dump is unacceptable. Class C material will be disposed of at East Sha Chau or taken to a landfill.

13.4 Key Issues

The key issues for the Shing Mun River Main Channel relate to the handling, transportation and disposal of sediment of varying contamination status. It will be important to minimise impacts on water quality and also take practical precautions to minimise odour generation. As this channel is well utilised for both passive and active recreational pursuits the timing of the dredging will be critical to avoid unacceptable noise, odour and water quality impacts.

The results from core sampling reveal that the sediment from Fo Tan Nullah is extremely contaminated with heavy metals. Consequently, the potential impacts on water quality and odour will be more locally severe than the impacts from the Main Channel. Similarly, there is potential for downstream transport of sediments resulting in secondary impacts on aquatic life in the Main Channel. Sediment transportation down the Main Channel from restoration dredging is also a key issue in regard to potential secondary impacts on sedentary species in Tolo Harbour.

There is the potential for interference with roads and pavements when accessing the more confined areas of Tai Shui Hang Stream and the upper reaches of Fo Tan Nullah and the Main Channel.

13.5 Impact Assessment

13.5.1 Noise Impact Assessment

Works Area

There are three proposed restoration dredging locations in the Main Channel and four proposed recurrent dredging locations from the tributaries. In addition proposed recurrent dredging locations are distributed along the length of the Main Channel. Dredging locations are shown in Figure 13.1.

Noise Sensitive Receivers

The most affected NSRs around the works area have been identified as those falling within a 300m buffer of the likely works area. The locations of the NSRs are shown in Figure 13.1 and are described in Table 13.4.

TABLE 13.4 DESCRIPTION OF NOISE SENSITIVE RECEIVERS

NSR	Description
D1	Shatin Temporary Housing Area
D2	Shatin Public Secondary School
D3	Yue Shing Court
D4	Buddhist Kok Kwong Secondary School
D5	Shatin Town Hall
D6	Shatin Centre
D7	Belair Garden
D8	Hip Wo House, Wo Che Estate
D9	Shatin Technical Institute
D10	Block 15, City One Shatin
D11	Chevalier Garden
D12	Ma On Shan Tsung Tsin Secondary School
D13	Block 13, City One Shatin
D14	Dwellings in Siu Lek Yuen
D15	Dwelling adjacent to Fo Tan Nullah
D16	Sui Wo court
D17	T. I. College
D18	Jockey Club Quarters

Assessment Criteria

Noise level are limited by the *Noise Control Ordinance (Cap 400) including its subsidiary regulations and the Technical Memoranda.* (TM).

In addition to the requirements imposed by the Noise Control Ordinance, the following requirements or interpretations will also be used as a standard in order to control noise generated from equipment and activities for the purpose of carrying out any construction work other than percussive piling during the time period from 0700 to 1900 hours on any day not being a general holiday:

(i) The noise level measured at 1 m from the most affected external facade of the nearby NSRs during any 30-minute period during normal weekly daytime periods between 0700 to 1900 hours will not exceed an equivalent sound level (L_{Aeq}) of 75 dB(A) or 70 dB(A) (or 65 dB(A) during examination) for schools.

(ii) Construction should not be undertaken during any other period, i.e. the restricted period, without the existence of the relevant Construction Noise Permit (CNP).

(iii) In accordance with TM, the area around the dredging locations in the Shing Mun River has an Area Sensitivity Rating (ASR) of 'B'. Therefore ANLs under the current regulation are 65 dB(A) from 1900 to 2300 hours all day Sunday and during general holidays; and 50 dB(A) between 2300 and 0700 hours. Since the NSRs D2, D4, D9, D12 and D17 are schools, it has been assumed that there will be no classes during the restricted hours. Therefore ANLs in the TM will be applicable.

Assessment Methodology

Since marine access to the dredging locations is feasible, the dredging works will be undertaken using a pontoon mounted excavator. Dredged material will be placed into small barges which will be pulled by a tug boat to the mouth of the Main channel for transfer into a larger derrick barge. The likely equipment and SPLs for dredging the Shing Mun River and tributaries are given in Table 13.5.

TABLE 13.5 TYPICAL MIX OF EQUIPMENT FOR DREDGING OPERATIONS

Identification Code	Description	Sound Power Level dB(A)
CNP 081	Excavator	112
CNP 221	Tug Boat	110
CNP 061	Derrick Barge	104

source: TM, EPD

The sound power levels of the equipment used in this assessment are derived from the TM. The excavator and tug boat were considered to be grouped at a position mid-way between the approximate geographical centre of the dredging area and its boundary nearest to the NSR. In the case of an oblong area, having a length to width ratio of 5:1 or more, then only the closest portion to the NSR has been considered, as defined in the TM. It was assumed that the derrick barge will be located close to the mouth of the channel for transfer of material to ESC.

A total sound power level of the dredging operation is obtained by summing all the individual sound power levels of the associated equipment.

The noise levels at each NSR are predicted by the following equation:

Predicted noise level = Total sound power level - 20 $\log_{10}$D - 8 dB(A)

where D is distance between the NSR and the noise source

A positive correction of 3 dB(A) is made to each predicted noise level due to all concurring activities to account for the facade deflection at the NSR. The predicted unmitigated noise levels are presented in Table 13.6. A detailed calculation spreadsheet is attached in Appendix A5.

TABLE 13.6 UNMITIGATED NOISE LEVELS AT NSRS

NSR	Predicted Noise Level dB(A)
D1	76[3]
D2*	67[4]
D3	68[2]
D4*	68[4]
D5	65[1]
D6	63[1]
D7	67[2]
D8	65[1]
D9*	64[1]
D10	66[2]
D11	76[3]
D12*	71[5]
D13	68[2]
D14	65[1]
D15	73[2]
D16	62[1]
D17*	68[4]
D18	62[1]

Note:

* *Those NSRs are schools*

1 *The PNL exceeds the ANL of 50 dB(A) from 2300 to 0700 hours for all days*

2 *The PNL exceeds the ANL of 65 dB(A) from 1900 to 2300 hours, plus all day Sundays and general holidays; and exceeds 50 dB(A) between 2300 and 0700 hours for all days*

3 *The PNL exceeds the daytime limit of 75 dB(A) and the ANL of 65 dB(A) from 1900 to 2300 hours, plus all day Sundays and general holidays; and exceeds 55 dB(A) between 2300 and 0700 hours for all days*

4 *The PNL exceeds the normal daytime limit of 65 dB(A) for schools during the examination period*

5 *The PNL exceeds the normal daytime limit of 70 dB(A) for schools during non-examination periods and 65 dB(A) during the examination period.*

The calculation indicates that the unmitigated predicted noise levels will exceed the ANLs for the restricted hours at the majority of selected NSRs. Therefore, work during restricted hours is not recommended. However, based on calculated noise levels, the dredging works are also likely to cause noise exceedance during normal day time hours, particularly at identified schools during their examination period, when the maximum noise exceedance will be up to 6 dB(A) in the absence of mitigation. Thus, it is important that dredging works avoid the examination period and therefore liaison with schools is recommended.

<u>Suggested Mitigation</u>

Noise levels can be reduced through the avoidance of unnecessary cumulative noise impacts. Phasing of works is considered to be the most cost effective way to control noise at or near NSRs and the Contractor should ensure that the minimum number of equipment is being operated at any one time. Mitigated noise levels are presented in Table 13.7 below.

TABLE 13.7 MITIGATED NOISE LEVELS AT NSRS

NSR	Predicted Noise Level dB(A)
D1	72 - 74[2]
D2*	62 - 64
D3	64 - 66[2]
D4*	64 - 66[4]
D5	60 - 62[1]
D6	59 - 61[1]
D7	63 - 65[1]
D8	61 - 63[1]
D9*	60 - 62
D10	62 - 64[1]
D11	72 - 74[2]
D12*	67 - 69[4]
D13	64 - 66[2]
D14	61 - 63[1]
D15	68 - 70[2]
D16	58 - 60[1]
D17*	64 - 66[4]
D18	58 - 60[1]

Note

* *Those NSRs are schools*

1 *The PNL exceeds the ANL of 50 dB(A) from 2300 to 0700 hours for all days*

2 *The PNL exceeds the ANL of 65 dB(A) from 1900 to 2300 hours, plus all day Sundays and general holidays; and exceeds 50 dB(A) between 2300 and 0700 hours for all days*

4 *The PNL exceeds the normal daytime limit of 65 dB(A) for schools during examination periods.*

All predicted noise levels fall within the daytime assessment criteria for dwellings and for schools outside of examination periods. Provided works do not extend into the evening or during the examination period, it is anticipated that there will be no residual noise impacts. In the event of complaints then noise mitigation will be subject to review as detailed in the EM&A manual and section 8 of Volume A.

13.5.2 Air Quality Assessment

In the Hong Kong Planning Standards and Guidelines (HKPSG) Nullahs are classified as a common air pollution source and sensitive uses are given as residential areas, nurseries, homes for the aged, hospitals and clinics, schools and active recreational activities. Sensitive Receivers are identified in Figure 13.1. Construction dust is unlikely to be a key issue along the Shing Mun given that marine access will be possible and a requirement for access roads is not anticipated. Bankside storage is not recommended for various reasons including the potential to increase dust and odour.

Significant odour impacts may arise where contaminated sediments are dredged for the identified restoration dredging. In the past odour impacts have been a problem and a contributory factor to the cessation of dredging operations in 1991. This was due to poor dredging practice using cutter suction dredgers to disperse sediments from inaccessible places to allow subsequent removal of material with grabs. The result was a high degree of disturbance and dispersal of the sediment which caused the release of odorous compounds. Use of small scale equipment recommended in Task 5 will eliminate the need for such practice.

Potential ASRs have been identified under channel specific issues and are shown in Figure 13.1. Of all the study channels the problem of odour is perhaps greatest in the Shing Mun River due to the large number of sensitive receivers and the extent of contamination of both sediment and water with odorous compounds, in particular hydrogen sulphide. The proposed dredging methods have the potential for short term increases in odour as sediment is brought to the surface increasing emissions of hydrogen sulphide. In the long term, dredging can reduce the current odour problem since hydrogen sulphide is continuously released from the contaminated sediment via the water column into the air and directly from sediment when it is exposed at low tide.

Odour Modelling

The EPD Shing Mun River Environmental Improvement Study, which is currently being undertaken by Aspinwall Cloustons Ltd sediment data have shown Hydrogen Sulphide to be the key cause of the existing odour problem. The potential short term releases of hydrogen sulphide gas was quantified using the standard short term industrial source complex (ISCST2) air quality model.

Dispersal of H_2S was modelled under three atmospheric conditions: stable, neutral and unstable and all wind directions (0-360°) were modelled. Hourly concentrations were produced by the model which were converted to 5 second averages. Results indicated that there would be no significant odour impact at the identified sensitive receivers, but odour is likely to be detected during dredging by those using the river side promenade. Whilst the contaminated sediments remains in the channel, without treatment, odour will continue to be a source of complaint from local residents, particularly at low tide for those using the channel for recreational purposes.

Mitigation

There are no proven methods for minimising odour releases when dredging apart from practical measures which can be incorporated through good working practice and are given in the standard specifications in Section 8.

13.5.3 Ecological Impact Assessment

The ecology of Inner Tolo Harbour is highly stressed due to historical and existing pollution, and the effects of deteriorating conditions have been recorded in several surveys. Evidence of mass mortality amongst sub-tidal bivalves in 1970-71, probably due to oxygen depletion of the water following development in the area, was recorded by Horikoshi and Thompson (1980). Taylor and Shin (1990) showed that marked changes had occurred in the composition, diversity and abundance of the gastropod fauna of Tolo Harbour and Channel during the period 1976-1986, almost certainly due to increased levels of disturbance and pollution in the harbour area. Similar reductions in benthic fish diversity have also been recorded (Lam 1990).

The coral communities in the harbour are under great stress and in some cases have already been destroyed by reclamation and deteriorating conditions. Declining growth rates, abundance and diversity, and attack by infauna and bio-eroding organisms are the result of increased suspended sediment loads and eutrophic conditions. For example, a 20m wide zone of coral between -0.5 and -2.0m C.D. reported by A. Chau in 1980 had been replaced by mussels (*Perna viridis)* and ascidians by 1986, with only very infrequent coral colonies (Scott and Cope 1990). Uncontrolled dredging of river channels entering Tolo Harbour could potentially have a significant impact upon the remaining ecology of the area.

Since dissolved oxygen levels are already low, any further decline in oxygen concentrations caused by dredging could lead to fish mortality. However, the fish community within the channel seems to be tolerant of low dissolved oxygen levels and based on reports of fish deaths during February 1996 and discussions with AFD, are most sensitive to low temperatures.

In the short-term there are likely to be very localised ecological impacts arising through the transportation and deposition of disturbed bed sediment. Given that the sediment toxicity is thought to have prevented the development of a robust ecosystem within the channel, it is considered that pollution tolerant species and species able to withstand physical disturbance will predominate in the channel. Consequently, impacts will be localised and are not considered to be significant. In the future the channel's ecosystem is likely to diversify, particularly in view of future environmental improvement works which are currently under discussion. Although increased community diversity will also be accompanied by increased sensitivity to disturbance, any future dredging works will be of a smaller scale in comparison to the initial restoration work and are therefore unlikely to have any long term negative impacts on ecology. Water Quality modelling has also indicated that the dredging impacts will not pose any threat to the ecology of Inner Tolo Harbour, provided good dredging practice is followed.

The long term impact of the works is likely to be an improvement in both water and sediment quality through the removal of contaminated sediments (as well as via enforcement of legislative controls on discharges) permitting the development of a more diverse riverine communities. Future EM&A should ensure that good dredging practice is followed to minimise short term ecological impacts.

13.5.4 Water Quality Impact Assessment

Recent water quality survey results undertaken for this study are shown in Figure 13.6 and indicate that dissolved oxygen levels are very low at all stations except D4 (the channel mouth) and progressively deteriorate upstream. Suspended solid concentrations were generally low and within acceptable levels. The river water is not, however, contaminated with detectable levels of metals apart from very low concentrations of zinc and mercury (max concentration recorded = 0.33 mg Zn/L and 1μg Hg/L). Given the results of the sediment analysis it is evident that metals are either being washed out into the harbour; (Tolo Harbour contained relatively high levels of zinc and lead in EPD's 1993 Marine Water Quality Survey), or are scavenged by particulates and settle out into the sediment within the channel itself.

Sediment quality analysis has revealed that the channel sediments are contaminated with lead, copper and zinc along the length of the channel, as indicated in Figure 13.4. The mouth of the main channel is considerably less contaminated than the upstream areas. In the channel mouth only lead was present at concentrations high enough to necessitate a grading as a Class 'C' material. From examinations of vertical distribution there is no obvious pattern in contamination with depth of sediment. Generally, levels of contamination in the main channel did not greatly exceed the lower limits for classification of material to Class 'C' contamination.

In Fo Tan Nullah the sediments are highly contaminated with copper twenty times greater than the minimum value for Class 'C' sediments under TC 1-1-92. This tributary also contains chromium up to three times greater than the minimum value for classification as Class 'C' material and nickel, lead and zinc two times the Class 'C' value. This channel passes through an industrial area and therefore it can be concluded that this contamination is a result of unauthorised discharge of industrial effluent. The contamination is possibly historic as a survey by the Local Control Office found no significant industrial pollution sources in 1993 due to enforcement actions under the WPCO. A review of water quality data in the past for Fo Tan Nullah would indicate that copper has been a significant pollution problem, in 1988 copper was present in the water at values as high as 845µg/l.

Some dredging in the Main Channel is inevitable and the result will have both positive and negative impacts on water quality. Dredging will result in long term improvements to water quality through the removal of contaminants which have the potential to be disturbed during storm events and made available in the water column.

In the short term, increases in suspended solids over a distance of 500m is predicted due to the loss of material to the water column. The potential exists for secondary impacts, an example being reductions in dissolved oxygen levels. However, as detailed in Section 3 of Volume A, the Water Quality Modelling indicates that dredging will impart only minor impacts on water quality.

13.6 Mitigation Measures

Mitigation required above that detailed in the standard specifications and addressed through improved dredging procedures, include the following:

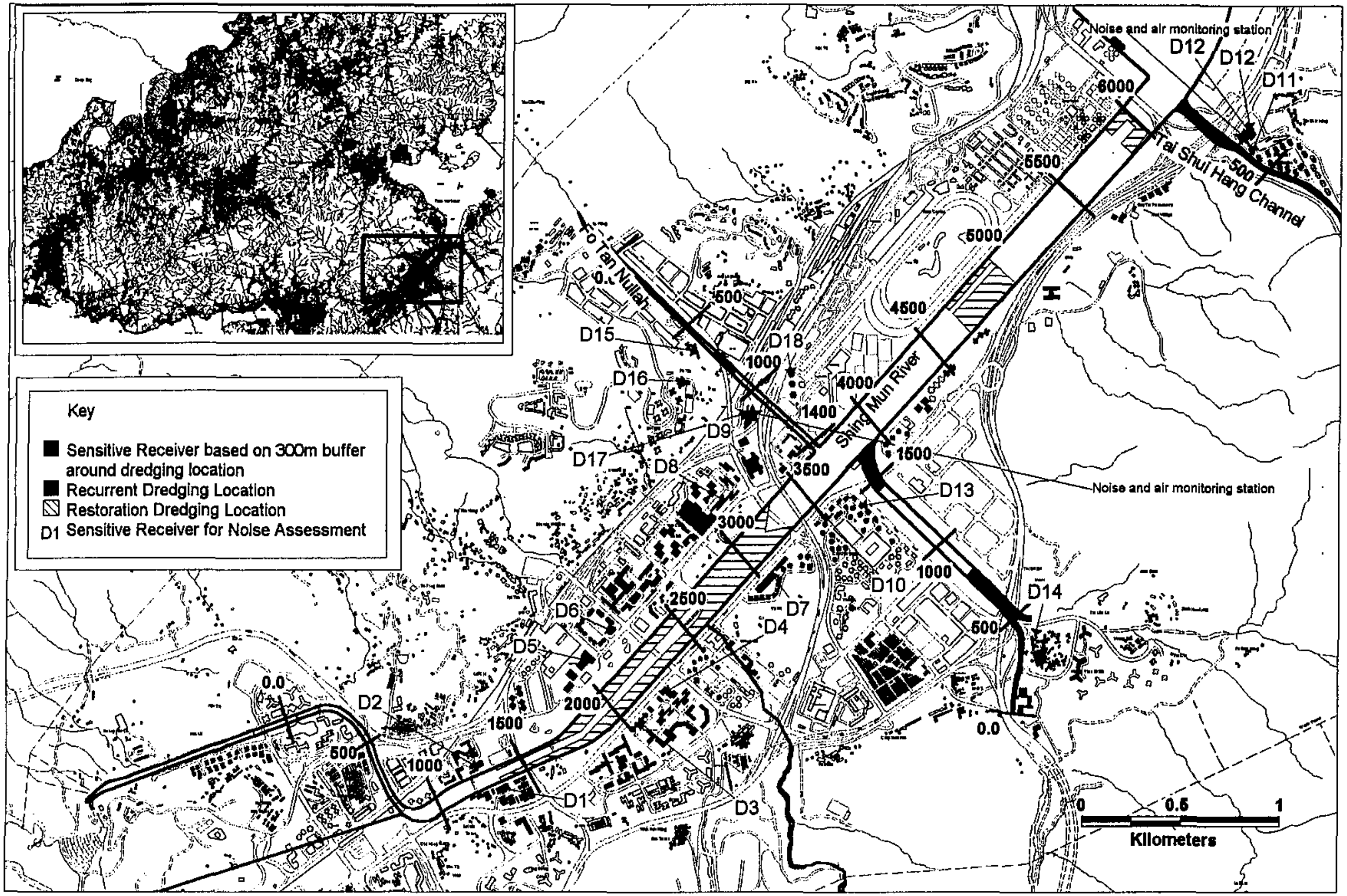
13.6.1 Air Quality

In the dry areas of Fo Tan Nullah removal of sediment may be required. This should be undertaken during dry/cool conditions to minimise odour. Water should not be used in this process as it only serves to disperse contaminants and generate odour.

13.6.2 Community

Works on the Main Channel shall not be undertaken during the Dragon Boat Season (April-June) and every effort should be made to minimise impacts on any other water-based recreational activities such as rowers using the Hong Kong Rowing Club.

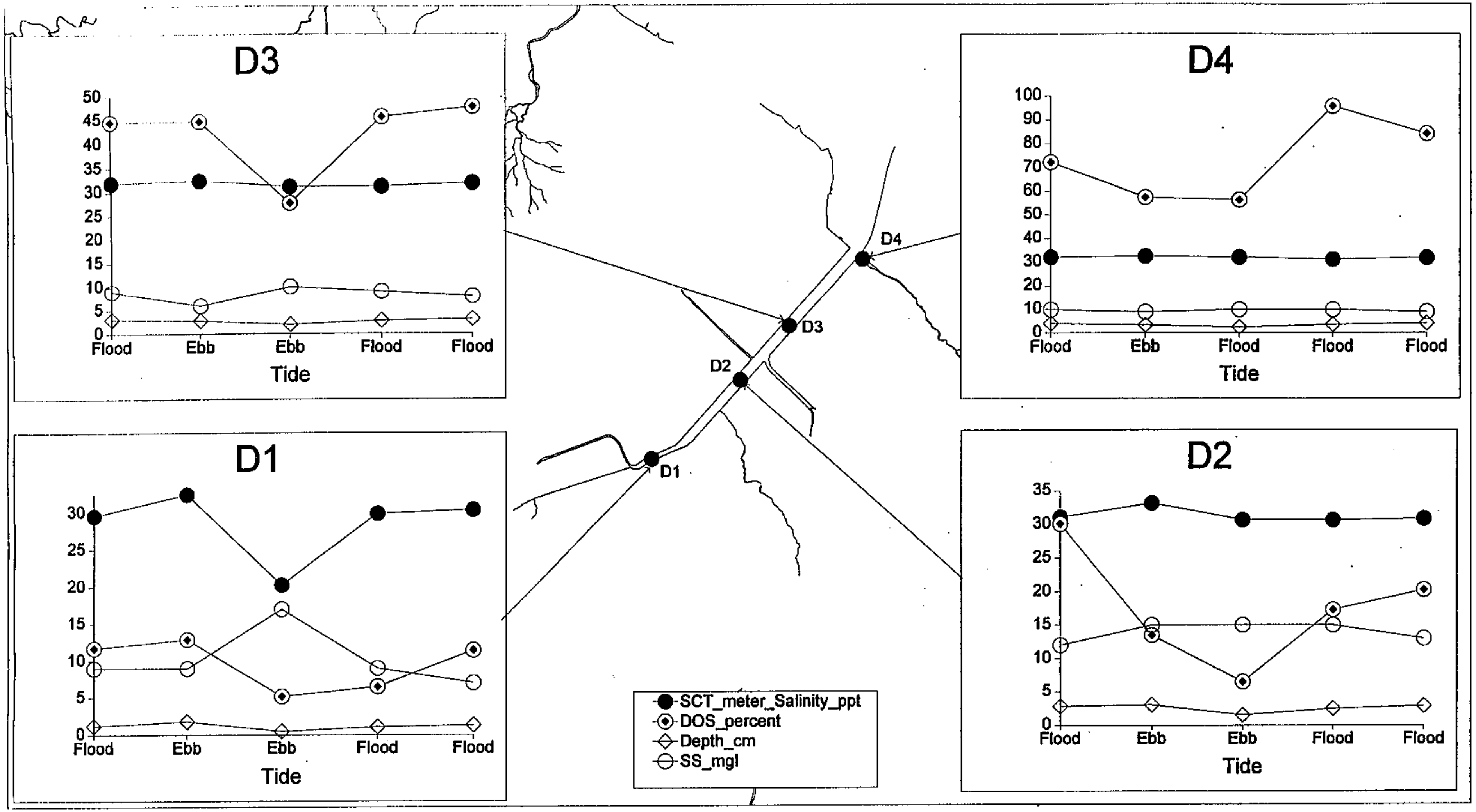
Finally, the on-going EPD study on the Shing Mun River, which may provide more information on the environmental improvement of the river in a wider perspective, is expected to be completed by July-August 1997. Appropriate recommendations from this study, when available, will also be taken into account in planning the restoration dredging works in the channel.



Hyder Consulting

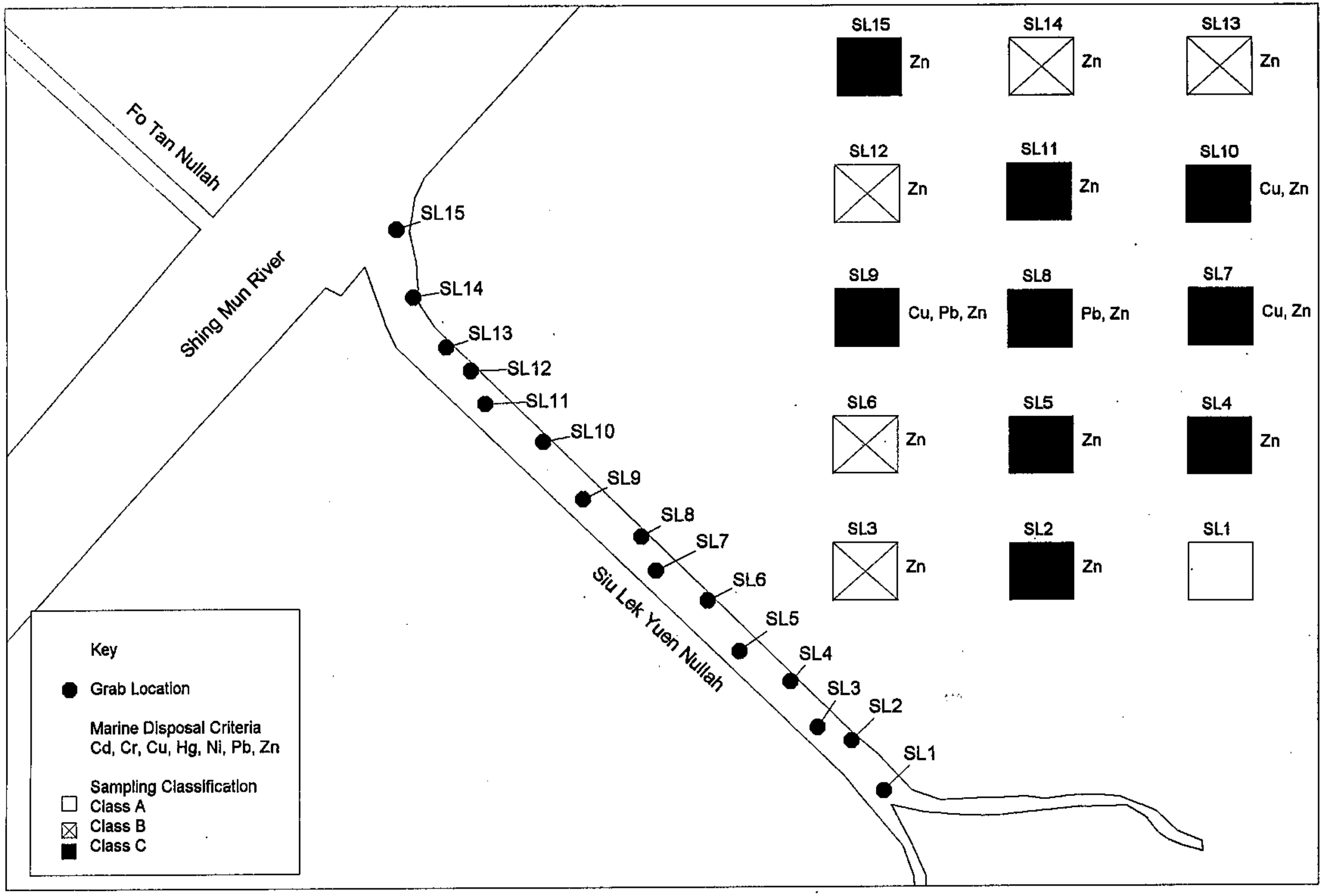
Figure 13.1 Potential Noise and Air Sensitive Receivers Near Proposed Dredging Locations Shing Mun River and Tributaries

Source: OZP



Hyder Consulting

Figure 13.2 Water Quality Monitoring Results from 17/04/1996
Shing Mun River and Tributaries



Hyder Consulting

Figure 13.3 Sediment Grab Analysis Results
Shing Mun River and Tributaries

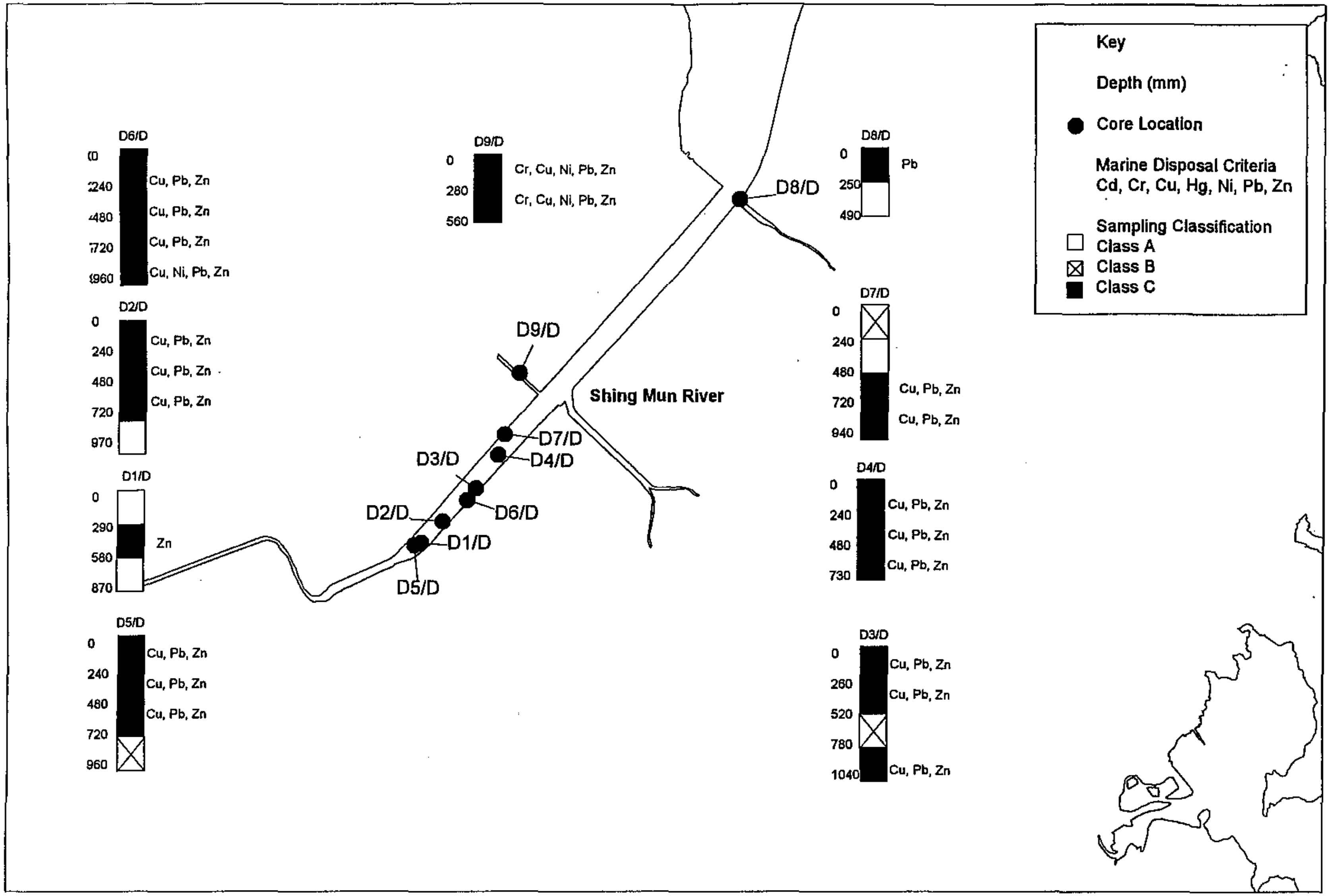


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Figure 13.4 Sediment Core Analysis Results
Shing Mun River and Tributaries

SECTION 14

EIA OF DREDGING WORKS IN TAI PO / LAM TSUEN RIVER CHANNELS AND TRIBUTARIES

14. EIA OF DREDGING WORKS IN TAI PO / LAM TSUEN RIVER CHANNELS AND TRIBUTARIES

14.1 Introduction

The Tai Po and Lam Tsuen Rivers are engineered channels in the Northeast New Territories which flow through the new town at Tai Po and drain into Tolo Harbour. The Lam Tsuen River flows eastwards through Tai Po town and drains the Lam Tsuen Valley - a catchment area of approximately 19 km^2, of which 16 km^2 are within water gathering grounds. The Lam Tsuen River is tidal up to about 200m downstream of the Tai Po-Tai Wo Road Bridge. After its confluence with the Tai Po River near Tai Po Hui the Lam Tsuen River passes through the urban area of Tai Po as an open channel.

The Tai Po River is a tributary of the Lam Tsuen River and enters Tai Po town from the south. The tidal reaches of the channel extend some 1,400m from its confluence with the Lam Tsuen River. The Tai Po River catchment covers an area of approximately 9 km^2. The riverbed of the entire tidal sections of both rivers are naturally unlined, with the exception of a short reach from the channel mouth to the confluence of the two rivers. This section has a rubble lining on a geotextile membrane. Figure 14.1 shows the dredging locations and the sensitive receivers to noise and air quality impacts.

The Tai Po and Lam Tsuen River Channels have been modelled under Task 4 and it has been shown that flood risk can be reduced through dredging. However, embankment raising is also necessary to provide appropriate freeboard.

14.2 Existing Environment

14.2.1 Existing and Future Land Uses

The land adjacent to the channel is largely urban and industrial in nature, with both banks of the river supporting high-density residential or commercial development, interspersed with land designated as having Governmental, Institutional and Community uses. Future development is likely to be consistent with the Territorial Strategy Review 1996 (Planning Environment and Lands Branch, Hong Kong Government 1996) which lists Tai Po as a key employment centre for business and industry.

The current catchment derived sediment load is estimated by Task 2 to be 3,532 tonnes/year. Rearing livestock is prohibited in large areas of the catchment and this is reflected in the low organic content of the sediments. Construction and quarrying activities are currently limited in the catchment area and so contribute little to the overall sediment load. Soft sediments of marine origin dominate the sediment balance in this channel.

14.2.2 Air Quality

Road traffic fumes and industrial effluents are considered to be the key source of air pollution in the vicinity of the channels. EPD operates a fixed measuring station in

Tai Po for monitoring of gaseous and particulate pollutants. Data for 1994 shows that there were no exceedances of the Air Quality Objectives. The key parameter for this study being Total Suspended Particulates which has a 24 hr standard of 260 ug/m^3 and a 1 hr guideline value set by EPD of 500 ug/m^3 for construction works.

A baseline survey of 24 hr TSP monitoring was conducted over a seven day period during November 1996 from the roof of Wong Shiu Chi Secondary School, Nan Wan Road (Figure 14.1). The results are summarised in Table 14.1 and are presented in full in Appendix A7. Field notes and methodologies are included as Appendix A4.

TABLE 14.1 SUMMARY OF BASELINE AIR QUALITY MONITORING RESULTS

Date of Sampling	Total Suspended Particulate TSP value $\mu g/Std.\ m^3$
15.11.96	77
16.11.96	111
17.11.96	116
18.11.96	99
19.11.96	123
20.11.96	116
21.11.96	113

NB: The Air Quality Objective for 24 hr. TSP measurements is 260 $\mu g/m^3$

The results show that the TSP results are consistently good over a period of 7 days and average at 107.8 $\mu g/Std.\ m^3$.

14.2.3 Noise

A noise baseline survey was undertaken during November 1996 from the roof of Wong Shiu Chi Secondary School. Background noise measurements including $L_{eq\ (30min)}$, L_{10} and L_{90} were taken over a three day monitoring period, using the methodology described in Appendix A4. The average values and range are summarised in Table 14.2, and are presented in full in Appendix A6.

TABLE 14.2 SUMMARY OF BASELINE NOISE MONITORING RESULTS

Noise Measurement	$L_{eq\ (30min)}$ dB(A)	L_{10} dB(A)	L_{90} dB(A)
Average	70.6	73.5	64.3
Range	69.6 - 71.4	72.5 - 74.0	63.5 - 65.0

The baseline results show that the noise environment in this location is influenced significantly by road traffic noise from the Nam Wan Road. The L_{90} results show that for 90% of the time the noise levels range from 63.5 to 65.0 dB(A), whereas the L_{10} results show a 10 dB(A) increase reflecting road traffic noise.

14.2.4 Hydrology and Water Quality

<u>Predicted Flooding</u>

Flood predictions in Task 4 were made for two case scenarios:

Case 1 - 10 years storm and a 200 years tide

Hydraulic modelling predicts no flooding on the Tai Po river and minor flooding <0.5m at chainage 1200-1800m on the Lam Tsuen River.

Case 2 - 50 years storm and 10 years tide

There is no flooding of the Tai Po River but the flooding on the Lam Tsuen at the same location increases to 0.5 - 1.0m.

With an increase in sedimentation of +0.5m there is no flooding of the Tai Po for both case 1 and 2. The Lam Tsuen floods at c1200-1800m for case 1 and 1000-1800m for case 2, based on increased sedimentation over c1250-3200m.

Pollutant Loads

The pollutant loadings predicted for 2001 into Tolo Harbour from the Tai Po River and Shing Mun River are given in Table 14.3.

TABLE 14.3 SUMMARY OF POLLUTANT LOADINGS INTO TOLO HARBOUR

Source		1988		2001	
		BOD (kg/day)	TN (kg/day)	BOD (kg/day)	TN (kg/day)
Domestic	Unsewered	2,380	750	4,080	1,240
Domestic	STW Effluent	40	35	45	40
Industrial		40	5	50	5
Livestock		580	85	-	-
Landfill	Leachate	110	615	-	-
TOTAL		**3,150**	**1,490**	**4,175**	**1,285**

Source: Tolo Harbour Catchment Study on Unsewered Developments, Balfours International
BOD = Biochemical Oxygen Demand, TN = Total Nitrogen

The data reflects a significant reduction in pollutant loads due to implementation of the Tolo Harbour Action plan. On completion of stage 2 treated effluents from both Tai Po and Sha Tin sewage treatment works will be exported out of the catchment to Victoria Harbour. A master plan has been developed for the provision of sewerage to 165 unsewered villages, with three implementation stages and completion in 2003. Interceptors for diverting polluted flows from the storm drains to the foul sewerage system were commissioned in 1993. Further connection works will follow for village houses to facilitate proper treatment and disposal. Through this and other enforcement activities such as landfill restoration and Livestock Waste Management, the trend is for gradual recovery and measurable improvement in water quality in Tolo Harbour.

Water Quality

Both the Lam Tsuen and Tai Po channels are priority watercourses monitored by EPD on a monthly basis. EPD have nine monitoring stations in the Lam Tsuen river, at six stations water is graded as 'Excellent' and the remainder is 'Good' or 'Fair'. This reflects a marked improvement through enforcement of the WPCO and the WDO. Water quality in the Tai Po River is graded as 'Excellent' in the upper reaches, 'Good' (in the middle section of the river with Dissolved oxygen levels > 7 mg/l) and 'Fair' in the lower reaches. The water quality showed full compliance with the WQOs for suspended solids and dissolved oxygen in 1994, (River Water Quality in Hong Kong for 1994, EPD 1995). Data obtained from EPD for 1995 indicates that the trend in improving water quality is continuing.

Water quality analysis was conducted specifically as part of this study during April 1996. The survey was undertaken at four locations through a twelve hour tidal cycle, using the methodology in Appendix A3. The results of the analysis of some of the parameters are summarised in Table 14.4 and are presented graphically in Figure 14.2. The monitoring locations are included as Appendix B2, and full water quality results are presented in Appendix A1.

TABLE 14.4 SUMMARY OF WATER QUALITY MONITORING RESULTS

Location	Salinity (ppt)	D.O. (mg/l)	D.O. (%)	S.S. (mg/l)	B.O.D. (mg/l)
E9	0.20 (0.20 - 0.20)	5.22 (5.05 - 5.44)	65.0 (60.4 - 68.0)	8.4 (6.0 - 16.0)	10.2 (9.0 - 12.0)
E7	28.32 (27.10 - 29.20)	1.89 (0.13 - 6.74)	22.9 (1.4 - 84.0)	4.8 (1.0 - 7.0)	8.4 (7.0 - 11.0)
E6	30.52 (29.70 - 31.40)	6.18 (3.39 - 8.39)	71.5 (38.7 - 97.2)	11.4 (8.0 - 19.0)	5.1 (3.0 - 6.5)
E5	30.94 (29.90 - 31.70)	6.19 (3.43 - 8.41)	71.5 (39.2 - 97.5)	11.0 (8.0 - 16.0)	5.0 (3.5 - 6.0)

The results at three of the stations show wide fluctuations in DO levels influenced by tidal action, as well as sewage discharges recorded on the day from a damaged pipe at the mouth of the channel.

Dissolved oxygen (D.O.) concentrations were relatively high at the channel mouth due its exposure and tidal action. Concentrations of D.O. were also relatively high at the upstream location (E9) due to the combined factors of an average water depth of less than 60 cm and a strong freshwater current as indicated by low salinity and conductivity levels.

The mixing of the channel water at locations E6 and E5 which generates oxygenation also leads to the circulation of suspended solids in the water column. Similarly, at E9 the shallow water restricts the dispersion of suspended material. In the middle stretch of the channel (E7) there is no water current most of the time. This situation of no water mixing leads to low oxygen and high suspended solids levels.

The BOD concentrations decrease uniformly from upstream to downstream monitoring locations. This would indicate that the major input of organic materials is from an upstream source and that such materials are increasingly decomposed by microbes as the channel water approaches Tolo Harbour.

Concentrations of zinc were detectable in the water sampled from the channels middle stretch (E7 = 0.34 mg/l) and mouth (E5 = 0.10 mg/l), but not at the intermediate location (E6). Mercury concentrations of 1 µg/l were detected both upstream (E9) and in mid-channel (E7). Generally metals were not present in detectable levels within the water column, although actual sediment analyses indicate that the sediments were contaminated with heavy metals.

Tables 14.5 and 14.6 below summarise results from the water quality monitoring undertaken at locations E5 and E6 which are closest to the proposed dredging locations.

TABLE 14.5 WATER QUALITY AT STATION E5

Time	S.S (mg/l)	BOD_5 (mg/l)	Sal. (ppt)	Temp. (°C)	D.O. (mg/l)	D.O. (%)	Current Velocity (m/s)	Depth (m)	Cond. (m/s)	Tide
07:31	9.0	3.5	31.6	21.3	3.74	43.4	0.043	2.05	48.83	Flood
10:30	8.0	4.5	31.7	21.3	7.09	81.7	0.025	2.00	48.41	Ebb
13:31	8.0	5.5	29.9	21.4	3.43	39.2	0.152	1.20	45.83	Ebb
16:31	16.0	5.5	30.6	22.1	8.41	97.5	0.031	1.95	46.46	Flood
19.31	14.0	6.0	30.9	22.0	8.26	95.8	0.00	2.10	47.23	Flood

TABLE 14.6 WATER QUALITY AT STATION E6

Time	S.S (mg/l)	BOD_5 (mg/l)	Sal. (ppt)	Temp. (°C)	D.O. (mg/l)	D.O. (%)	Current Velocity (m/s)	Depth (m)	Cond. (m/s)	Tide
07:58	8.0	3.0	31.3	21.4	3.65	42.5	0.035	1.90	48.33	Flood
11:05	8.0	4.0	31.4	21.4	7.32	84.2	0.024	1.90	48.07	Ebb
13:58	12.0	6.5	29.7	21.5	3.39	38.7	0.167	1.10	45.67	Ebb
16:58	19.0	6.0	30.0	22.2	8.39	97.2	0.030	1.85	46.17	Flood
20:02	10.0	6.0	30.2	22.0	8.13	94.8	0.000	2.00	46.75	Flood

Reviewing the results in the above tables shows that at low water depths on the ebb tide i.e. 1.2 and 1.1 metres, the available oxygen drops significantly to < 3.5 mg/l or < 40% saturation. This would tend to suggest that the system is most under stress on the ebb tide low water levels.

14.2.5 Sediment

Both channels were recently dredged by CED as part of their maintenance dredging programme for which sediment analysis was undertaken by EPD. More recently grab samples were taken from the Rivers during August 1995, with five core samples consequently collected during December 1995: three from the Tai Po River and two from the Lam Tsuen River. The location and analytical results of core sampling are presented in Figure 14.3 and summarised below. Full core sampling results are presented in Appendix B4.

Characteristics

The initial results from the five core samples indicate that the sediment is of a fine silty nature along both of the channels. However, visual observations contradict these findings and state that the sediment is generally non-cohesive and of a coarse grain size. Task 5 concludes that the majority is unlikely to be free draining and will contain an appreciable amount of rubbish and debris. The moisture content of the core sediment samples averaged at 20 - 25 %.

Quality

The sediment analysis undertaken by EPD during recent channel works classified the sediment as "contaminated". The results from the five sediment core samples are presented in Figure 14.3 and illustrate the distribution of contaminants in relation to core depth. The sediment analysed from the Tai Po channel is graded as Class 'C' for copper and lead under TC 1-1-92. At the confluence of the channels copper was not found in significant concentrations and only lead was present at levels that would grade the sediment as Class 'C'.

As indicated in Figure 14.3 the Lam Tsuen Channel was sampled in two locations upstream of its confluence with the Tai Po River. The sediment was found to be contaminated with lead, copper and zinc, with levels generally 1-2 times greater than the criteria for Class 'C' contamination.

Total organic carbon levels were less than 0.5% for most of the sediment analysed in these channels indicating that livestock waste and other sources of organic waste were not a significant contributor to the sediment within the channel.

14.2.6 Ecology

Riparian Flora and Fauna

The value of riparian ecology is limited due to the urban nature of the surrounding land and concrete or stone lining of the channel banks. There are few areas that have retained natural vegetation within the tidal zone. Both banks of the river support high-density residential or commercial development. Areas of parkland and landscaped features around residential blocks provide habitat for birdlife, but the only natural habitat of any significance is in the upper reaches of the catchment.

The banks of both rivers are used by herons and egrets which feed on the numerous fish, mainly mullet, *Mugil cephalus* and *Tilapia* sp.

Aquatic Fauna

The channelisation of the lower Lam Tsuen River during the 1980's cleared dense growths of aquatic plants in the river channel, thus eliminating habitat for a range of animals (Dudgeon and Corlett 1994). This, combined with probable contamination of the channel bed with industrial effluents, will prevent the development of any great faunal diversity within the channel, although large numbers of pollution tolerant organisms may be present.

As for Shing Mun River, the river drains into Tolo Harbour considered to be an ecologically important area since it supports one of the few remaining coral communities in Hong Kong and contains or borders nine designated SSSIs (Figure 4.2). Tolo Channel reef community is considered interesting due the representation of a rare order of anthozoan (order Antipatharia) black corals (Scott, 1984).

14.3 Proposed Work

14.3.1 Dredging Requirements

Modelling under Task 4 has indicated that the Tai Po - Lam Tsuen River system is in approximate equilibrium with respect to marine sediments. Coarse-grained fluviatile sediment accumulation is expected at Ch. 3100-3200 along the Lam Tsuen River and at Ch. 700-1000 along the Tai Po River. This accumulation gives rise to respective annual yields of 1,200m^3 and 1,000 m^3. Construction-derived sediment contributes an additional 350m^3 of material to the Tai Po River, and an extra 600m^3 to the Lam Tsuen River.

Task 4 predicts that the combined dredging requirement for flood trigger level avoidance and for culvert clearance is some 5,400m^3 for Tai Po River, and around 41,500m^3 for the Lam Tsuen River. However these channels have both been recently dredged, thus precluding the need to dredge again specifically for restoration purposes. Modelling predicts that dredging the Lam Tsuen River up to -2.0 mPD reduces the flooding extent by around 300m for a 1 in 200 year tide.

Modelling indicates that an additional sediment depth of 0.5m in either the Tai Po or the Lam Tsuen Rivers is sufficient to cause an increase in the level of flood risk.

Task 4 and 5 Recommendations: The maintenance dredging of the Tai Po River every three years is recommended to prevent sediment accumulation of 0.5m.

14.3.2 Dredging Strategy

The dredging strategy is detailed in the Task 5 Final Report. The key points are as follows:

i. *Access:* The Lam Tsuen River is large and deep enough for marine access. Two existing ramps will be used to access the highest reaches of the channel. Marine access on the Tai Po River is feasible only as far as the KCR bridge, after which shallow draft floating plant will be placed in the river from two existing ramps.

ii. ***Dredging:*** Task 5 has indicated that pontoon-mounted grab dredgers and backhoes can be used for undertaking the maintenance work in the lower reaches of both channels. Excavators will be used in the upper reaches in order to gain access under the low bridges. The high intertidal and supratidal sections of the Lam Tsuen River will be worked using wheeled mini-excavators and manual methods. Dredging with a small grab of approximately 1-2 m^3 will remove about 3,500m^3 of sediment per week. Therefore the proposed works duration for each channel will be about 7 working days.

iii. ***Transport:*** Excavated material from the lower reaches of each channel will be transported initially by loading into small barges for transshipment onto larger barges for marine transport. If a land-based disposal option is utilised then overland transport should be considered particularly for material dredged from shallow waters and requiring transshipment.

iv. ***Disposal Options:*** If dredging is deemed necessary along the Tai Po River, disposal to East Sha Chau would be required for the class C sediments. In the event that new guidelines based on EVS' study recommendations are enacted, Tier III and Tier IV testing will be necessary to determine the disposal option. If analytical results show the sediment to be contaminated to Class 3, then landfill disposal is necessary. Otherwise, disposal to East Sha Chau along with sediment from the Lam Tsuen River is suggested.

14.4 Key Issues

Water Quality

- Mobilisation of contaminated fine sediment.
- Further depletion of dissolved oxygen in the water column.

Ecology

- The possibility of further deterioration of the ecological resources of Tolo Harbour due to resuspension and transport downstream of contaminated sediments.
- Disturbance of benthic infauna along both channels.

Community Impacts

- Potential noise and odour impacts on Sensitive Receivers.
- Dredging will have visual impacts on the residents in the vicinity of the channel as well as on people using the promenade and park areas.
- Disturbance to recreational use of River Channels and adjacent walkways.

14.5 Impact Assessment

14.5.1 Noise Impact Assessment

Works Area

There are two proposed recurrent dredging locations along the Tai Po/Lam Tsuen River channels, as shown in Figure 14.1.

Noise Sensitive Receivers

The most affected NSRs around the works area have been identified as those falling within a 300m buffer of the likely works area. The locations of the NSRs are shown in Figure 14.1 and are described in Table 14.7 below.

TABLE 14.7 DESCRIPTION OF NOISE SENSITIVE RECEIVERS

NSR	Description
E1	Fung Leung Kit Secondary School
E2	Kwong Yee House, Kwong Fuk Estate

Assessment Criteria

Noise level are limited by the Noise Control Ordinance (Cap 400) including its subsidiary regulations and the Technical Memoranda. (TM).

In addition to the requirements imposed by the Noise Control Ordinance, the following requirements or interpretations will also be used as a standard in order to control noise generated from equipment and activities for the purpose of carrying out any construction work other than percussive piling during the time period from 0700 to 1900 hours on any day not being a general holiday:

i) The noise level measured at 1 m from the most affected external facade of the nearby NSRs during any 30-minute period during normal weekly daytime periods between 0700 to 1900 hours will not exceed an equivalent sound level (L_{Aeq}) of 75 dB(A) or 70 dB(A) (or 65 dB(A) during examination) for schools.

ii) Construction should not be undertaken during any other period, the restricted period, without the existence of the relevant Construction Noise Permit (CNP).

iii) In accordance with TM, the area around the dredging locations in Tai Po/ Lam Tsuen Rivers has an Area Sensitivity Rating (ASR) of 'B'. Therefore ANLs under the current regulation are 65 dB(A) from 1900 to 2300 hours plus all day Sundays and general holidays and 50 dB(A) between 2300 and 0700 hours. Since E1 is a school and it is assumed that there will be no classes during all restricted hours. Therefore ANLs in TM will be applied on them.

Assessment Methodology

Marine access to the lower reaches of channel is feasible for the Lam Tsuen River works area, the dredging works will be undertaken using a pontoon mounted excavator and the dredged material will be transported by derrick barge. However, for the Tai Po River works area, the dredging works will be again undertaken by pontoon mounted excavator but the dredged material will be transported by trucks. In this case the trucks only transport the dredged material off the site once it is full. The engine of the truck is assumed to be switched off during most of the time at the site. The noise impact generated from the truck is therefore considered insignificant and has not taken into account in this assessment. Likely equipment for dredging is shown in Table 14.8.

TABLE 14.8 TYPICAL MIX OF EQUIPMENT FOR DREDGING OPERATIONS

Identification Code	Description	Sound Power Level dB(A)
CNP 081	Excavator	112
CNP 0611	Derrick Barge	104

The sound power levels of the equipment used in this assessment are derived from the TM. The equipment were considered to be grouped at a position mid-way between the approximate geographical centre of the dredging area and its boundary nearest to the NSR. In the case of an oblong area, having a length to width ratio of 5:1 or more, then only the closest portion to the NSR has been considered, as defined in the TM.

A total sound power level of the dredging operation is obtained by summing all the individual sound power levels of the associated equipment.

The noise levels at each NSR are predicted by the following equation:

Predicted noise level = Total sound power level - 20 $\log_{10}D$ - 8 dB(A)

where D is distance between the NSR and the noise source

A positive correction of 3 dB(A) is given to each predicted noise level for concurring activities to account for the facade reflection at the NSR. The predicted unmitigated noise levels are presented in Table 14.9. A detailed calculation spreadsheet is attached as Appendix A5.

TABLE 14.9 UNMITIGATED NOISE LEVELS AT NSRS

NSR	Predicted Noise Level dB(A)
E1*	77[5]
E2	64[1]

Note:

* *NSR is a school*

1 *The PNL exceeds the ANL of 50 dB(A) from 2300 to 0700 hours for all days;*

5 *The PNL exceeds the normal daytime limit of 70 dB(A) for schools, and exceeds 65 dB(A) during examination periods.*

The calculation indicates that the proposed works in the Tai Po River will pose a significant noise impact on NSR E1, Fung Leung Kit Secondary School. The noise exceedance is anticipated to be up to 12 dB(A) for examination periods and 7 dB(A) for non-examination periods. In order to minimise the impact, the dredging works should be scheduled during the non-examination period. Operations likely to produce the greatest noise levels (i.e. excavation) should be scheduled at the end of school day. (i.e. after 16:00 hours).

For the Lam Tsuen channel, the unmitigated predicted noise level at E2 is below the daytime guideline of 75 dB(A) and ANL of 65 dB(A) for 1900-2300 on normal days plus 0700-2300 on general holidays including Sunday. Therefore, adverse noise impacts from Lam Tsuen River dredging are not anticipated, provided the works do not extend beyond 1900 hours.

<u>Suggested Mitigation</u>

The sound power level (SPL) of the excavator used for noise calculations is derived from the TM and is considered very conservative. After consultation regarding the Task 5 recommendations, it has been determined that the proposed excavator for dredging operations is a smaller plant than that used in the TM, and consequently the proposed excavator is likely to have a lower SPL. This is considered the most cost effective way to control the excessive noise at source.

Appropriate mitigation measures should be incorporated into the dredging manuals to bring down the noise level at NSR E1 close to 70 dB(A) for schools (65 dB(A) during examinations).

14.5.2 Air Quality Assessment

Initially, air quality impacts were raised as a potential key issue due to the expected large volumes of dredged sediment and the associated handling, storage and transportation requirements. However, the anticipated volumes of sediment have reduced considerably and significant dust (TSP) concentrations are not predicted from dredging operations. Thus, no quantitative assessment of TSP impacts in the Tai Po / Lam Tsuen River Channels and Tributaries has been conducted.

TSP levels are not anticipated to be significant given the small volumes of material involved and the fact that neither temporary access roads nor storage are required.

Odour may be generated from the dredging and handling of sediments. The sediment is known to be of a fine nature and is contaminated with heavy metals. Therefore it could potentially result in odour impacts as it is disturbed and brought to the surface. However, the results from sediment cores E2 and E3, from the proposed dredging location on the Tai Po River, were both low in nutrients, whilst ammoniacal nitrogen and organic carbon concentrations were usually too low to detect (Appendix B4).

There is a possibility that the sediment to be dredged at the mouth of the Lam Tsuen River is more contaminated than the core samples. However, due to the presence of an artificial rubble and geotextile lining, the sediment was not sampled at the channel mouth. The nearby Tai Po Industrial Estate has several discharging premises, including a gas works, brewery and sewage treatment plant. Particulates within these discharges may potentially accumulate at the channel mouth. No odour was detected in this area during preliminary site observations. The practical mitigation measures as detailed in section 8 are considered sufficient to maintain odour at acceptable levels.

14.5.3 Ecological Impacts

As dredging will be restricted to the tidal portions of the river channels, strictly freshwater biota will not be affected by the works. Direct impacts will be to estuarine species in the lower river channels. The ecological consequences of these direct impacts will not be of great importance due to the artificial nature of the channels and the already degraded sediment conditions and water quality in the tidal zone.

Similarly, there are no terrestrial ecological concerns due to the developed nature of the surrounding land and river banks.

Whereas dredging operations are unlikely to have any long-term impact on birds as a consequence of noise or general nuisance, the foraging habitat of the birds could be affected or lost if future dredging requirements were defined in upstream areas. While conditions are sub-optimal for the birds due to the steepness of the artificial banks, no data are available to quantify wading bird use of the area. Foraging will be easier for the birds at low tides when the channel bed is more exposed. A potential impact of the dredging works is to reduce foraging success at low tide due to loss of sediment and therefore increased water depth.

Down stream impacts on Tolo Harbour are of concern since all coral communities are vulnerable to smothering and the effects of turbidity which diminishes sunlight penetration. Such conditions can force corals into the shallowest waters where they are subject to the greatest fluctuations of temperature and salinity, given that Hong Kong waters are on the fringe of the Indo-Pacific reef complex such fluctuations can be lethal. Control of water quality impacts through good dredging practice can minimise such impacts.

14.5.4 Water Quality Impacts

The impact of dredging contaminated material could have localised, short term impacts on the water quality, particularly through the mobilisation and transport of heavy metal ions, nutrients and suspended solids. The mass deposition of disturbed suspended material could theoretically smother aquatic flora, thus disrupting photosynthetic efficiency and resulting in reduced oxygen production. As both rivers already experience critically low dissolved oxygen concentrations at specific times of the year, there could be secondary impacts on aquatic fauna, particularly sedentary species. The cumulative impacts on the water quality and ecosystems in Tolo Harbour is also an issue.

Whilst such impacts are feasible our research and international practice shows that controlled dredging work is unlikely to have a significant impact on water quality. This is due to the fact that the contaminants are generally bound up in the fine sediment fraction. The smothering or removal of benthic fauna which are entrained in the sediment is not considered to be of major significance due to the impoverished nature of the infauna and the small scale of the dredging operation.

14.6 Mitigation Measures

Mitigation measures should be included in contractual form in the dredging contracts manual for the maintenance dredging works and subject to environmental monitoring and audit. Those measures required over and above the standard specifications proposed in Section 8, include the following:

14.6.1 Noise

For works in close proximity to the Fung Leung Kit secondary school (E1) `the most effective mitigation measure is to avoid examination periods and use small scale equipment and undertake noisy activities (such as excavation) outside of school hours (lunchtimes and after 1600hrs).

Though not directly effective in reducing noise levels good communication can reduce the nuisance impact. Schools and other institutions likely to be affected by the works should be informed well in advance of the works and kept informed of progress.

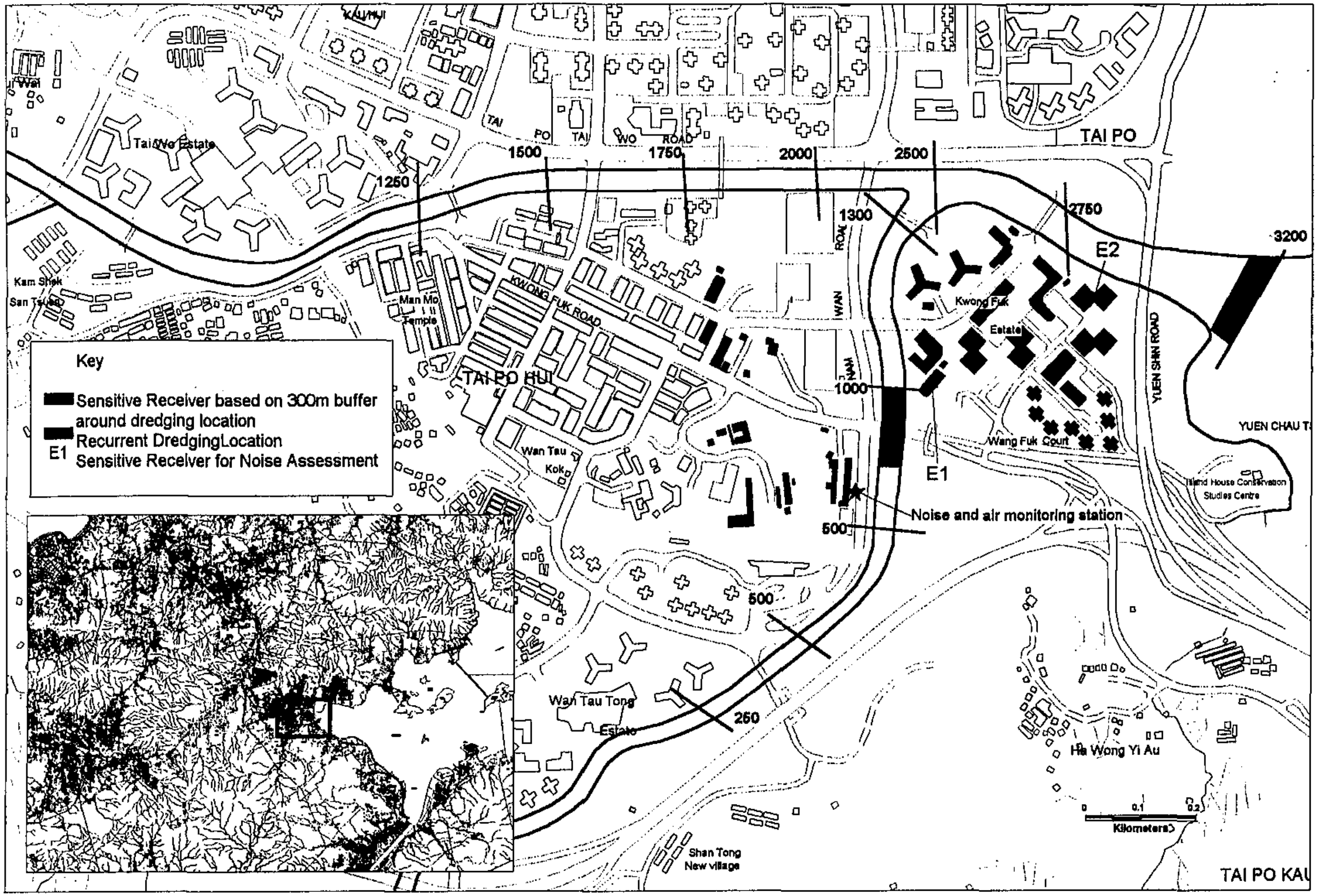

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Figure 14.1 Potential Noise and Air Sensitive Receivers Near Proposed Dredging Location Tai Po/ Lam Tsuen River Channel and Tributaries

Source: Lands Department OZP

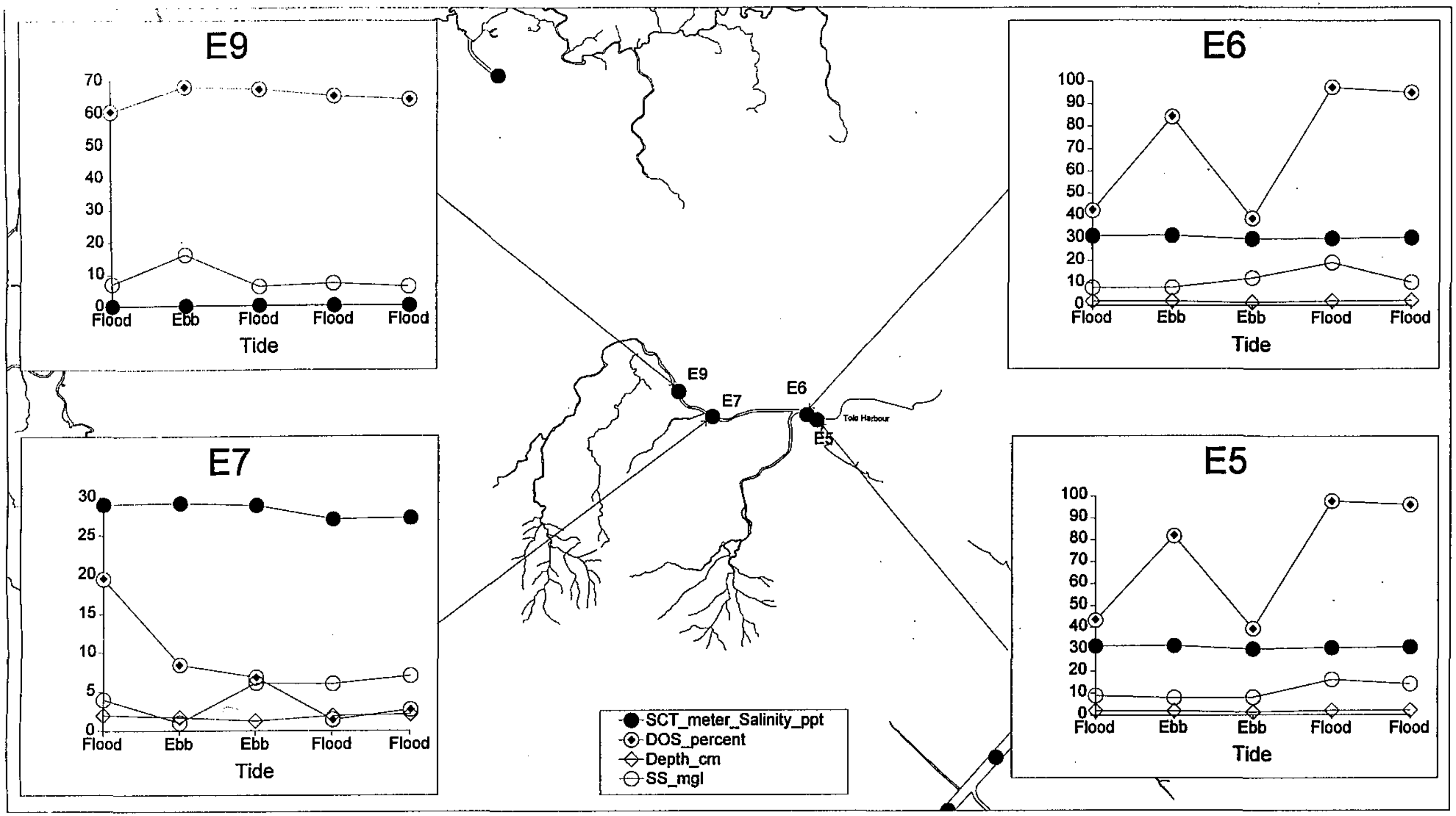

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Figure 14.2 - Water Quality Monitoring Results from 17/04/1996
Tai Po/Lam Tsuen River Channel and Tributaries

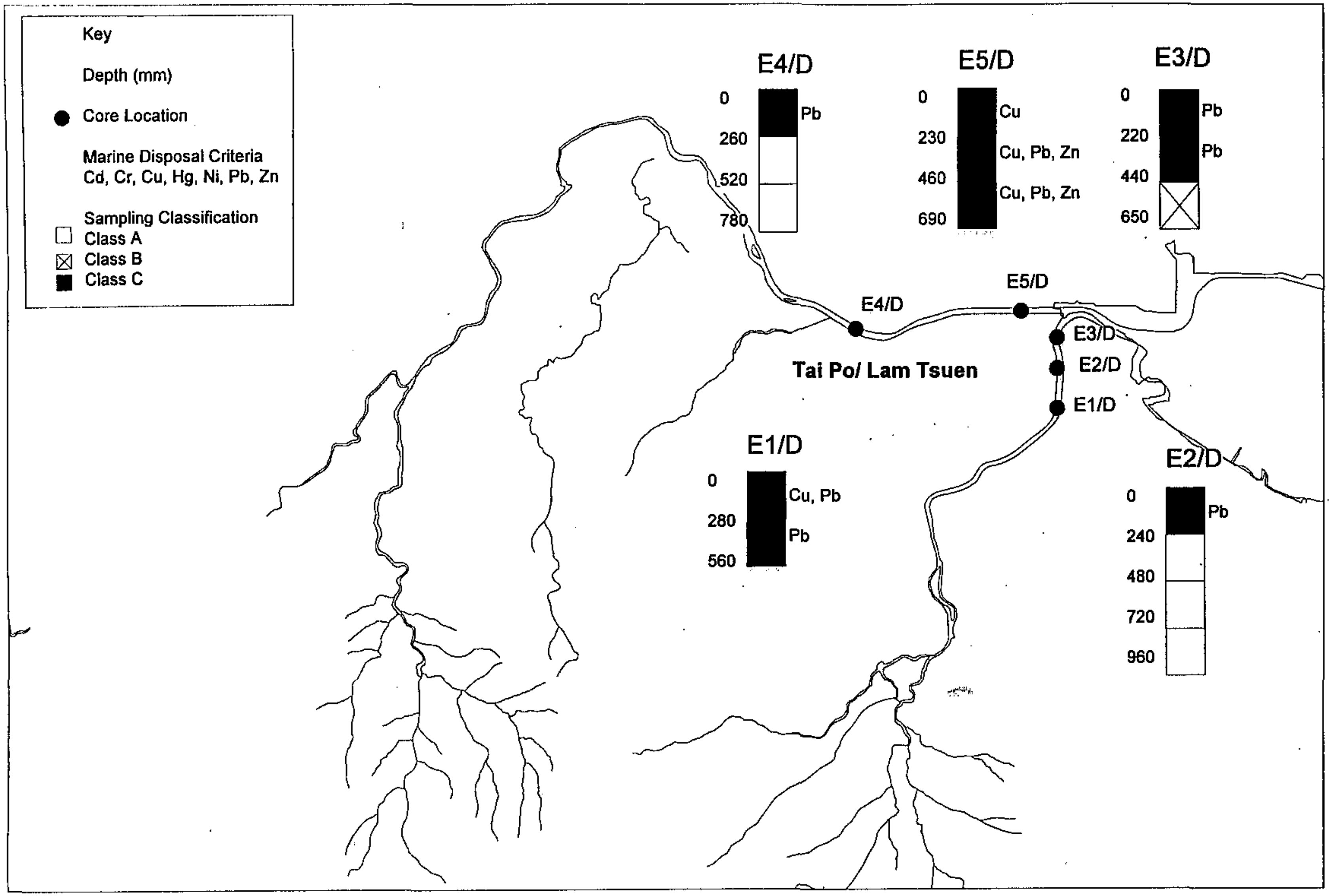

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Figure 14.3 Sediment Core Analysis Results
Tai Po/ Lam Tsuen River Channel and Tributaries

SECTION 15

EIA OF DREDGING WORKS IN THE RIVER INDUS CHANNEL

15. EIA OF DREDGING WORKS IN THE RIVER INDUS CHANNEL

15.1 Introduction

The River Indus and its two tributaries, the Beas and the Sutlej, lie in the Northern New Territories and form one of the largest river systems in the Territory with a catchment area of some 62 km^2. The Indus River flows for some 49 km prior to draining into Deep Bay via the Shenzhen River. Water levels in the River Indus are therefore influenced by levels in the Shenzhen River. The location of the existing Channel is displayed in Figure 15.1.

Structural improvements to reduce flooding are planned for the Indus through training of the major rivers in the basin and smaller scale local river training projects. Village and flood protection schemes such as a poldered village scheme and local channel improvements to protect villages in the flood prone areas are also planned. Finally river rehabilitation schemes are to be undertaken on sections of the drainage system where capacity has been adversely affected by development or neglect.

Under the existing hydraulic situation the channel floods periodically. The flood risk cannot be alleviated through maintenance dredging alone, although it would improve the situation. Once constructed, the occurrence of siltation is likely to be greater in the trained river channel. The location of the trained channel, and its potential noise and air quality Sensitive Receivers is displayed in Figure 15.2.

The River Indus Basin was studied in detail in 1988 in a project undertaken for Territory Development Department, North East Development Office (Maunsells Consultants Asia Ltd., 1989) and again in the TELADFLOCOSS II studies.

15.2 Existing Environment

15.2.1 Existing and Future Land Uses

Around half of the River Indus catchment is comprised of agricultural / grassland uses. Natural vegetation covers much of the channel banks and woodland covers approximately 15% of the catchment and is largely made up of orchard or plantation species. Two percent of the catchment is covered by erodable bare soil with less than 1% of the land area under construction. Urban areas account for about one third of the catchment's area. Fish ponds line the lower reach of the west bank of the river immediately upstream from Shenzhen River. Birds from the Ngam Pin Egretry feed in nearby fish ponds on the Indus River flood plain and also forage along the channel banks.

The River Indus has been diverted and straightened along much of its length to accommodate the Kowloon-Canton Railway and water supply corridors between Hong Kong and China. In the future, the trained alignment from Sheung Shui to Lo Wu will run between the existing KCR line and the new proposed West Rail.

15.2.2 Air Quality and Noise

A site visit in September 1995 indicated that the air quality in the vicinity if the channel was affected by odour from the channel, particularly in the upper reaches of the study area and discharges entering the channel. No major roads follow the course of the channel and therefore the air quality was found to be relatively good.

No data has been collected for the other channels in the Indus area.

Noise levels were found to be typical of rural areas in Hong Kong in the range of 50 - 55 dB(A) for $L_{eq(5min)}$. However, only spot measurements have been taken. No detailed baseline survey has been commissioned since proposed training works will influence the data.

15.2.3 Hydrology and Water Quality

Flood History and Predicted Flooding

The channel has an extensive history of flooding both upstream and downstream of its inflatable dam, possibly a result of limited channel capacity and the influence of the Shenzhen river. Flood risk has been increased through the construction of roads and railways in the lower parts of the basin which have formed barriers across the flood plain. This, together with land uses such as fish ponds and reclamation for container storage, which reduce flood storage, has increased flooding in the basin. Furthermore, the rapid and intensive urbanisation of the Shenzhen Basin has had an adverse impact on the Indus Catchment.

Fifteen villages in the Indus Basin are prone to flooding and the problem has been worsened by a lack of channel maintenance, largely due to difficulties experienced with access. Flood damage costs for Typhoons Warren and Brenda and Tropical Storm Faye has been estimated at a total of HK$26 million (Binnie Consultants, 1993).

Flooding predictions were modelled in Task 4 under two scenarios for the existing River Indus channel:

Case 1 - 10 years storm and 50 years tide:

Severe flooding is predicted along the Main Channel between Ch. 0-5300m with the Shenzhen River untrained. A trained Shenzhen River reduces the flooding along the Main Channel of the River Indus to 0-4700m, although flooding is still severe.

Both the River Beas and the River Sutlej flood severely and to the same extents, regardless of whether the Shenzhen River is trained or not. The Beas floods between 0-2700m, and the Sutlej between 0-1120m.

Case 2 - 50 years storm and 10 years tide:

The predicted flooding along both the River Beas and the River Sutlej is of the same severity and along the same chainages as described in Case 1. Flooding along the Main Channel is still severe between ch. 0-5300m when the

Shenzhen River is untrained, but training of the Shenzhen River restricts severe flooding to 0-4500m.

Under the future Scenario, with a trained Shenzhen River, no flooding is predicted for the Main Channel of the River Indus or for either of its tributaries.

Pollutant Loads

According to the EPD (1995), as of the end of 1994 there were about 200 livestock farms operating within the River Indus catchment. There were also anticipated to be discharges into the River from 55 cottage industrial premises, 267 commercial premises, 8,000 unsewered village houses, 12 private sewage treatment plants and 137 other discharges from institutional and government premises. As of the end of 1994 there were approximately 210 registered chemical waste producers in the catchment, compared with 159 at the end of 1993. The BOD loading in the Indus was 2,743 kg/day as at the end of 1994, half of which was from livestock waste (EPD, 1995).

The River Beas, a tributary of the Indus, receives most of its waste discharge from the 150 livestock farms along its catchment. As at the end of 1994 the BOD of the River Beas was measured as 2,962 kg/day, with 1,743 kg/day from livestock waste alone (EPD, 1995).

The BOD loadings in the River Indus and the River Beas have been reduced by 74% and 75% respectively since the introduction of the livestock waste controls, Water Pollution Control Ordinance Cap. 358 (WPCO) and Waste Disposal Ordinance Cap. 354 (WDO) (EPD, 1993). However, the average levels of *E. coli* along the whole of the River Indus exceed 100,000 counts /100 ml (EPD, 1995). Counts are likely to be even greater in the River Beas.

Water Quality

With the exception of the uppermost reaches of the channel, studies have shown that the tidal reach of the River Indus is highly contaminated with pollutants (Peking University, 1995). The River Indus is routinely monitored by the EPD and on the basis of monitoring conducted during 1994 was given a 'bad' water quality ranking (Appendix B1). This was mainly due to large quantities of livestock waste which were discharged into the channel resulting in high levels of faecal pollution. Cottage industries, unsewered villages and commercial premises are to a lesser extent responsible for the pollution. The water quality in the River Beas was classified as 'bad' upstream and 'bad' to 'very bad' downstream at its confluence (EPD, 1995).

Water quality analysis was conducted specifically as part of this study during April 1996, using the methodology described in Appendix A3. The survey was carried out across a twelve hour tidal cycle at three locations from the River Indus and one from the River Beas (Appendix B2). The results are presented graphically in Figure 15.3, and are summarised in Table 15.1. The full results are presented in Appendix A1.

TABLE 15.1 SUMMARY OF WATER QUALITY MONITORING RESULTS

Location	Salinity (ppt)	D.O. (mg/l)	D.O. (%)	S.S. (mg/l)	B.O.D. (mg/l)
F3 (R. Beas)	0.56 (0.30 - 0.90)	0.71 (0.45 - 0.94)	8.0 (5.4 - 10.3)	40.6 (32.0 - 56.0)	65.6 (48.0 - 85.0)
F6 (R. Indus)	0.42 (0.20 - 0.70)	2.45 (2.23 - 2.81)	29.1 (25.7 - 33.4)	32.8 (28.0 - 38.0)	8.9 (7.5 - 11.0)
F5 (R. Indus)	0.34 (0.10 - 0.60)	1.19 (0.48 - 3.31)	14.0 (5.6 - 39.4)	28.4 (25.0 - 35.0)	20.7 (15.0 - 29.5)
F1 (R. Indus)	0.38 (0.30 - 0.50)	0.45 (0.36 - 0.51)	5.1 (4.1 - 5.9)	41.6 (26.0 - 70.0)	15.1 (12.0 - 19.0)

Due to the size of the catchment the volume of freshwater flowing down the River Indus and its tributaries prevents any significant incursion of marine water except in the driest of periods. Thus the salinity levels are uniformly low along the River length. Similarly, at the River mouth (F1) there is not sufficient tidal mixing to increase dissolved oxygen (D.O.) levels above 0.51 mg/l. Where D.O. concentrations are highest is upstream in the River Indus (F6) where flow rates are greatest and the water is shallowest.

The River Beas tributary has by far the greatest B.O.D. concentration, probably due to livestock waste inputs. Consequently the Beas also had high suspended solids (S.S.) levels. The River Indus only had comparably high S.S. concentrations at its mouth. The Indus' B.O.D. levels were significantly lower than that from the Beas and displayed their highest values after the confluence of the River Beas.

Zinc concentrations were detected in all the River Beas (F3) water samples (max = 0.17 mg/l). However, Beas zinc concentrations were lower than the levels recorded in the River Indus at both upstream (F6) and downstream (F1) locations, with averages of 0.234 mg/l and 0.242 mg/l respectively. The Indus also had detectable levels of mercury (1 μg/l) at each sampling location.

15.2.4 Sediment

Grab samples were collected from the rivers in the catchment during July / August 1995. Based on the results of grab samples, core samples were taken at four locations specifically for this Study during December 1995. The locations and results of core sampling are presented in Figure 15.4 and summarised below. The full core sampling results are included in Appendix B4.

<u>Characteristics</u>

During a site visit to the channel on 22 September 1995, sediment was being excavated and stored on the channel banks. From visual observations the sediment was largely coarse grained sandy material. The sediment possibly consisted of material washed into the channel during the major storm events experienced throughout the Territory in July and August 1995. The sediment did not have a strong odour.

The results of core sample analysis show that sediment in the Indus beside the confluence with the River Beas and upstream within the main Indus channel is predominantly coarse grained sand. The middle reaches of the Indus further downstream have a layer of coarse silt over medium - coarse grained sand. It is likely that the silt found in the mid - lower reaches of the channel is of marine origin.

Quality

Three of the four cores taken from the Indus River were contaminated to Class 'C' level, using the classification defined in TC 1-1-92. Two of the cores, both from the mid - lower channel, were contaminated only in the upper 0.5m with copper and zinc, whilst the upstream sample was contaminated only in its uppermost 0.25m with zinc. Contamination by copper and zinc may be considered indicative of livestock waste, although the low organic carbon content in the sediment does not add further support to this. Under the proposed guidelines for sediment disposal currently being devised by EVS Environmental Consultants, the sediment in the River Indus is considered to be potential Class 3 material. Tier IV testing is likely to be required in the future. High nutrient concentrations were detected and may be associated with agricultural runoff. Organic contaminants were undetectable from chemical scans carried out on grab samples.

15.2.5 Ecology

Riparian Flora and Fauna

The catchment of the River Indus is generally agricultural. The river banks are well vegetated with grasses and reeds, with trees growing in some areas. Existing tree cover is largely made up of orchard or plantation species. Fish ponds line the lower reach of the west bank of the river immediately upstream from Shenzhen River.

The most important avian resource is the Ngam Pin Egretry which is located on the west side of the river in woodlands at the foot of Crest Hill. Birds using the egretry may feed in fish ponds on the Indus River flood plain, and may forage along the banks of the Indus as well.

Aquatic Fauna

The tidal reach of the Indus River is known to be virtually abiotic (Peking Univ. 1995). Therefore, aquatic fauna is not an ecological concern.

The benthic community is expected to be of low diversity due to the generally poor environmental conditions in the river, and the fish ponds adjacent to the channel are thought to be of greater importance to birds than the channel itself.

15.3 Proposed Works

15.3.1 Dredging Requirements

Present Situation

The results of modelling indicate high bed shear stresses, so it is concluded that the existing channels are at or close to dynamic equilibrium.

The entire River Indus system, including its tributaries, is at present prone to flooding in all but a small area. Task 4 indicated that channel dredging down to 0m PD would not prevent flooding during an extreme event of 1 in 200 years, but may reduce the magnitude.

Fluviatile sediment is expected to accumulate near the confluences of the channels and may affect drainage capacity. The net accumulation of coarse grained fluviatile sediments which enter the catchment upstream and settle at the confluences is estimated to be 4,100 m^3: River Indus - 2,700m^3; River Beas - 1,000m^3, and River Sutlej - 400m^3. The sediment input from construction works is estimated to be around 560m^3 per year.

There are no culverts which require restoration dredging.

Task 4 and 5 Recommendations: As bed level variations prevented the accurate modelling of sediment accumulation rates and locations, annual monitoring is recommended. On inspection, it is also recommended to consider a volume of around 5,000m^3 of sediment which may alleviate the severity of flooding. Similarly, it is suggested that inputs of construction-derived material be dredged upon inspection.

Future Situation (after full training of River Indus)

Task 4 predicts no flooding in the future channels even after raising the bed levels to +1m PD. It is also predicted that the sediment equilibrium in the future Indus Main Channel will prevent flood trigger levels being reached.

The same fluviatile input is expected in the future as occurs presently: Ch. 1000-1500 for the Indus Main Channel; Ch. 1000-1300 for the River Beas; and Ch. 300-500 for the River Sutlej. The respective annual sedimentation rates are 14 cm, 8 cm and 5 cm.

Task 4 and 5 Recommendations: A monitoring programme is recommended in order to more accurately determine the maintenance dredging requirements. Similarly, monitoring is suggested to determine the input from construction works.

15.3.2 Dredging Strategy (Existing and Future Channels)

i. **Access:** Security restrictions along the Shenzhen River and at the Frontier Closed Area prevent access from the marine side at all times. Thus the channel will only be accessible from the land, and all equipment will be transported along temporary access roads. Access to the existing channel will be through the deployment of long-reach cranes at the channel banks to lower equipment as is necessary.

Future access will also be via land but will be made easier due to the installation of a 4m wide access road along the entire length of the channels.

ii. **Dredging:** For both the existing channel and the future channel, pontoon mounted grab dredgers and backhoes will operate within the channel in conjunction with long reach excavators operating from the channel banks. This practice has been observed on previous occasions for River Indus works. Dredging plant will load into pontoon mounted skips within the channel which in turn will be unloaded by long reach grab or excavator situated on the channel bank where it will be temporarily stored.

iii. **Transport:** Unless the dredged material is clean and can be used locally, it will require road transportation for both land based disposal and marine disposal options. A water-tight vehicle will be necessary for either option. Marine disposal will most likely entail haulage to Tuen Mun.

iv. **Disposal Strategy:** Under the existing criteria the sediments are class C and should be disposed of to East Sha Chau or to landfill. Under the EVS recommended guidelines, if tier IV testing determines sediment to be Class 3, it will require landfill disposal. Moderately contaminated material should preferably be disposed of at landfill due to the distance and double handling involved for marine disposal. Disposal to East Sha Chau is suggested if landfill disposal is unacceptable.

Any uncontaminated material should be given a beneficial use, such as fill material for impending construction works in the region. Sediment core analysis indicated that the sediments in the upstream sections of the catchment are uncontaminated, whilst only the surface 0.5m of material from the downstream cores was found to be contaminated. Thus, it may be possible to dispose of some of the deeper material to agricultural land depending on the recommended dredging depth. A continuation of past practise of disposal to fish ponds is ecologically unacceptable.

15.4 Key Issues

Water Quality

- The release of sediment-bound contaminants may arise through dredging activities with potential impacts on sensitive receivers situated downstream. The types of contaminants include heavy metals, pesticides and organic wastes.

Ecology

- Further deterioration of Shenzhen River water quality due to the resuspension and transport downstream of contaminated sediments and consequent impacts on aquatic biology and associated food chains;
- Contamination of brackish or fresh water habitats used by herons and egrets nesting at the Ngam Pin egretry;
- Deterioration of water and/or sediment quality affecting the macrobenthos of Deep Bay mudflats as a food source for resident and migrant bird species; and

- Bank-side degradation due to either dredging or transport resulting in habitat damage or loss.

The extent of impacts to adjacent land and ponds will depend upon the methods used for dredging and eventual spoil disposal and the contractual controls and their enforcement.

Community

The removal of large quantities of sediment may result in dredging and transport associated impacts e.g. noise, dust and odour

15.5 Impact Assessment

15.5.1 Noise Impact Assessment

Works Areas

There are three proposed recurrent dredging locations in the existing River Indus channel and Tributaries, and three proposed recurrent dredging locations for the future Channel. These are shown in Figures 15.1 and 15.2 respectively.

Noise Sensitive Receivers

The most affected NSRs around the works area have been identified as those falling within a 300m buffer of the likely works area. No NSRs were found near the dredging locations for the existing River Indus. The locations of the NSRs around the future River Indus Channel are shown in Figure 15.2 and are described in Table 15.2.

TABLE 15.2 DESCRIPTION OF NOISE SENSITIVE RECEIVERS

NSR	Description
F1	Dwellings adjacent to Fu Tei Au Road
F2	Sheung Shui Temporary Housing Area

Noise Impact Assessment Criteria

Noise level are limited by the *Noise Control Ordinance (Cap 400) including its subsidiary regulations and the Technical Memoranda.* (TM).

In addition to the requirements imposed by the Noise Control Ordinance, the following requirements or interpretations will also be used as a standard in order to control noise generated from equipment and activities for the purpose of carrying out any construction work other than percussive piling during the time period from 0700 to 1900 hours on any day not being a general holiday:

i) The noise level measured at 1 m from the most affected external facade of the nearby NSRs during any 30-minute period during normal weekly daytime periods between 0700 to 1900 hours will not exceed an equivalent sound level (L_{Aeq}) of 75 dB(A) or 70 dB(A) (or 65 dB(A) during examination) for schools.

ii) Construction should not be undertaken during any other period, the restricted period, without the existence of the relevant Construction Noise Permit (CNP).

iii) In accordance with TM, the area around the dredging locations has an Area Sensitivity Rating (ASR) of 'A'. Therefore ANLs under the current regulation are 60 dB(A) from 1900 to 2300 hours plus all day Sundays and general holidays and 45 dB(A) between 2300 and 0700 hours

Assessment Methodology

For the dredging works in the middle of river, the works will be undertaken using a pontoon mounted grab then the dredged material will be transferred into the pontoon mounted skip. A long reach excavator will further transfer dredged material from the skip to the trucks. For the dredging works near the bank , the works will be simply undertaken by a land based excavator and the dredged material will be transported by trucks. The trucks will transport the dredged material to landfill site or East Sha Chau for disposal. In this case the trucks only transport the dredged material off the site once it is full. The engine of the truck is assumed to be switched off during most of the time at the site. The noise impact generated from the truck is therefore considered insignificant and has not taken into account in this assessment. The likely equipment for dredging in the future is shown in Table 15.3.

TABLE 15.3 TYPICAL MIX OF EQUIPMENT FOR DREDGING OPERATIONS

Identification Code	Description	Sound Power Level dB(A)
CNP 063	Dredger, grab	112
CNP 081	Excavator	112

The sound power levels of the equipment used in this assessment are derived from the TM. The equipment were considered to be grouped at a position mid-way between the approximate geographical centre of the dredging area and its boundary nearest to the NSR. In the case of an oblong area, having a length to width ratio of 5:1 or more, then only the closest portion to the NSR has been considered, as defined in the TM.

A total sound power level of the dredging operation is obtained by the summation of the individual sound power levels of the associated equipment.

The noise levels at each NSR are predicted by the following equation:

Predicted noise level = Total sound power level - 20 log10D - 8 dB(A)

where D is distance between the NSR and the noise source

A positive correction of 3 dB(A) was made to each predicted noise level arising from concurring activities to account for the facade reflection at the NSR. The predicted unmitigated noise levels for the River Indus (Future Scenario) are presented in Table 15.4. A detailed calculation spreadsheet is attached in Appendix A5.

TABLE 15.4 UNMITIGATED NOISE LEVELS AT NSRS

NSR	Predicted Noise Level dB(A)
F1	74[2]
F2	75[2]

Note: [2] PNL exceed the ANLs for all restricted hours.

As calculations indicate that unmitigated PNLs at both NSRs exceed the ANLs for all restricted hours, works during restricted hours are not recommended.

As the PNLs at both NSRs are within the day-time guideline of 75 dB(A), adverse noise impacts are not anticipated, provided the works do not extend into restricted hours.

15.5.2 Air Quality Assessment

Dust

With respect to the existing channel there is little potential to generate dust from dredging works provided that good practise is followed. Dredged material will be temporarily stored in skips and covered to prevent fugitive dust emissions. Although the construction of temporary access roads is necessary, there are no ASRs in the vicinity of the existing channel. Thus, the standard mitigation clauses detailed in Section 8 are considered sufficient to enforce good practice and avoid unacceptable dust impact.

For the future channel, dredging will occur adjacent to two ASRs. Thus strict adherence to general mitigation will be necessary to avoid dust emissions. There will be no need for access road construction.

Odour

The sediment within the existing channel has a low organic matter content, therefore organic based odours are not anticipated. Odour generation can be minimised through reducing material exposure and wetting the sediment. Such practice is recommended for each channel through general contractual clauses as detailed in Section 8.

15.5.3 Ecological Impacts

The river training of the Shenzhen River, from Lo Wu to the river mouth, is under construction for approximately 48 months, beginning in May 1995. During this time the impacts of maintenance dredging in the River Indus will be cumulative with the impacts of the training project of the Shenzhen River. The potential for adverse impacts on the downstream benthos, particularly on the inner Deep Bay mud flats, is a concern regarding cumulative impacts. However, the benthic community is expected to be of low diversity due to the generally poor environmental conditions in the river. These impacts are therefore not predicted to be significant.

Access to the channel banks for the removal of sediment or for dredging may cause damage to the bankside vegetation resulting in a loss of foraging habitat and damage to adjacent fish ponds.

The extent of impacts to adjacent land and fish ponds can be minimised through control of activities and avoiding stockpiling on the channel banks and adjacent fish ponds. In the event that adjacent areas are damaged, vegetation should be restored and erosion controlled through replanting/reseeding or, in the case of fishponds, restoration of water quality to permit continuation of fish culture.

15.5.4 Water Quality Impacts

Downstream impacts due to increased water turbidity and resuspension of pollutants may arise depending on the dredging and environmental protection methods employed. The impacts of dredging will not have significant adverse effects on the water quality within the river channel itself in the short term as the water quality is already considered to be poor and therefore unlikely to support sensitive aquatic life.

In the longer term should help to improve river water quality through the removal of pollutants bound in the sediment, in conjunction with EPD measures to control livestock waste and other waste water discharges.

15.6 Mitigation Measures

The standard specifications detailed in Section 8 are considered sufficient to mitigate potential impacts.

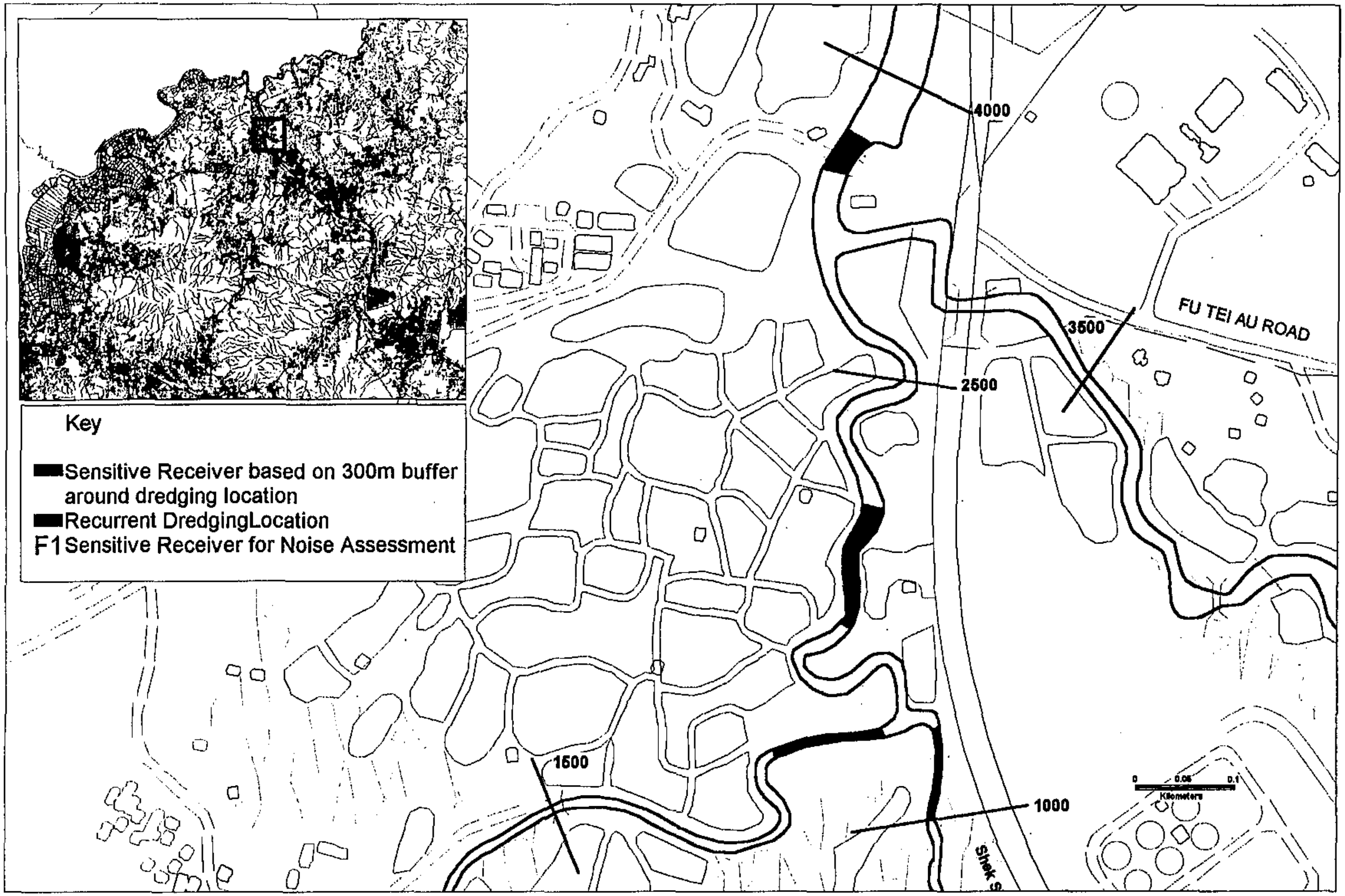

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Figure 15.1 Potential Noise and Air Sensentive Receivers Near Proposed Dredging Location
River Indus Channel and Tributaries - Present Scenario

Source: Lands Department
OZP

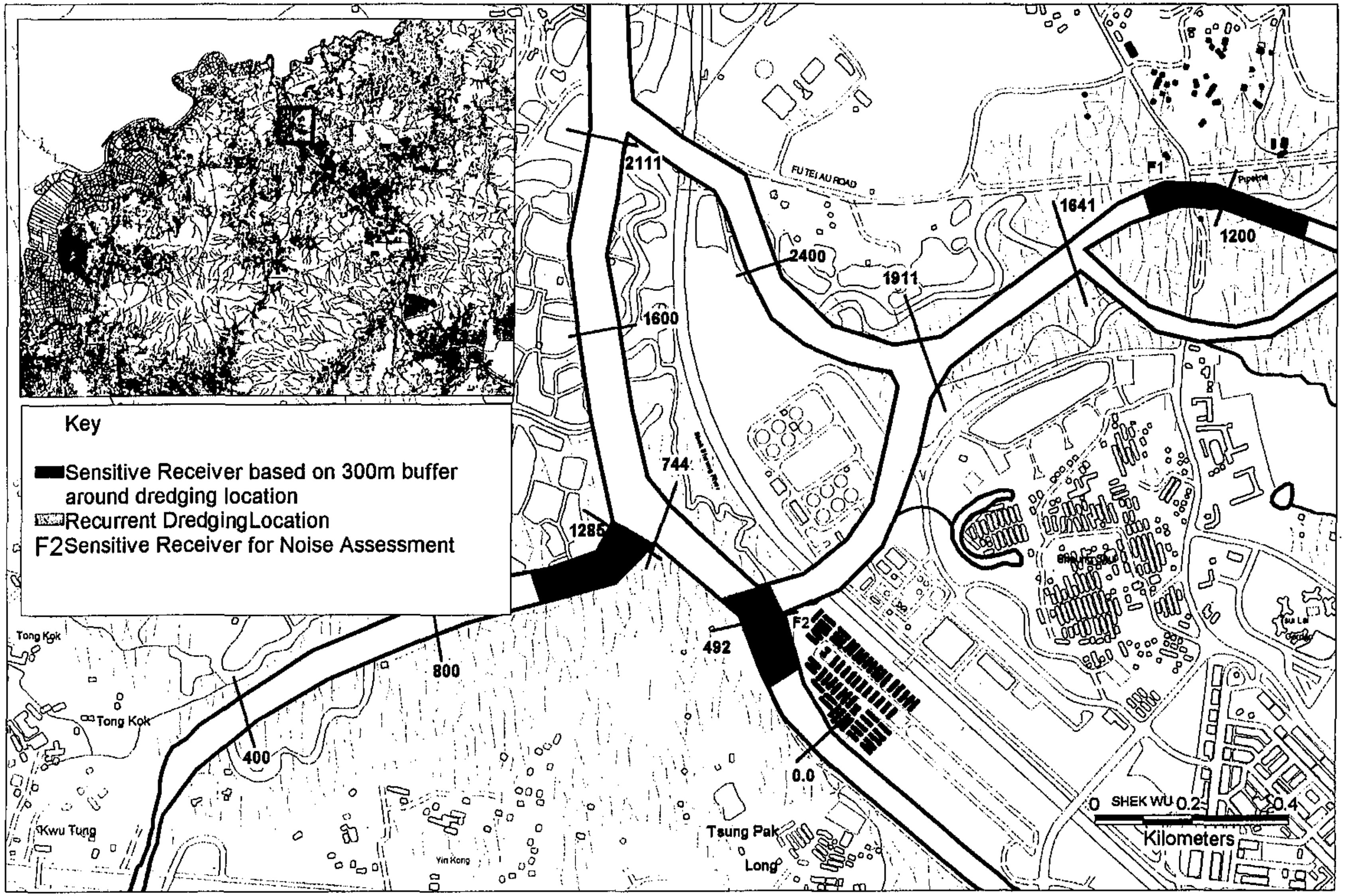

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Figure 15.2 Potential Noise and Air Sensentive Receivers Near Proposed Dredging Location River Indus Channel and Tributaries - Future Scenario

Source: Lands Department OZP

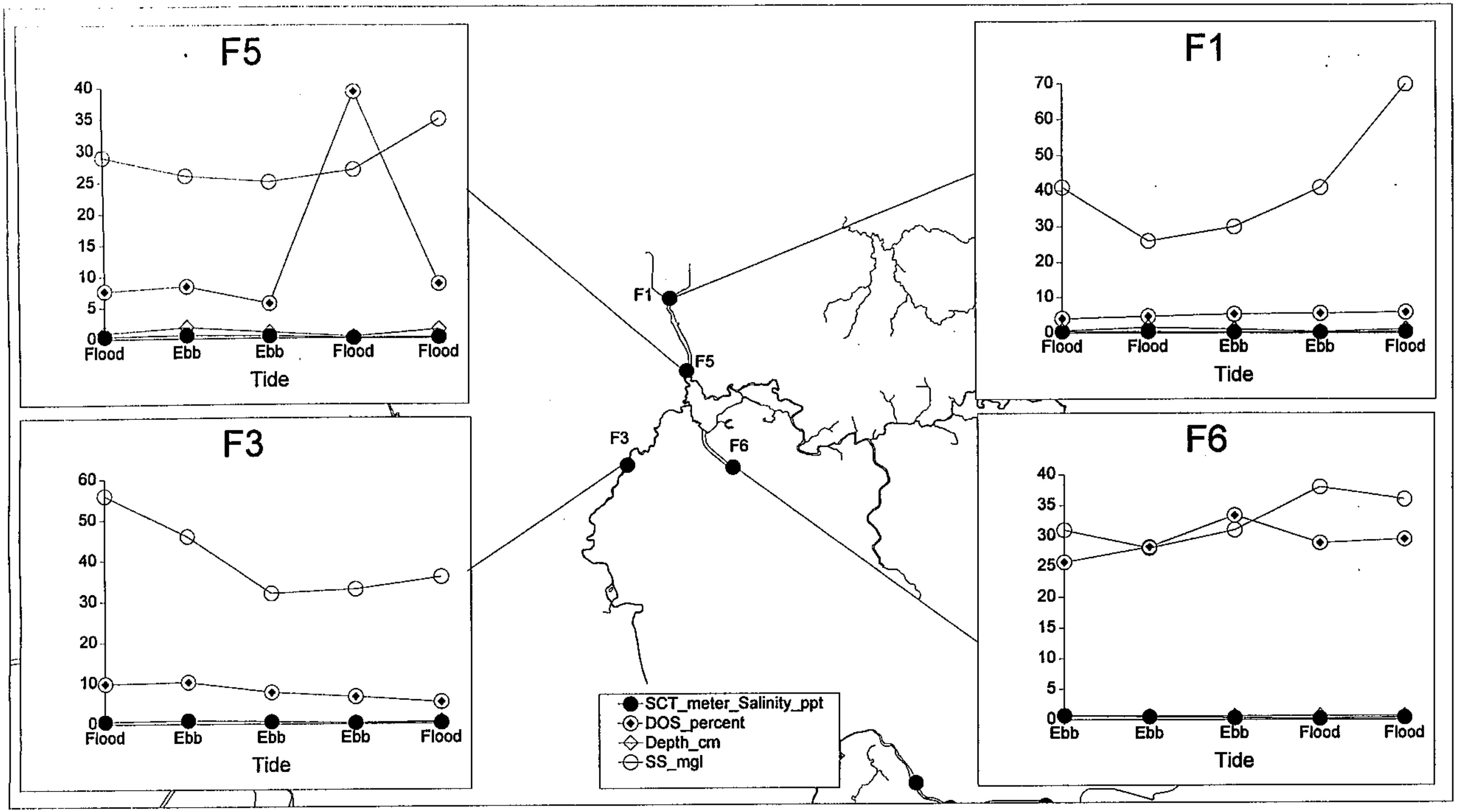

Figure 15.3 Water Quality Monitoring Results from 16/04/1996
River Indus Channel and Tributaries

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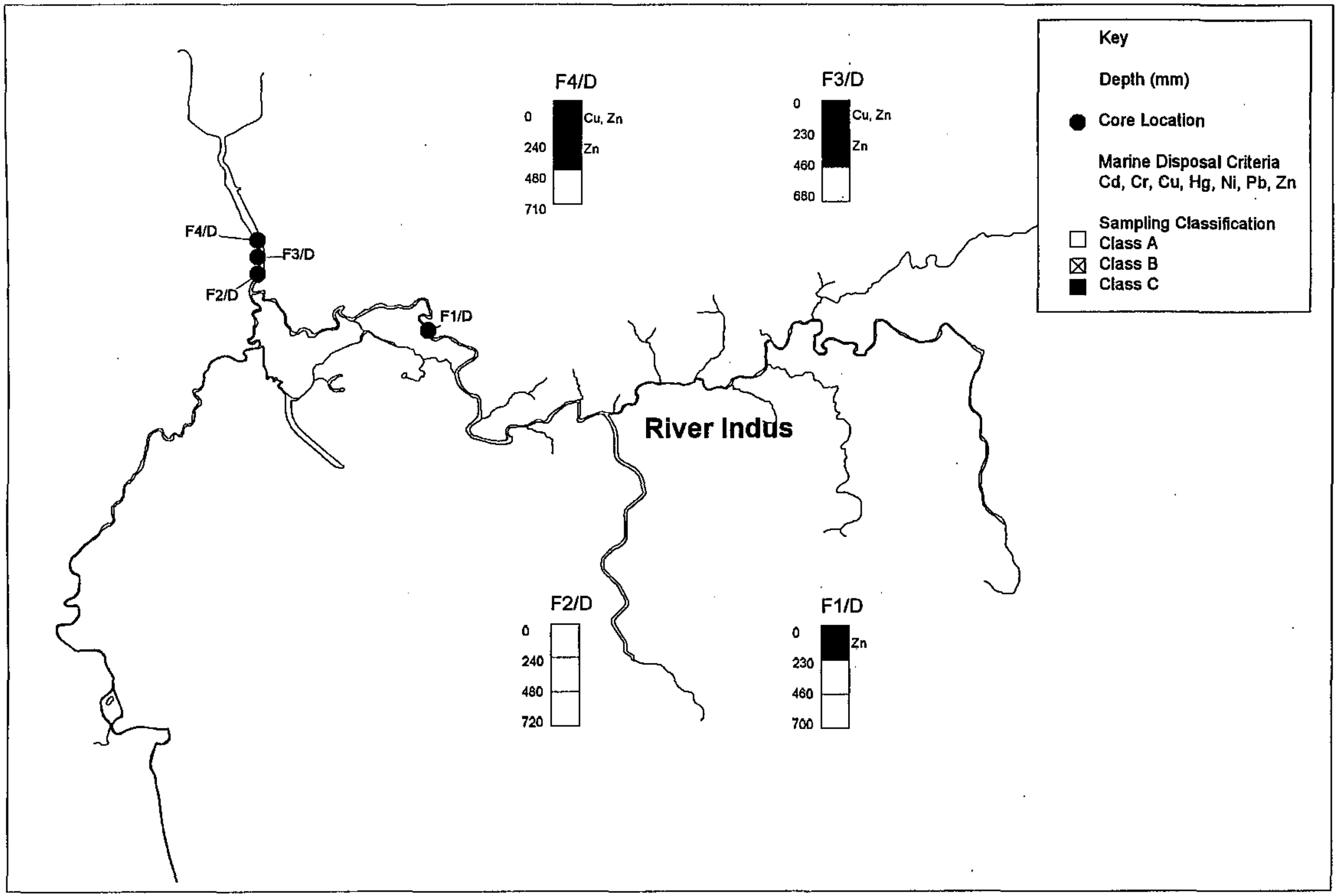

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Figure 15.4 Sediment Core Analysis Results
River Indus Channel and Tributaries

SECTION 16

EIA OF DREDGING WORKS IN THE SAN TIN RIVER CHANNEL

16. EIA OF DREDGING WORKS IN THE SAN TIN MAIN DRAINAGE CHANNELS

16.1 Introduction

The San Tin Main Drainage Channels consist of three inter-linked river channels: East, West and Central. They lie within and adjacent to the restricted border area in the North West New Territories. The channels, with a combined total catchment area of 9.88 km^2, are subsidiaries of the Shenzhen River and ultimately drain into Deep Bay. The Mai Po Nature Reserve lies to the west of the channels. Figure 16.1 shows the location of the existing channel, the expected dredging locations and the sensitive receivers.

The area is currently subject to intense development pressure to provide facilities for cross border links at Lok Ma Chau.

16.2 Existing Environment

16.2.1 Existing and Future Land Uses

The catchment is largely rural in nature, surrounded by a low lying area consisting mainly of fish ponds and agricultural land. Fish ponds account for some 29% of land use within the catchment - the greatest percentage cover for any channel in the Study. The area covered by woodland is relatively small (10%) and there are also areas of grassland at the catchment fringes. The remainder of the land is mainly used for rural development, container storage and other port back-up uses. The channels themselves are characterised by extensive growth of water hyacinth.

Structural improvements to the drainage channels have been planned to reduce flood risk. Figure 16.2 shows the predicted dredging locations for the future scenario, with potential sensitive receivers to noise and air quality impacts. River rehabilitation works have also taken place on sections of the channels where the flow capacity has been adversely affected by development or lack of maintenance. Studies have also been commissioned on the provision of flood protection to villages in the San Tin area, through use of poldering techniques. Both the existing and future dredging scenarios for the San Tin Main drainage channels are included in this section.

16.2.2 Air Quality

When the upper reaches of the three channels were surveyed in May 1995, the air quality was found to be generally good. However, where the main road crosses the southern-most channel, the air quality was badly affected by exhaust gases from heavy vehicles. Slight odours were detected from two of the channels.

The lower reaches of the channels were visited in September 1995. Air quality was very poor as a result of odour emissions. The major source of both chemical and organic odour was the nearby Shenzhen River.

The baseline survey was conducted over a seven day period during November 1996. Measurements of 24 hour TSP concentrations were made from an open yard in form of No. 24, Yan Shau Wai, as displayed in Figure 16.1. The results are summarised in Table 16.1 and are presented in full in Appendix A7. Field notes and methodologies are included as Appendix A4.

TABLE 16.1 SUMMARY OF BASELINE AIR QUALITY MONITORING RESULTS

Date of Sampling	Total Suspended Particulate TSP value ug/Std. m^3
15.11.96	195
16.11.96	240
17.11.96	260
18.11.96	160
19.11.96	250
20.11.96	264
21.11.96	186

NB: The Air Quality Objective for 24 hr. TSP measurements is 260 ug/m^3

The results show consistently poor air quality averaging at 222 ug/m^3 per day. The possible sources of this pollution depend on the prevailing wind direction, and include construction works for the Route 3 Highway project to the south, and residential construction at Tin Shui Wai to the west. However, construction projects in Shenzhen were considered to be the dominant source of particulates.

16.2.3 Noise

Traffic noise assessments carried out around Castle Peak Road during May 1995 produced noise levels exceeding 60 dB(A). Away from the road the background noise levels were low, ranging 49.2 - 50.8 dB(A).

A noise baseline survey was undertaken during November 1996 at the San Tin Main Drainage Channel, using the methodology in Appendix A4. Background noise measurements including $L_{eq\ (30min)}$, L_{10} and L_{90} were taken from an open area in front of No. 68 Yan Shau Wai, as shown in Figure 16.1. The average values and ranges are summarised in Table 16.2, and are presented in full in Appendix A6.

TABLE 16.2 SUMMARY OF BASELINE NOISE MONITORING RESULTS

Noise Measurement	$L_{eq\ (30min)}$ dB(A)	L_{10} dB(A)	L_{90} dB(A)
Average	51.1	52.3	46.9
Range	45.4 - 59.9	47.5 - 60.0	41.5 - 52.5

The results reflect the relatively quiet nature of an essentially rural environment. Analysis of the detailed results shows that noise levels were significantly higher on one out of the three sampling days. The difference between the sampling days in this case most likely reflects the influence of dogs barking and other noise peaks typically encountered in village areas.

16.2.4 Hydrology and Water Quality

Flood History and Predicted Flooding

The San Tin Basin is a small subsidiary of the Shenzhen River Basin from which a number of minor tributaries enter the Shenzhen River. The relatively small channel size and local constrictions often lead to flooding of surrounding areas following even minor rainstorms. The resulting flood waters are shallow, but increasingly more widespread due to the large area of land taken up by container storage which minimises flood storage capacity due to the reduction in land area through which water can drain. The presence within the channels of water hyacinth and substantial sedimentation also reduces the ability of the channel to convey flood waters effectively. Dredging in the San Tin system of waterways (near the lower reaches of the Shenzhen River), was last undertaken by DSD in 1995 for maintenance of channel capacity. Dredged materials were disposed of off-site by DSD's term Contractor. Land access was used for both the dredging and disposal operations.

Structural improvements to the drainage channels, major river training, poldered village schemes at San Tin and Chau Tai and local river training at Mai Po Leung have been planned to reduce flood risk. In addition, river rehabilitation has taken place on sections of the drainage system where capacity is adversely affected by development or neglect.

The major villages susceptible to flooding in the San Tin Basin are San Tin, Mai Po and Chau Tau which lie alongside the New Territories Circular Road. According to Phase 2 of the Study, Tropical Storm Faye caused HK$22 million worth of damage (Binnie Consultants, 1993).

Flooding predictions were modelled in Task 4 under two scenarios for the existing San Tin channel:

Case 1 - 10 years storm and 50 years tide; and

Case 2 - 50 years storm and 10 years tide:

> For both Cases, the extent of flooding predicted is minor and is restricted to the same chainages. The East Channel floods between ch. 0-2300m, whilst the West Channel floods between ch. 1000-2400m. No flooding is predicted along the Yan Shau Wai.

No flooding is predicted under the future Scenario for either case.

Pollutant Loads

According to data received from EPD Local Control Office, the greatest source of pollutant loadings into the channels is livestock waste. The BOD loading into San Tin and Ngau Tam Mei from this waste source is 6,359 kg/day. It is also likely that the villages along the upper reaches of the channels discharge untreated sewage into the water course.

Water Quality

The three main drainage channels are not routinely monitored by EPD. However, field observations indicate that the water quality in the channels is of a poor quality. Each of the channels contain large volumes of sediment and the upper reaches of southern-most channel were found to have completely silted up as a result. The two other channels were found to be covered with water hyacinth along their upper reaches. Water was noted as having a brown coloration and as being stagnant resulting in a strong odour probably a result of gases generated within the sediment, e.g. methane, hydrogen sulphide.

16.2.5 Sediment

Sediment grab samples were taken from the San Tin main drainage channels in August / September 1995. Core samples were collected from the East and West Channels for analysis during December 1995. Figure 16.3 presents the results of the sediment core analyses from seven sampling locations. Full core results are presented as Appendix B4.

Characteristics

Sampling of bed sediment along the two channels revealed a median grain size indicative of silt / clay. This was generally concentrated up to 1m below the channel bed surface. The dry density of the clay in the upper bed sediment is between 350 and 550 kg/m^3 whilst that in the lower bed has a dry density of up to 1000 kg/m^3 due to further consolidation. Coarse grained sand was encountered upstream in a tributary of the San Tin East channel and fine grained sand was identified in a minor channel further downstream, also in the East channel.

Quality

Analysis undertaken during 1993 for Phase 1 of the Village Flood Protection Works indicated that sediment from the San Tin main drainage channels was generally uncontaminated. Thus it was given a Class 'A' category based on TC 1-1-92. In a small number of cases zinc was present in sufficiently elevated concentrations to classify the sediment as moderately contaminated, Class 'B'.

The results of both the grab and core analysis from 1995 revealed that sediment samples from the West Channel are now heavily contaminated (Class 'C') with copper, lead and zinc. The sediment in the main East Channel is uncontaminated in its upper reaches whilst further downstream the top 0.24m of sediment warranted a Class 'B' grading. There is further contamination of the central drainage channel, which drains into the northern channel, to Class 'C' due to copper, nickel, lead and zinc.

Organic carbon concentrations were low in the grab and core samples. Nutrient levels were high, particularly nitrogen (>1000 mg/kg) and phosphorus (>2000 mg/kg) which indicates agricultural runoff.

16.2.6 Ecology

Riparian Flora and Fauna

A bird survey was conducted along the San Tin Channels on the morning of March 23rd 1996. Only those species which were seen or heard along the actual channels were recorded. The locations of the transects are displayed in Figure 16.4. The results of the survey are shown in Table 16.3.

The channels at Yan Shau Wai were very heavily vegetated with water hyacinth (*Eichhornia crassipes)* and *Phragmites* sp., whilst mangroves and dwarf trees were present at the channel mouths. The riparian zone consisted simply of fishpond bunds. Birds observed included species common in disturbed agricultural and village sites. Avian species of some conservation concern which forage along the San Tin channels include Little and Cattle Egrets, Chinese Pond Herons, Night Herons, and other members of the *Ardeidae* family. Rails, including Moorhens and White-breasted Waterhens, are also known to feed along the channels. The dense growth of floating water hyacinth on the channels apparently supported abundant insect fauna, as House Swifts, Pacific Swifts, and Barn Swallows were foraging in large groups (50-100 birds) over the channels.

TABLE 16.3 BIRDS RECORDED ALONG THE SAN TIN CHANNELS

Common Name (Species Name)	Number
Chinese Pond Heron (Ardeola bacchus)	69
Night Heron (Nycticorax nycticorax)	1
Little Egret (Egretta garzetta)	4
Black-eared Kite (Milvus lineatus)	3
White-breasted Waterhen (Amaurornis phoenicurus)	4
Moorhen (Gallinula chloropus)	2
Common Sandpiper (Actitis hypoleucos)	9
Green Sandpiper (Tringa ochropus)	5
Redshank (Tringa totanus)	4
Spotted Dove (Streptopelia chinensis)	23
Rufous Turtle-dove (Streptopelia orientalis)	8
Common Kingfisher (Alcedo atthis)	1
White-breasted Kingfisher (Halcyon smyrnensis)	2
House Swift (Apus nipalensis)	15
Barn Swallow (Hirundo rustica)	204
Richard's Pipit (Anthus richardi)	2
Olive-backed Pipit (Anthus hodgsoni)	17
Red-throated Pipit (Anthus cervinus)	4
Grey Wagtail (Motacilla cinerea)	42
White Wagtail (Motacilla alba)	10
Chinese Bulbul (Pycnonotus sinensis)	9
Magpie Robin (Copsychus saularis)	2
Siberian Stonechat (Saxicola maura)	7
Fantail Warbler (Cisticola juncidis)	38
Yellow-bellied Prinia (Prinia flaviventris)	83

Common Name (Species Name)	Number
Plain Prinia (Prinia inornata)	50
Dusky Warbler (Phylloscopus fuscatus)	1
Rufous-backed Shrike (Lanius schach)	3
Unidentified bunting	5
Tree Sparrow (Passer montanus)	8
White-cheeked Starling (Sturnus cineraceus)	50
Silky Starling (Sturnus sericeus)	120
Black-necked Starling (Sturnus nigricollis)	11
Crested Myna (Acridotheres cristatellus)	55
Common Myna (Acridotheres tristis)	2
Black Drongo (Dicrurus macrocercus)	2
Magpie (Pica pica)	1
Number of individuals	**876**
Number of species	**37**
Diversity	**2.69**

Aquatic Fauna

No invertebrate fauna was observed, although it is likely that many invertebrates shelter under and within the water hyacinth. Given the organic pollution and anoxic conditions of the channels, no aquatic communities of conservation importance are expected to exist. However, the high numbers of pollution resistant organisms are providing food for wading birds and therefore are of value in the local food chain.

16.3 Proposed Works

16.3.1 Dredging Requirements

Present Situation

Task 4 has indicated that the present channels flood along most of their length. Modelling indicated that raising or lowering of the bed had only a marginal effect on water levels in the channel and the task report concludes that flooding is largely a result of low bank levels. A key feature of these channels is the large amounts of water hyacinth within the channel which are severely disturbing dynamic sediment processes such as erosion thus allowing sedimentation.

The bed strength of the Channels is strong due to the presence of the submerged roots of hyacinth which effectively binds and consolidates the soft sediment. Consequently, between 3,000-6,000 m^3 of fine sediment accumulates annually along the whole length of the existing Channels. Removal of this volume will not alleviate flooding during extreme events but could help to improve the situation.

There is no sediment input from construction works, and there are no culverts / pipes of concern. Thus, restoration dredging is unnecessary.

Task 4 and 5 Recommendations: The annual maintenance dredging of between 3,000-6,000 m^3 of soft sediment is recommended in the San Tin Channels. The annual removal of a small volume of fluviatile sediment (around $460m^3$) is recommended by Task 4 from the upstream catchments.

Future Situation

The future channel, should it be built, will have the capacity to contain flood waters but, due to its size, will encourage sedimentation within the channel. Should maintenance dredging be necessary, it is likely to be in the locations indicated on Figure 16.2.

Sedimentation to a level of 1.5m above the base condition bed levels does not produce flooding in either the East of West Channel. Sedimentation to a level of 2.0m above the base condition bed levels in both of the channels does produce flooding for a 1 in 50 year rainfall combined with a 1 in 10 year tide level. In the upper channel, predicted water levels rise above the top level of the banks by approximately 0.1m along an 80m stretch of channel at the upstream boundary. In the lower channel, the predicted water levels coincide with the top level of the banks from the upstream boundary to an approximate chainage of 100m. As such, any sedimentation above this level will produce flooding in this area.

A prediction of the future sedimentation indicates that around $2,100m^3$ of coarse fluviatile material could potentially require removal from the upper reaches of both the San Tin East (Ch. 1600-1900) and San Tin West (Ch. 200-600). If considered necessary, dredging will be carried out on a ten year cycle. A small volume of sediment will require annual removal from the proposed culvert between the village plodder scheme and the West channel. In the future, most of the soft sediment along the existing channel will be eroded by high bed shear stresses.

Task 4 and 5 Recommendations: The removal of around $420m^3$ of coarse grained fluviatile sediment which enters the Channels upstream is recommended. Dredging is suggested every ten years and will be focused around Ch. 1600-1900 on the Proposed Eastern Channel, and at Ch. 200-600 on the proposed Western Channel.

Vegetation growth monitoring is recommended, along with assessments of bed development and the depth at which equilibrium is reached. This will enable the prediction of maintenance dredging frequency and volume. Monitoring is also suggested to determine any future recurrent dredging.

16.3.2 Dredging Strategy

In the event of dredging, the strategy as recommended by Task 5 is summarised below:

i. **Access:** Marine access to the current and future Channels is impossible due to the presence of the border fence. Land access, although currently difficult, will be necessary and may involve the construction of temporary access routes. The remnants of temporary berms from previous dredging works will facilitate vehicular access along the channel banks. It is anticipated that access to the future

Channels will be made easier due to the need for road construction and road improvement for the engineering works.

ii. **Dredging:** The Channels should be dredged using specialist equipment such as long reach excavators or amphi-dredgers which would be brought in by road. Floating plant will be lowered into the Channels from vantage points at the banks. Dredged material will require temporary storage in covered skips at the side of the Channels.

iii. **Transport:** All material which cannot be used in the vicinity of the dredging locations will require road transportation, either directly to a land-based disposal site or to Tuen Mun if a marine disposal option is chosen. Water-tight vehicles will be used.

iv. **Disposal Strategy:** As the Channels will be accessed from the land, land-based disposal options are preferable. Disposal of contaminated sediment to WENT strategic landfill is considered as a potential option. Alternatively, marine disposal to East Sha Chau is possible, but requires that the sediment undergoes long haulage to Tuen Mun and then necessitates double-handling.

As the sediment is generally contaminated throughout the existing Channels, beneficial uses may not be possible. Uncontaminated sediment from the future Channels could be used locally as construction fill material or in village poldering programmes.

Given the ecological and flood storage importance of maintaining the extent of the wetland in the vicinity of the Ramsar site, fish ponds are not recommended as disposal sites unless the dredged sediment can be used in bund creation or habitat management/enhancement.

The removal of water hyacinth which grows extensively within the existing Channels could have benefits through its potential use as a composting material. However, this needs careful consideration since its removal is likely to result in significant damage or loss of bank-side vegetation, as well as creating a potential odour nuisance for local residents. It is recommended that such a beneficial use is implemented with a view to minimising the pressures on existing waste disposal facilities as well as encouraging resource reuse and recycling.

16.4 Key Issues

The key issues for San Tin Channels relate largely to the significant ecological value of the area. Despite the fact that the sediments in the existing Channels are contaminated and the water is of a poor quality, the environment supports a diverse bird community and large numbers of invertebrates. Thus, any proposed dredging must avoid unnecessary damage to bankside and channel habitats. Avifauna may also be prone to disturbance from dredging noise.

In the future, river training and flood protection of villages by poldering is planned. Thus, the level and significance of flood risk needs to monitored regularly over the coming years.

16.5 Impact Assessment

16.5.1 Noise Impact Assessment

Works Area

Recurrent dredging is proposed along the entire existing San Tin system, as displayed in Figure 16.1. Figure 16.2 shows the two proposed recurrent dredging locations for the future scenario.

Noise Sensitive Receivers

The most affected NSRs around the works area have been identified as those falling within a 300m buffer of the likely dredging locations. The NSRs for both the existing and future situation are displayed in Figures 16.1 and 16.2 respectively, and are described in Table 16.4.

TABLE 16.4 DESCRIPTION OF NOISE SENSITIVE RECEIVERS

NSR	Description
G1	Yau Shau Wai
G2	Tsing Lung Tsuen
G3	Village adjacent to Castle Peak Road
G4	Ha Wan Tsuen
Ramsar Site	Deep Bay/ Mai Po/ Buffer Zone 1&2

Note: G2 and G3 will be affected by the dredging works in both existing channels and future channel of San Tin Main Drainage.

Noise Impact Assessment Criteria

Noise level are limited by the *Noise Control Ordinance (Cap 400) including its subsidiary regulations and the Technical Memoranda.* (TM).

In addition to the requirements imposed by the Noise Control Ordinance, the following requirements or interpretations will also be used as a standard in order to control noise generated from equipment and activities for the purpose of carrying out any construction work other than percussive piling during the time period from 0700 to 1900 hours on any day not being a general holiday:

(i) The noise level measured at 1 m from the most affected external facade of the nearby NSRs during any 30-minute period during normal weekly daytime periods between 0700 to 1900 hours will not exceed an equivalent sound level (L_{Aeq}) of 75 dB(A) or 70 dB(A) (or 65 dB(A) during examination) for schools.

(ii) Construction should not be undertaken during any other period, the restricted period, without the existence of the relevant Construction Noise Permit (CNP).

(iii) In accordance with TM, the area around the dredging locations has an Area Sensitivity Rating (ASR) of 'A'. Therefore ANLs under the current regulation are 60 dB(A) from 1900 to 2300 hours plus all day Sundays and general holidays and 45 dB(A) between 2300 and 0700 hours.

Part of the proposed dredging works (approximately 69% of the total length of the existing channels) in San Tin Main Drainage Channel fall within the Deep Bay Buffer Zone (Buffer Zone 2), and a very small proportion (approximately 2.6% of the total length of the existing channels) also fall within the Inner Deep Bay Buffer Zone (Buffer Zone 1). The locations of the proposed works for the existing and future channels in relation to the restricted areas are shown in Figures 16.5 and 16.6 respectively. Thus, in addition to the standard noise requirements, a more restrictive *Deep Bay Guidelines* for protecting the sensitive habitats in Deep Bay have been used as standards. The Noise Levels Limits for Construction Works in the Deep Bay Area are presented in the Table 16.5.

TABLE 16.5 NOISE LEVEL LIMITS FOR CONSTRUCTION WORKS IN THE DEEP BAY AREA

(a) Within the Deep Bay area, but outside the Inner Deep Bay Special Measure Zone

Time Period	Acceptable Noise Level dB(A)[1]
Weekdays 0700 - 1900 hours[2]	75
Weekdays 1900 -2300 hours	60
General holidays including Sundays 0700 -2300 hours	60
All days 2300 - 0700 hours	45

1 (5 min) L_{eq} measured at the building facade of a Noise Sensitive receiver (NSR)
2 Alternative limit for weekdays, 0700 - 1900 hours, is 10 dB(A) above the ambient noise level (measured as 1-hour L_{90} dB(A)

(b) Within the Inner Deep Bay Special Measure Zone

Time Period	Acceptable Noise Level dB(A)[1]
All days 0700 - 2300 hours[2]	60
All days 2300 -0700 hours	45

1 (5 min) L_{eq} measured freefield, 100 m from the site boundary
2 Alternative limit for weekdays, 0700 - 1900 hours, 5 dB(A) above the ambient noise level (measured as 1 hour L_{90} dB(A)

Assessment Methodology

The dredging works will be undertaken using a long reach excavator and dredged material will be transported off site by trucks. The trucks will transport the dredged material to a landfill site or to East Sha Chau for disposal. It has been proposed by Task 5 that the trucks will only transport the dredged material off the site once they are full. The engine of the truck is assumed to be switched off during most of the time at the site. The noise impact generated from the truck is therefore considered insignificant and has not taken into account in this assessment. The likely equipment to be used for dredging is shown in Table 16.6.

TABLE 16.6 TYPICAL MIX OF EQUIPMENT FOR DREDGING OPERATIONS

Identification Code	Description	Sound Power Level dB(A)
CNP 081	Excavator	112

The sound power levels of the equipment used in this assessment are derived from the TM.

The equipment were considered to be grouped at a position mid-way between the approximate geographical centre of the dredging area and its boundary nearest to the NSR. In the case of an oblong area, having a length to width ratio of 5:1 or more, then only the closest portion to the NSR has been considered, as defined in the TM.

A total sound power level of the dredging operation is obtained by the summation of the individual sound power levels of the associated equipment.

For the dredging works falling within the Inner Deep Bay Buffer Zone (Buffer Zone 1), the noise prediction is made at a point 100m outside the works boundary (freefield) and is predicted by the following equation:

> Predicted noise level (PNL) = Total sound power level - 20 $\log_{10}(100)$ - 8 dB(A)
>
> PNL at 100 m from site boundary = 64 dB(A)[1]
>
> PNL exceeds noise limit of 60 dB(A) for all days 0700-2300 hours that set for Inner Deep Bay Buffer Zone (Buffer Zone 1).

For the dredging works outside the Inner Deep Bay Zone but within the Special Measures Zone (Buffer Zone 2), the noise level predictions are made at a point 100m outside the site boundary (freefield) and predicted as above.

> PNL at 100m from site boundary= 64 dB(A)
>
> PNL does not exceed daytime guideline values in the Deep Bay area outside of Buffer Zone 1 but does exceed weekday guidelines between 1900 -2300 hours, general holidays including Sundays 0700 -2300 hours and guideline noise values for all days between 2300 - 0700 hours

The noise level predictions for all other areas outside of the Deep Bay Area (taken as Buffer Zone 2) are made at 1 meter from the facade of NSRs that shown in Table 16.4.

The noise levels at each NSR are predicted by the following equation:

> Predicted noise level = Total sound power level - 20 $\log_{10}D$ - 8 + 3 dB(A)
>
> where D is distance between the NSR and the noise source

The predicted unmitigated noise levels are presented in Table 16.7. A detailed calculation spreadsheet is attached in Appendix A5.

TABLE 16.7 UNMITIGATED NOISE LEVELS AT NSRS

NSR	Predicted Noise Level dB(A) Dredging In Existing Channels	Predicted Noise Level dB(A) Dredging In Future Channels
G1	75[2]	-
G2	63[2]	62[2]
G3	63[2]	64[2]
G4	-	60[1]
Inner Deep Bay	64[3]	n/a
Deep Bay Area	64[2]	64[2]

Note:

1 *The PNL exceeds the ANL for all days 2300 - 0700 hours*

2 *The PNL exceeds the ANLs for weekdays 1900-2300 hours , general holidays including Sundays 0700 - 2300 hours, and all days 2300-0700 hours*

3 *The PNL exceeds Daytime Guideline values for Inner Deep Bay SMZ*

Outside of the Deep Bay area, the calculations indicate that predicted noise levels at all selected NSRs are within the guideline of 75 dB(A) for weekdays between 0700 and 1900 hours, hence the dredging works will not pose a significant noise impact on the NSRs provided that the works will not extend into restricted hours.

Daytime noise levels are only exceeded for the small area of works which will take place within Buffer Zone 1 (2.6 % of the dredging length). Future dredging will not take place within Inner Deep Bay (Buffer Zone 1) and will only border Buffer Zone 2. Daytime guidelines will therefore not be exceeded in the future channel.

16.5.2 Air Quality Assessment

Initially, air quality impacts were raised as a potential key issue due to the expected large volumes of dredged sediment and the associated handling, storage and transportation requirements. However, the anticipated volumes of sediment have reduced considerably and significant dust (TSP) concentrations are not predicted from dredging operations. Thus, no quantitative assessment of the potential works impact has been conducted.

The average background value for 24-hr TSP monitoring is already high, at 222 ug/m^3. Thus, any further release of particulates could cause the exceedance of the 24-hr TSP limit of 260 ug/m^3. Dust emissions may potentially arise through the movement of traffic along temporary access roads, particularly in the upper reaches of the East Channel due to the proximity of Yau Shau Wai Village. Northerly winds which occur during the dry season may increase any potential impacts. However, as all dredged material will remain covered in skips during the works no significant dust impacts are anticipated.

The small volumes of material to be dredged in the future, and the proposed dredging locations in relation to ASRs, will prevent the likelihood of dust impacts.

The channels, especially where there is a lack of water hyacinth, already emit a strong odour which could be worsened in the short term with dredging, but improved in the long term through removal of the odour source. The odour currently released by the channel sediment may be increased due to the exposure of fine material through dredging works. With respect to ASRs in the vicinity of the works, there are residential areas in the upper reaches of each channel. The results from the sediment cores nearest to the ASRs, cores G1 and G4 (Figure 16.3), reveal high concentrations of nutrients (N and P) and high levels of ammoniacal nitrogen (Appendix B4). Thus, the general mitigation in Section 8 should be followed to minimise potential odour impacts.

16.5.3 Ecological Impacts

Dredging works along the San Tin Main Drainage Channels have the potential to cause direct and indirect impacts on the sensitive ecosystems which exist in the area. The channel mouths lie within Buffer Zone 1 which was designated to protect a wetland of international conservation importance (Figure 4.2 and 16.4).

Although the channels were originally built to a certain configuration and hydraulic capacity which should ideally be maintained through dredging, certain conditions have developed in the channel whereby dredging may result in adverse impacts on channel ecology. Such impacts should be weighed against benefits to be had from possible dredging, particularly in terms of flood alleviation and an acceptable solution found.

Due to the physiology of the dense aquatic vegetation found on San Tin the plants provides a degree of biological water treatment, without which the discharge to Shenzhen River and ultimately to Inner Deep Bay would carry greater pollutant loads. A reduction in vegetation cover will reduce this treatment and also the area for deposition of insect eggs, thus degrading the prey base upon which the majority of birds recorded during the avifauna surveys depend. Dredging will therefore have significant although localised ecological impact.

Noise emissions from proposed works may have an impact on the activities of species in the area, particularly the roosting and nesting habits of avifauna. Noise impacts were addressed under section 16.5.1.

16.5.4 Water Quality Impacts

The channels contain contaminated water and sediment, but the dense aquatic vegetation on and within the channels provides a degree of biological water treatment. Without that level of treatment, the discharge from the nullahs to Shenzhen River and ultimately to inner Deep Bay could carry greater pollutant loads. Dredging would remove the vegetation from the nullahs, thereby eliminating the agent of biological water treatment. This would increase the pollution exposure of the downstream wetlands in the recently designated Ramsar Site.

The water velocities in San Tin Channel do not exceed the critical bed shear stress. Moreover, because most of the channel bed is densely vegetated, the resistance to erosion increases considerably. The result is that soft sediments deposited in San Tin channel will not be eroded during flood conditions.

The existing channel will only be dredged when and where flood trigger levels are exceeded this will restrict operations to short channel sections and therefore minimise impact potential. The future channel scenario is likely to require maintenance dredging once sediment has accumulated to approximately 2m. As with all dredging activities there will be impacts on water quality as a result of sediment release. The extent of this impact will depend on the water quality and sediment quality and the in-stream fauna of the new channel(s).

Downstream impacts on the is already heavily polluted Shenzhen River would be an issue of concern, particularly as it discharges into Inner Deep Bay. However, the specific impact of the works themselves on existing water quality would be negligible due to the impoverished water quality in Shenzhen River and Deep Bay.

16.6 Mitigation Measures

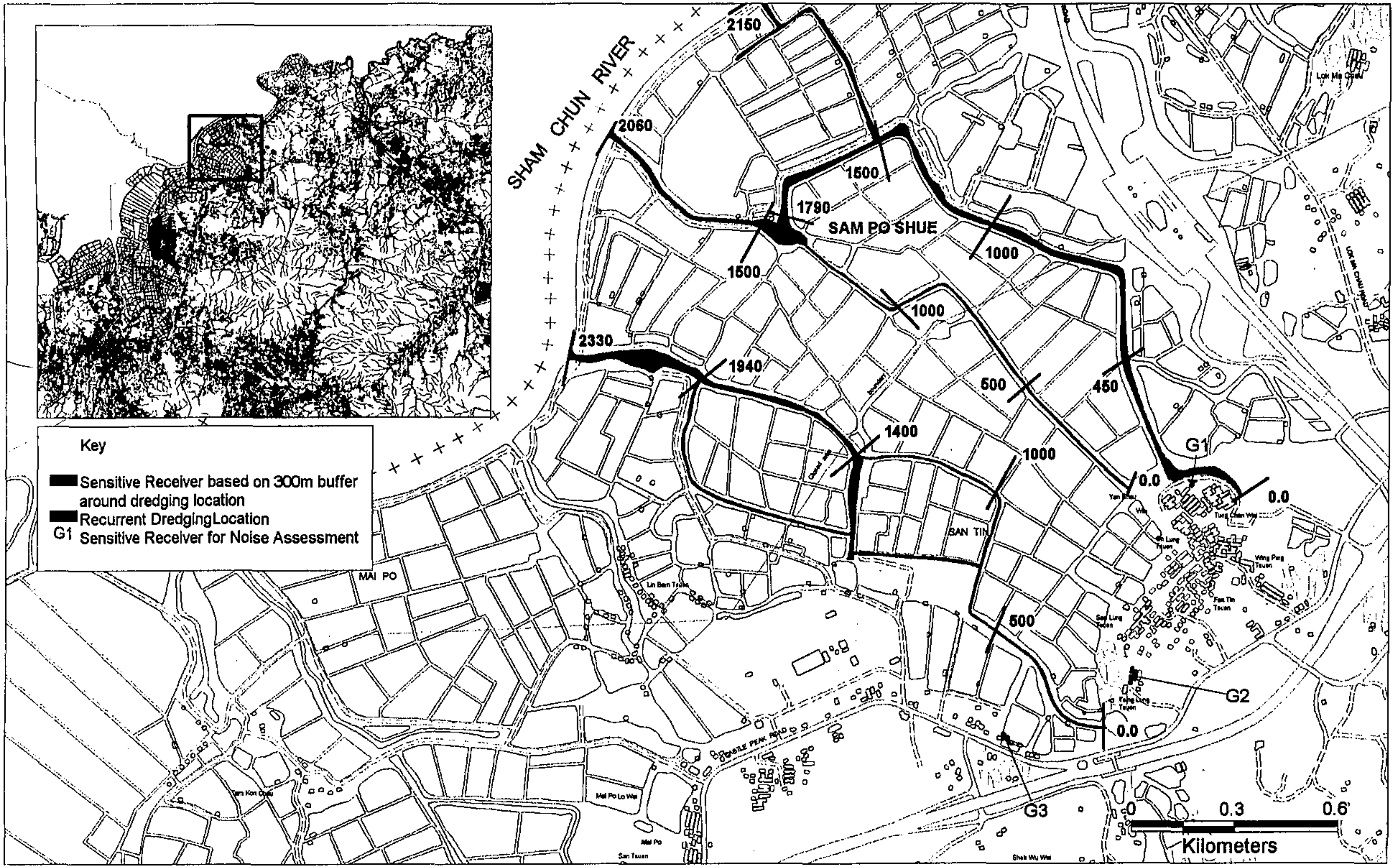
Mitigation required over and above the standard mitigation detailed in section 8 includes the following:

16.6.1 Noise

The amount of dredging in Buffer Zone 1 is very small and therefore the duration of dredging within this area will be very short. It is recommended that working hours within Buffer Zone 1 are however restricted to 0800-1700 hrs to minimise disturbance to birds at dawn and dusk. Working methods and programme should be discussed with WWF and AFD.

16.6.2 Ecology

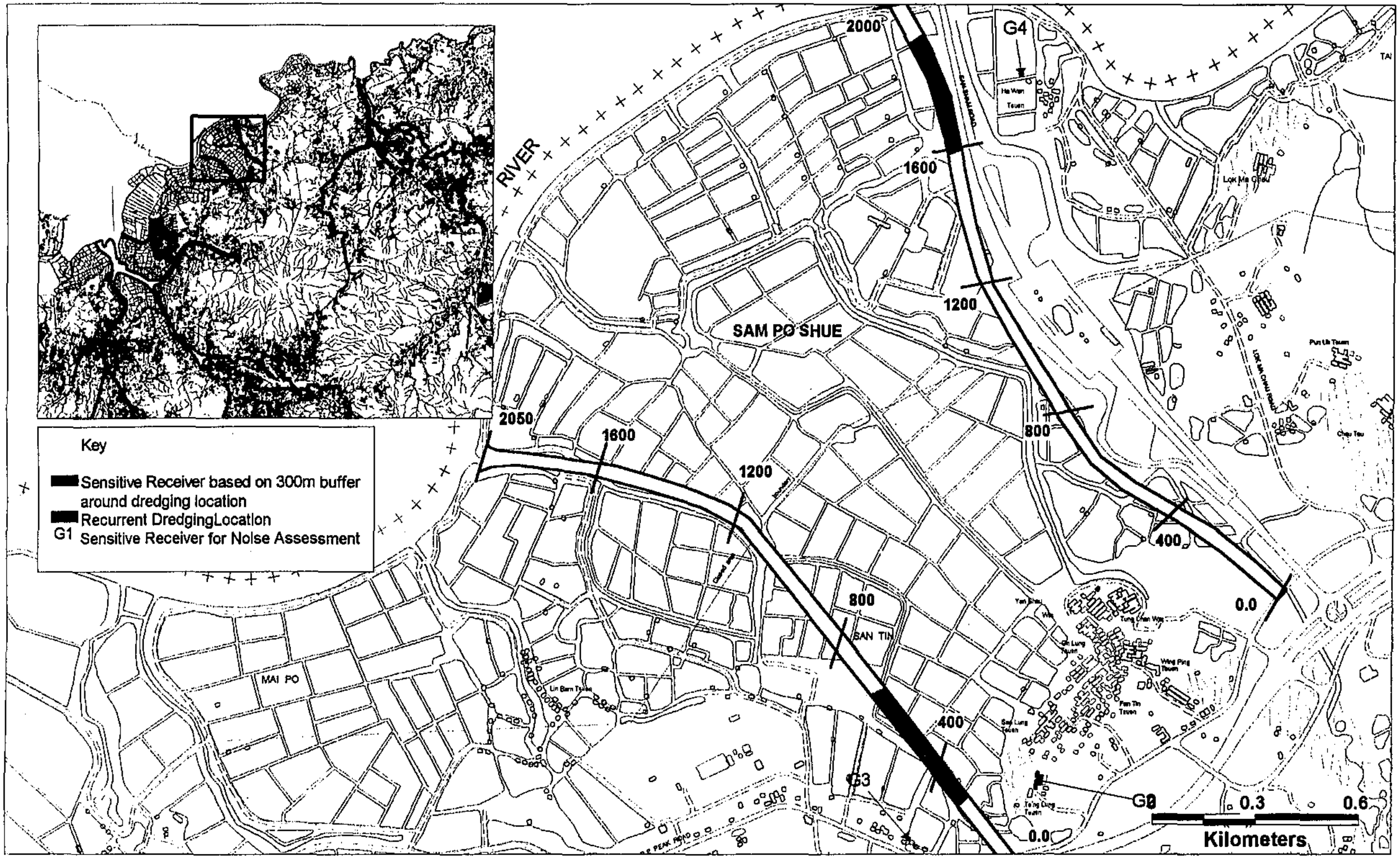
The aquatic vegetation within the channel acts as a source of biological water treatment which will be lost upon removal of the water hyacinth. Floating vegetation along the channels currently provides a valuable breeding habitat for the prey of large numbers of insectivorous birds. Removal of this vegetation should be restricted to the area identified for dredging.



Hyder Consulting

Figure 16.1 Potential Noise and Air Sensitive Receivers Near Proposed Dredging Locations San Tin Main Drainage Channels - Present Scenario

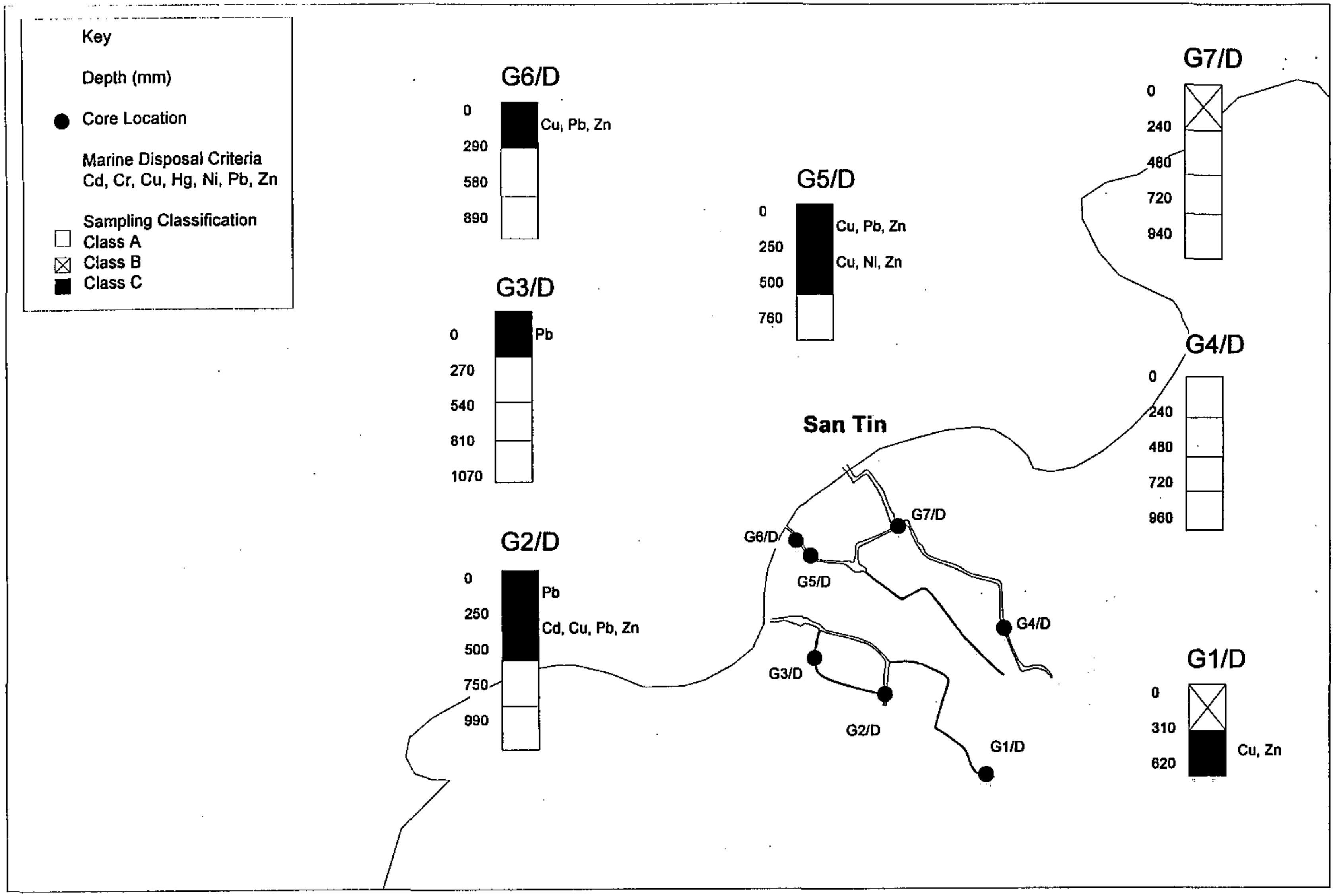
Source: Lands Department OZP



Hyder Consulting

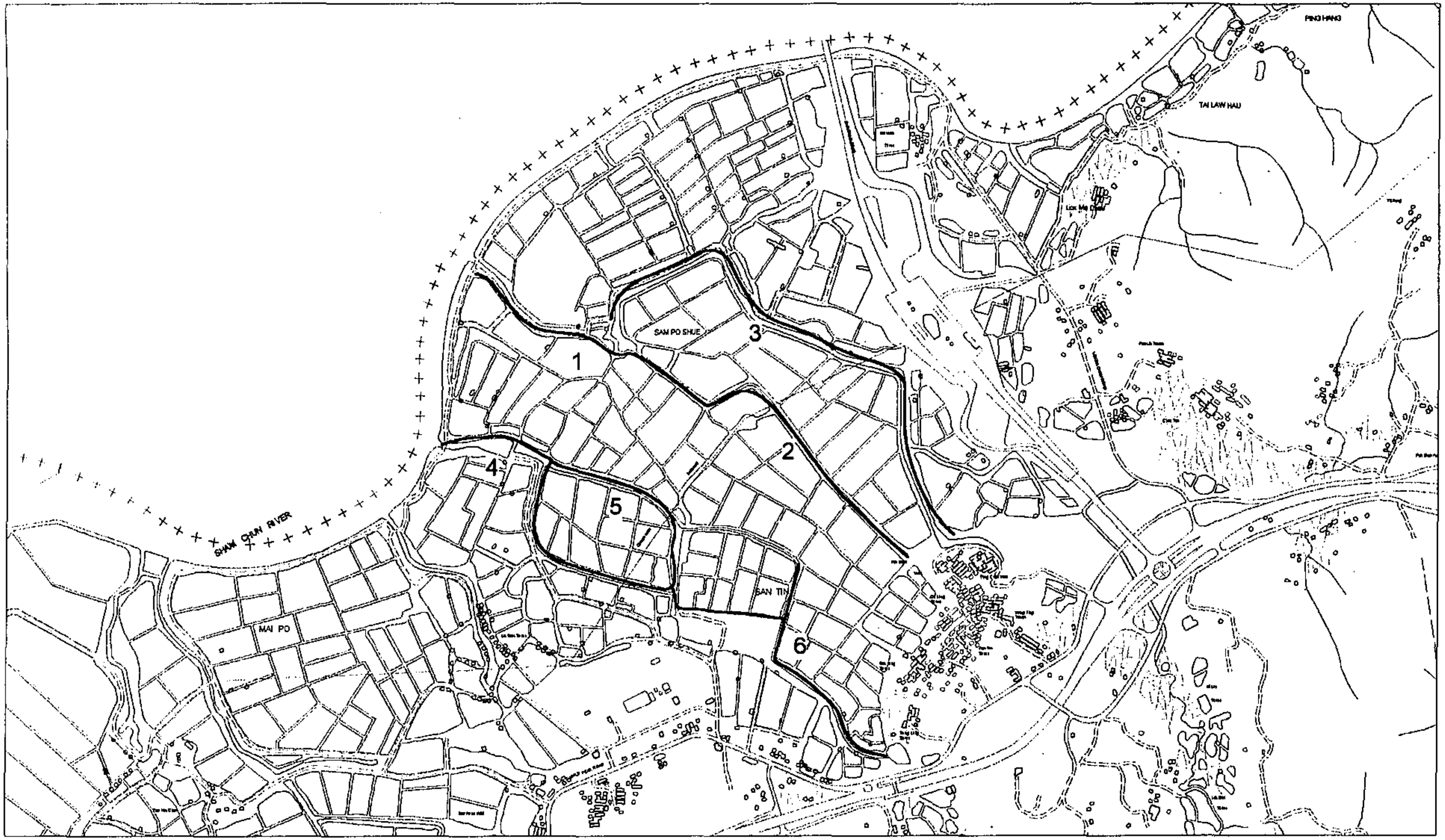
Figure 16.2 Potential Noise and Air Sensitive Receivers Near Proposed Dredging Locations San Tin Main Drainage Channels - Future Scenario

Source: Lands Department
OZP



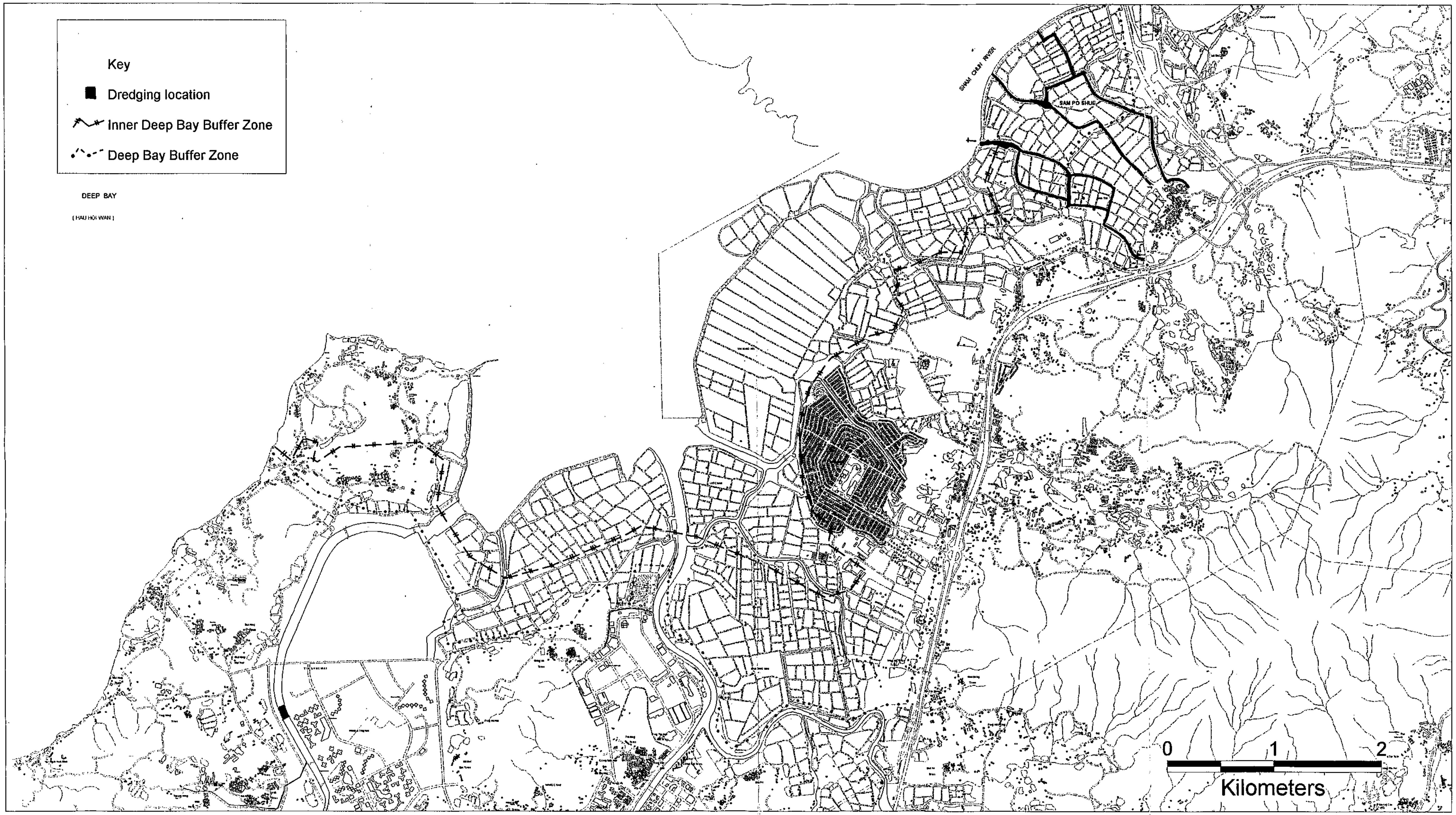
Hyder Consulting

Figure 16.3 Sediment Core Anslysis Results
San Tin Main Drainage Channels



Hyder Consulting

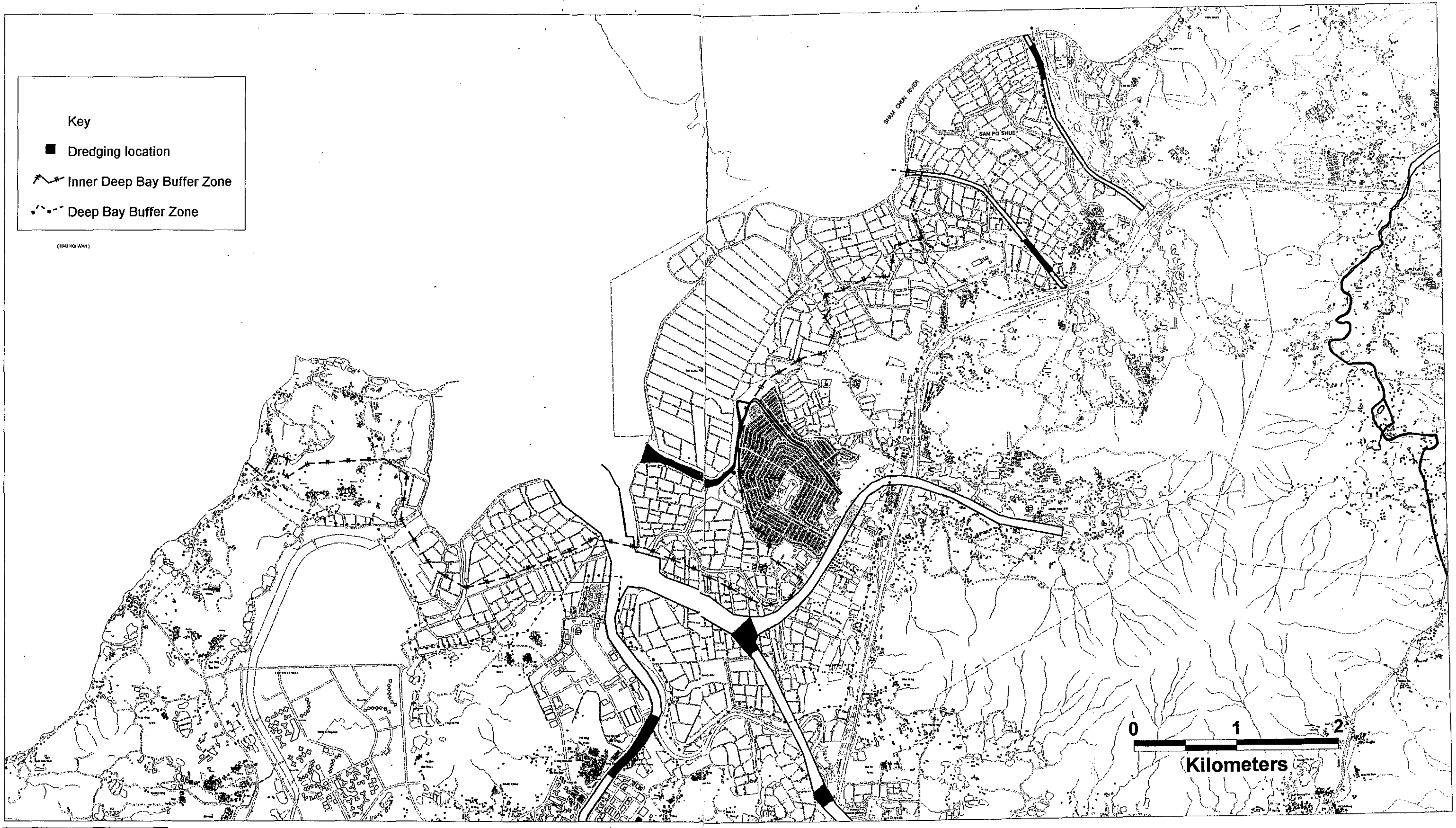
Figure 16.4 Bird Transect Locations
San Tin Drainage Channels



Hyder Consulting

Figure 16.5 Proposed Dredging Locations In Relation To Restricted Areas
Tin Shui Wai Western and Eastern Drainage Channels and San Tin Main Drainage Channels - Present Scenario

Source: Lands Department
A.F.D.



Hyder Consulting

Figure 16.6 Proposed Dredging Locations In Relation To Restricted Areas
San Tin Main Drainage Channels and Yuen Long Basin River Channels - Future Scenario

Source: Lands Department
A.F.D.

SECTION 17

EIA OF DREDGING WORKS IN YUEN LONG, KAM TIN AND NGAU TAM MEI MAIN DRAINAGE CHANNEL

17. EIA OF DREDGING WORKS IN YUEN LONG, KAM TIN AND NGAU TAM MEI MAIN DRAINAGE CHANNELS

17.1 Introduction

The Yuen Long / Kam Tin / Ngau Tam Mei river system lies in the Northwest New Territories and is the largest in this Study with a total catchment area of approximately 89 km^2. The channels' locations are displayed as Figure 17.1, along with the locations of noise and air Sensitive Receivers.

Yuen Long creek is the longest channel at 60 km and rises in the Tai Lam Country Park. It flows for some 12 km through Yuen Long town in the form of an open nullah. The Yuen Long creek catchment covers an area of 26.7 km^2 and is intermediate in size between the catchments of the Kam Tin at 44.3 km^2 and the Ngau Tam Mei at 14 km^2. In its lower reaches Yuen Long creek converges with the 50 km long Kam Tin River and the much smaller Ngau Tam Mei channel to form the Shan Pui River prior to draining into Inner Deep Bay.

An extensive river training programme is currently underway in the Yuen Long basin to reduce the existing flood risk and to provide primary drainage infrastructure for future development. Poldered village schemes and local channel improvements to protect 56 flood prone villages are also planned. Finally, river rehabilitation schemes are planned on sections of the drainage channels where capacity is adversely affected by development or neglect. These projects are, according to Phase 2 of the TELADFLOCOSS, all required to reduce flood risk, especially given the planned development to the south of Yuen Long.

17.2 Existing Environment

17.2.1 Existing and Future Land Uses

The existing land use is predominantly grassland and agriculture which comprises around 40% of the catchment area. Approximately 10% of the area is occupied by fish ponds. Soil erosion occurs in the area due to bare hill sides occupying 4% of the catchment. Construction activities presently cover less than one percent of the catchment.

On completion of the drainage improvement scheme currently in progress, it is anticipated there will be no remaining areas of natural channel within the present study limits. The new channels will have a combination of lined and unlined channel beds, with reinforced banks, and will consequently be of reduced ecological value.

17.2.2 Air Quality and Noise

No existing data on air quality for this area has been obtained from EPD. During a site visit in May 1996 the air quality was noted as being poor in the upper reaches of the channel as a result of high concentrations of traffic around Yuen Long new town. Further downstream, the air quality was affected by emissions from the Yuen Long industrial estate from which a chemical odour was detected.

Background noise was measured along Yuen Long Creek during the field survey and ranged between 49.0 dB(A) - 67.3 dB(A) in the upper reaches where traffic contributed significantly to noise. River training works in progress were responsible for elevated noise levels in the mouth of the channel (up to 53.4 dB(A)).

17.2.3 Hydrology and Water Quality

Flood History and Predicted Flooding

Historically, this area has been prone to flooding but large scale river training is currently under way for the catchment. Yuen Long creek has sufficient capacity to convey storm flows into Deep Bay except during extreme events. The Kam Tin and Ngau Tam Mei channels are largely natural and are more prone to flooding.

Within the basin there are 56 villages, as well as fishponds, paddy fields and container storage yards which are all prone to flooding. The estimated costs of flood damage caused by Typhoon Warren (1988), Typhoon Brenda (1989) and Tropical Storm Faye (1992) has been estimated at a total of HK$51 million (Binnie Consultants, 1993a).

Flooding predictions were modelled in Task 4 under two scenarios for the existing Yuen Long, Kam Tin and Ngau Tam Mei River channels:

Case 1 - 10 years storm and 50 years tide; and

Case 2 - 50 years storm and 10 years tide:

> No flooding is predicted under either case for the Yuen Long, Kam Tin or Ngau Tam Mei River Channels. Under Case 1, minor flooding is predicted between Ch. 1000-2300m and Ch. 2800-3900m for Wo Sang Wai, whilst the location of minor flooding is restricted to around Ch. 2000m under Case 2.

Pollutant Loads

At the end of 1993 Yuen Long Creek received discharges from 35 industries, 47 commercial premises and 452 active farms, whilst there were 534 active farms, 33 industrial premises, 51 commercial premises and a total of 6 sewage treatment plants discharging into the Kam Tin River (EPD, 1994c).

As at the end of 1993 there had been a 66% reduction in BOD load from livestock waste in Yuen Long Creek since the implementation of the WCO (EPD, 1994c). By the end of 1994 the BOD load from livestock waste had been further reduced to 4,356 kg/day (68%), whilst discharges from domestic, industrial, commercial and institutional sources had a BOD load of 2,146 kg/day, representing a 64% reduction since the implementation of the WPCO (EPD, 1995).

In Kam Tin River there was a reduction in BOD load attributable to livestock waste of 60% as at the end of 1993. Reductions in BOD from industrial and institutional discharges of 59% and 100% respectively were achieved after the implementation of the WPCO to the end of 1993 (EPD, 1994c). By the end of 1994 BOD levels from livestock waste were down by 57% (EPD, 1995).

Water Quality

The water quality in the Yuen Long channel area is routinely monitored by the EPD. The 1993 River Water Quality Report indicated that the water quality was generally 'very bad' (Appendix B1). By 1995 the channel water quality was graded as 'very bad' at most monitoring locations and 'bad' elsewhere in both the Yuen Long Creek and Kam Tin River. The annual mean dissolved oxygen concentration was below 2 mg/l for Yuen Long Creek and less than 1 mg/l in the Kam Tin River.

The water quality has been worsened by the poor dispersive capacity of inner Deep Bay, thus enabling the local retention of livestock waste entering the channel. Despite recent reductions in the influx of livestock waste, the poor water quality in the channels is still a result of such discharges as indicated by the high annual median values of BOD (>100 mg/L) and ammoniacal nitrogen (>25 mg/L). By the end of 1994 however, BOD loads from livestock waste were reduced to 51%. The average *E. coli* concentration from two monitoring locations in Yuen Long Creek was around 22 x 10^6 /100 ml. Annual median values of BOD, ammoniacal nitrogen and suspended solids were consistently lower in the Kam Tin River (EPD, 1995).

17.2.4 Sediment

Neither grab nor core samples were taken from the channels within the Yuen Long river system specifically for this study due to dredging works for the ongoing channel retraining.

Characteristics

Particle Size Distribution (PSD) tests were carried out on a total of sixteen sediment core samples collected from a 2 km stretch of the Kam Tin River during the EIA of the 43CD works (ERM, 1996). The average PSD results revealed that the sediment predominantly consists of sandy silt, with about 15% clay and a small proportion of gravel. Silt dominated in 63% of the cores, with sand dominant in the remainder.

Quality

The Yuen Long channel has been maintenance dredged in the past. Sediment quality was determined at sampling stations along the Yuen Long Creek and Kam Tin River by Binnie and Partners (1984) and by ERM (1995a). The samples taken from stations relevant to this maintenance dredging work were classified as Class 'C' under TC 1-1-92. The poor sediment quality around the lower reaches of the channel is exacerbated by continual sedimentation due to the sheltered nature of inner Deep Bay.

17.2.5 Ecology

The channel lies in close proximity the internationally important Ramsar site in Deep Bay and the mouth of the Shan Pui River lies within Buffer Zone 1. A considerable proportion of the Kam Tin and Ngau Tam Mei channels lie within Buffer Zone 2 (Figure 16.6). Works and development are controlled within these Buffer Zones to afford a degree of protection to the birds using the Deep Bay and Mai Po wetlands.

Riparian Flora and Fauna

Vegetation surveys were undertaken along the banks of the Shan Pui and Kam Tin Rivers by Binnie Consultants Ltd. (1992). The survey locations are included in Appendix B5.

Mangroves occur along the banks of the Shan Pui River throughout its intertidal reaches. The occurrence and dominance of the different species varies along the course of the river, with mangroves giving way to increasing numbers of brackish or terrestrial species upstream. Mangrove stand development improves in the downstream stretch of the river, and species richness and average tree height were found to increase closer to Deep Bay. The mangrove community in inner Deep Bay close to the mouth of the Shan Pui River was dominated by a mixture of young *Aegiceras corniculatum* and *Acanthus ilicifolius,* with *Kandelia candel* restricted to the landward edge of the community, fringing fish ponds and bunds. The mangal within the mouth of the river consisted of more mature trees, with similar densities of *K. candel* and *Avicennia marina.* The most important species recorded during the survey, and their relative abundance, are displayed in Table 17.1.

TABLE 17.1 PLANT SPECIES RECORDED NEAR THE SHAN PUI RIVER

Species	Zone						
	OZ	S1	S2	S3	S4	S5	S6
Aegiceras corniculatum	C	C	C	C	C	C	O
Kandelia candel	C	C	C	C	C	C	O
Avicennia marina	C	C	R	-	-	-	-
Derris trifoliata	O	O	O	O	O	O	R
Acrostichum aureum	O	O	O	O	R	-	-
Acanthus ilicifolius	C	C	C	C	C	C	O
Eichhornia crassipes	-	-	R	R	R	R	R
Excoecaria agallocha	-	-	-	O	O	O	-
Lantana camara	-	-	-	O	O	R	R
Macaranga tanarius	-	-	-	R	R	R	R
Sapium sebiferum	-	-	-	R	R	R	R
Melia azedarach	-	-	-	R	R	R	R
Cyperus malaccensis	O	O	O	R	R	-	-
Clerodendrum inerme	-	-	O	C	C	C	O
Phragmites communis	-	-	-	-	-	R	O
Canavalia maritima	-	-	-	O	O	R	R
Mikania guaco	-	-	-	O	O	C	C
Hibiscus tiliaceus	O	O	O	O	O	-	-
Eucalyptus citriodora	-	-	C	C	O	O	R
Parsiflora foetida	-	-	O	O	O	O	-

Source: Binnie Consultants Ltd. (1992)

- *not recorded.*

C common;

O occasional;

R rare;

The vegetation along the banks of the Kam Tin River has been greatly disturbed and modified by human activities. The plant species recorded along the river are typical of similar riparian habitats in Hong Kong, and are displayed in Table 17.2. The community is dominated by exotic species, such as the grass *Brachiara muticai*, an African species now naturalised in Hong Kong and commonly found on riverbanks. Other exotics found along the river include *Ricinus communis, Eichhornia crassipes* and *Eleusine indica*, which are all fast growing, weedy species.

TABLE 17.2 PLANT SPECIES RECORDED NEAR THE KAM TIN RIVER

Species	Zone					
	K1	K2	K3	K4	K5	K6
Ipomea aquatica	-	-	-	-	-	*
Ipomea triloba	-	-	*	*	*	-
Eleocharis sp.	-	-	-	-	*	*
Alocasia odora	-	-	*	*	*	*
Eichhornia crassipes	*	*	*	*	*	*
Mikania gauco	*	*	*	*	*	-
Ricinus communis	-	-	*	*	*	-
Xanthium stromarium	-	-	-	*	*	-
Sapium sebiferum	-	-	*	*	*	-
Psidium guajava	-	-	-	-	-	*
Canavalia maritima	*	-	-	—	-	-
Lantana camera	*	-	-	-	-	-
Eucalyptus citriodora	-	*	*	*	*	-
Bacopa monniera	-	-	-	*	-	-
Commelina communis	-	-	-	-	-	*
Brachiara mutica	*	*	*	*	*	*
Eleusine indica	-	-	*	*	*	-

Source: Binnie Consultants Ltd. (1992)

* *present;*

\- *not recorded.*

Avian fauna along the Shan Pui River is known to be rich in term of species representation and seasonal abundance. Inner Deep Bay mud flats, intertidal shallows, fish ponds, and mangroves line both banks of the channel, and provide a diverse range of foraging habitats for birds of local, regional, and global conservation concern. The Shan Pui egretry was located in the mangroves at the river mouth during spring 1995, and supported a diverse colony of Cattle and Little Egrets, Chinese Pond Herons, and Night Herons. Birds from this egretry were observed feeding along the river channel, in the mangrove, on the mud flats, and in fish ponds near the egretry.

The avifauna along the intertidal reach of Kam Tin River is also rich and seasonally abundant (ERM 1995a, 1995b, 1995c). Birds of primary conservation concern are herons and egrets which nest in colonies along the channel and forage in the channel and adjacent wetland habitats (CES 1995a, 1995b). Channel construction was underway at the time of this report in the intertidal reach of Kam Tin River.

<u>Aquatic Fauna</u>

The Shan Pui River was found by Binnie Consultants (1992) to have a very impoverished macrobenthic community, with most of the channel bed being abiotic, and the river as a whole supporting few animals, both in terms of density and species richness.

Immediately seaward of the mouth of the Shan Pui River, species richness, diversity and biomass were found to increase sharply. The greatest species diversity occurred in the mangrove mud of inner Deep Bay, followed by samples from the mangroves at the mouth of the Shan Pui River. High animal densities were also recorded from these sites and the biotic communities here included several species of interest. The small ocypodid crab *Paracleistoma depressum* which was found in low densities in the mangrove forest floor was last recorded in 1940, whilst the large fiddler crab (*Uca* cf. *paradussumieri)* and a small burrowing anemone new to Hong Kong records were also recorded. The open mudflat immediately seaward of the discharge point of the Shan Pui River displayed a lower species richness than the mangrove forest (Binnie Consultants, 1992).

Fiddler crabs were abundant on the banks of the lowest kilometre of the river, and represent the most important group of macroinvertebrates found due to the otherwise impoverished nature of the macrobenthos along the rest of the rivers' course. Four species were found in the area, with *Uca arcuata* and *U. acuta* dominating the upstream banks, while seawards on the mudflat of inner Deep Bay and in the mangrove forests were increasing numbers of *U. dussumieri* and *U. chlorophthalmus* (Binnie Consultants, 1992).

The Kam Tin River is similar to the Shan Pui in that it also has an impoverished macrobenthic community, with low species diversity, density and biomass (Binnie Consultants, 1992). The river was found to be anoxic except under conditions of maximum tidal flushing from Deep Bay, and this has probably prevented benthic colonisation. Tidal flushing probably allows some species tolerant of hypoxic conditions to survive, as indicated by the sighting of a catfish (probably *Silurus* sp.) in the middle stretch of the river.

17.3 Proposed Works

17.3.1 Dredging Requirements

For the Yuen Long/Kam Tin/Ngau Tam Mei River Channel system, only the future dredging requirements were modelled by Task 4. The predictions indicate that there will be a significant input of fluviatile sediment into the upstream section of the Channels. The annual fluviatile inputs to the Yuen Long River, Kam Tin River, and the Ngau Tam Mei River are predicted to be in the order of $2200m^3$, $2900m^3$ and $600m^3$ respectively. Due to longitudinal variations in channel width, sediment will accumulate around the junctions of the Kam Tin and Ngau Tam Mei Rivers and along Ch. 800 - 1500 of the Yuen Long River. There will be continuous localised occurrences of erosion and deposition.

Due to the location of construction works in the area, Task 4 predicts an influx of construction-derived sediment into the Wo Sang Wai Channel and its tributaries. These inputs have been estimated at $1760m^3$ per year and will enter the Channel as diffusive sources along a 2 km stretch. Dynamic equilibrium is expected to be attained with respect to marine sediment.

Modelling indicates that culverts and drainage pipes are at a low level and are thus susceptible to blockages. Consequently there may be a requirement to excavate sediment downstream from each culvert in order to avoid exceeding the flooding trigger level. Task 4 predicts the total volume to be in the order of 1,970m^3/year

Task 4 and 5 Recommendations: Should dredging occur, the frequency for both the Kam Tin and Ngan Tam Mei channels will be every 10 years, and Yuen Long creek every 5 years. The recommended frequency of dredging in the Wo Sang Wai channel is every 10 years.

As future inputs of construction-derived material into the Yuen Long Channel system is predicted, monitoring is recommended to assess more accurately the actual volumes. Monitoring is also suggested in order to verify that the future recurrent dredging of culverts and pipes will keep clearance levels below flood trigger levels.

17.3.2 Dredging Strategy

The complete dredging strategy is detailed in the Task 5 Final Report. The key points are as follows:

i. ***Access:*** The various berms and access roads constructed primarily to facilitate the main drainage channel works will also aid land access by trucks where land-based disposal is necessary. Access to the Wo Sang Wai Channel will require temporary road construction.

ii. ***Dredging:*** So as to restrict sediment release, pontoon-mounted grabs and excavators will be used along the tidal stretches of the Yuen Long, Kam Tin and Ngau Tam Mei Rivers. The uppermost 400 m of Yuen Long River may require tidal working, with tyred excavators loading into trucks at the channel bank. Dredging from the Wo Sang Wai Channel is likely to be manual due to the sensitivity of its environs.

iii. ***Transport:*** For marine disposal water-tight trucks will transfer contaminated sediments from the channel banks via road to seaworthy barges in or near Tuen Mun. If a land based disposal option is chosen then trucks will transport the sediment.

iv. ***Disposal options:*** The future sediment disposal strategy for the channels depends greatly upon the level of sediment contamination. If the sediment is contaminated then transfer to the East Sha Chau Contaminated mud pits is feasible, particularly in the short term. In the longer term, transfer overland to the WENT landfill is an option depending on the volumes involved and the sediment water content. Beneficial uses are preferable for clean sediment, such as disposal to nearby agricultural land or use in construction works. Alternatively, uncontaminated material could be disposed of at a redundant MBA.

17.4 Key Issues

General: The Yuen Long, Kam Tin and Ngau Tam Mei channels all flow into Inner Deep Bay which has been identified as a key sensitive receiver due to its ecological importance and its use for oyster cultivation and fishing.

Water Quality

- The release and transportation of contaminants during dredging work would have an adverse impact upon water quality further downstream, exacerbated by the poor capacity of Deep Bay to disperse pollutants.

Ecology

- Dredging will result in physical and chemical disturbance of the channel ecosystem through the transport of contaminated sediments.
- Sediment release will also result in an impact upon the remaining mangrove habitat at the channel mouth in Inner Deep Bay.
- Environmental impacts on the macrobenthos and riparian habitats will ultimately affect the avifauna higher up the food chain.
- Visual and noise impacts affecting avifauna nesting habits.

Community Impacts

- Capture fisheries activities in Deep Bay (Hong Kong and Shenzhen sides) result in an annual production of over 1000 tonnes of fish worth approximately HK$212.22 million (Hong Kong - Guandong Environmental Protection Liaison Group, 1992). Thus any impact on these fisheries would greatly affect the livelihood of many in the local community.
- Noise impacts on residential NSR for future dredging works.

17.5 Impact Assessment

17.5.1 Noise Impact Assessment

Works Area

There are a total of five recurrent dredging locations proposed for the future Yuen Long, Kam Tin and Ngau Tam Mei River Channels, as shown in Figure 17.1.

Noise Sensitive Receivers

The most affected NSRs have been identified as those falling within a 300m buffer of the likely dredging locations. These are shown in Figure 17.1 and are displayed in Table 17.3.

TABLE 17.3 DESCRIPTION OF NOISE SENSITIVE RECEIVERS

NSR	Description
H1	Fairview Park
H2	Chuk Yuen Tsuen
H3	Tung Tau Wai Sun Tsuen
H4	San Pui Chung Hau Tsuen
Ramsar Site	Deep Bay/Mai Po/Buffer Zones 1&2

Noise Impact Assessment Criteria

Noise level are limited by the Noise Control Ordinance (Cap 400) including its subsidiary regulations and the Technical Memoranda (TM).

In addition to the requirements imposed by the Noise Control Ordinance, the following requirements or interpretations will also be used as a standard to control noise generation from any construction work other than percussive piling during the time period from 0700 to 1900 hours on any day not being a general holiday:

(i) The noise level measured at 1 m from the most affected external facade of the nearby NSRs during any 30-minute period during normal weekly daytime periods between 0700 to 1900 hours will not exceed an equivalent sound level (L_{Aeq}) of 75 dB(A) or 70 dB(A) (or 65 dB(A) during examination) for schools.

(ii) Construction should not be undertaken during any other period, the restricted period, without the existence of the relevant Construction Noise Permit (CNP).

(iii) In accordance with TM, the area around the dredging locations has an Area Sensitivity Rating (ASR) of 'A'. Therefore ANLs under the current regulation are 60 dB(A) from 1900 to 2300 hours plus all day Sundays and general holidays and 45 dB(A) between 2300 and 0700 hours

Part of the proposed dredging works in Yuen Long, Kam Tin and Ngau Tam Mei River Channels fall within the Deep Bay Buffer Zone (Buffer Zone 2), whilst the proposed works along the Wo Sang Wai Channel fall within the Inner Deep Bay Buffer Zone (Buffer Zone 1). The proposed dredging locations in relation to these restricted areas are displayed in Figure 16.6. Thus, in addition to the above requirements, the more restrictive *Deep Bay Guidelines* for protecting the sensitive habitats in Deep Bay will also be used as standards. The Noise Levels Limits for Construction Works in the Deep Bay Area are presented in the Table 17.4.

TABLE 17.4 NOISE LEVEL LIMITS FOR CONSTRUCTION WORKS IN THE DEEP BAY AREA

(a) Outside the Inner Deep Bay Special Measure Zone

Time Period	Acceptable Noise Level dB(A)[1]
Weekdays 0700 - 1900 hours[2]	75
Weekdays 1900 -2300 hours	60
General holidays including Sundays 0700 -2300 hours	60
All days 2300 - 0700 hours	45

1. (5 min) L_{eq} measured at the building facade of a Noise Sensitive receiver (NSR)
2. Alternative limit for weekdays, 0700 - 1900 hours, is 10 dB(A) above the ambient noise level (measured as 1-hour L_{90} dB(A)

(b) Within the Inner Deep Bay Special Measure Zone

Time Period	Acceptable Noise Level dB(A)[1]
All days 0700 - 2300 hours[2]	60
All days 2300 -0700 hours	45

1. (5 min) L_{eq} measured free field, 100 m from the site boundary
2. Alternative limit for weekdays, 0700 - 1900 hours, 5 dB(A) above the ambient noise level (measured as 1 hour L_{90} dB(A)

Assessment Methodology

The dredging works will be undertaken using a pontoon mounted excavator, then the dredged material will be transported for disposal by trucks. In this case the trucks only transport the dredged material off the site once it is full. It is assumed that the engine of the truck will be switched off during most of the time at the dredging site. The noise impact generated from the truck is therefore considered insignificant and has not been considered in this assessment. The likely equipment for dredging is shown in Table 17.5.

TABLE 17.5 TYPICAL MIX OF EQUIPMENT FOR DREDGING OPERATIONS

Identification Code	Description	Sound Power Level dB(A)
CNP 081	Excavator	112

The sound power levels of the equipment used in this assessment are derived from the TM.

The equipment was considered to be grouped at a position mid-way between the centre of the dredging area and its boundary nearest to the NSR. In the case of an oblong area, having a length to width ratio of 5:1 or more, then only the closest portion to the NSR has been considered, as defined in the TM.

The total sound power level of the dredging operation is obtained by summing all the individual sound power levels of the associated equipment.

Where dredging works fall within the Inner Deep Bay Buffer Zone, the noise prediction is made at a point 100m outside the site boundary (freefield) using the following equation:

Predicted noise level (PNL) = Total sound power level - 20 $\log_{10}(100)$ - 8 dB(A)

PNL at 100 m from site boundary = 64 dB(A)[1]

Note: [1] PNL exceed noise limit of 60 dB(A) for all days 0700-2300 hours that set for Inner Deep Bay Buffer Zone.

Similarly noise levels predicted for works in Buffer Zone 2, 100m from the site boundary will be 64 dB(A).

For the dredging works outside the Inner Deep Bay Zone, the noise level predictions are made 1 meter from the facade of NSRs that shown in Table 17.3

The noise levels at each NSR are predicted by the following equation:

Predicted noise level = Total sound power level - 20 $\log_{10}D$ - 8 + 3 dB(A)

where D is distance between the NSR and the noise source

The predicted unmitigated noise levels are presented in Table 17.6. A detailed calculation spreadsheet is attached in Appendix A5.

TABLE 17.6 UNMITIGATED NOISE LEVELS AT NSRS

NSR	Predicted Noise Level dB(A)
H1	65[1]
H2	65[1]
H3	73[2]
H4	75[2]
Inner Deep Bay (BZ1)	64[3]
Deep Bay (BZ2)	64[2]

Note:

1 *PNL exceed the ANL for all days 2300 - 0700 hours*

2 *PNL exceed the ANLs for weekdays 1900-2300 hours, general holidays including Sundays 0700 - 2300 hours and all days 2300-0700 hours*

3 *PNL exceeds daytime noise levels for Inner Deep Bay (60dB(A))*

The calculations indicate that the predicted noise levels for each NSR does not exceed the guideline of 75 dB(A) for weekdays between 0700 and 1900 hours. Hence the dredging works in proximity to these NSRs will not pose a significant noise impact. provided works do not extend into restricted hours.

Potential impacts could arise through the use of mechanical equipment for dredging works along the Wo Sang Wai channel since it lies within the Ineer Deep Bay Special Measures Zone. Any mechanical equipment will emit noise levels which exceed the 60 dB(A) limit for the Inner Deep Bay Buffer Zone.

Suggested Mitigation Measures

The use of smaller and quieter excavators for dredging operations is considered the most cost effective way to control excessive noise at source. In reality the equipment proposed for use by Task 5 will be smaller than traditional dredging equipment upon which the TM SPL levels are based and so actual noise emissions will be lower. Practical mitigation options are limited for such works and it is therefore recommended that works be restricted to between 0800hrs-1700hrs to avoid disturbance to birds at dusk and dawn. Wherever possible manual methods of excavation should be used in Wo San Wai.

All works should be undertaken during daytime hours to avoid unacceptable exceedances of ANLs during restricted hours.

17.5.2 Air Quality Assessment

Initially, air quality impacts were raised as a potential key issue due to the expected large volumes of dredged sediment and the associated handling, storage and transportation requirements. However, the anticipated volumes of sediment have reduced considerably and significant dust (TSP) concentrations are not predicted from dredging operations. Thus, no quantitative assessment of TSP impacts in the Yuen Long Basin has been conducted.

Due to the on-going channel works, an assessment of air quality for the existing channel was inappropriate. Should it occur, dredging in the future Yuen Long Basin channels was predicted by Task 4 to yield 7,500m^3 of sediment annually. There are no plans to store material at banksides which precludes potential dust impacts. The dredging/storage methods to be used are also not conducive to dust generation. In view of the future development of the Basin (including Route 3 and West Rail), ambient TSP concentrations are likely to show an increase.

17.5.3 Ecological Impacts

Channel construction in the intertidal reach of the Shan Pui and Kam Tin Rivers was underway at the time of this report. It would be expected that the most significant impacts on bird life will result from channel construction, and that maintenance dredging will be of secondary importance over a much longer time scale. In order to minimise the ecological impacts of noise generation, particularly on bird activities, dredging will only be permitted during the hours of 08.00 and 17.00 in Deep Bay buffer zone 1.

Loss of bird foraging habitat due to maintenance dredging would occur primarily from deepening of the channel and the loss of macrobenthos within the channel and on mud flats at the mouth of the Shan Pui River. Loss of foraging habitat has the potential to impact upon bird populations including winter visitors, migrants, and breeding residents. Of the breeding residents, herons and egrets nesting at the Shan Pui egretry would probably be most affected by such a loss. However, given that the actual maintenance dredging will be restricted to areas exceeding the defined flood trigger levels impacts will be short term and confined to relatively small areas.

Disturbance to breeding and roosting birds caused by noise emissions from works within the Deep Bay area is addressed under section 17.5.1.

17.5.4 Water Quality Impacts

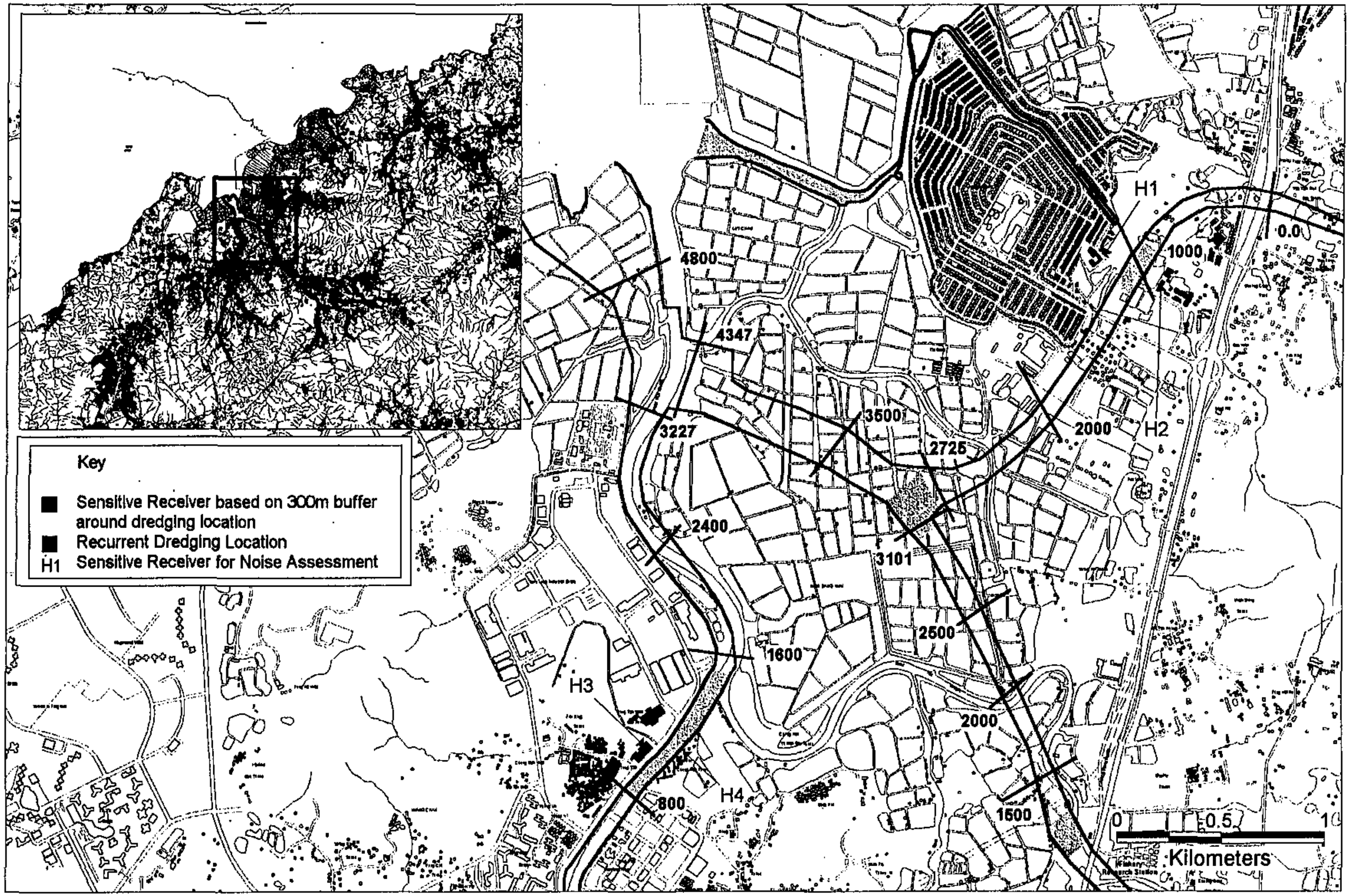
Due to the extreme ecological sensitivity of inner Deep Bay into which the Yuen Long catchment drains, any detrimental alterations in water quality could have damaging and even permanent effects on the ecological balance of the area. For the retrained channel there is an opportunity to minimise inputs of sediment from erosion and inputs of industrial effluent through greater enforcement of existing legislation.

17.6 Mitigation Measures

The following measures should be considered in addition to the standard specifications in Section 8.

17.6.1 Noise

An assessment of noise levels generated by the proposed works along the Wo Sang Wai Channel has demonstrated noise levels in exceedance of the acceptable 60 dB(A) limit. Thus, any avifauna within the vicinity of the proposed works boundary will be subjected to noise levels which exceed the permissible levels within the Inner Deep Bay Buffer Zone. Works in buffer zone 1 should therefore be restricted to avoid dawn and dusk hours (0800 - 1700 hours).



Hyder Consulting

Figure 17.1 Potential Noise and Air Sensitive Receivers Near Proposed Dredging Locations Yuen Long/Kam Tin/Ngau Tam Mei River Channels (post retraining works)

Source: Lands Department
OZP

SECTION 18

EIA OF DREDGING WORKS IN TIN SHUI WAI RIVER CHANNELS

18. EIA OF DREDGING WORKS IN TIN SHUI WAI RIVER CHANNELS

18.1 Introduction

Situated in the Northwest New Territories, the relatively narrow Tin Shui Wai Basin covers an area of approximately 20 km^2. Within the basin is the Tin Shui Wai Drainage channel which consists of three branches: the Western (Main) Channel and Eastern Channel, which were both realigned during the recent reclamation of the area, and the Link Channel. Figure 18.1 shows the location of the channel, the proposed dredging locations and sensitive receivers to noise and air quality impacts. The Channels drain into Inner Deep Bay, an area of international importance to birds, to the north of Tin Shui Wai new town.

18.2 Existing Environment

18.2.1 Existing and Future Land Uses

At present there is an area of residential development to the east of the Western channel, slightly south of the link road. However, the area is currently being extensively developed with the second phase of the Tin Shui Wai new town extension on the Reserve Zone adjacent to the study channel. It has been recommended that part of the Eastern Channel will be filled for future development and the flow will be conveyed by the extension of an existing box culvert.

The land use in this catchment is predominantly urban (54%). By the end of 1994 there were 59 industrial discharges and 61 other discharging premises. The upper catchment is largely rural and undeveloped, with grassland and livestock rearing. There were 275 operational livestock farms in the area as of 1994. Fish ponds account for approximately 10% of the area. 2% of the catchment is bare soil, whilst construction activities account for almost 1% of the land use, (Task 2 Report, 1996 and EPD, 1995).

18.2.2 Air Quality

Due to the absence of major roads and polluting industries in the vicinity of the Channel, air quality is generally good. A slight odour was detected around the mouth of the channel which appeared to be a result of the estuarine mud accumulating in the lower reaches of the channel. Such odour incidences are likely to be caused by historical livestock waste inputs to the channel. In future there is also the potential for odour problems from the development of the area to the north of the link road, Tin Shui Wai Reserve Zone .

The baseline survey of 24 hr TSP monitoring was conducted over a seven day period during November 1996 from the roof of MFBM Chan Lui Chung Tak Memorial College. The location is displayed in Figure 18.1. The results are summarised in Table 18.1 and are presented in full in Appendix A7. Field notes and methodologies are included as Appendix A4.

TABLE 18.1 SUMMARY OF BASELINE AIR QUALITY MONITORING RESULTS

Date of Sampling	Total Suspended Particulate TSP value ug/Std. m^3
22.11.96	182
23.11.96	236
24.11.96	146
25.11.96	137
26.11.96	255
27.11.96	155
28.11.96	119

NB: The Air Quality Objective for 24 hr. TSP measurements is 260 ug/m^3

The results show a significant variation in the TSP values recorded, which most likely reflects the influence of construction sites in the Tin Shui Wai area and possibly sites in Shenzhen. The average TSP value recorded over the 7 day period was 175.7 ug/Std. m^3.

18.2.3 Noise

A noise baseline survey was undertaken over three days during November 1996 from the roof of Chan Lui Chung Tak Memorial College. The methodology followed is described in Appendix A4. The average values and measurement range for $L_{eq(30min)}$, L_{10} and L_{90} are summarised in Table 18.2. The full results of the survey are presented in Appendix A6.

TABLE 18.2 SUMMARY OF BASELINE NOISE MONITORING RESULTS

Noise Measurement	$L_{eq\,(30min)}$ dB(A)	L_{10} dB(A)	L_{90} dB(A)
Average	62.14	65.16	55.37
Range	59.6 - 68.2	63.0 - 71.5	50.5 - 60.5

The results show that noise levels are significantly influenced by both road traffic noise from Tin Ying Road and further housing construction to the north and north east, including hammer piling. The L_{90} results show that for 90% of the time the noise levels range from 50.5 to 60.5 dB(A), whereas the L_{10} results show a 10 dB(A) increase relecting noise peaks from the above sources.

18.2.4 Hydrology and Water Quality

Flood History and Predicted Flooding

The Tin Shui Wai Basin was once very prone to flood damage but flood protection schemes implemented in recent years have reduced flooding from a regional problem to a local one. Channel improvements on all major water courses in the basin have involved engineering channels or culverts with adequate capacity to convey flood flows. Work has also been undertaken to create six poldered villages in the basin. Much of the length of the western drainage channel has been concrete lined while tidal portions of the channel in the Government land bank are presently unlined but are hydraulically capable of containing flood waters (Binnie Consultants, 1993).

Localised flooding resulted from Tropical Storm Faye 1992 which caused HK$2.5 million of damage. Local flood problems can be attributed to haphazard development around the Tin Shui Wai New Town and large scale use of land for fish ponds and container storage. Land to the south east of the Western Channel mouth is particularly prone to flooding. It is anticipated that careful, planned development and improved maintenance of the channels will reduce localised flooding in the future (Binnie Consultants, 1993).

Flooding predictions were modelled in Task 4 under two scenarios for the existing Tin Shui Wai River channel:

Case 1 - 10 years storm and 50 years tide:

> Minor flooding is predicted along the Western Channel at ch. 3100-3600m, and along the East Channel between ch. 2400-2500m. No flooding is predicted along the Link Channel.

Case 2 - 50 years storm and 10 years tide:

> No flooding is predicted for any of the Channels.

Pollutant Loads

From the implementation of the WPCO and the WCO in 1990 to the end of 1994, BOD loadings into the Tin Shui Wai Western Channel had decreased from 11,553 kg/day to 3,146 kg/day (73% reduction). Of this BOD loading reduction, 72% was specifically from livestock waste, 20% was from domestic waste with an 86% decrease in industrial, commercial and institutional pollution (EPD, 1995).

Water Quality

The Tin Shui Wai Western Channel is routinely monitored by EPD. The EPD's 1993 river water quality report classed the lower reaches of the temporary western drainage channel as 'bad', whilst the upper reaches had improved from 'bad' to 'fair' from the previous year's monitoring report (EPD, 1994c). However, by the end of 1994 the water quality in the whole of the Channel was again classed as 'bad' (Appendix B1) (EPD, 1995).

The non-tidal reaches of the Western Channel are likely to improve in terms of water quality following the implementation of measures such as dry weather flow interceptors and an inflatable dam, both of which can reduce pollutants entering the nullah. The inflatable dam prevents tidal water in the lower reaches of the channel from entering the main channel adjacent to the existing new town. The main discharge point for pollutants into the tidal reaches of the nullah is on the right bank of the channel opposite the village of Mong Tseng Wai. Poor dispersion in Deep Bay exacerbates the pollution problem in the tidal stretch of the Channel.

Water quality surveys carried out by Binnie and Partners and Shankland Cox in 1984 included a sampling station on the Tin Shui Wai Western Channel. The results showed very high levels of organic pollution indicated by high levels of ammoniacal nitrogen, particularly during the dry season. Dissolved oxygen concentrations were very low during the wet season, and the Channel was essentially anoxic during the dry season.

Water quality analysis was conducted at the Western Channel specifically as part of this study during April 1996, using the methodology as set out in Appendix A3. The results of the analysis are presented in Table 18.3. The survey was undertaken through a twelve hour tidal cycle (Appendix B2) at three locations. The monitoring locations and trends in some of the key water quality parameters are displayed graphically in Figure 18.2. The full results are presented in Appendix A1.

TABLE 18.3 A SUMMARY OF WATER QUALITY MONITORING RESULTS

Location	Salinity (ppt)	D.O. (mg/l)	D.O. (%)	S.S. (mg/l)	B.O.D. (mg/l)
I1	7.14 (5.80 - 8.60)	0.27 (0.13 - 0.49)	3.1 (1.5 - 5.6)	18.8 (7.0 - 30.0)	16.1 (6.0 - 20.5)
I6	7.68 (7.1 - 8.2)	0.33 (0.31 - 0.36)	3.94 (3.2 - 5.7)	83.0 (49.0 - 110.0)	19.4 (13.5 - 25.0)
I5	11.98 (11.50 - 12.40)	0.22 (0.21 - 0.24)	2.6 (2.5 - 2.7)	47.4 (22.0 - 87.0)	10.5 (6.5 - 16.5)

Salinity levels decrease upstream, although concentrations at the mouth are extremely low even during flood tide. At the nullah mouth (I5) and mid-reaches (I6) the suspended solids levels are highest during flood tide. Dissolved oxygen is extremely low throughout the channel, with the maximum concentration at just 0.49 mg/l (I1).

Zinc concentrations were detectable at each location, with the mid-stream (I6) displaying the highest levels (0.38 mg/l). For each location, zinc levels were highest during the ebb tide. Mercury concentrations were also detectable upstream (I1) and at mid-stream (I6) during the last ebb tide sampled (1 mg/l). This indicates either an upstream pollution source which is carried downstream during ebb tides or historical sediment contamination from mixed industrial and livestock waste sources.

18.2.5 Sediment

Grab samples were taken from the channel in August 1995, with subsequent core samples collected from four different locations along the lower Western Channel during December 1995. The sampling locations and sediment quality results of the cores are displayed as Figure 18.3. The full results of core sampling are in Appendix B4.

<u>Characteristics</u>

The sediment in the channel generally consisted of grey/black sticky clay in its lower reaches. The two cores furthest upstream (I1 and I2) had high silt contents, averaging over 80% silt for the upper 0.5m. The channel sediment was found to become slightly coarser on approach to the sea with an increasing presence of fine sand. It is likely that the fine silt found beyond the mouth has been deposited by the tide and is of marine origin. The extensive mud flats which have developed in the mouth of the channel and inner Deep Bay add support to this.

Quality

Core analysis revealed that the main channel contains both heavily contaminated and uncontaminated material. In comparison with results from other study channels the sediment was relatively clean. Only sample I2, taken from the Channel bend, was sufficiently contaminated with chromium, copper, nickel and zinc to satisfy Class 'C' criteria. The other cores from the channel were almost entirely uncontaminated, except for a patch of zinc contamination detected at I3, downstream from a storm water outlet.

Organic carbon was low, whilst nutrients such as nitrogen and phosphorus were present in high levels in the contaminated sample. Although not heavily contaminated with metals, the mud in the mouth of the channel was noted during site visits as being black, anoxic and odorous.

18.2.6 Ecology

The area adjacent to the Tin Shui Wai Channels contains numerous ecologically important areas which are sensitive to environmental disturbance. These primarily include the inter-tidal areas of Inner Deep Bay, together with Mai Po; the Deep Bay Buffer Zones (Buffer Zones 1 and 2, Figure 16.5) which were designated to protect the SSSI; and the boundary of the Ramsar Site, which is close to the mouth of the channels and therefore could potentially be affected by dredging operations. Until the mid 1980s the area was predominately used for fish cultivation. A large area of fish ponds was lost to the Tin Shui Wai Reserve Zone reclamation and conservation of remaining fishponds is of importance given their ecological value.

Riparian Flora and Fauna

The Tin Shui Wai Western and Eastern Channels are fringed by mangroves along most of their tidal portions. Extensive stands of mangrove, dominated by *Kandelia candel*, *Aegiceras corniculatum* and *Acanthus ilicifolius*, exist at the mouth of the western channel and along much of the length of the tidal creek linking the eastern and western channels. The mangal along the left bank of the western channel thins rapidly above the Tsim Bei Tsui road bridge to a fringe of predominantly *A. ilicifolius*. Along the right bank the dense *Kandelia /Aegiceras/ Acanthus* association continues for approximately 500m.

A bird survey was conducted along both the Western and Eastern Drainage Channels of the Tin Shui Wai River on the morning of March 27th 1996. The transect locations are displayed in Figure 18.4.

Observations made along the Western Channel identified a total of 30 species, as listed in Table 18.4. Teal was the most abundant species, along with Redshank, Wigeon and Little Egret. These species predominated in the actual channel where they were observed foraging close to the mouth. The bird use of banksides was low compared to the available area, due to a generally poor habitat quality.

TABLE 18.4 WESTERN CHANNEL BIRD TRANSECT RESULTS

Common Name (Species Name)	Number
Grey Heron (Ardea cinerea)	5
Chinese Pond Heron (Ardeola bacchus)	6
Little Egret (Egretta garzetta)	51
Great Egret (Casmerodius albus)	2
Wigeon (Anas penelope)	35
Teal (Anas crecca)	400
Black-eared Kite (Milvus lineatus)	2
White-breasted Waterhen (Amaurornis phoenicurus)	5
Moorhen (Gallinula chloropus)	2
Common Sandpiper (Actitis hypoleucos)	3
Green Sandpiper (Tringa ochropus)	2
Redshank (Tringa totanus)	25
Spotted Dove (Streptopelia chinensis)	2
Koel (Eudynamis scolopacea)	1
Greater Coucal (Centropus sinensis)	1
Barn Swallow (Hirundo rustica)	6
Richard's Pipit (Anthus richardi)	3
Grey Wagtail (Motacilla cinerea)	1
White Wagtail (Motacilla alba)	1
Chinese Bulbul (Pycnonotus sinensis)	1
Fantail Warbler (Cisticola juncidis)	1
Dusky Warbler (Phylloscopus fuscatus)	1
Yellow-bellied Prinia (Prinia flaviventris)	4
Plain Prinia (Prinia inornata)	8
Masked Bunting (Emberiza spodocephala)	15
Tree Sparrow (Passer montanus)	6
Black-necked Starling (Sturnus nigricollis)	6
Crested Myna (Acridotheres cristatellus)	29
Collared Crow (Corvus torquatus)	2
Magpie (Pica pica)	1
Number of Individuals	**627**
Number of Species	**30**
Diversity	**1.60**

Bird species diversity was calculated to be greater along the Eastern Channel, as displayed in Table 18.5. This is likely to be due to increased habitat diversity and quality, coupled with the absence of large bodies of open water. The predominance of reed-bed as a habitat appeared to enhance the suitability of the area for graminivorous birds.

TABLE 18.5 EASTERN CHANNEL BIRD TRANSECT RESULTS

Common Name (Species Name)	Number
Cormorant (Phalacrocorax carbo)	1
Grey Heron (Ardea cinerea)	1
Chinese Pond Heron (Ardeola bacchus)	2
Great Egret (Casmerodius albus)	1
Black-eared Kite (Milvus lineatus)	1
White-breasted Waterhen (Amaurornis phoenicurus)	3
Coot (Fulica atra)	4
Spotted Dove (Streptopelia orientalis)	3
Richard's Pipit (Anthus richardi)	2
Chinese Bulbul (Pycnonotus sinensis)	23
Siberian Stonechat (Saxicola maura)	1
Fantail Warbler (Cisticola juncidis)	5
Yellow-bellied Prinia (Prinia flaviventris)	21
Plain Prinia (Prinia inornata)	15
Unidentified warbler	1
Black-faced Laughing-Thrush (Garrulax perspicillatus)	2
Rufous-backed Shrike (Lanius schach)	1
Black Drongo (Dicrurus macrocercus)	2
Black-necked Starling (Sturnus nigricollis)	2
Number of individuals	**91**
Number of species	**19**
Diversity	**2.27**

The habitats alongside both channels, and their use by the avifauna recorded during the surveys are displayed in Table 18.6.

TABLE 18.6 HABITAT USE BY BIRDS ALONG TIN SHUI WAI CHANNELS

	Western Channel		Eastern Channel	
HABITAT	**NO. OF BIRDS**	**% OF TOTAL**	**NO. OF BIRDS**	**% OF TOTAL**
Channel	454	72%	12	13%
Mudflat	54	9%		
Bund	50	8%	6	7%
Reedbed			42	46%
Woodland	36	6%	16	18%
Mangrove	31	5%		
Grass			13	14%
Shrub			2	2%
Farm/village	2	<1%		

<u>Aquatic Fauna</u>

The water quality conditions in the Tin Shui Wai channels preclude the existence of a diverse aquatic fauna. However, the use of the mud banks along the lower portion of the western channel by foraging birds at low tide indicates the presence of invertebrate prey. Tidal flushing at the mouth of the channel is greater than elsewhere, thus slightly improving conditions relative to the rest of the channel for invertebrates. Marine and estuarine fish enter the river to feed on the incoming tide, whilst fry use the mangal fringes as a nursery.

18.3 Proposed Works

18.3.1 Dredging Requirements

With respect to marine sediments, Task 4 hydraulic modelling has indicated that channel bed levels are generally in hydrodynamic equilibrium and below the flooding trigger level. Thus, maintenance dredging is not necessary for marine sediment incursion.

Fluviatile sediment enters the channels at a rate of some $690m^3$ per year and is expected to accumulate mainly upstream of the inflatable dam in the Western channel. This accumulation amounts to about 10 cm/year. Construction activities account for a total of approximately $2400m^3$ per year of sediment in the lower sections of the channels. There are no significant side channels or culverts which could be affected by blockages.

The hydraulic gates in the Eastern Channel cause a water level rise of up to 0.5m but this is contained within the channel as the banks are sufficiently high. Siltation of 1 m in the Western and Eastern channels (downstream of the Ch. 2000), and of 1 m in the Link Channel, creates an almost critical situation in the upper Western Channel. Although dredging may help to alleviate flooding upstream, the tidal elevation has a dominant effect on flooding in the downstream region of the Western and Eastern Channels.

Task 4 and 5 Recommendations: Dredging the Main Channel to +0m PD will not alleviate flooding around Ch. 2500 in the East Channel.

As a bed level rise of 1m shortly upstream from the inflatable dam does not affect the flood risk, the dredging of fluviatile sediment is recommended every 10 years.

As inputs of construction-derived material are diffuse, a monitoring programme is recommended to determine accretion rates. Dredging will be necessary if trigger levels are exceeded.

18.3.2 Dredging Strategy

In the event that it is decided that dredging is to occur, the following strategy based on Task 5 is suggested:

i. *Access:* With the exception of the border area road bridge, the Western channel is accessible from the marine side as far upstream as the dam. Western channel bed levels will enable access by very shallow-draft vessels only, although dredging the channel to a greater depth could allow access by larger vessels.

Bank side access to both channels is relatively easy at present due to the undeveloped nature of the surrounding land and could be implemented through the use of a ramp situated close to the fabridam on the east bank. Land access to the Eastern channel is also possible via tracks. Marine access to the Eastern channel is impossible on the marine side due to a very low bridge at the mouth.

*ii. **Dredging:*** The Western Channel can be dredged either through the use of a barge or pontoon mounted grab or a backhoe, with sediment loaded into a small barge or a pontoon-mounted skip depending on the disposal option. Upstream of the fabridam, dredging could be carried out using wheeled or tracked excavators which load into trucks.

Due to access restrictions the Eastern channel could only realistically be dredged using very small plant mounted on pontoons which load into pontoon-mounted skips. There is also the possibility along the Eastern channel of excavation using long reach excavators from the bank where accessible for loading into trucks.

*iii. **Transport:*** For dredged sediment from the Western Channel, transportation would be by road followed by barge transfer for marine disposal, or directly by truck for land disposal. All dredged material from the Eastern Channel will be transported by truck.

*iv. **Disposal Strategy:*** Disposal of contaminated sediment would most likely be to East Sha Chau. Uncontaminated sediment could be transported to a redundant marine borrow area or disposed of on private land.

Sediment from the Western Channel would ideally be disposed of at the WENT landfill site, which is relatively close to the channel. This would minimise risks associated with transport of material, reduce the need for transhipment into larger vessels, and ultimately reduce costs. Alternatively, disposal could be to East Sha Chau if the potential impacts of landfill disposal are considered too great. Sediment from the Eastern Channel could be disposed of at a strategic landfill, or at East Sha Chau after transhipment to barge at Tuen Mun.

Beneficial use of Tin Shui Wai sediment could include habitat creation within the proposed ecological park as contained in the Masterplan for the next phase of the new town development.

18.4 Key Issues

Ecology

- Damage to mangroves and riparian vegetation may result from dredging operations in the east channel, and to a much lesser extent in the west channel.
- Loss of bird foraging habitat on mud flats within the Western Channel is a concern as waterfowl rely on these foraging sites, particularly during winter.
- The intertidal areas of Deep Bay contain the only areas of oyster beds in Hong Kong which are estimated to cover 4072 hectares (Young & Melville, 1992). Oyster production is particularly sensitive to pollution from metals such as cadmium and from faecal pollution.

- Resuspension and transport downstream of heavily contaminated sediment will be a concern relative to wading bird foraging on the mudflats within the west channel and in inner Deep Bay beyond the mouth of the channel.

Community Impacts

- In the future, the planned new town extension of Tin Shui Wai onto the Reserve Zone may introduce new sensitive receivers such as residential areas which may be affected by noise and odour associated with dredging operations.

18.5 Impact Assessment

18.5.1 Noise Impact Assessment

Works Area

There is only one proposed dredging location in Tin Shui Wai Drainage Channels and this is shown in Figure 18.1, along with the noise sensitive receivers.

Noise Sensitive Receivers

The most affected NSRs around the works area have been identified as those falling within a 300m buffer of the likely works area and are listed in Table 18.7.

TABLE 18.7 DESCRIPTION OF NOISE SENSITIVE RECEIVERS

NSR	Description
I1	Shui Lung House of Tin Shui Estate
I2	Chai Lui Chung Tak Secondary School
Ramsar Site	Deep Bay/Mai Po area, Buffer Zone 1 and 2

Noise Impact Assessment Criteria

Noise level are limited by the *Noise Control Ordinance (Cap 400) including its subsidiary regulations and the Technical Memoranda.* (TM).

In addition to the requirements imposed by the Noise Control Ordinance, the following requirements or interpretations will also be used as a standard in order to control noise generated from equipment and activities for the purpose of carrying out any construction work other than percussive piling during the time period from 0700 to 1900 hours on any day not being a general holiday:

i) The noise level measured at 1 m from the most affected external facade of the nearby NSRs during any 30-minute period during normal weekly daytime periods between 0700 to 1900 hours will not exceed an equivalent sound level (L_{Aeq}) of 75 dB(A) or 70 dB(A) (or 65 dB(A) during examination) for schools.

ii) Construction should not be undertaken during any other period, the restricted period, without the existence of the relevant Construction Noise Permit (CNP).

iii) In accordance with TM, the area around the dredging locations for the Tin Shui Wai river channels has an Area Sensitivity Rating (ASR) of 'B'. Therefore ANLs under the current regulation are 65 dB(A) from 1900 to 2300 hours plus all day Sundays and general holidays and 50 dB(A) between 2300 and 0700 hours.

Assessment Methodology

The dredging works will be undertaken using a wheeled excavator and the dredged material will be transported will be transported by trucks. In this case the trucks only transport the dredged material off the site once it is full. The engine of the truck is assumed to be switched off during most of the time at the site. The noise impact generated from the truck is therefore considered insignificant and has not taken into account in this assessment. The likely equipment for dredging is shown in Table 18.8.

TABLE 18.8 TYPICAL MIX OF EQUIPMENT FOR DREDGING OPERATIONS

Identification Code	Description	Sound Power Level dB(A)
CNP 081	Excavator	112

The sound power levels of the equipment used in this assessment are derived from the TM.

The excavator was considered at a position mid-way between the approximate geographical centre of the dredging area and its boundary nearest to the NSR. In the case of an oblong area, having a length to width ratio of 5:1 or more, then only the closest portion to the NSR has been considered, as defined in the TM.

A total sound power level of the dredging operation is obtained by summing all the individual sound power levels of the associated equipment.

The noise levels at each NSR are predicted by the following equation:

Predicted noise level = Total sound power level - 20 $\log_{10}D$ - 8 dB(A)

where D is distance between the NSR and the noise source

A positive correction of 3 dB(A) is made to each predicted noise level due to all concurring activities to account for the facade reflection at the NSR. The predicted unmitigated noise levels are presented in Table 18.9. A detailed calculation spreadsheet is attached in Appendix A5.

TABLE 18.9 UNMITIGATED NOISE LEVELS AT NSRS

NSR	Predicted Noise Level dB(A)
I1	67[2]
I2*	63

Note:

* *NSR is a school*

2 *The PNL exceeds the ANL of 65 dB(A) between 1900 and 2300 hours, plus all day Sundays and general holidays, and exceeds 50 dB(A) between 2300 and 0700 hours for all days*

The calculation indicate the predicted noise levels at both selected sensitive receivers is within the daytime guideline of 75 dB(A). Therefore adverse noise impact is not anticipated provided that the works do not extend into restricted hours.

Should the dredging works extend to the lower reaches of the channel in the future then the Deep Bay Special Measures Zone noise guidelines would apply to protect birds from noise disturbance. It can be assumed that the noise levels would be similar to those predicted for Yuen Long and San Tin 100m from the dredging area, i.e. 64 dB(A). Day time noise levels would therefore be exceeded and since it is difficult to mitigate noise impacts it is recommended that work hours are restricted, particulalry during the migratory season, to avoid dusk and dawn as well as night time when disturbance would be greater.

18.5.2 Air Quality Assessment

Odour

Although no sediment core sampling was undertaken at the proposed dredging location, the water quality there is poor as indicated by very low D.O. concentrations. Water analysis also revealed detectable concentrations of zinc and mercury which indicates a pollution discharge further upstream. The results of the nearest sediment core show contamination with heavy metals. Thus the sediment in the proposed dredging location is also assumed to be contaminated. Assuming that the sediment at the dredging location is also silty in nature, then there is the potential for odour impacts when the material becomes exposed.

Dust

The relatively moist condition of the silty sediment means that dust generation is not considered as an issue so long as material is removed from the site reasonably quickly. The lack of suitable storage areas requires that sediment will be temporarily stored in skips prior to removal from the site.

18.5.3 Ecological Impact Assessment

Despite its poor water quality, the Tin Shui Wai channel supports a large number of pollution tolerant benthic organisms. The improved water quality at the channel mouth enables a more diverse benthic community to exist, which in turn attracts a large number of wading birds.

Recent ecological surveys were undertaken which focused on studying the avifauna of the channels. The studies found that the area of primary bird use was in the large stands of mangroves on the mudflats at the channel mouth. Should dredging occur at the channel mouth then some loss of mangroves may result. The mangroves at the mouth of the Tin Shui Wai channel and Shan Pui River are used by nesting herons and egrets. As the available nesting habitats for these species has declined regionally in recent years due to the loss of woodlands, the retention of these mangroves is considered a conservation priority.

Deepening of the channel through removal of accumulated sediments would result in loss of foraging habitats for ducks as well as for wading birds. From the perspective of avian conservation, dredging the channel in the reach below Lau Fau Shan would reduce the extent of shallow water and mud flats, thereby reducing the availability of foraging habitat.

Where and when dredging is considered essential for flood alleviation it is recommended that impacts on the key sites of ecological value are minimised. Furthermore, any dredging works recommended will need to consider the impacts on mangal communities which provide valuable bird habitat and to a certain extent help to remove pollutants from the water. The mangroves also stabilise and bind the sediments and consequently provide a habitat for invertebrates and fish fry which are prey for both migratory and resident bird populations.

18.5.4 Water Quality Impacts

Should the main channel be dredged then there is the potential to release contaminants in the channel which could affect water quality down stream and within Inner Deep Bay. These impacts would be relatively short term, as recent studies by Binnie Consultants Ltd. have indicated that the metals are strongly associated with the sediment and not readily lost to the water column where they would become available to marine organisms. Dredging in the downstream section of the channel, within 500m of the Buffer Zone 1 boundary would require the implementation of the extensive monitoring programme (Category C) described in section 8.

18.6 Mitigation Measures

Mitigation measures required over and above the standard specifications in section 8 includes the following:

18.6.1 Noise

Restricted hours of working are required for works that extend into Inner Deep Bay Buffer zone (Buffer Zone 1), i.e. 0800 - 1700 hours.

18.6.2 Ecology

Should dredging be required in the mouth of the Tin Shui Wai channels, it will be critically important to minimise damage and disturbance to habitats outside the channel area to be dredged.

Standard specifications will be followed as listed in Section 8 of volume A. Should dredging occur within 500m of Buffer Zone 1 then the works will be subject to comprehensive water monitoring and audit as outlined in Section 8.

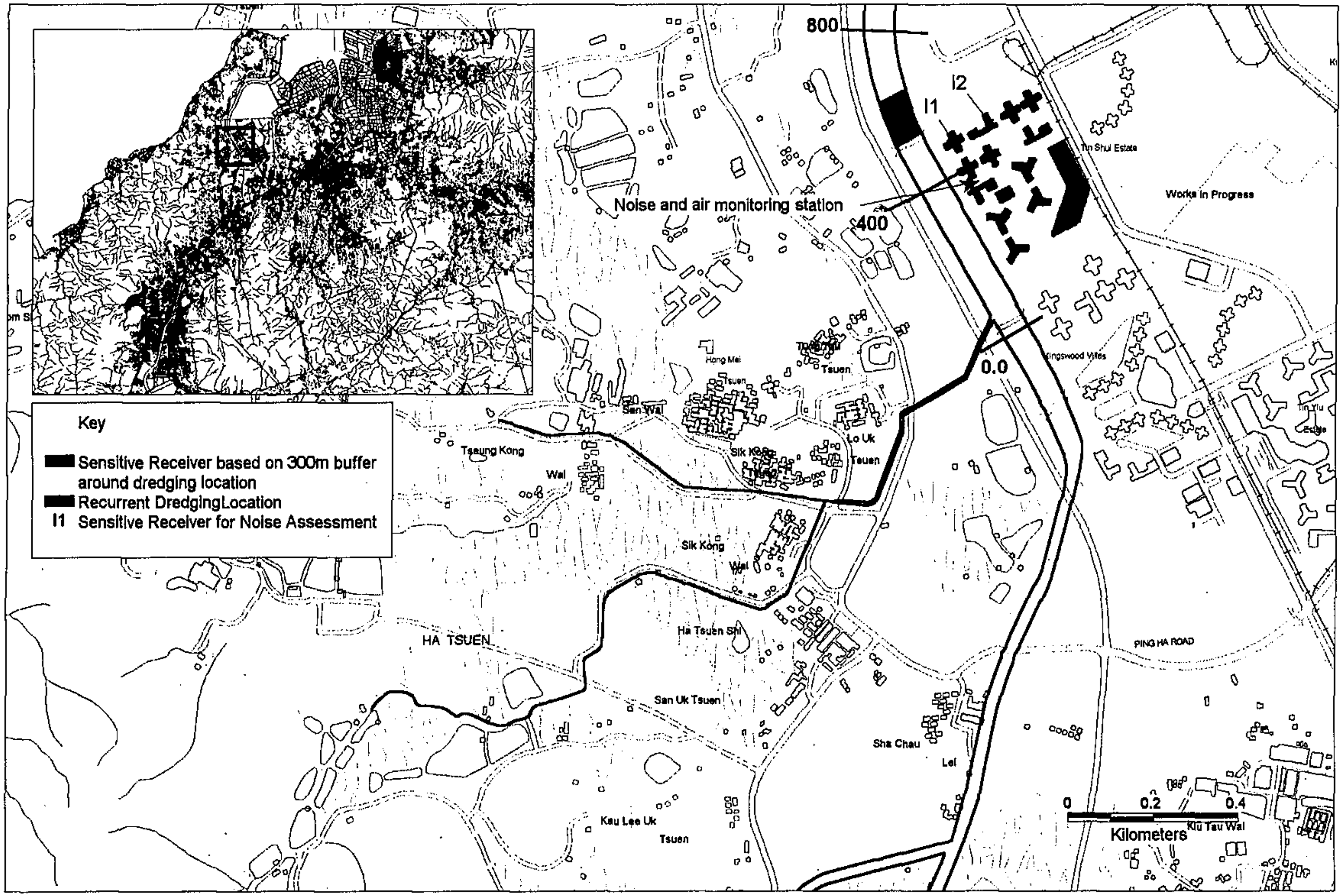


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Figure 18.1 Potential Noise and Air Sensitive Receiver Near Proposed Dredging Location Tin Shui Wai Western and Eastern Drainage Channels

Source: Lands Department
OZP

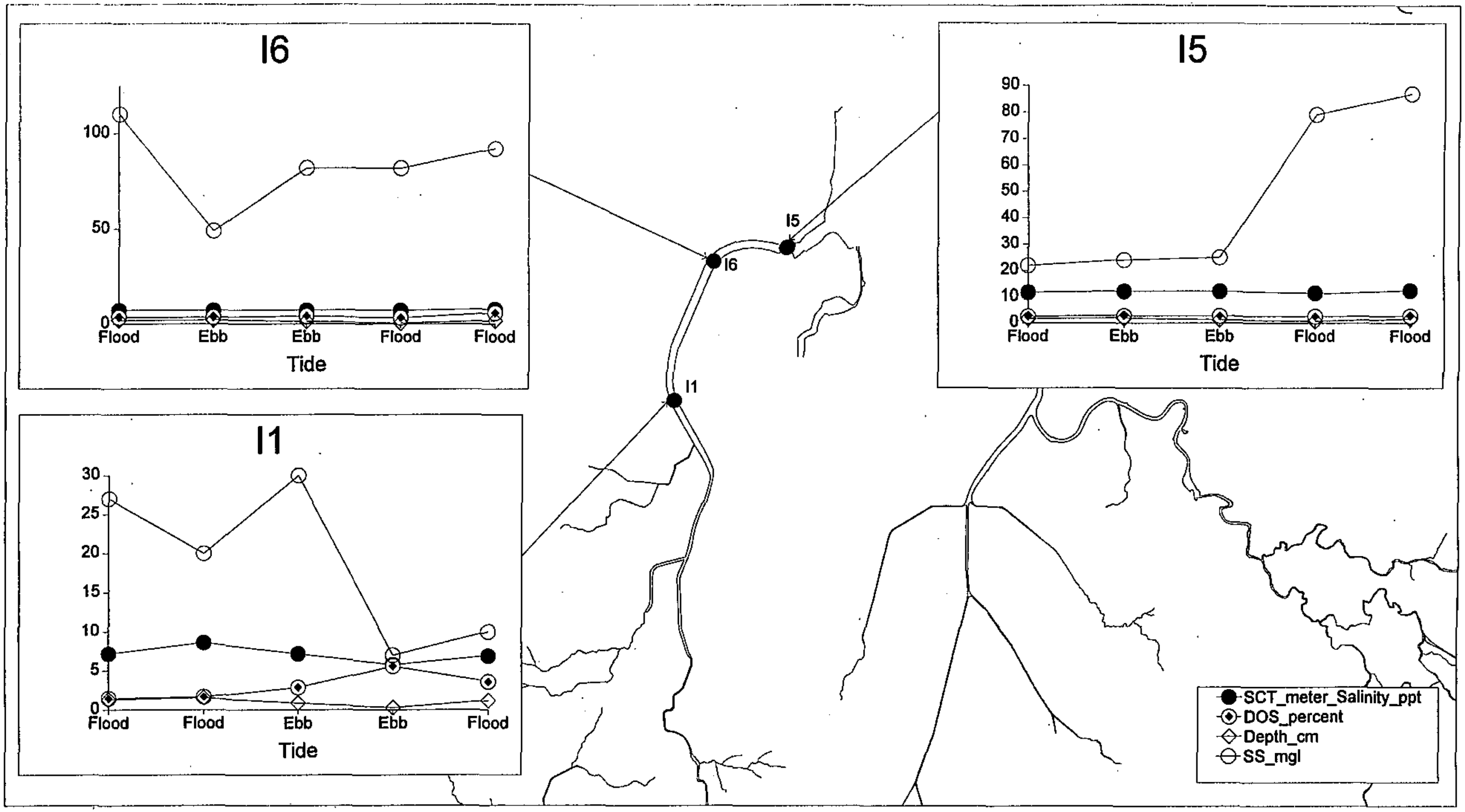

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Figure 18.2 Water Quality Monitoring Results from 16/04/1996
Tin Shui Wai Western and Eastern Drainage Channels

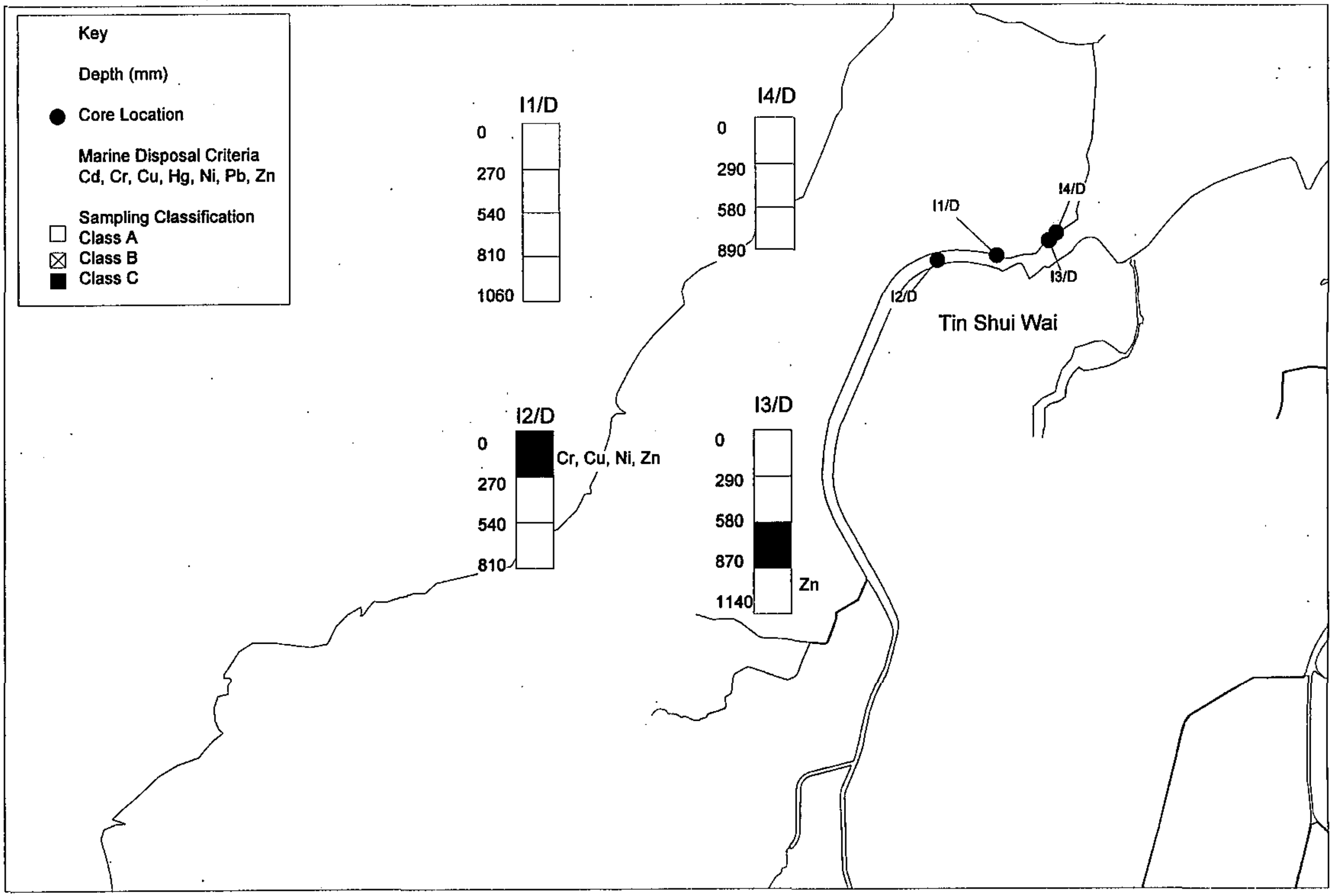

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Figure 18.3 Sediment Core Aanalysis Results
Tin Shui Wai Eastern Drainage Channels

SECTION 19

EIA OF DREDGING WORKS IN TUEN MUN RIVER CHANNEL

19. EIA OF DREDGING WORKS IN TUEN MUN RIVER CHANNEL

19.1 Introduction

Tuen Mun River is located in the Western New Territories, as displayed in Figure 19.1. This figures also indicates the Sensitive Receivers to noise and air quality impacts. The River is engineered along much of its 38 km length and is fed by numerous small tributaries which rise in its catchment of 16.5 km^2. The upstream reaches of the channel include the Yuen Long - Tuen Mun Corridor areas of San Hing Tsuen and Lam Tei. In its lower reaches the River flows through Tuen Mun new town as an open nullah for approximately 4 km before draining into the typhoon shelter at Castle Peak Bay, within the North West Water Control Zone. The tidal limit of the Tuen Mun River reaches approximately 100m downstream of the Lam Tei interchange, where the channel narrows from 50m to around 10m.

19.2 Existing Environment

19.2.1 Existing and Future Land Uses

The Tuen Mun River flows through a predominately urban environment, with 50% of the catchment developed particularly at the southern end of the channel. One quarter of the catchment area is used for grassland and agricultural land. A high percentage cover (7%) comprises bare soil, mainly on the hillsides to the north where erosion is concentrated.

19.2.2 Air Quality

During the River Corridor Survey the air quality around the middle section of the channel was noted as being poor, particularly due to vehicle emissions. An odour was also detected along the channel, apparently relating to effluent discharge.

A baseline survey to determine the 24-hr Total Suspended Particulate (TSP) concentration was undertaken from the roof of Tuen Mun Islamic Secondary School. Measurements were carried out over nine consecutive days during November / December 1996. The results are summarised in Table 19.1 and are presented in full in Appendix A7. Field notes and methodologies are included in Appendix A4.

TABLE 19.1 SUMMARY OF BASELINE AIR QUALITY MONITORING RESULTS

Date of Sampling	Total Suspended Particulate TSP value ug/Std. m^3
29.11.96	268
30.11.96	166
1.12.96	192
2.12.96	196
3.12.96	100
4.12.96	202
5.12.96	168
6.12.96	160
7.12.96	149

NB: The Air Quality Objective for 24 hr. TSP measurements is 260 ug/m^3

The TSP average over a 24 hour period is 177.9 ug/m^3, with a range from 100 to 268 ug/m^3. This variation in range is likely to reflect the impact of fluctuations in wind speed and direction on local industrial and vehicular emissions.

19.2.3 Noise

Preliminary background noise measurements taken along the channel during the initial field visit were high due to traffic from Castle Peak Road, Tuen Mun Road and the Yuen Long Highway. The Light Rail Transit (LRT) also runs along side the channel contributing to the background noise. Noise levels were found to range between 58.5 and 73.5 dB(A).

A more detailed noise baseline survey was undertaken in November 1996 from the roof of Tuen Mun Islamic Secondary School. The methodology used is included as Appendix A4. Baseline noise measurements including $L_{eq\ (30min)}$, L_{10} and L_{90} were taken and the average values and range are summarised in Table 19.2. The full results of the survey are presented in Appendix A6.

TABLE 19.2 SUMMARY OF BASELINE NOISE MONITORING RESULTS

Noise Measurement	$L_{eq\ (30min)}$ dB(A)	L_{10} dB(A)	L_{90} dB(A)
Average	61.51	63.30	58.83
Range	59.6 - 62.6	61.0 - 66.0	57.0 - 60.0

The baseline results show that noise levels in this location are consistently around 60 dB(A). The location is influenced by a combination of noise sources, mainly from the opposite side of the River, including road and industrial source noise.

19.2.4 Hydrology and Water Quality

<u>Flood History and Predicted Flooding</u>

The upper reaches of the channel have been prone to flooding in the past, possibly due to the limited capacity of the urban drainage system rather than the channel itself.

Flooding predictions were modelled in Task 4 under two scenarios for the existing Tuen Mun River channel:

Case 1 - 10 years storm and 200 years tide:

Minor flooding is predicted between ch. 3200-3400m.

Case 2 - 200 years storm and 10 years tide:

No flooding is predicted.

Pollutant Loads

According to EPD records from 1993 the Tuen Mun River is polluted largely as a result of industrial effluent. It has been expressed that up to 90% of total pollution may be from industrial discharges (Planning Department, 1993). Many effluent discharge points from industrial sites were observed along the channel during a site visit, and these have traditionally been responsible for high levels of metals in the channel. The River is also characterised by a number of discharges of untreated wastewaters from residential sources, particularly squatter villages.

The retention time within the Tuen Mun River is long and its assimilative capacity low. Concentrations of heavy metals were consistently high in the San Hing Tsuen tributary. Levels of aluminium, copper, and zinc were significantly greater than results from the remainder of the Tuen Mun River, whilst the *E. coli* concentration averaged at 4.0×10^6 count/100 ml (EPD, 1995).

Pollutant loads in the channel as a whole have generally decreased in recent years due to a major reduction in the numbers of livestock raised in the area following the implementation of the livestcok waste control scheme in 1995. Loads have declined further following the implementation and enforcement of WPCO in 1992. As of the end of 1994, an average BOD load reduction of 79% was achieved in domestic, industrial, commercial and institutional waste due to WPCO implementation. Furthermore, a 97% reduction in BOD from livestock waste was achieved due to WDO implementation (EPD, 1995).

Water Quality

The Tuen Mun River is routinely monitored by EPD as a priority watercourse. In 1993 the water quality was graded as 'fair' to 'very bad' by EPD, but by 1995 the quality had improved considerably within much of the channel to a classification of 'fair' (Appendix B1). Suspended solids concentrations in the water column are generally low due to the low velocities in the nullah.

The San Hing Tsuen, tributary is largely responsible for a lowering of the water quality in the Tuen Mun River. It has the lowest annual average concentration for dissolved oxygen and the highest average concentrations for BOD, suspended solids and ammoniacal nitrogen (EPD, 1995).

Water quality analysis was conducted specifically as part of this study during April 1996, using the methodology cited in Appendix A3. The results of the analysis are presented in Table 19.3. The survey was undertaken through a twelve hour tidal cycle at four locations (Appendix B2). The monitoring locations and key results are displayed in Figure 19.2, and the full results in Appendix A1.

TABLE 19.3 SUMMARY OF WATER QUALITY MONITORING RESULTS

Location	Salinity (ppt)	D.O. (mg/l)	D.O. (%)	S.S. (mg/l)	B.O.D. (mg/l)
J1	10.50 (2.1 - 16.9)	3.80 (3.25 - 4.53)	44.9 (39.0 - 53.8)	24.8 (3.0 - 73.0)	24.8 (3 - 73)
J3A	24.48 (24.2 - 24.9)	1.93 (0.63 - 3.81)	23.0 (7.5 - 46.7)	18.6 (9.0 - 41.0)	18.6 (9 - 41)
J3B	25.12 (24.6 - 25.8)	2.45 (1.36 - 3.96)	28.5 (14.9 - 48.1)	14.8 (10.0 - 21.0)	14.8 (10 - 21)
J4	28.76 (26.0 - 29.8)	4.36 (3.17 - 5.37)	50.6 (38.1 - 61.4)	22.2 (16.0 - 36.0)	22.2 (16 - 36)

The complete data showed that dissolved oxygen levels were variable within the channel but generally higher than those found in the other large channels in the study. However, at one sampling station (J3A), close to the industrial area in Tuen Mun, dissolved oxygen levels were very low on both the ebb and flood tide. Downstream at station J3B the D.O. concentration had generally increased slightly.

The monitoring location furthest upstream (J1) was right beside the tidal limit and consequently displayed the highest magnitude of salinity concentrations. The highest suspended solids and B.O.D concentrations were also recorded from J1 during ebb tide when the salinity levels were around 2 ppt. Thus the freshwater flow had become dominant and brought with it fluviatile sediment. The water at the channel mouth (J4) also had a high B.O.D., but due to the presence of organic matter of marine origin.

The sampled water contained small concentrations (in terms of toxicity) of zinc (max = 0.89 mg Zn/l) and mercury (max = 1µg Hg/l) both downstream and upstream of the industrial area in Tuen Mun.

19.2.5 Sediment

Grab samples were taken from along the Tuen Mun River during July 1995. Where contamination levels and channel bed depths were sufficient to justify additional sampling, cores were collected to a depth of one metre during December 1995. Each core was segmented to facilitate easier storage and laboratory analysis. The results of the analysis are summarised below, and are displayed in Figure 19.3 along with sampling locations. Full core results are included in Appendix B4.

<u>Characteristics</u>

The sediment particle size analysis from the cores showed that the channel bed was composed of fine silt and clay based upon the median grain size. Due to the fine nature of the sediment it is likely that it is cohesive. The silt fraction was generally higher in the two cores taken furthest upstream (J1 and J2).

Quality

The channel has been maintenance dredged in the past and sediments were analysed prior to dredging in 1990. The laboratory report for the samples collected during this dredging indicates that the sediment contained elevated levels of chromium, copper, nickel, zinc, lead and cadmium classifying it as Class 'C'. The dyeing industries, circuit board manufacturers and electroplating industries within the Tuen Mun catchment are responsible for high levels of chromium, copper and nickel respectively.

The analysis of the four cores taken during December revealed that the sediment was highly contaminated (Class 'C') at all depths and for all samples. In certain cases, contamination within the core samples was found to be worse at greater depths. The key contaminants found at high concentrations in each sample were chromium, copper, lead, nickel and zinc. These were generally present in concentrations up to two times greater than the TC 1-1-92 Class 'C' criteria. One sample contained copper concentrations which exceeded the Class 'C' criteria by five times. Under the new sediment disposal guidelines being devised by EVS Consultants, such high levels of contamination necessitate Tier III and IV biological testing and may be unacceptable for marine disposal.

Organic carbon concentrations were relatively high (< 6%) and nutrients such as nitrogen and phosphorus also displayed elevated concentrations.

19.2.6 Ecology

Riparian Flora and Fauna

The land adjacent to the Tuen Mun River Channel is both heavily urbanised and industrialised, and therefore no riparian flora or fauna of ecological conservation importance exists.

Aquatic Fauna

The presence of a diverse aquatic fauna or communities of ecological conservation value are likely to be precluded by the poor water quality and the accumulation of contaminants in the sediment on the channel bed. The aquatic fauna will be dominated by small numbers of opportunist species.

19.3 Proposed Works

19.3.1 Dredging Requirements

Task 4 modelling indicates that flooding will occur over a 200m stretch of the River around Ch. 3300 for a 1 in 200 years tide.

In the lower 2 km of the Tuen Mun River Channel the bed shear stress is low. Thus, it is likely that marine sediment accumulation occurs and that the River is not yet in equilibrium.

Present construction works contribute approximately, 1,000 m^3/year of sediment, mainly in the final 0.5 km of the River, and result in the annual accretion of around

1.5 cm. Other inputs of coarse-grained sediment are from the sub-catchments, and equate to 960 m^3/year. This is equivalent to an annual accretion rate of 2 cm between Ch. 2100-2500. Even after 10 years of accumulation, the raise in bed level will not reach the Flood Trigger level proposed.

It is estimated from CED's sounding records that around 7,400 m^3 of sediment requires restoration dredging around Ch. 2200 - 2300.

Around 10,000 m^3/year of sediment is currently being dredged from near Ch. 3900 by CED. The volume is mainly from inputs of coarse construction-derived material from Area 19.

Task 4 and 5 Recommendations:

- To prevent flooding from a 200 year tide at around Ch. 3300 it is recommended that the bank level is raised.
- Recurrent dredging of the eroded material from Ch. 3600-3800 is recommended, along with restoration dredging of the material at Ch. 2200-2300. This should be in combination with a monitoring programme to determine the volume and frequency of recurrent dredging.

19.3.2 Dredging Strategy

The following dredging strategy is based on Task 5 recommendations:

i. **Access:** The channel is large enough for marine access to be possible. There are however several low bridges across the river such as the one for Pui To road which may prevent the use of large sized dredging barges. Where bridges prevent access of barges, there are also several points at which access from the banks is a possibility.

ii. **Dredging:** The channel can be dredged downstream of the LRT bridge with pontoon-mounted grab and backhoes, loading into small and medium sized barges. Upstream of the LRT bridge tyred excavators will be used.

iii. **Transport:** The most obvious transport option would be by barge given that marine access is possible and the closest disposal site is East Sha Chau contaminated mud pits. Material loaded into small barges will be transferred into larger marine-going barges at the River mouth. Should the material be taken to landfill then direct transfer is possible to WENT or by road in closed trucks.

iv. **Disposal Strategy:** The most practical disposal option for contaminated dredged sediment is to East Sha Chau, particularly where dredging has been undertaken using barges as opposed to land based equipment. Using Marine disposal sites will entail minimal transport and handling, thus reducing the potential for environmental impacts. Dredged material from Tuen Mun River Channel would not significantly add to the loads at East Sha Chau. Given that the mudpits at East Sha Chau are subject to environmental controls and monitoring, it is considered that this is an environmentally acceptable option in the short term.

Land based disposal options include the CED operated Pillar Point Landfill site and EPD's WENT landfill which are relatively close to the site. Material upstream of the LRT bridge will be disposed of at a landfill if it contains a substantial volume of rubbish. Sediment which Tier III and Tier IV testing determines to be Class 3 will require landfill disposal, preferably WENT.

While material is currently seriously contaminated, long term controls on pollution sources should improve the situation and beneficial uses are therefore potential long term options for the sediment.

19.4 Key Issues

Water Quality

- Dredging has the potential for negative impacts through the mobilisation and transportation of contaminated sediment and suspended solids. A decrease in the D.O. concentrations could also occur. Given that water quality is showing a trend of improvement in this channel, impacts are a key issue.

Community Impacts

- As the channel lies in an urbanised area, key features of its banks are the promenades and town park which provide a recreational facility for the local community. Thus, dredging has the potential to disrupt the community in terms of noise, odour, visual impacts and access restrictions.
- Residential areas and schools along the channel are potentially sensitive to noise arising from maintenance activities and odour emissions from the channel. The noise impacts, however, are not expected to significantly increase noise experienced at these sites due to the fact that busy roads lie between the residential estates and the channel.
- Community impacts may also arise from access restrictions, as low road bridges may result in the need to divert traffic when lowering equipment. Channel access from the banks may also cause temporary problems if footpaths, cycle ways and promenades are blocked.

19.5 Impact Assessment

19.5.1 Noise Impact Assessment

Works Area

There is one proposed restoration and one recurrent dredging locations in the Tuen Mun River Channel, as shown in Figure 19.1.

Noise Sensitive Receivers

The most affected NSRs around the works area have been identified as those falling within a 300m buffer of the likely works area. The locations of the NSRs are shown in Figure 19.1 and are described in Table 19.4.

TABLE 19.4 DESCRIPTION OF NOISE SENSITIVE RECEIVERS

NSR	Description
J1	Sun Fat Estate
J2	Sun Tuen Mun Centre

Noise Impact Assessment Criteria

Noise levels are controlled by the *Noise Control Ordinance (Cap 400) including its subsidiary regulations and the Technical Memoranda.* (TM).

In addition to the requirements imposed by the Noise Control Ordinance, the following requirements or interpretations were also used as a standard in order to control noise generated from equipment and activities for the purpose of carrying out any construction work other than percussive piling during the time period from 0700 to 1900 hours on any day not being a general holiday:

i) The noise level measured at 1 m from the most affected external facade of the nearby NSRs during any 30-minute period during normal weekly daytime periods between 0700 to 1900 hours will not exceed an equivalent sound level (L_{Aeq}) of 75 dB(A) or 70 dB(A) (or 65 dB(A) during examination) for schools.

ii) Construction should not be undertaken during any other period, the restricted period, without the existence of the relevant Construction Noise Permit (CNP).

iii) In accordance with TM, the area around the dredging locations in Tuen Mun River Channel has an Area Sensitivity Rating (ASR) of 'B'. Therefore ANLs under the current regulation are 65 dB(A) from 1900 to 2300 hours plus all day Sundays and general holidays and 50 dB(A) between 2300 and 0700 hours. Since NSR1 is a school and it is assumed that there will be no classes during all restricted hours. Therefore ANLs in TM will be applied on them.

Assessment Methodology

The dredging works will be undertaken using a pontoon mounted grab/excavator, followed by barge and tug-boat transportation. The likely equipment used during dredging is shown in Table 19.5.

TABLE 19.5 TYPICAL MIX OF EQUIPMENT FOR DREDGING OPERATIONS

Identification Code	Description	Sound Power Level dB(A)
CNP 081	Grab/Excavator	112
CNP 221	Tug Boat	110

The sound power levels of the equipment used in this assessment are derived from the TM.

The equipment was considered to be grouped at a position mid-way between the approximate geographical centre of the dredging area and its boundary nearest to the

NSR. In the case of an oblong area, having a length to width ratio of 5:1 or more, then only the closest portion to the NSR was considered, as defined in the TM.

A total sound power level of the dredging operation was obtained by the summation of all the individual sound power levels of the associated equipment.

The noise levels at each NSR are predicted by the following equation:

Predicted noise level = Total sound power level - 20 $\log_{10}D$ - 8 dB(A)

where D is distance between the NSR and the noise source

A positive correction of 3 dB(A) is made to each predicted noise level due to all concurring activities to account for the facade reflection at the NSR. The predicted unmitigated noise levels are presented in Table 19.6. A detailed calculation spreadsheet is attached in Appendix A5.

TABLE 19.6 UNMITIGATED NOISE LEVELS AT NSRS

NSR	Predicted Noise Level dB(A)
J1*	71[2]
J2	67[2]

Note:

2 *The PNL exceed the ANL of 65 dB(A) from 1900 to 2300 hours, plus all day Sundays and general holidays; and exceeds 50 dB(A) between 2300 and 0700 hours for all days*

The calculation indicated the predicted noise levels at both selected sensitive receivers are within the day time guideline of 75 dB(A). Within J1 there is a school at which noise should not exceed 70dB(A) during the day and 65 dB(A) during examinations. Therefore for residential areas adverse noise impacts are not anticipated provided that the works do not extend into restricted hours. For the school, provided works do not coincide with examination periods, adverse impacts are not anticipated.

19.5.2 Air Quality Impact Assessment

Initially, air quality impacts were identified as a potential key issue due to the expected large volumes of dredged sediment and the associated handling, storage and transportation requirements. However, the anticipated volumes of sediment have been reduced considerably and significant dust (TSP) concentrations are not predicted from dredging operations.

The sediment is of a fine nature and will not give rise to dust emissions provided material is removed from site before completely drying. Also bankside storage of sediment is not recommended given the proximity of ASRs thus impacts will be avoided. All material stored will be kept covered prior to transfer from site. Provided that the general mitigation measures recommended in Section 8 are enforced, air quality impacts with respect to odour and dust are not anticipated.

19.5.3 Water Quality Impacts

Since the water quality is improving in the Tuen Mun River, dredging may have impacts on dissolved oxygen levels and cause short term increases in suspended solids. However, given that the channel is not an ecologically important area or an important fisheries resource the impacts of these short term changes in water quality are not considered significant. As good practice, it is recommended that the general mitigation measures for all dredging works are implemented to minimise release of sediment and water quality impacts. In the longer term, removing contaminated sediment has the potential benefit of further improving water quality which, together with enforcement of legislation on existing polluting discharges, could significantly improve the conditions in the channel.

19.6 Mitigation Measures

The standard specifications detailed in section 8 is considered sufficient to mitigate impacts to acceptable levels.

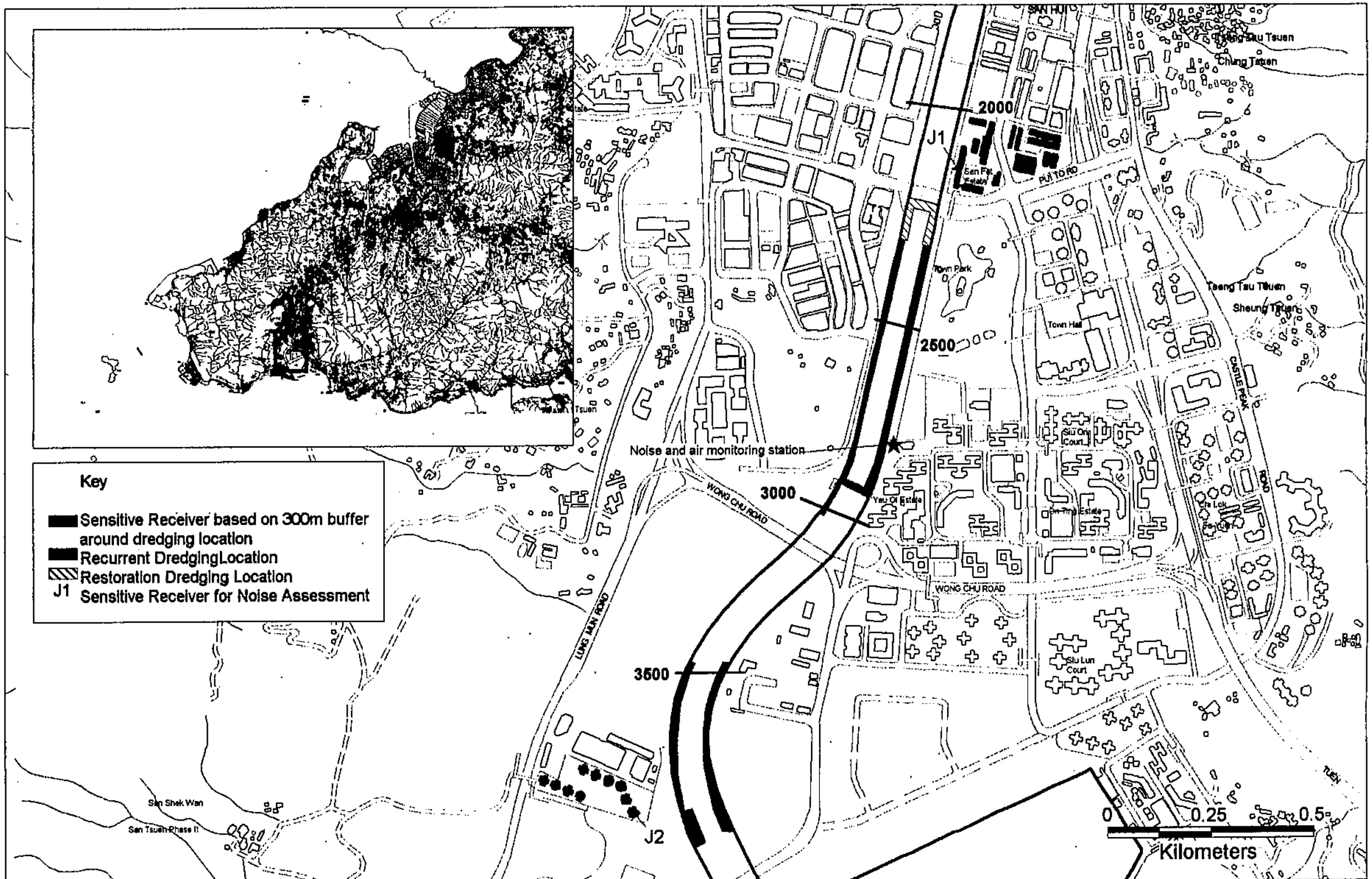

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Figure 19.1 Potential Noise and Air Sensitive Receivers Near Proposed Dredging Locations Tuen Mun River Channel

Source: Lands Department OZP

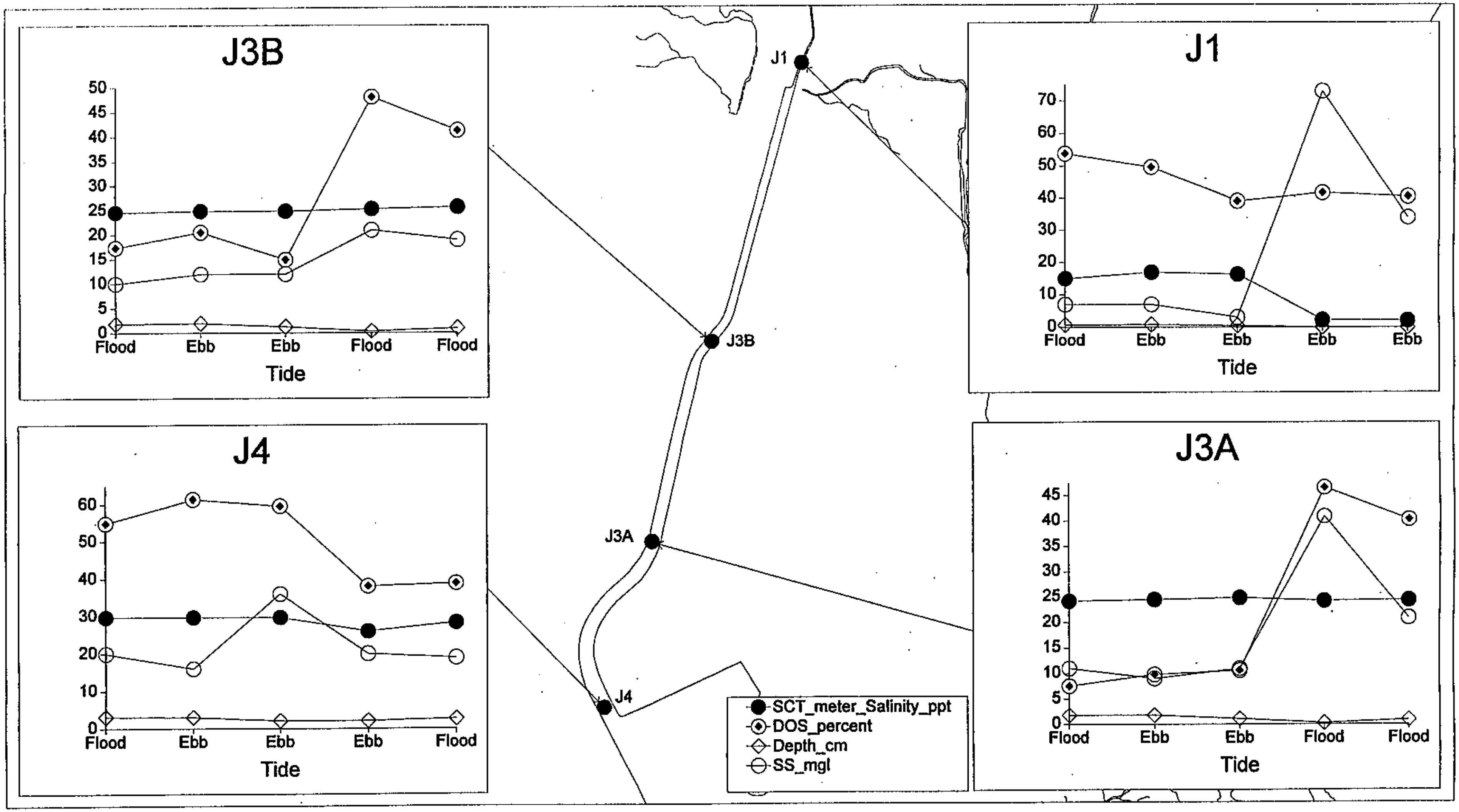

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Figure 19.2 Water Quality Monitoring Results from 18/04/1996
Tuen Mun River Channel

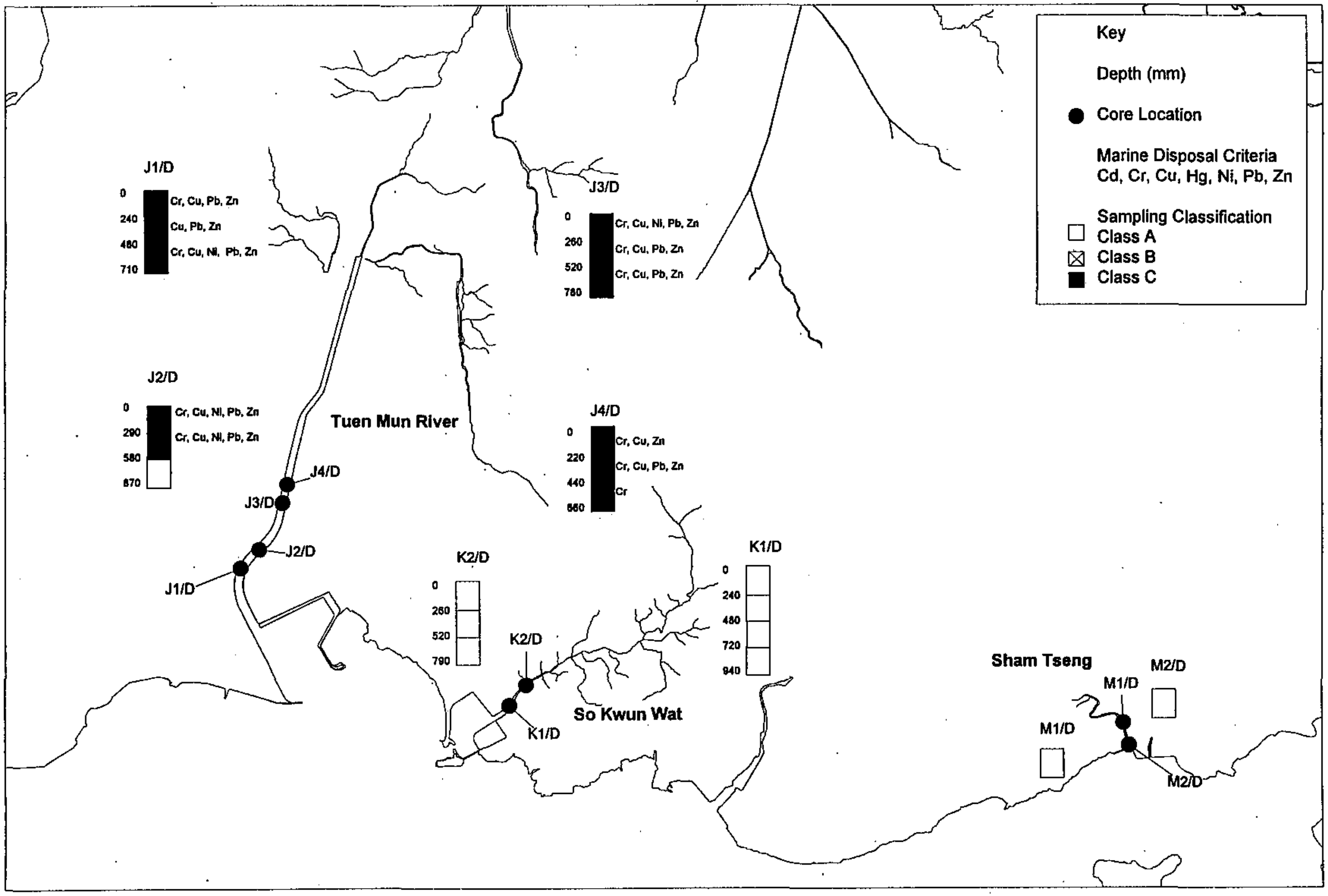

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Figure 19.3 Sediment Core Analysis Results
Tuen Mun River Channel, So Kwun Wat Drainage Channel, and Sham Tseng Nullah

SECTION 20

EIA OF DREDGING WORKS IN SO KWUN WAT RIVER CHANNEL

20. EIA OF DREDGING WORKS IN SO KWUN WAT RIVER CHANNEL

20.1 Introduction

The So Kwun Wat channel is located in the Southwest New Territories, south of the Tai Lam Chung reservoir and east of Tuen Mun New Town, as displayed in Figure 20.1. The potential Sensitive Receivers to noise and air quality impacts are also shown by Figure 20.1. The channel and its tributaries flow for approximately 3 km, although just 700m of the channel length is tidal. The channel is less than 25m wide for most of its length but broadens to approximately 50m wide at its mouth. Boulders are deposited along much of the channel and there are areas of construction debris in places.

20.2 Existing Environment

20.2.1 Existing and Future Land Uses

The upper reaches of the channel pass through the southern boundary of Tai Lam Country Park into an adjacent area of Green Belt. Further down stream the middle reaches of the channel pass through extensive village housing and agricultural areas, particularly on the west bank, before entering an increasingly urbanized area. Approaching the channel mouth, on the east bank is a residential area whilst the land bordering the western bank is predominately used for container storage. Three residential areas are located in the vicinity of the channel including, the Hong Kong Gold Coast to the south of Castle Peak Road, and the villages of Kar Wo Lei and So Kwun Tan to the north.

Future land uses in the vicinity of the channel have been outlined as further village type developments within the existing village areas. At the mouth of the channel works are currently in progress for the development of So Kwun Wat Marina. Adjacent to the marina development area the land is outlined for further high rise residential development.

20.2.2 Air Quality

Baseline air quality was determined during November 1996, from the backyard of Lot 612D, 18 Miles, next to the river channel (Figure 20.1). Monitoring was conducted over seven consecutive days to determine the Total Suspended Particulates (TSP) concentration over a 24 hour period. The methodology used is described in Appendix A4. The results are summarised below in Table 20.1, and are presented in full in Appendix A7.

TABLE 20.1 SUMMARY OF BASELINE AIR QUALITY MONITORING RESULTS

Date of Sampling	Total Suspended Particulate TSP value ug/Std. m^3
22.11.96	189
23.11.96	205
24.11.96	155
25.11.96	116
26.11.96	220
27.11.96	162
28.11.96	126

NB: The Air Quality Objective for 24 hr. TSP measurements is 260 ug/m^3

Observations indicate that the air quality is influenced by vehicle exhausts and dust from traffic on the Tuen Mun and Castle Peak roads. The average TSP value recorded during the monitoring period was 168 ug/Std. m^3.

20.2.3 Noise

The baseline noise survey was undertaken during November 1996 from the front of a village house in Kar Lo Wei village facing the channel. The methodology is in Appendix A4. Noise measurements including $L_{eq\,(30min)}$, L_{10} and L_{90} were taken and the average values and range over a three day monitoring period are summarised in Table 20.2. Full results are presented in Appendix A6.

TABLE 20.2 SUMMARY OF BASELINE NOISE MONITORING RESULTS

Noise Measurement	$L_{eq\,(30min)}$ dB(A)	L_{10} dB(A)	L_{90} dB(A)
Average	55.3	56.6	49.1
Range	49.9 - 61.5	52.0 - 62.5	43.5 - 52.0

The results reflect the relatively quiet rural environment. The difference between the L_{10} and the L_{90} values demonstrates the influence of road traffic noise from Castle Peak Road, as well as typical village noise peaks.

20.2.4 Hydrology and Water Quality

Flood History and Predicted Flooding

The So Kwun Wat Channel was most recently dredged in July 1994 and March 1995 and is known to have a history of flooding under base conditions in its upper reaches.

Flooding predictions were modelled in Task 4 under two scenarios for the existing So Kwun Wat River Channel:

Case 1 - 2 years storm and 10 years tide:

moderate flooding (0.5-1.0m) is predicted at chainage 0-200m.

Case 2 - 10 years storm and 2 years tide:

severe flooding is predicted (>1.0m) at chainage 0-200m.

Pollutant Loads

The site survey was undertaken at the end of March 1995. During the visit, no discharges were recorded entering the channel. No data has been received from the Local Control Office (Territory West) for this channel.

Water Quality

This channel is not routinely monitored by EPD and there is no data available on the water quality. Field observations indicated that the channel contains significant amounts of rubbish and construction debris, particularly in the mid section of the tidal reaches. In the downstream sections of the river the water quality is influenced by marine water, whilst in the upstream reaches of the channel the freshwater appears to be clear and of good quality.

20.2.5 Sediment

The channel was maintenance dredged as recently as July 1994 and March 1995. However, no sediment data is available from the sediment surveys. Field survey observations revealed that in proximity to the villages there is a significant amount of solid debris in the channel, particularly construction waste. The most recent surveys of the channel involved five grab samples taken during July 1995 with two core samples collected during December 1995.

Characteristics

Both grab and core samples were taken from the bed of the So Kwun Wat channel in order to determine grain size distribution. Analysis of the core samples taken downstream, close to the channel mouth, shows that the surface sediment consists of silt, with coarse sand and gravel becoming predominant with increasing depth. The upstream core, which is beyond the proposed dredging location, is comprised predominantly of coarse sand. Core locations and results are displayed in Figure 19.3. The locations and contamination classification for the grab samples are displayed in Figure 20.2. The full core results are presented in Appendix B4.

Quality

Three of the grab samples revealed that the sediment is sufficiently contaminated with lead and zinc to justify a Class 'C' grading (Appendix B3). In contrast, the core samples collected at a later date did not contain any Class 'C' material and are classed as uncontaminated. Nutrient concentrations and organic carbon and organic matter levels were low, suggesting that the sediment mainly comprises naturally eroded soil and construction-derived materials.

20.2.6 Ecology

Riparian Flora and Fauna

Surrounding land uses include open storage, residential and agricultural. Some trees remain along the mid and upper portions of the study area, while the channel bank structure varies between earth, rocks and concrete. No terrestrial flora or fauna of significance was observed during the river inspections and the River Corridor Survey.

Aquatic Fauna

The tidal portion of the channel is used by marine and salt tolerant stream fish, whilst freshwater fish are confined to the non-tidal area. The diversity of the aquatic community will depend on the sediment and water quality, which were generally found to be of a good quality. However, intertidal diversity is anticipated to be low due to the artificial channel mouth.

20.3 Proposed Works

20.3.1 Dredging Requirements

With sedimentation of +1.0 m PD between Ch. 0-200m and Ch. 400-650m, the extent and severity of the predicted flooding does not change from base levels. Task 4 has indicated that dredging would only have marginal effects on water levels, resulting in moderate flooding for both a 1 in 10 year tide and a 1 in 10 year storm.

With respect to marine sediment the So Kwun Wat channel is self-cleansing. The combined load of fluviatile sediment and that from construction activity is estimated to be 1,150 m^3 per year, and is predicted to be deposited mainly between chainages 320 and 520 m. Annual accretion of 10 cm is expected from fluviatile sediment and 5 cm from construction works. There is no requirement for restoration dredging since Task 4 has not identified any side channels or culverts of concern.

Task 4 and 5 Recommendation: It is recommended that maintenance dredging is carried out every four years, with a view to leaving a margin of some 20 cm between the maximum predicted high water level and the lowest bank level.

20.3.2 Dredging Strategy

Should dredging occur, the suggested strategy is based upon the recommendations of Task 5:

i. ***Access:*** Marine access is possible only at the channel mouth below Castle Peak Road bridge, although even here there is limited access. The remainder of the channel can only be accessed using land based plant deployed from the bank side. A small parking area adjacent to Castle Peak Road provides the only access from the east bank and tracked dredgers could be deployed using a mechanical crane. Access to the channel from the west bank is easier, but would require the formation of temporary earth ramps. Access is easiest further upstream close to the Tuen Mun Road bridge near the confluence.

ii. ***Transport:*** As the sediment is generally coarse and free-draining, and since dredging will be undertaken using land-based plant, the material will typically have a low water content. Consequently the sediment should be suitable for road transport after a relatively short period of bank-side dewatering. Soft sediment, if dredged at the channel mouth, will require barge transfer to the mud pits at ESC.

iii. ***Dredging:*** Maintenance of the upper section of the channel above the footbridge would best be carried out using a combination of excavation by tracked backhoe and manual clearance. Between the footbridge and Castle Peak Road bridge, low ground pressure tracked excavators could be deployed, with dozer blades if necessary, to stockpile the sediment adjacent to Castle Peak Road for subsequent transfer to trucks. This includes the area of restricted sediment removal due to low tides under the bridge. A grab dredger could be used if maintenance is required at the mouth of the channel. For the short stretch of the single tributary to be excavated, maintenance would be carried out using a combination of tracked backhoe and manual clearance. All dredged material should be stored in covered skips prior to transportation off-site.

iv. ***Disposal Strategy:*** The channel sediment is generally coarse and consequently free-draining. In addition, excavation will be by land-based excavator which aids draining of the material. These factors, along with the large amount of construction debris in the channel, indicates that a land-based disposal is most feasible. A Public Dump facility would be the best short-term option. Alternatively, material could be re-used or disposed on private land. If dredging is undertaken at the channel mouth then the predominantly marine sediment will probably be contaminated, thus justifying disposal to the ESC contaminated mud pits.

20.4 Key Issues

Ecology

- Land based plant will require access to the sides of the channel and will create initial disturbance. Damage to bankside vegetation must be minimised or avoided.

Community Impacts

- Residential areas along the channel are located less than 20 metres from the likely dredging location. The operation of equipment so close to sensitive receivers will generate significant noise impacts.

20.5 Impact Assessment

20.5.1 Noise and Air Quality

Works Area

There is only one proposed recurrent dredging location in So Kwun Wat as shown in Figure 20.1.

Noise Sensitive Receivers

The NSRs around the works area which are most likely to be affected are those falling within a 300m buffer of the anticipated works area. The locations of the NSRs are shown in Figure 20.1 and are described in Table 20.3 below:

TABLE 20.3 DESCRIPTION OF NOISE SENSITIVE RECEIVERS

NSR	Description
K1	Kar Wo Lei
K2	Hong Kong Gold Coast
K3	So Kwun Tan

Noise Impact Assessment Criteria

Noise levels are limited by the Noise Control Ordinance (Cap 400) including its subsidiary regulations and the Technical Memoranda. (TM).

In addition to the requirements imposed by the Noise Control Ordinance, the following requirements or interpretations were used as a standard in order to control noise generated from equipment and activities for the purpose of carrying out any construction work other than percussive piling during the time period from 0700 to 1900 hours on any day not being a general holiday:

i) The noise level measured at 1m from the most affected external facade of the nearby NSRs during any 30-minute period during normal weekly daytime periods between 0700 to 1900 hours will not exceed an equivalent sound level (L_{eq}) of 75 dB(A) or 70 dB(A) (or 65 dB(A) during examination) for schools.

ii) Construction should not be undertaken during any other period, the restricted period, without the existence of the relevant Construction Noise Permit (CNP).

iii) In accordance with TM, the area around the dredging locations in So Kwun Wat has an Area Sensitivity Rating (ASR) of 'A'. Therefore ANLs under the current regulation are 60 dB(A) from 1900 to 2300 hours plus all day Sundays and general holidays and 45 dB(A) between 2300 and 0700 hours.

Assessment Methodology

The proposed dredging works will be undertaken using a low ground pressure tracked excavator and the dredged material will be transported off site by trucks once full. The engine of the truck is assumed to be switched off during most of the time at the site. The noise impact generated from trucks is therefore considered insignificant and is not considered in this assessment. The equipment likely to be required for dredging is shown in Table 20.4.

TABLE 20.4 TYPICAL MIX OF EQUIPMENT FOR DREDGING OPERATIONS

Identification Code	Description	Sound Power Level dB(A)
CNP 081	Excavator	112

The sound power levels of the equipment used in this assessment are derived from the TM.

The excavator is considered to be located at a position mid-way between the approximate geographical centre of the dredging area and its boundary nearest to the NSR. In the case of an oblong area, having a length to width ratio of 5:1 or more, then the closest portion to the NSR only has been considered, as defined in the TM.

A total sound power level of the dredging operation is obtained by summing all the individual sound power levels of the associated equipment.

The noise levels at each NSR are predicted by the following equation:

Predicted noise level = Total sound power level - 20 $\log_{10}D$ - 8 dB(A)

where D is distance between the NSR and the noise source

A positive correction of 3 dB(A) is made to each predicted noise level due to all concurring activities to account for the facade reflection at the NSR. The predicted unmitigated noise levels are presented in Table 20.5. A detailed calculation spreadsheet is attached in Appendix A5.

TABLE 20.5 UNMITIGATED NOISE LEVELS AT NSRS

NSR	Predicted Noise Level dB(A)
K1	84[3]
K2	73[2]
K3	88[3]

Note:

2 *The PNL exceeds the ANL of 60 dB(A) from 1900 to 2300 hours, plus all day Sundays and general holidays, and 45 dB(A) between 2300 and 0700 hours for all days*

3 *The PNL exceeds the day time guideline of 75 dB(A) and the ANL of 60 dB(A) from 1900 to 2300 hours, plus all day Sundays and general holidays; and exceeds 45 dB(A) between 2300 and 0700 hours for all days*

Due to the short distances from both K1 and K3 to the proposed dredging location, respective predicted noise levels up to 84 dB(A) and 88 dB(A) are anticipated. Therefore mitigation measures are necessary if noise emissions are to be kept within or close to EPD guideline values.

Suggested Mitigation Measures

Appropriate mitigation measures should be incorporated into the dredging manuals to bring down the noise level close to or below the 75 dB(A) guideline.

It is anticipated that the actual equipment used will have a lower SPL than that set out in the TM. Using smaller plant and equipment such as that being recommended by Task 5 for the dredging operation is considered the most cost effective way to control the excessive noise at source.

Although an acoustic barrier is considered an effective way of obtaining an overall noise reduction of between 5 to 10 dB(A), the short duration of the proposed dredging works dictates that the construction of such a barrier is not cost effective. Temporary noise barriers are an alternative but their erection can cause equally significant impacts in terms of noise, blockage of footpaths and visual impacts. Liaison with affected institutions is recommended to explain the need for the proposed works. No works should be undertaken during night time hours.

20.5.2 Air Quality Assessment

As the average background 24 hr-TSP concentration was 160 ug/m^3, additional TSP inputs to the local environment from dredging works must be avoided to maintain acceptable air quality. Since dredged material will be stored in covered skips to avoid dust emissions, no further release is anticipated. Dust emissions from vehicle movements are anticipated to be negligible, so no impacts should arise provided the general measures in Section 8 are followed.

The generally coarse nature of the sediment in the So Kwun Wat Channel is unsuitable for adsorption by contaminated material particles, although the surface sediment in core K1 was comprised of silt. However, the presence of odour generating substances in the sediment, such as ammoniacal nitrogen and organic carbon, was very low. No odour was detected emanating from the Channel during preliminary site investigations and odour is not considered as a potential constraint to dredging works. Adherence to the air quality mitigation measures included in Section 8 is necessary.

20.5.3 Ecological Impacts

The potential for ecological impact arising from the dredging itself is low, although land access to the channel may result in damage to the remaining bankside vegetation and associated fauna. It will be necessary to recognise this as a potential constraint to dredging operations and unavoidable damage to vegetation should be mitigated through reseeding, also necessary for erosion control. Seed mixes should be native species typical of the local habitats. Suggested species are given in Section 4.

20.5.4 Water Quality Impacts

There is a considerable amount of debris which may need to be removed prior to dredging in order to minimise the impacts on water quality. On a site visit in November litter clearance of the channel was observed. A boom had been placed across the channel immediately south of the Castle Peak Road, presumably by the management of the Gold Coast Residential Area. This may therefore be appropriate during the dredging operations to contain floating debris within the works area.

The channel bed sediments are of a coarse nature which reduces the likelihood of additional impacts occurring from the presence of organic or heavy metal contaminants. Provided that good practice is observed impacts on water quality will be within acceptable levels.

20.6 Mitigation Measures

Mitigation measures proposed over and above the standard mitigation in section 8 is discussed below:

20.6.1 Noise

The proposed maintenance dredging will be in close proximity to many sensitive receivers on both sides of the downstream section of the channel. Noise impacts are therefore of concern. The unmitigated noise level at Sensitive Receivers (SRs) K2 is 73 dB(A), thus daytime dredging is acceptable. For NSRs K1 and K3 however, the unmitigated noise levels are anticipated to reach 84 and 88 dB(A) respectively and as a result exceed daytime noise criteria by up to 13 dB(A). Although temporary noise barriers could in theory achieve a 10dB(A) reduction at NSRs, their installation and very presence is considered to have a far greater impact than the short duration of noise likely to be experienced when the dredger is actually operating close to the

NSR. Noise monitoring will be required for works of two weeks or more within 50m of a particular SR.

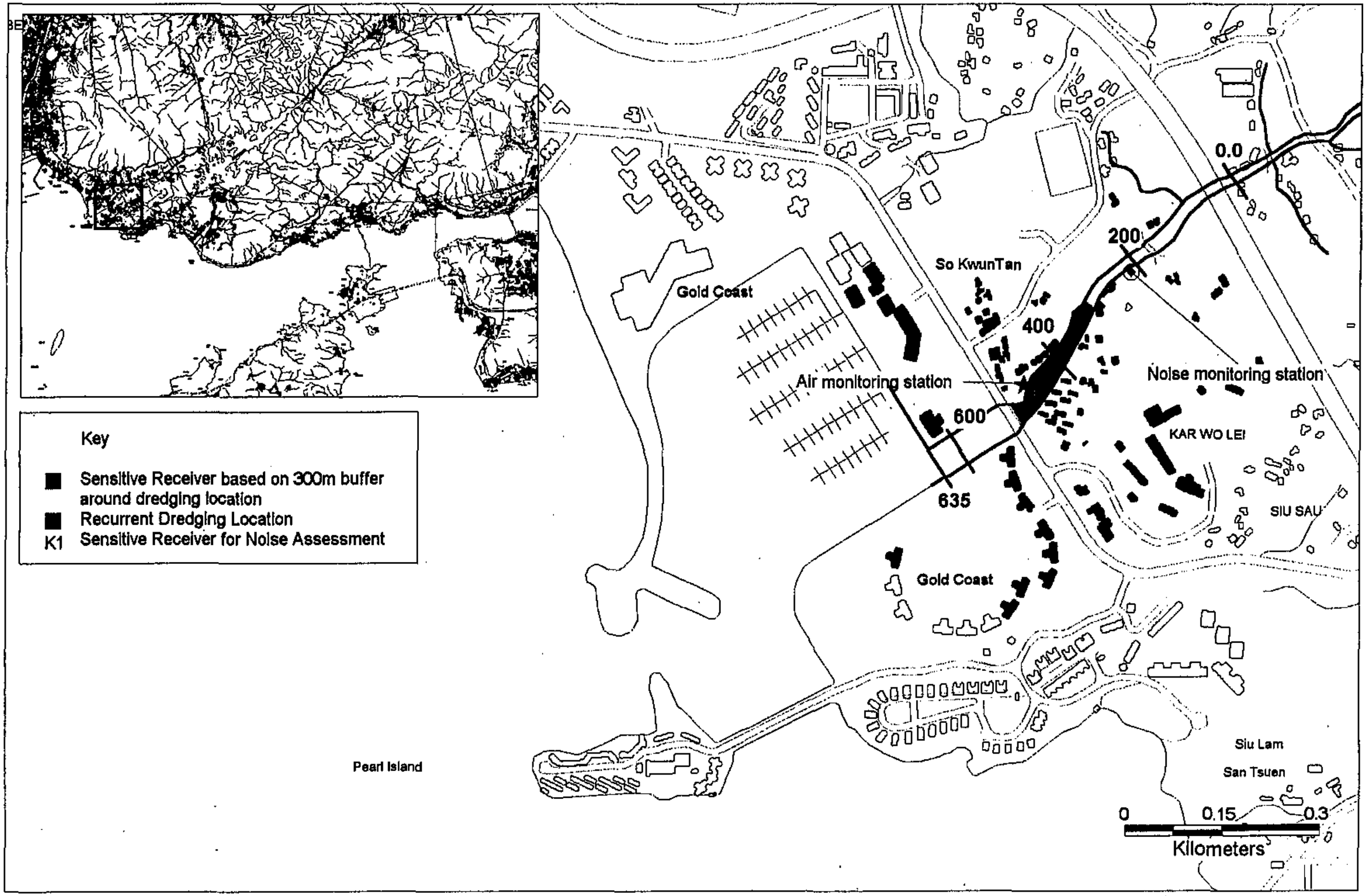

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Figure 20.1 Potential Noise and Air Sensitive Receivers Near Proposed Dredging Locations So Kwun Wat Drainage Channel

Source: Lands Department OZP

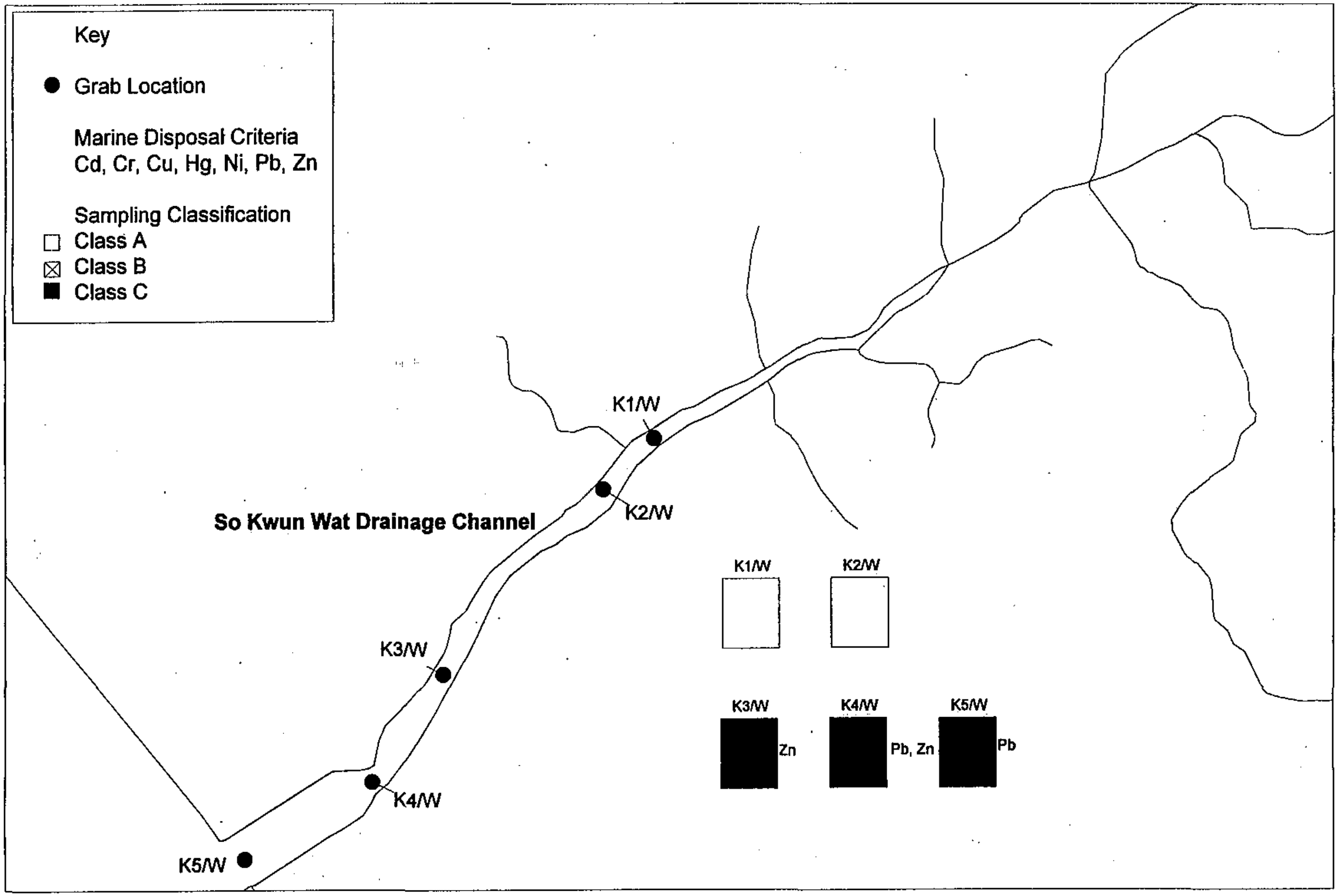

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Figure 20.2 Sediment Grab Analysis Results So Kwun Wat Drainage Channel

SECTION 21

EIA OF DREDGING WORKS IN TAI LAM CHUNG RIVER CHANNEL

21. EIA OF DREDGING WORKS IN TAI LAM CHUNG RIVER CHANNEL

21.1 Introduction

Tai Lam Chung River Channel is located in the Southeast New Territories, approximately equidistant from Tuen Mun and Tsuen Wan. The channel flows for 1.6 km between the Tai Lam Chung Reservoir and Lantau Bay and lies in a catchment area of just 2.5 km^2. The channel location and its Sensitive Receivers are displayed in Figure 21.1.

At present, maintenance of the stretch of channel between the mouth and Cedric Bridge is the responsibility of the Civil Engineering Department (CED), whilst maintenance of the channel upstream of this is the responsibility of Drainage Services Department (DSD).

21.2 Existing Environment

21.2.1 Existing and Future Land Uses

To the south of the reservoir the channel is surrounded by the Tai Lam Correctional Institution. Further downstream between the middle and lower-reaches are areas of open storage, whilst at the channel mouth is the Seaman's Training Centre. The channel banks are covered in vegetation along much of their length, beyond which there is a substantial area of Green Belt which acts as a buffer zone to the Country Park. Agricultural land and grassland account for 57% of the catchment area with some 5% comprised of erodable bare soil. There is very limited residential development along the channel's length.

Utility service pipes are present in places under the channel. A 750 mm diameter gas pipeline has recently been laid beneath the east side of the channel bed from the CSD facility to the mouth, whilst there is a water mains pipe 1-2m under the bed from slightly upstream of Cedric Bridge to the channel mouth.

The only development type so far proposed for the surrounding land is an extension of the existing village areas which exist around the middle reaches of the channel.

21.2.2 Air Quality and Noise

Field observations during a site visit in March indicates that there are no major sources of air pollution affecting air quality in the upper and lower portions of the study area. No odour was detected around the channel.

Baseline noise levels at the lower section of the channel were very high due to channel works and road traffic, ranging between 56.6 dB(A) to 70.3 dB(A).

21.2.3 Hydrology and Water Quality

<u>Flood History and Predicted Flooding</u>

Historically the channel has been prone to flooding. Flooding predictions were modelled in Task 4 under two scenarios for the existing Tai Lam Chung River channel: Under a 2 years storm and 10 years tide, minor flooding occurs between ch. 1400-1700m. For a 10 years storm and 2 years tide no flooding is predicted.

Pollutant Loads

No data has been received from the EPD Local Control Office for pollutant loadings into the channel. The channel is not routinely monitored by EPD and there is therefore presently very little data relating to pollutant loading into the channel. No discharge pipes were observed during the site visit in March.

Water Quality

The Tai Lam Chung River Channel is not routinely monitored by EPD and was not included in the water quality surveys. No other sources of water quality data have been identified.

21.2.4 Sediment

The bed sediment in the Tai Lam Chung has been sampled and analysed on several occasions in recent times. This has mainly been prior to maintenance dredging which commenced in August 1994 and continued into 1995. Grab samples were collected from nine locations from the channel specifically for the purposes of this Study. Sample collection was restricted to the upstream section of the channel due to engineering works. The locations and grab results are displayed in Figure 21.2. Full grab results are presented in Appendix B3. No core samples were taken from the channel.

Characteristics

The results of sampling in April 1995 revealed that the sediment consists of a light grey sticky clay, becoming increasingly coarser further downstream. Particle size analysis of the July 1995 upstream grab samples was undertaken. The results classified the sediment from coarse sand to gravel, with a small silt component - a conclusion which is also supported by wet season visual observations.

Quality

Sediment grab samples were analysed prior to the 1994/95 engineering works and the metal concentrations were compared to EPD contamination criteria. It was found that samples close to the channel mouth were contaminated with copper and zinc to Class 'C'. Samples taken in the mid-upper reaches of the tidal channel indicated that the majority of the sediment was uncontaminated, Class 'A'.

The results from the grab samples indicate that the sediment is generally clean. However, two samples contained elevated levels of lead. Organic carbon content in the grab samples was low.

21.2.5 Ecology

Riparian Flora and Fauna

The tidal portion of the channel has concrete-lined banks and the surrounding land is developed. The terrestrial ecology is considered to be of little conservation value. The middle and upper portions of the channel have earth banks and much less dense urban development in surrounding areas. In these areas the bankside trees and vegetation represent a habitat increasingly under threat in Hong Kong. Such areas should be conserved as a diminishing resource, despite the fact that they have no special ecological significance. The man-made nature of the channel in the inter-tidal reach precludes the presence of ecological resources of conservation interest.

Aquatic Fauna

No information is available at present though it would appear from the River Corridor Survey that there is unlikely to be any species of high conservation value in the channel.

21.3 Proposed Works

21.3.1 Dredging Requirements

Tai Lam Chung channel is generally self-cleansing, so marine sediment accumulation is not considered as affecting the extent or frequency of flooding in any way.

The annual input from coarse fluviatile sediment is 280 m^3. Due to the presence of the Reservoir, all inputs are from the lateral sub-catchments.

Modelling indicates that sedimentation of up to 1 m above present bed levels in the lower section of the channel would have a negligible effect on predicted water levels and therefore does not increase flooding. Sedimentation of 0.5m along the entire length of the channel raises predicted water levels in the upper reaches of the channel. However the raised levels are adequately contained by the channel banks. Dredging in the sections where flooding is observed under base conditions has no noticeable effect on the predicted water levels in this area, and as such does not alleviate flooding during extreme events.

Task 4 and 5 Recommendations: The river is self-cleansing with respect to soft-sediment in all areas, except for 300 - 400m beyond the second bridge where sediment may accumulate.

It is recommended that fluviatile inputs around Ch. 1100 should undergo maintenance dredging every 10 years, with the exact locations of dredging to be determined by a monitoring programme.

21.3.2 Dredging Strategy

i **Access:** The lower reaches of the channel are only accessible at low water due to the height restriction of Tai Lam Bridge at the mouth of the channel. Low air-draft equipment would thus be required. Access to the wider section of the channel adjacent to the Customs and Excise Training Centre will be via an existing ramp on the east bank at chainage 1150. It is likely that the majority of dredging will be in the mid to upper reaches of the channel where land access is more practical.

ii **Dredging:** In the lower reaches of the channel it is likely that marine plant such as pontoon-mounted grabs or excavators will be used. In the wider middle section of the channel it may be necessary to deploy a combination of tracked and pontoon-mounted excavators with small barges to transfer sediment to skips at the bankside. Upstream, land-based tracked excavators and manual methods of excavation will be required. Mini excavators and manual methods will be required in the uppermost section, adjacent to the Correctional Institution

iii **Transport:** The most likely transport option would be by barge where marine access is possible. Where the channel is accessed from the bank side it will be more convenient to transport the material by road to a land based disposal site.

iv **Disposal Strategy:** The sediments in the lower channel, below Cedric Bridge, contain a considerable proportion of fines and if uncontaminated may best be disposed of in a redundant MBA. The disposal of any contaminated sediment would most likely be to the nearby marine disposal area at East Sha Chau, or possibly a future ISM facility.

Land based disposal options would most sensibly include the WENT landfill which is relatively close to the channel. The sediment above Cedric Bridge is relatively coarse and consequently could have potential for a beneficial use. Disposal to a Public Dump or private land are also viable options for sediment from the middle and upper reaches of the channel.

21.4 Key Issues

Ecology

- Damage to bankside vegetation may arise from land access, particularly in the upper reaches of the Channel.

Water Quality

- Dredging will lead to the release of bed sediment into flowing water, and consequently there are possibilities of physio-chemical disturbance to the water column.

Community Impacts

- Dredging is considered a key issue as regards noise impacts due to the presence of numerous residential NSRs.

21.5 Impact Assessment

21.5.1 Noise Impact Assessment

Works Area

There is only one proposed recurrent dredging location in Tai Lam Chung River Channel and this is shown in Figure 21.1.

Noise Sensitive Receivers

The most affected NSRs around the works area have been identified as those falling within a 300m buffer of the likely works area. The locations of the NSRs are shown in Figure 21.1 and are described in Table 21.1 below

TABLE 21.1 DESCRIPTION OF NOISE SENSITIVE RECEIVERS

NSR	Description
L1	Tai Lam Chung Tsuen
L2	Luen On San Tsuen

Noise Impact Assessment Criteria

Noise levels are limited by the Noise Control Ordinance (Cap 400) including its subsidiary regulations and the Technical Memoranda. (TM).

In addition to the requirements imposed by the Noise Control Ordinance, the following requirements or interpretations were used as a standard in order to control noise generated from equipment and activities for the purpose of carrying out any construction work other than percussive piling during the time period from 0700 to 1900 hours on any day not being a general holiday:

i) The noise level measured at 1 m from the most affected external facade of the nearby NSRs during any 30-minute period during normal weekly daytime periods between 0700 to 1900 hours will not exceed an equivalent sound level (L_{Aeq}) of 75 dB(A) or 70 dB(A) (or 65 dB(A) during examination) for schools.

ii) Construction should not be undertaken during any other period, the restricted period, without the existence of the relevant Construction Noise Permit (CNP).

iii) In accordance with TM, the area around the dredging locations in Tai Lam Chung River Channel has an Area Sensitivity Rating (ASR) of 'A'. Therefore ANLs under the current regulation are 60 dB(A) from 1900 to 2300 hours plus all day Sundays and general holidays and 45 dB(A) between 2300 and 0700 hours.

Assessment Methodology

It is understood from task 5 that the dredging works will be undertaken using a pontoon mounted grab/excavator and the dredged material will be transported off site by barges. Tug boats will be involved during transportation. The likely equipment to be used for dredging is shown in Table 21.2.

TABLE 21.2 TYPICAL MIX OF EQUIPMENT FOR DREDGING OPERATIONS

Identification Code	Description	Sound Power Level dB(A)
CNP 081	Grab/Excavator	112
CNP 221	Tug Boat	110

The sound power levels of the equipment used in this assessment are derived from the TM.

The equipment was considered to be grouped at a position mid-way between the approximate geographical centre of the dredging area and its boundary nearest to the NSR. In the case of an oblong area, having a length to width ratio of 5:1 or more, then only the closest portion to the NSR has been considered, as defined in the TM.

A total sound power level of the dredging operation is obtained by summing all the individual sound power levels of the associated equipment.

The noise levels at each NSR are predicted by the following equation:

Predicted noise level = Total sound power level - 20 $\log_{10}D$ - 8 dB(A)

where D is distance between the NSR and the noise source

A positive correction of 3 dB(A) was made to each predicted noise level arising from concurring activities to account for the facade reflection at the NSR. The predicted unmitigated noise levels are presented in Table 21.3. A detailed calculation spreadsheet is attached in Appendix A5.

TABLE 21.3 UNMITIGATED NOISE LEVELS AT NSRS

NSR	Predicted Noise Level dB(A)
L1	83[3]
L2	66[2]

Note:

2 *The PNL exceeds the evening ANL of 60 dB(A), plus all day Sundays and general holidays, and exceeds 45 dB(A) between 2300 and 0700 hours for all days*

3 *The PNL exceeds the daytime guideline of 75 dB(A) and 60 dB(A) from 1900 to 2300 hours, plus all day Sundays and general holidays, and exceeds 45 dB(A) between 2300 and 0700 hours for all days*

Due to the short distance between L1 and the proposed dredging location, noise level predictions are as great as 83 dB(A) under the worst case scenario: (note: both pontoon mounted grab and tug boat are in full operation). Significant noise impacts due to the dredging works are anticipated at L1 even during day time in normal weekdays. Therefore mitigation measures are necessary if EPD daytime guidelines are to be met (75dB(A)).

<u>Suggested Mitigation Measures</u>

Appropriate mitigation measures include the phasing of works to avoid cumulative noise impacts. The contractor should ensure that either only the grab or a tug boat is operated at any one time. The mitigated predicted noise levels at NSRs are presented in the Table 21.4 below. It is noted that the predicted mitigated noise levels at L1 still exceed the daytime guideline noise levels by 6 dB(A) so further mitigation measures are necessary.

TABLE 21.4 MITIGATED NOISE LEVELS AT NSRS

NSR	Predicted Noise Level dB(A)
L1	79 - 81[3]
L2	62 - 64[2]

Note:

2 *The PNL exceeds the ANL of 60 dB(A) from 1900 to 2300 hours plus all day during Sunday and general holidays; and 45 dB(A) from 2300 to 0700 hours for all days*

3 *The PNL exceeds the daytime guideline of 75 dB(A) and ANLs of 60 dB(A) from 1900 to 2300 hours plus all day during Sundays and general holidays; and 45 dB(A) from 2300 to 0700 hours for all days*

As for the other channels, task 5 proposes to use small scale dredging equipment for the maintenance works which are likely to have a lower SPL than that quoted in the TM. It is probable that the predicted noise levels are worst case and in reality are likely to be lower. Acoustic barriers are an effective way of obtaining an overall noise reduction of between 5 to 10 dB(A) but the short duration of the proposed dredging works means that the construction of such a barrier is not cost effective. Temporary barriers can cause noise impacts during erection and relocation and blockages of footpaths as well as visual impacts. Temporary barriers are therefore not recommended.

21.5.2 Air Quality Assessment

The results of preliminary field observations indicated no potential sources of dust or odour in the vicinity of the prospective dredging works. As sediment testing revealed that the bed material is clean, and as all dredged material will be kept in covered skips prior to transfer away from site, no air quality impacts are anticipated.

21.5.3 Water Quality Impacts

Impacts associated with contaminant release are not a major issue for this channel due to the generally good sediment quality. The sediment grab samples taken from the proposed dredging location were all Class 'A'. The release of particulates and the physical impacts on water quality associated with increased turbidity will not result in significant water quality impacts as supported by the modelling findings, Section 3, Volume A. Given that the ecology of the channel is not of great interest and that the sediment is predominantly clean, water quality impacts will not have significant secondary impacts on fauna and flora.

21.6 Mitigation Measures

Provided the standard specifications listed in Section 8 are followed, no further mitigation other than for potential noise impacts is considered necessary.

21.6.1 Noise

Work will be confined to normal daytime hours in view of the methods to be employed. As the mitigated noise level at NSR L1 exceeds the guideline of 75 dB(A) by up to 6 dB(A), additional mitigation is needed to achieve the daytime guideline. However, as discussed for So Kwun Wat, the requirement for noise barriers is inappropriate given the short duration of the works and also impacts associated with the barrier and its erection and dismantling.

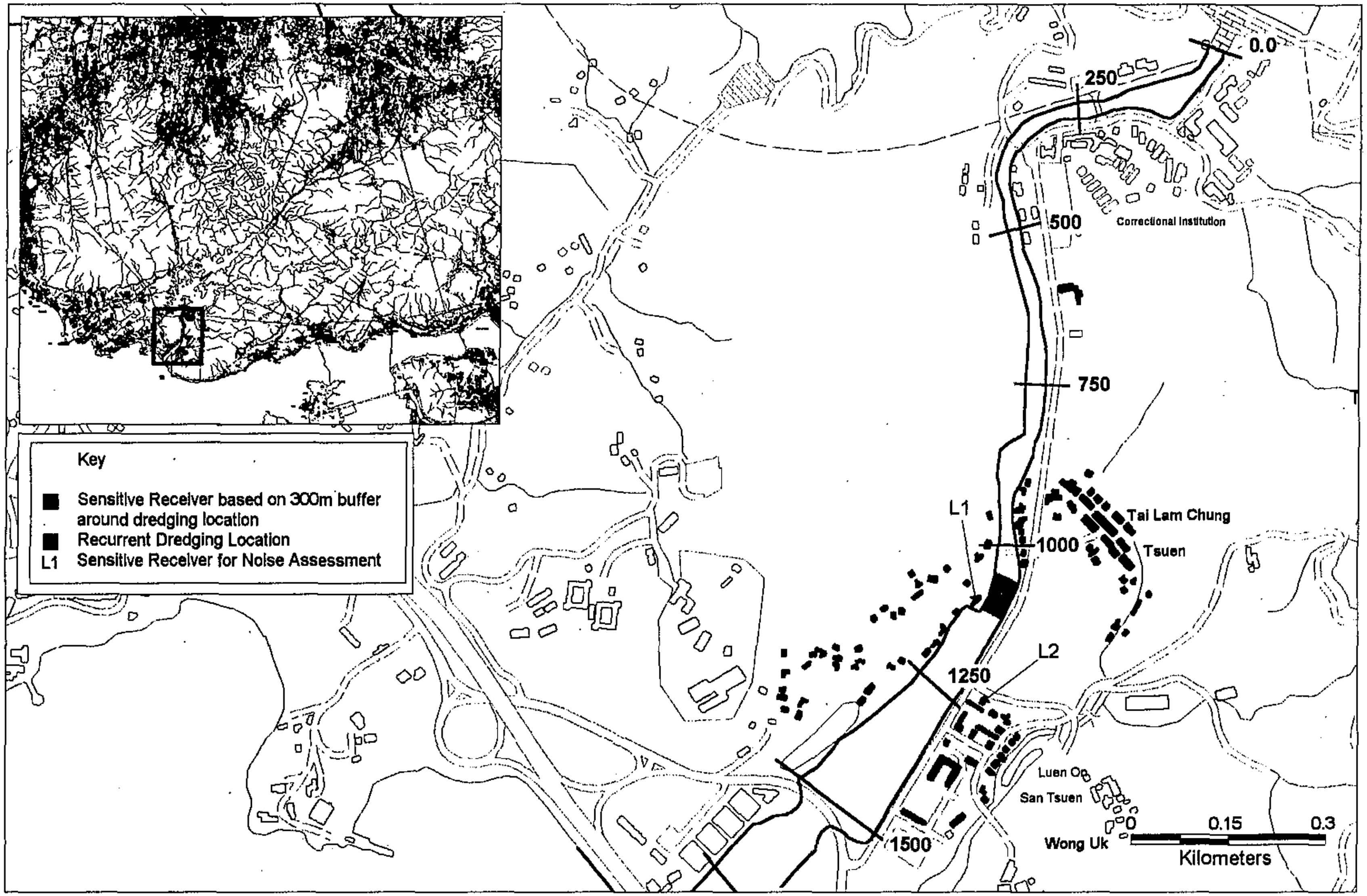

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Figure 21.1 Potential Noise and Air Sensitive Receivers Near Proposed Dredging Location Tai Lam Chung River Channel

Source: Lands Department OZP

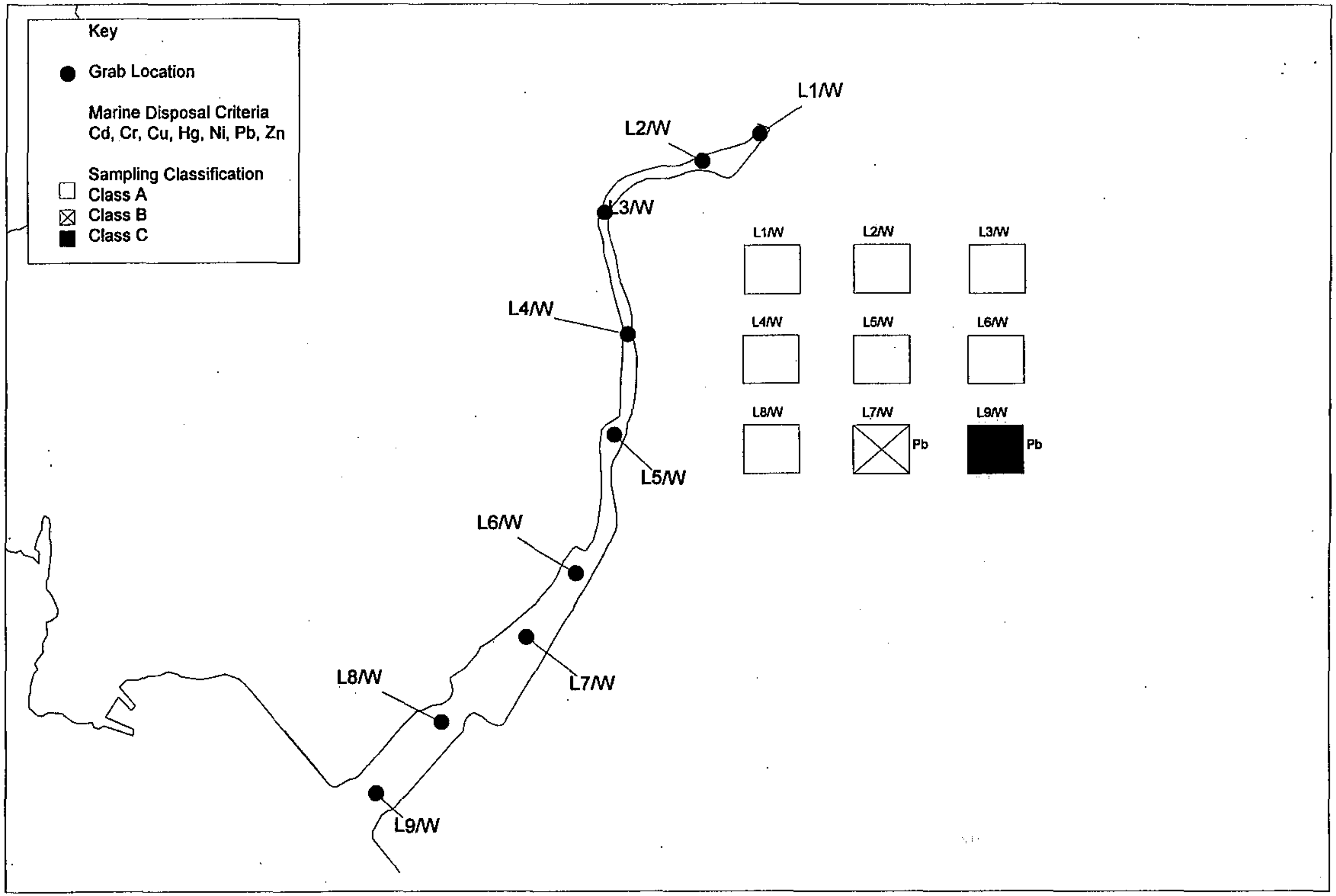

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Figure 21.2 Sediment Grab Analysis Results
Tai Lam Chung River Channel

SECTION 22

EIA OF DREDGING WORKS IN SHAM TSENG NULLAH

22. EIA OF DREDGING WORKS IN SHAM TSENG NULLAH

22.1 Introduction

Sham Tseng Nullah is located in the Southwest New Territories, west of Tsuen Wan. The location of the channel and Sensitive Receivers to noise and air quality impacts are displayed in Figure 22.1. The total channel length is approximately 1.3 km, although the tidal reach is limited to some 400m. The channel flows from the Sham Tseng Settlement Basin out into the Ma Wan Channel between Tsuen Wan and Tuen Mun New Towns.

22.2 Existing Environment

22.2.1 Existing and Future Land Uses

Below the settlement basin the upper reaches of the nullah pass through undulating and undeveloped land via an engineered channel with a sequence of weirs. The middle reaches pass through an area of predominantly residential development which continues along the west side of the channel down to its mouth, whilst on the east side of the mouth is the San Miguel Brewery.

Reclamation is planned at Sham Tseng and as part of this plan it is intended to deck over the nullah south of the Castle Peak Road and to extend it through a culvert to the new foreshore. The new reclamation extending to the west of the nullah will provide for residential, new roads, schools and open space.

22.2.2 Air Quality and Noise

Field observations have indicated that the air quality around Sham Tseng Nullah is affected in the low-mid reaches of the channel by traffic emissions from Tuen Mun Road and Castle Peak Road. EPD's nearest air quality monitoring station is located in the comparatively densely populated area of Tsuen Wan and data for 1995 shows an exceedance of the annual average Air Quality Objective for Total Suspended Particulates, (*Environment Hong Kong 1996, EPD*). The air baseline survey for the So Kwun Wat channel is November 1996 is likely to provide the best indication of air quality in this area, with results averaging out at 168 ug/m^3 for 24 hour TSP monitoring.

During a site visit a strong organic odour was detected at the downstream end of the stilted village in Sham Tseng. The source is thought to be the discharge of untreated sewage and/or the discharge of effluent rich in organic waste from the many restaurants in the area.

This channel was not subject to the baseline noise survey, however, background noise levels were measured during the early phases of this study in the upper and lower reaches of the channel. Downstream noise levels were recorded as 63 dB(A) $L_{eq\ (5mins)}$ and were influenced by the San Miguel Brewery and traffic from Castle Peak Road. Upstream noise levels were lower, around 56.6 dB(A) $L_{eq\ (5mins)}$ reflecting the flow of water in the channel as the dominant noise source.

22.2.3 Hydrology and Water Quality

Flood History and Predicted Flooding

There are no historical records of flooding in Sham Tseng nullah.

Flooding predictions were modelled in Task 4 under two scenarios for the existing Sham Tseng channel:

Case 1 - 10 years storm and 200 years tide:

moderate flooding (0.5-1.0m) is predicted at chainage 0-110m; and

Case 2 - 200 years storm and 10 years tide:

severe flooding (>1.0m) is predicted at chainage 0-90m.

Pollutant Loads

Data received from EPD, Local Control Office indicates that the BOD loadings into the channel are approximately 395 kg/day. The 1991 Tsuen Wan, Kwai Chung, Tsing Yi Masterplan Study states that the nullah adjacent to Sham Tseng village is seriously affected by pollution. There are no comprehensive sewage collection systems for the stilted village at Sham Tseng and therefore much of the waste is discharged directly into the nullah. Results from a grab sampling point downstream of the village revealed that the water had the highest BOD loadings and faecal bacteria counts of all channels sampled by grab samples in the Sewerage Master Plan (SMP) Study for the area (EPD, 1991).

Water Quality

The Sham Tseng Nullah is not routinely monitored by EPD. Past studies have indicated that the channel is subjected to organic pollution from the surrounding land and consequently the water is likely to be of a poor quality. Away from the tidal reaches of the channel, up-stream of the stilted village, the water quality improves and features such as weirs, pools and riffles increase the oxygen concentration and provide a suitable habitat for aquatic life.

Water quality analysis was undertaken during April 1996 at two locations (Appendix B2). The methodology used is presented in Appendix A3. A summary of the water quality is displayed in Table 22.1. The monitoring locations and key parameters are displayed in Figures 22.2, with the full results presented in Appendix A1.

TABLE 22.1 SUMMARY OF WATER QUALITY MONITORING RESULTS

Location	Salinity (ppt)	D.O. (mg/l)	D.O. (%)	S.S. (mg/l)	B.O.D. (mg/l)
M1	0.12 (0.10 - 0.20)	2.28 (2.19 - 2.43)	26.5 (25.5 - 29.1)	6.8 (4.0 - 9.0)	7.8 (5.5 - 10.0)
M3	24.12 (0.40 - 31.10)	3.72 (1.94 - 5.15)	43.1 (23.1 - 58.2)	93.4 (21.0 - 330.0)	34.0 (<3.0 - 94.0)

Salinity levels display consistency upstream (M1) beyond the tidal reach. At the channel mouth (M3) salinity is generally representative of marine water with the exception of the final monitoring result on the ebb tide where a fast flow rate and very shallow water depth enabled the freshwater flow to dominate.

Suspended solids and dissolved oxygen concentrations upstream are low and remain consistent due to stable environmental conditions. In contrast, at the nullah mouth (M3) the tidal influence and variation in current speed leads to greater fluctuations. Similarly, there is upstream consistency in B.O.D and Ammoniacal-N concentrations whilst levels fluctuate downstream due to the continual ebb and flow of the tide which carries and disperses organic matter.

Zinc concentrations above the level of detection were recorded in the morning at both locations and on both tides, with upstream (M1) concentrations highest. However, during the afternoon ebb tide additional concentrations of 0.05 mg/l and 0.28 mg/l were recorded from M3 which indicates downstream transport. By the return of the later flood tide zinc concentrations were undetectable.

The detailed water quality results from monitoring Stations M1 and M3 over a 12 hour tidal cycle are displayed below in Tables 22.2 and 22.3 respectively. At Station M1 the water depth and current was very low, possibly reflecting wastewater discharges as evidenced by the high conductivity levels. Dissolved oxygen concentrations were found to be <2.5 mg/l and high levels of Ammoniacal Nitrogen were recorded averaging at 7.0 mgN/l. The results indicate that the source of this wastewater is organic pollution most probably from domestic sewage, agricultural livestock waste or restaurant waste products.

TABLE 22.2 WATER QUALITY AT STATION M1

Time	S.S. (mg/l)	NH_3-N (mg/l)	BOD_5 (mg/l)	Sal. (ppt)	Temp (°C)	D.O (mg/l)	D.O.S (%)	Current Velocity (m/s)	Depth (m)	Cond. (m/s)	Tide
06:46	4.0	4.6	5.5	0.20	22.0	2.28	26.1	0.064	0.02	340.0	Flood
09:04	8.0	8.6	9.5	0.10	22.7	2.19	25.5	0.058	0.02	284.0	Ebb
12:45	7.0	8.6	10.0	0.10	22.8	2.21	25.7	0.060	0.02	280.0	Ebb
15:45	9.0	6.9	7.0	0.10	24.0	2.43	29.1	0.054	0.02	240.0	Ebb
18:45	6.0	5.8	7.0	0.10	23.9	2.27	26.3	0.060	0.02	232.0	Flood

Sampling near the mouth of the channel (Station M3) in what was predominantly sea water indicated that wastewater pollution is also significant, as demonstrated by the results in Table 22.3. Sampling at 15:31 hours produced the highest recorded value for several water parameters, including temperature, B.O.D, S.S. and Ammoniacal-N, whilst D.O. concentrations also reached their lowest level. These results appear to have been influenced by a large input of biodegradable organic matter which was carried down the nullah on the ebb tide. The likely source of this organic pollution is most probably from domestic sewage, agricultural livestock waste or restaurant waste products. The water quality at the other sampling times is comparatively less polluted but also indicates organic pollution.

TABLE 22.3 WATER QUALITY AT STATION M3

Time	S.S. (mg/l)	NH_3-N (mg/l)	BOD_5 (mg/l)	Sal. (ppt)	Temp. (°C)	D.O (mg/l)	D.O.S (%)	Current Velocity (m/s)	Depth (m)	Cond. (m/s)	Tide
07:12	24.0	0.1	7.0	29.3	20.5	5.15	58.2	0.035	0.80	45.47	Flood
10.05	47.0	0.5	32.0	31.1	20.8	3.43	39.4	0.000	1.10	47.62	Ebb
13.02	45.0	0.7	34.0	30.6	21.3	3.12	36.4	0.032	0.9	47.13	Ebb
15:31	330.0	9.8	94.0	0.40	24.3	1.94	23.1	0.084	0.3	808.0	Ebb
18:30	21.0	0.1	<3.0	29.2	22.2	4.95	58.1	0.052	0.3	45.0	Flood

22.2.4 Sediment

Surface grab sampling was conducted during August 1995, with a core sampling survey carried out during December 1995. The findings of grab and core sample analysis are summarised below. The locations and results of core sampling are displayed in Figure 19.3. Full core sampling results are presented in Appendix B4.

Characteristics

Core sampling from two locations in the tidal reaches of the nullah indicated that there was a consistent layer of sediment approximately 1m thick on the channel bed. The sediments in this layer are generally coarse, interspersed with general debris.

Quality

Grab sample analysis failed to show any heavy metal contamination within the sediment. Sub-sampling of the sediment cores also revealed that each sample contained metals in sufficiently low concentrations to classify the sediment as Class 'A' under TC 1-1-92 marine disposal criteria. The Total Organic Carbon (TOC) content was also found to be unexpectedly low (<0.5%) and nutrients (TP and TN) were low compared to many of the other study channels. These results are unexpected given the extent of pollution evident and laboratory error remains a possibility, particularly for the TOC measurements.

It is anticipated that the sediment is contaminated with organic waste downstream of the stilted village. Samples analysed in the Tsuen Wan, Kwai Chung, Tsing Yi SMP Study have indicated that sediment is contaminated with organic waste due to its high BOD loads (EPD, 1991).

When compared to the newly developed sediment classification, based on the need for biological testing to identify toxicity, the sediment in Sham Tseng does not exceed the $ISQV_L$ and therefore would fall into Class 1, suitable for open sea disposal.

22.2.5 Ecology

Riparian Flora and Fauna

The highly developed surrounding area precludes the existence of terrestrial flora and fauna of interest within the tidal reaches of the channel.

Aquatic Fauna

High levels of organic pollution from industry, restaurants and residential development has led to poor sediment and water quality. Benthic communities are thus likely to be low in diversity in the lower reaches of the channel, although a high abundance of pollution tolerant organisms may occur. Further up stream where pools and riffles are present, aquatic communities are expected to be richer in species.

22.3 Proposed Works

22.3.1 Dredging Requirements

Modelling results from Task 4 revealed that flooding is possible along the first 100m of the upstream tidal section of the channel which cannot be alleviated by dredging. Overall sedimentation of 1m will cause a slight increase in the flood level and the channel length subject to flooding.

Accumulation of fluviatile sediment is expected to occur at a slow rate of about 40 mm per year in the downstream section of the channel, at Ch. 170 - 240. This represents an input of about 4 cm per year, equivalent to some 70 m^3/year. No significant input of construction-derived sediment is predicted, and culvert clearance levels are above bed levels.

Only 80 m of the Nullah from chainage 280m to the mouth, has a natural bed and can be dredged. Dredging this area does not reduce the level of flooding observed under base conditions. Sedimentation of 0.5m above the present bed levels along the length of the nullah has no significant effect on the extent of flooding observed under base conditions. The deposition of 1.0m of sediment above the present bed levels along the entire channel would increase the extent of flooding observed under base conditions at the upstream end of the nullah during a 1 in 200 year rainfall. However, the results of surveys show no evidence of sedimentation occurring to these extents.

Task 4 and 5 Recommendations: As annual fluviatile sedimentation rates are anticipated to be in the order of 4 cm, it is recommended that no maintenance dredging need occur for the first decades. Flooding trigger levels and culvert clearance levels are comfortably above bed levels, so it is also recommended that there be no restoration dredging.

22.3.2 Dredging Strategy

No recurrent or restoration dredging is considered necessary at present. If future dredging requirements are identified through the monitoring programme the following dredging strategy, based on Task 5 recommendations, is suggested:

i **Access**: Marine access is possible as far as Castle Peak Road bridge. Consequently only shallow draft vessels can access the area to operate for short periods during high tides. Land based plant could be used during low tides, but would need to be lowered into the Nullah by crane from the bridge. Beyond Castle Peak Road bridge access to the nullah is only possible for land based plant and manual methods of dredging. An access ramp exists on the channel's western bank slightly up from the Tuen Mun Road bridge.

ii **Dredging:** As far as practicable debris and refuse should be removed from the channel prior to dredging. If the channel bed is dredged under dry-season conditions then it is not considered necessary to further reduce the sediment's water content. Small land-based plant and manual clearance methods will be used above Castle Peak Road Bridge. Below the bridge marine plant will be used. Dredged material will be temporarily stored in covered skips prior to transfer off-site.

iii **Transport:** Dredged material from above Castle Peak Road Bridge will be transported by road, whilst below the bridge shallow draft barges will transfer into larger marine-going barges for disposal.

iv **Disposal Strategy:** It is possible that the dredged sediment in the future scenario will be contaminated with organic waste. Furthermore, the sediment may contain significant levels of general refuse and debris which would render the material unsuitable for disposal in a Public Dump. The most feasible land-based disposal option is to a strategic landfill site, with the future development of an ISM facility also a long term possibility. In the event that marine plant is used to excavate the channel below Castle Peak Road bridge then disposal to East Sha Chau is a feasible option.

22.4 Key Issues

Community Impacts

- Residential areas are located along much of the middle and lower regions of the nullah. There are high rise residential developments adjacent to the channel mouth on the western bank, and there is also a residential area along both channel banks upstream of Castle Peak Road bridge.
- The stilted village on the east bank extends well into the channel and may be particularly affected by odour and noise impacts.

22.5 Impact Assessment

22.5.1 Noise Impact Assessment

No baseline survey for noise was conducted since there are no current maintenance dredging requirements. However, the following assessment provides an indication of the likely noise impact should work be recommended in the future.

Works Area

Figure 22.1 illustrates the location of Noise Sensitive Receivers (NSRs) within a 500m buffer of the likely works area.

Noise Sensitive Receivers

The most affected NSRs have been identified and their location and distance from the centre of the works area are shown in Figure 22.1 and described in Table 22.4 below.

TABLE 22.4 DESCRIPTION OF NOISE SENSITIVE RECEIVERS

NSR	Description	Distance
M1	Sham Tseng Village	65 m
M2	New Residential blocks to the west of the channel mouth	65 m

Assessment Criteria

Noise level are limited by the *Noise Control Ordinance (Cap 400) including its subsidiary regulations and the Technical Memoranda.* (TM).

In addition to the requirements imposed by the Noise Control Ordinance, the following requirements or interpretations will also be used as a standard in order to control noise generated from equipment and activities for the purpose of carrying out any construction work other than percussive piling during the time period from 0700 to 1900 hours on any day not being a general holiday:

i) The noise level measured at 1 m from the most affected external facade of the nearby NSRs during any 30-minute period during normal weekly daytime periods between 0700 to 1900 hours will not exceed an equivalent sound level (LAeq) of 75 dB(A) or 70 dB(A) (or 65 dB(A) during examination) for schools.

ii) Construction should not be undertaken during any other period, the restricted period, without the existence of the relevant Construction Noise Permit (CNP).

iii) In accordance with TM, the area around the proposed dredging location has an Area Sensitivity Rating (ASR) of 'B'. The Acceptable Noise Levels (ANLs) under the current regulation are 65 dB(A) from 1900 to 2300 hours plus all day Sundays and general holidays and 50 dB(A) between 2300 and 0700 hours.

Assessment Methodology

Marine access to the lower reaches of the channel is feasible and dredged material could be transported by barge. However, for the upstream areas shallow draft floating plant would have to be placed in the river by crane and the dredged material will be transported by dump truck. The likely equipment for dredging is presented in Table 22.5.

TABLE 22.5 TYPICAL MIX OF EQUIPMENT FOR DREDGING OPERATIONS

Identification Code	Description	Sound Power Level dB(A)
CNP 081	Excavator	112

The sound power levels of the equipment used in this assessment are derived from the TM. The equipment were considered to be grouped equidistant from the approximate geographical centre of the dredging area and the boundary of the nearest NSR. In the case of an oblong area, having a length to width ratio of 5:1 or more, then only the closest portion to the NSR has been considered, as defined in the TM.

A total sound power level of the dredging operation is obtained by summing all the individual sound power levels of the associated equipment.

The noise levels at each NSR are predicted by the following equation:

Predicted noise level = Total sound power level - 20 $\log_{10}D$ - 8 dB(A)

where D is distance between the NSR and the notional noise source

A positive correction of 3 dB(A) is made to each predicted noise level due to all concurring activities to account for the facade reflection at the NSR. The predicted unmitigated noise levels are presented in Table 22.6. A detailed calculation spreadsheet is attached in Appendix A5.

TABLE 22.6 UNMITIGATED NOISE LEVELS AT NSRS

NSR	Predicted Noise Level dB(A)
M1	73[1]
M2	73[1]

Note:

1 *The PNL exceeds the ANL of 65 dB(A) from 1900 to 2300 hours, plus all day Sundays and general holidays; and exceeds 50 dB(A) between 2300 and 0700 hours for all days.*

The predicted noise levels fall within the guideline of 75 dB(A) for normal daytime hours. However as the calculation indicates that the noise levels will exceed the ANLs for the restricted period, work during this period is not recommended without the implementation of significant mitigation measures which are not considered cost effective.

22.5.2 Air Quality Assessment

The data collated to date on odour is not consistent. Site inspections have revealed significant odour from domestic sewage and organic waste. For example, during preliminary survey work a strong organic odour was detected at the downstream end of the stilted village. However, this is not reflected in the sediment grab samples which have indicated a low organic carbon content. Given the disparity in the data we recommend that odour be considered as a key issue and therefore a potential constraint to dredging operations should they be required.

Provided that good practise is observed at all times and the mitigation measures detailed below are followed dust is not considered to be a major constraint to the works.

22.5.3 Ecological Impacts

It is unlikely that there will be any ecological impact upstream of the tidal stretch where there exists some bankside vegetation and trees. Within the tidal area, although resuspension and downstream transport of sediments will occur, the poor quality of the water has prevented the development of a diverse biotic community. Consequently there is unlikely to be any additional ecological impact from the works.

22.5.4 Water Quality Impacts

During and after dredging there will be suspension and re-suspension of sediment which will be transported downstream. This activity may release nutrients contained in the sediment and potentially any contaminants bound in the fine sediment fraction. However, the low nutrient and organic content of the sediment together with the existing poor water quality means that the impacts of short-term recurrent dredging works on water quality will not be significant.

It is recommended that in the future efforts are made to control pollution at source to improve both sediment and water quality in this channel.

22.6 Mitigation Measures

No additional mitigation is required over and above the standard specifications recommended in Section 8, Volume A.

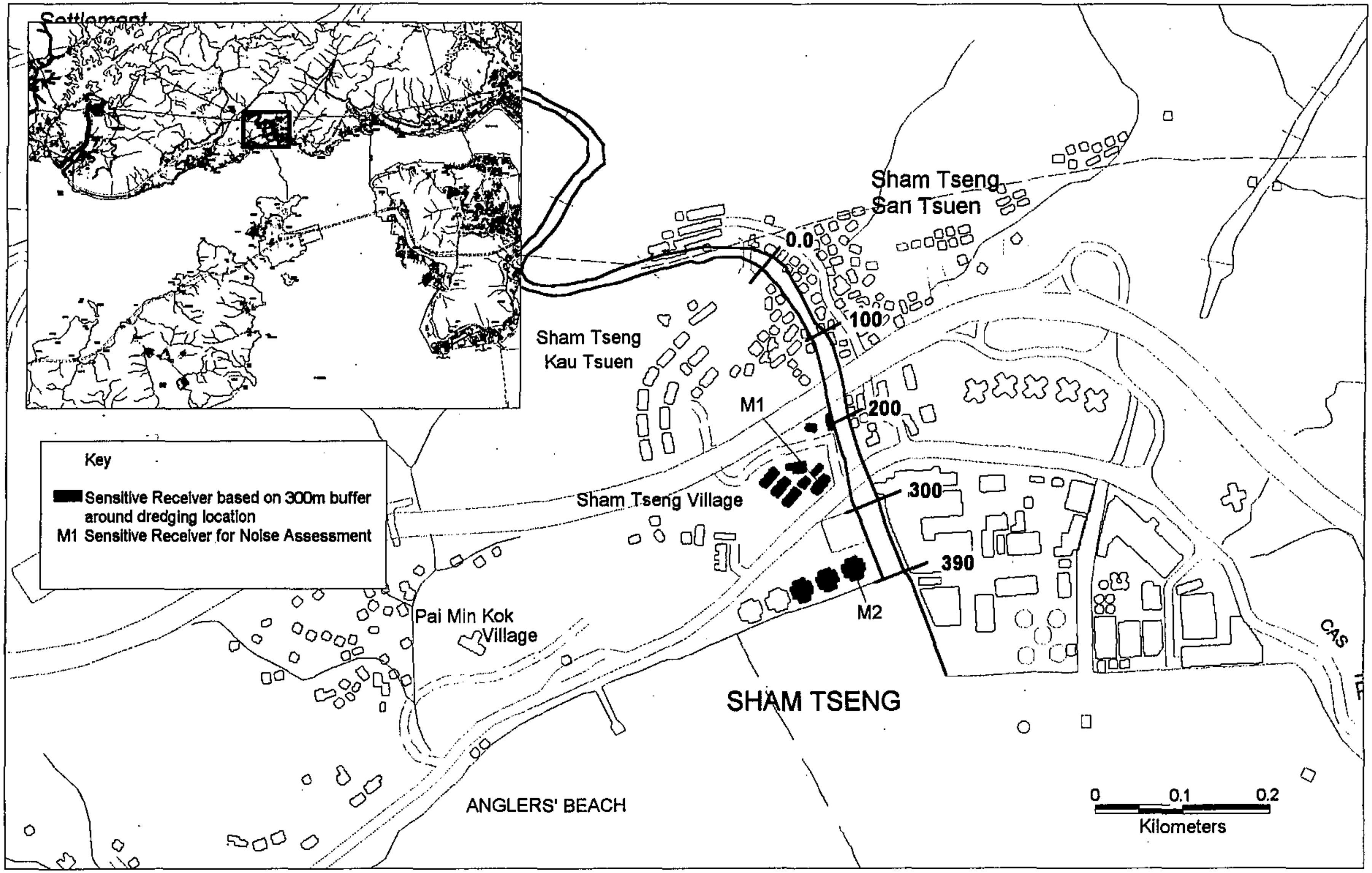

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Figure 22.1 Potential Noise Sensitive Receivers
Sham Tseng Nullah

Source: Lands Department
OZP

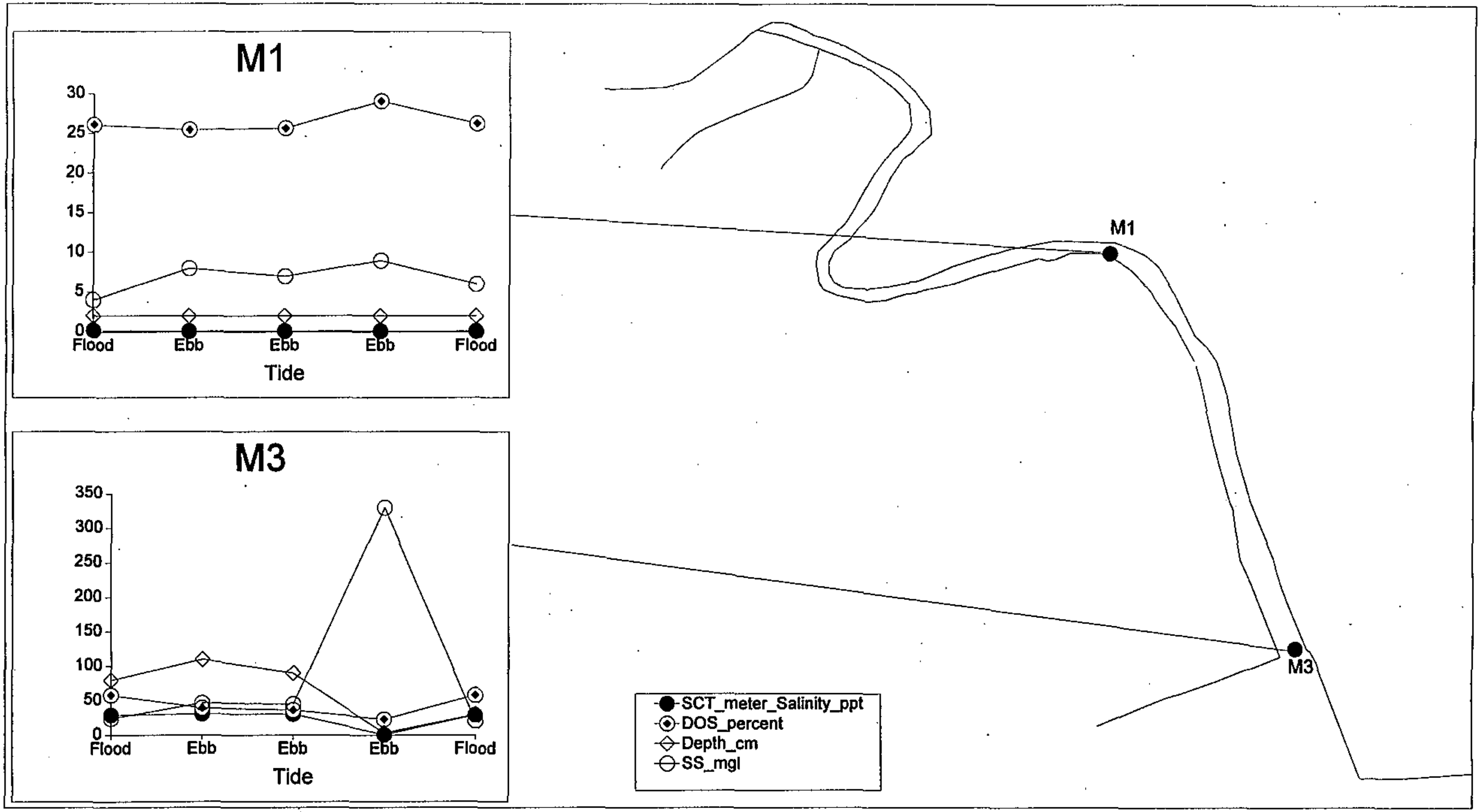

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Figure 22.2 Water Quality Monitoring Results from 18/04/1996
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APPENDICES

APPENDIX B1

1995 WATER QUALITY INDICES FOR CHANNELS
ROUTINELY MONITORED BY EPD

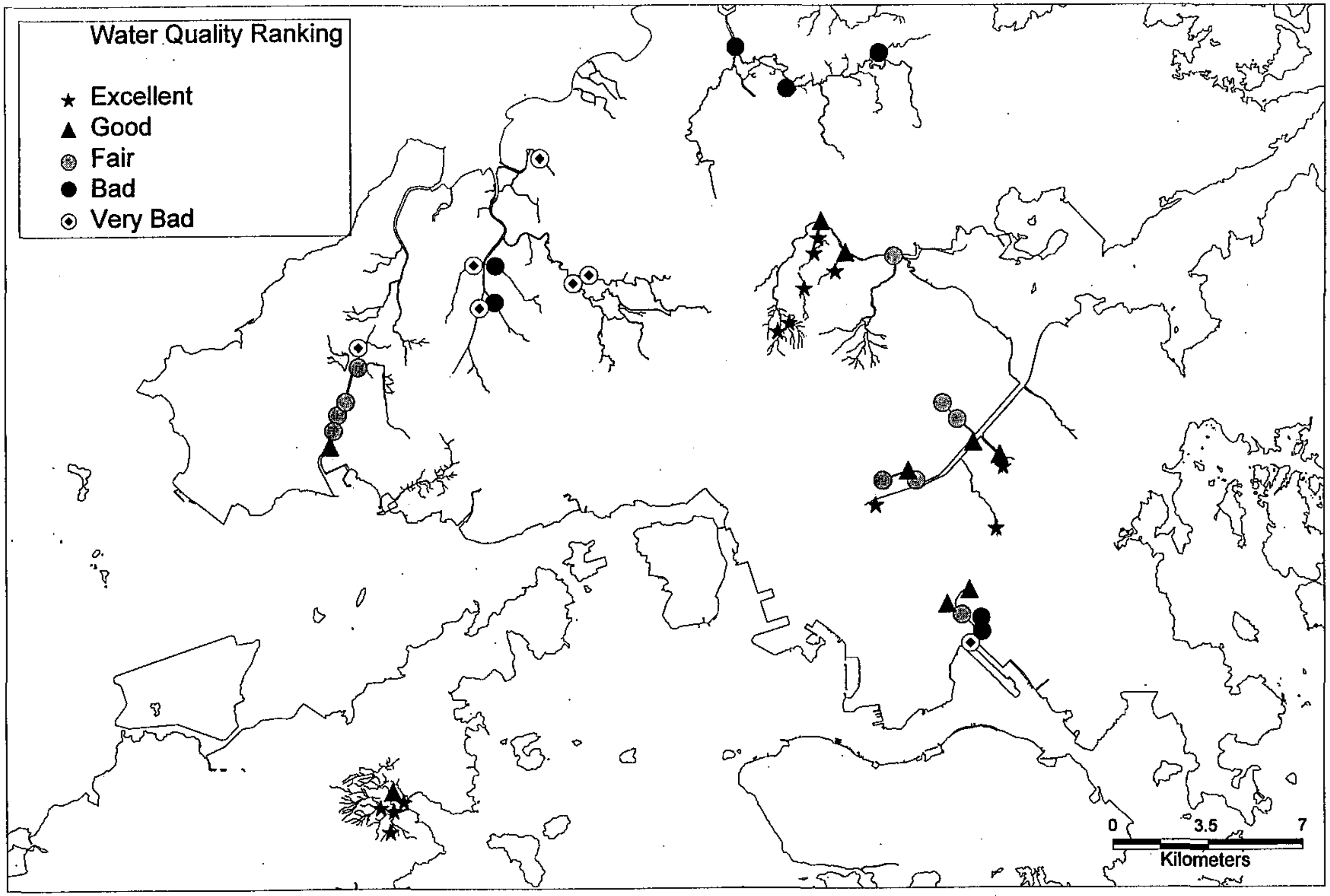

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Figure B1 1995 Water Quality Indices for Channels routinely monitored by EPD

APPENDIX B2

LOCATIONS FOR BASELINE WATER QUALITY MONITORING

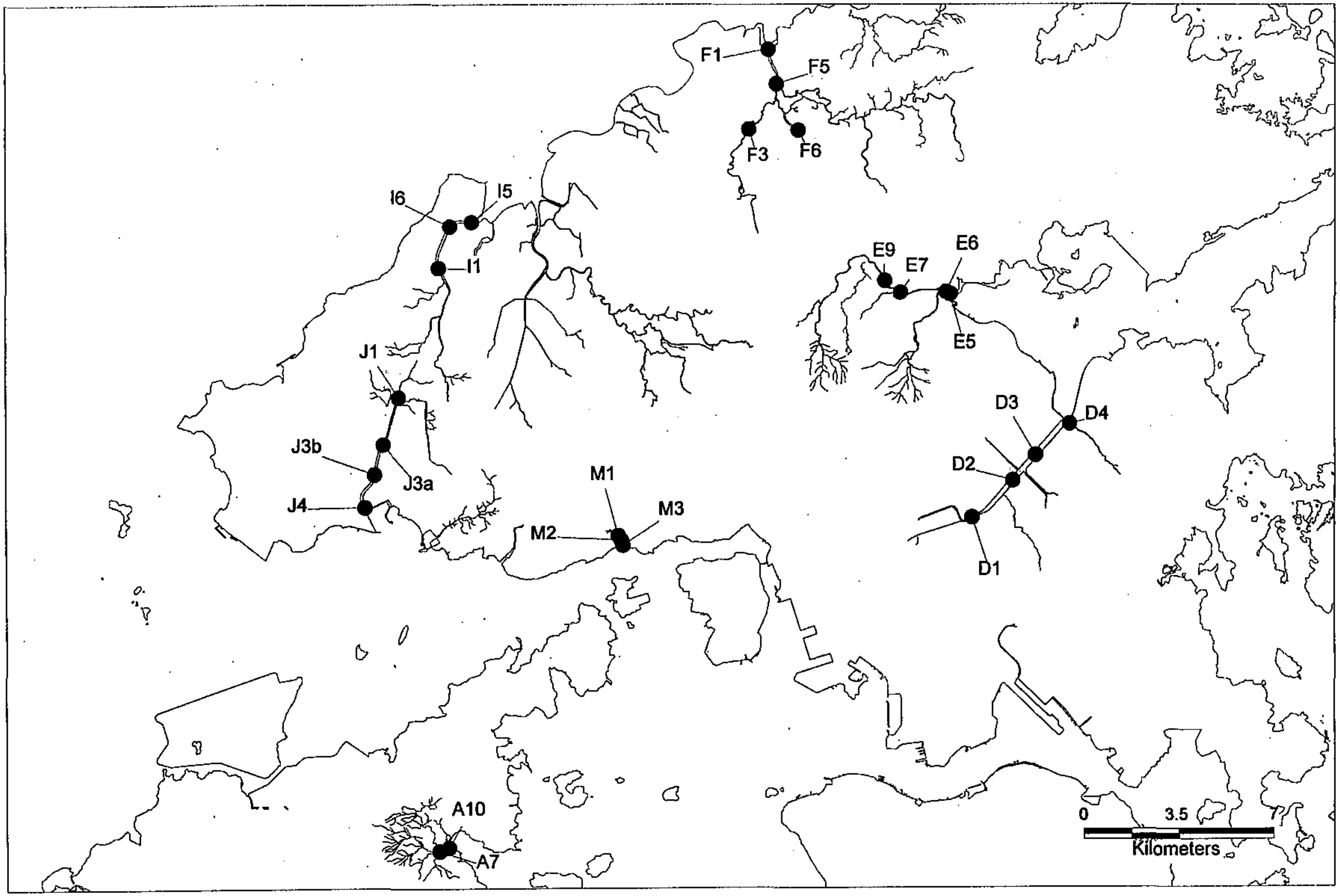

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Figure B2 Locations for Baseline Water Quality Monitoring

APPENDIX B3

SEDIMENT GRAB SAMPLE ANALYTICAL RESULTS
(WET-SEASON SURVEY)

[redacted]

ALS Technichem (HK) Pty l

HOKLAS

Registration No. 66

Test Report

Client Name:	Electronic & Geophysical Services Ltd. 12/F, Park Commercial Centre 2-12 Shelter Street, Causeway Bay Hong Kong
Attention:	Mr. Matthew W. C. Lai
Report No:	HK041
Location:	All Rivers
Date Received:	18th September 1995
Date Completed:	21st September 1995
Test Methods:	Sediments for : - Polyaromatic Hydrocarbons by in-house method HK/EP075 B Polychorinated Biphenyls by in-house method HK/EP066

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Authorised by: ____________________ Date issued: 13th October 1995

Mr. H. Tang
Manager - Organics

Unit 6, G/F, Trans Asia Centre, 18 Kin Hong Street, Kwai Chung, N.T. Hong Kong. Tel : 2610 1044 Fax : 2610 2021

ALS TECHNICHEM (H.K.)
ANALYTICAL REPORT

Contact :	Mr. Matthew Lai	Batch No.:	41
Client :	Electronic & Geophysical Services Limited	No. of samples:	16
Address :	12/F, Park Commercial Centre, 2-12 Shelter Street, Causeway Bay, Hong Kong.		
		Date received :	18/09/95
Sample type :	Soil	Date completed :	21/09/95

Method	Analysis description	Units	LOR	B9/W	D7/W	D10/W	J4/W	J6/W	J8/W	J10/W
	Internal sample no.			HK041-1	HK041-2	HK041-3	HK041-4	HK041-5	HK041-6	HK041-7
EP075-B	POLYAROMATIC HYDROCARBONS									
EP075-B	Naphthalene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	2-Methylnaphthalene	mg/kg	0.5	0.54	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	2-Chloronaphthalene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	Acenaphthalene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	Acenaphthacene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	Fluorene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	Phenanthrene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	3.3	< LOR	< LOR
EP075-B	Anthracene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	Fluoranthrene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	Pyrene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	1.5	< LOR	< LOR
EP075-B	N-2-Fluorenylacetimide	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	Benz(a)anthracene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	Chrysene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	0.63	< LOR	< LOR
EP075-B	Benzo(b)&(k)fluoranthrene	mg/kg	1	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	7,12-Dimethyl benz(a)anthracene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	0.93	< LOR	< LOR
EP075-B	Benzo(a)pyrene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	3-Methylchloanthrene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	Indeno(1,2,3-cd)anthracene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	Dibenz(a,h)anthracene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	Benzo(g,h,i)perylene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR

Comments:

Samples analysed on an as received basis. Results reported on dry weight basis. Sample preparation techniques : Semivolatile - separatory funnel and tumbler, Volatile components : purge and trap. Sample analysis techniques : Semivolatile components - GC/MS, TPH -GC/FID; Volatile. components - GC/MS; Pesticides GC/MS. LOR = Level Of Reporting.

ALS TECHNICHEM (H.K.)
ANALYTICAL REPORT

Contact :	Mr. Matthew Lai	Batch No.:	41
lient :	Electronic & Geophysical Services Limited	No. of samples:	16
ddress :	12/F, Park Commercial Centre, 2-12 Shelter Street, Causeway Bay, Hong Kong.		
		Date received :	18/09/95
ample type :	Soil	Date completed :	21/09/95

ethod	Analysis description	Units	LOR	K4/W	K5/W	E6/W	E8/W	E9/W	I1/W	I3/W
	Internal sample no.			HK041-8	HK041-9	HK041-10	HK041-11	HK041-12	HK041-13	HK041-14
EP075-B	POLYAROMATIC HYDROCARBONS									
EP075-B	Naphthalene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	2-Methylnaphthalene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	2-Chloronaphthalene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	Acenaphthalene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	Acenaphthacene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	Fluorene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	Phenanthrene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	Anthracene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	Fluoranthrene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	Pyrene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	N-2-Fluorenylacetimide	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	Benz(a)anthracene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	Chrysene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	Benzo(b)&(k)fluoranthrene	mg/kg	1	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	7,12-Dimethyl benz(a)anthracene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	Benzo(a)pyrene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	3-Methylchloanthrene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	Indeno(1,2,3-cd)anthracene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	Dibenz(a,h)anthracene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
EP075-B	Benzo(g,h,i)perylene	mg/kg	0.5	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR

omments:

ples analysed on an as received basis. Results reported on dry weight basis. Sample preparation techniques : Semivolatile - separatory el and tumbler, Volatile components : purge and trap. Sample analysis techniques : Semivolatile components - GC/MS, TPH -GC/FID; Volatile mponents - GC/MS; Pesticides GC/MS. LOR = Level Of Reporting.

ALS TECHNICHEM (H.K.)
ANALYTICAL REPORT

Contact :	Mr. Matthew Lai	Batch No.:	41
Client :	Electronic & Geophysical Services Limited	No. of samples:	16
Address :	12/F, Park Commercial Centre, 2-12 Shelter Street, Causeway Bay, Hong Kong.		
		Date received :	18/09/95
Sample type :	Soil	Date completed :	21/09/95

Method	Analysis description	Units	LOR	I4/W	M4/W
	Internal sample no.			HK041-15	HK041-16
EP075-B	POLYAROMATIC HYDROCARBONS				
EP075-B	Naphthalene	mg/kg	0.5	< LOR	< LOR
EP075-B	2-Methylnaphthalene	mg/kg	0.5	< LOR	< LOR
EP075-B	2-Chloronaphthalene	mg/kg	0.5	< LOR	< LOR
EP075-B	Acenaphthalene	mg/kg	0.5	< LOR	< LOR
EP075-B	Acenaphthacene	mg/kg	0.5	< LOR	< LOR
EP075-B	Fluorene	mg/kg	0.5	< LOR	< LOR
EP075-B	Phenanthrene	mg/kg	0.5	< LOR	< LOR
EP075-B	Anthracene	mg/kg	0.5	< LOR	< LOR
EP075-B	Fluoranthrene	mg/kg	0.5	< LOR	< LOR
EP075-B	Pyrene	mg/kg	0.5	< LOR	< LOR
EP075-B	N-2-Fluorenylacetimide	mg/kg	0.5	< LOR	< LOR
EP075-B	Benz(a)anthracene	mg/kg	0.5	< LOR	< LOR
EP075-B	Chrysene	mg/kg	0.5	< LOR	< LOR
EP075-B	Benzo(b)&(k)fluoranthrene	mg/kg	1	< LOR	< LOR
EP075-B	7,12-Dimethyl benz(a)anthracene	mg/kg	0.5	< LOR	< LOR
EP075-B	Benzo(a)pyrene	mg/kg	0.5	< LOR	< LOR
EP075-B	3-Methylchloanthrene	mg/kg	0.5	< LOR	< LOR
EP075-B	Indeno(1,2,3-cd)anthracene	mg/kg	0.5	< LOR	< LOR
EP075-B	Dibenz(a,h)anthracene	mg/kg	0.5	< LOR	< LOR
EP075-B	Benzo(g,h,i)perylene	mg/kg	0.5	< LOR	< LOR

Comments:

Samples analysed on an as received basis. Results reported on dry weight basis. Sample preparation techniques : Semivolatile - separatory funnel and tumbler, Volatile components : purge and trap. Sample analysis techniques : Semivolatile components - GC/MS, TPH -GC/FID; Volatile components - GC/MS; Pesticides GC/MS. LOR = Level Of Reporting.

ALS TECHNICHEM (H.K.)
ANALYTICAL REPORT

Contact : Mr. Matthew Lai
Client : Electronic & Geophysical Services Limited
Address : 12/F, Park Commercial Centre,
2-12 Shelter Street, Causeway Bay,
Hong Kong.

Batch No.: HK041
No. of samples: 16

Date received : 18/09/95
Date completed : 20/09/95

Sample type : Soil

Method	Analysis description	Units	LOR	89/W	D7/W	D10/W	J4/W	J6/W	J8/W
	Internal sample no.			HK041-1	HK041-2	HK041-3	HK041-4	HK041-5	HK041-6
EP066	POLYCHLORINATED BIPHENYLS								
EP066	Total PCB	mg/kg	0.1	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR

Method	Analysis description	Units	LOR	J10/W	K4/W	K5/W	E6/W	E8/W	E9/W
	Internal sample no.			HK041-7	HK041-8	HK041-9	HK041-10	HK041-11	HK041-12
EP066	POLYCHLORINATED BIPHENYLS								
EP066	Total PCB	mg/kg	0.1	< LOR	< LOR	< LOR	0.23	< LOR	< LOR

Method	Analysis description	Units	LOR	I1/W	I3/W	I4/W	M4/W
	Internal sample no.			HK041-13	HK041-14	HK041-15	HK041-16
EP066	POLYCHLORINATED BIPHENYLS						
EP066	Total PCB	mg/kg	0.1	< LOR	< LOR	< LOR	< LOR

Comments:

Samples analysed on an as received basis. Results reported on dry weight basis. Sample preparation techniques : Semivolatile - separatory funnel and tumbler, Volatile components : purge and trap. Sample analysis techniques : Semivolatile components - GC/MS, TPH -GC/FID; Volatile components - GC/MS; Pesticides GC/MS. LOR = Level Of Reporting.

[redacted]

ALS Technichem (HK) Pty

HOKLAS
Registration No.

Test Report

Client Name:	Electronic & Geophysical Services Ltd. 12/F, Park Commercial Centre 2-12 Shelter Street, Causeway Bay Hong Kong
Attention:	Mr. Matthew W. C. Lai
Report No:	HK024/HK026
Location:	A - River Silver
Date Received:	31st July 1995/2nd August 1995
Date Completed:	14th August 1995
Test Methods:	Sediments for : - Particle sizing to 63 microns by in-house method HK/P008 Total Organic Carbon by in-house method HK/EP005 Total Inorganic Carbon by in-house method HK/EP006 Total Carbon by in-house method HK/EP007 Metals by ICPMS using in-house method HK/EG020 Ammonia (as N) by in-house method HK/EK055 Total nitrogen by in-house method HK/EK062 Total phosphorus by in-house method HK/EK067 Particle sizing 63 to 2 microns by Coulter Analyser

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Authorised by: [signature]

Mr. R. Fung
Manager - Environmental

Date issued: 13th October 1995

Unit 6, G/F, Trans Asia Centre, 18 Kin Hong Street, Kwai Chung, N.T. Hong Kong. Tel : 2610 1044 Fax : 2610 2021

ALS TECHNICHEM (H.K.)
ANALYTICAL REPORT

Contact :	Mr. Matthew Lai	Batch No.:	HK024/026
Client :	Electronic & Geophysical Services Ltd	No. of samples:	7
Address :	12/F, Park Commercial Centre 2-12 Shelter Street, Causeway Bay Hong Kong		
		Date received :	31/07/95
Sample type :	Sediment	Date completed :	02/08/95

Method	Analysis description	Units	LOR	A-3/W	A-4/W	A-5/W	A-6/W	A-7/W
	Internal Sample Number			HK026-1	HK026-2	HK026-3	HK026-4	HK026-5
	Metals by ICPMS							
EG020	Cadmium	mg/kg	0.02	<LOR	0.13	<LOR	0.02	<LOR
EG020	Chromium	mg/kg	0.1	4.3	8.9	2.0	3.5	1.7
EG020	Copper	mg/kg	0.1	5.5	12.9	1.5	6.1	1.3
EG020	Mercury	mg/kg	0.1	<LOR	<LOR	<LOR	<LOR	<LOR
EG020	Nickel	mg/kg	0.1	2.3	3.9	1.3	2.4	1.3
EG020	Lead	mg/kg	0.1	21.3	43.5	15.4	26.5	13.8
EG020	Zinc	mg/kg	1.0	35	74	30	52	17
	Nutrients							
EK055	Ammonia Nitrogen	mg/kg	1	1.8	0.5	<LOR	<LOR	2.6
EK062	Total Nitrogen	mg/kg	10	84.2	80.0	119	42.1	168
EK067	Total Phosphorus	mg/kg	1	222	507	106	86	48
	Organic Constituents							
EP007	Total Carbon	%	0.01	0.35	1.80	0.10	0.02	1.34
EP006	Total Inorganic Carbon	%	0.01	<LOR	<LOR	<LOR	<LOR	<LOR
EP005	Total Organic Carbon	%	0.01	0.35	1.80	0.10	0.02	1.34

Method	Analysis description	Units	LOR	A-8W	A-9W	A-10W
	Internal Sample Number			HK024-3	HK024-2	HK024-1
	Metals by ICPMS					
EG020	Cadmium	mg/kg	0.02	<LOR	<LOR	0.13
EG020	Chromium	mg/kg	0.1	2.0	2.8	15.6
EG020	Copper	mg/kg	0.1	2.1	5.4	22.9
EG020	Mercury	mg/kg	0.1	<LOR	<LOR	<LOR
EG020	Nickel	mg/kg	0.1	1.6	2.0	11.3
EG020	Lead	mg/kg	0.1	16.3	14.4	46.8
EG020	Zinc	mg/kg	1.0	28	43	101
	Nutrients					
EK055	Ammonia Nitrogen	mg/kg	1	2	1.4	9
EK062	Total Nitrogen	mg/kg	10	47.6	63.2	80.7
EK067	Total Phosphorus	mg/kg	1	58	77	221
	Organic Constituents					
EP007	Total Carbon	%	0.01	0.05	0.21	1.45
EP006	Total Inorganic Carbon	%	0.01	<LOR	<LOR	0.19
EP005	Total Organic Carbon	%	0.01	0.05	0.21	1.27

Comments:
Samples analysed on an as received basis. Results reported on a dry weight basis.

ALS TECHNICHEM (H.K.)
ANALYTICAL REPORT

Contact : Mr. Matthew Lai
Client : Electronic & Geophysical Services Ltd
Address : 12/F, Park Commercial Centre
2-12 Shelter Street, Causeway Bay
Hong Kong

Batch No.: HK024/HK026
No. of samples: 8

Date received : 31/7/95-02/08/95
Date completed : 14/08/95

Sample type : Sediment

Particle Size Analysis

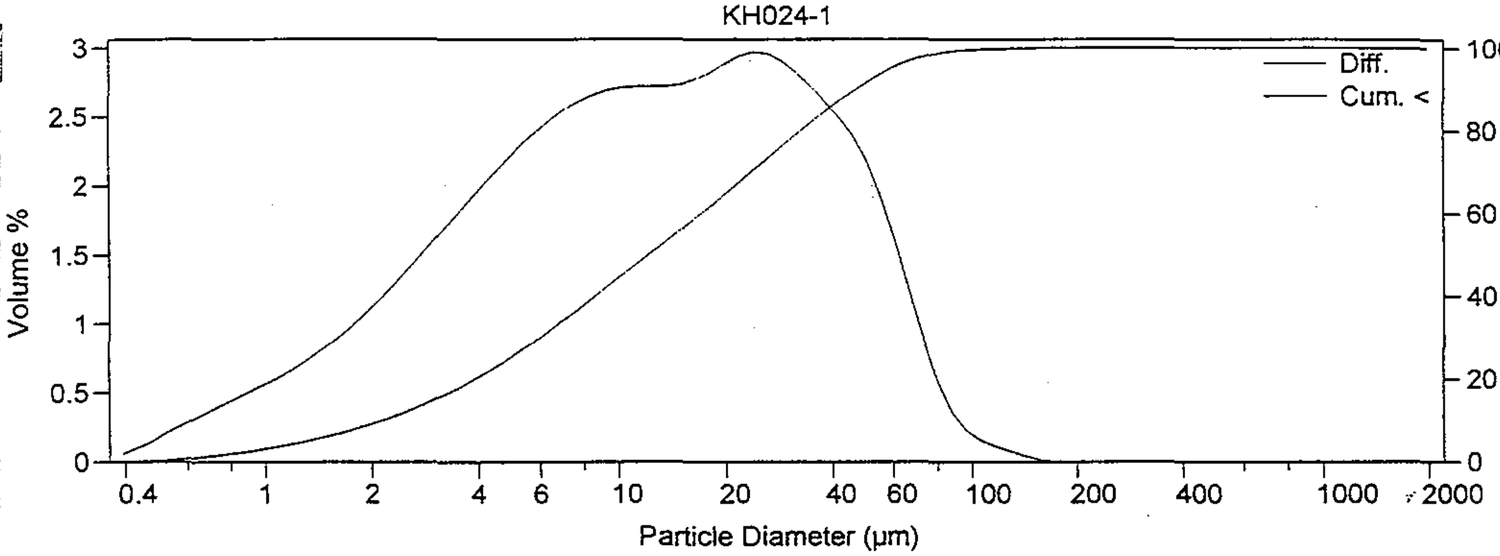
Percent Retained

Sample No.	Lab. No.	Total dry weight (%)	Sieve Size							
			+2mm	+710um	+300um	+150um	+106um	+75um	+63um	-63um
A-3/W	HK026-1	100.0	13.4	39.6	27.9	12.2	2.3	1.7	0.5	2.3
A-4/W	HK026-2	100.0	21.1	28.8	21.4	11.8	2.1	3.2	1.2	10.4
A-5/W	HK026-3	100.0	9.8	74.7	14.6	0.5	0.0	0.0	0.0	0.3
A-6/W	HK026-4	100.0	13.4	63.1	22.0	1.2	0.1	0.1	0.0	0.0
A-7/W	HK026-5	100.0	16.6	55.7	26.3	1.1	0.0	0.0	0.0	0.2
A-8/W	HK024-3	100.0	41.0	46.4	11.0	0.8	0.0	0.0	0.0	0.8
A-9/W	HK024-2	100.0	17.3	53.8	24.0	2.3	0.3	0.3	0.1	1.9
A-10/W	HK024-1	100.0	46.9	22.5	10.7	7.1	0.6	0.9	0.3	11.0

Cumulative Percent Retained

Sample No.	Lab. No.	Total dry weight (%)	Sieve Size							
			+2mm	+710um	+300um	+150um	+106um	+75um	+63um	-63um
A-3/W	HK026-1		13.4	53.0	80.9	93.1	95.4	97.2	97.7	100.0
A-4/W	HK026-2		21.1	49.9	71.3	83.0	85.2	88.4	89.6	100.0
A-5/W	HK026-3		9.8	84.5	99.1	99.6	99.7	99.7	99.7	100.0
A-6/W	HK026-4		13.4	76.6	98.5	99.7	99.8	100.0	100.0	100.0
A-7/W	HK026-5		16.6	72.3	98.6	99.7	99.7	99.8	99.8	100.0
A-8/W	HK024-3		41.0	87.4	98.3	99.1	99.2	99.2	99.2	100.0
A-9/W	HK024-2		17.3	71.2	95.2	97.4	97.7	98.0	98.1	100.0
A-10/W	HK024-1		46.9	69.4	80.1	87.2	87.9	88.8	89.0	100.0

File name:	HK024-1.$01	Group ID:	hk024-1
Sample ID:	KH024-1		
Operator:	Gao	Run number:	19
Comments:	ALS Technichem (HK) Pty Ltd , normal run		
Optical model:	Fraunhofer		
LS 230	Hazardous Fluids Module		
Start time:	16:34 9 Sep 1995	Run length:	60 Seconds
Pump speed:	60		
Obscuration:	15%		
Fluid:	Water		
Software:	2.05	Firmware:	2.02 2.02



Volume Statistics (Arithmetic) hk024-1.$01

Calculations from 0.375 µm to 2000 µm

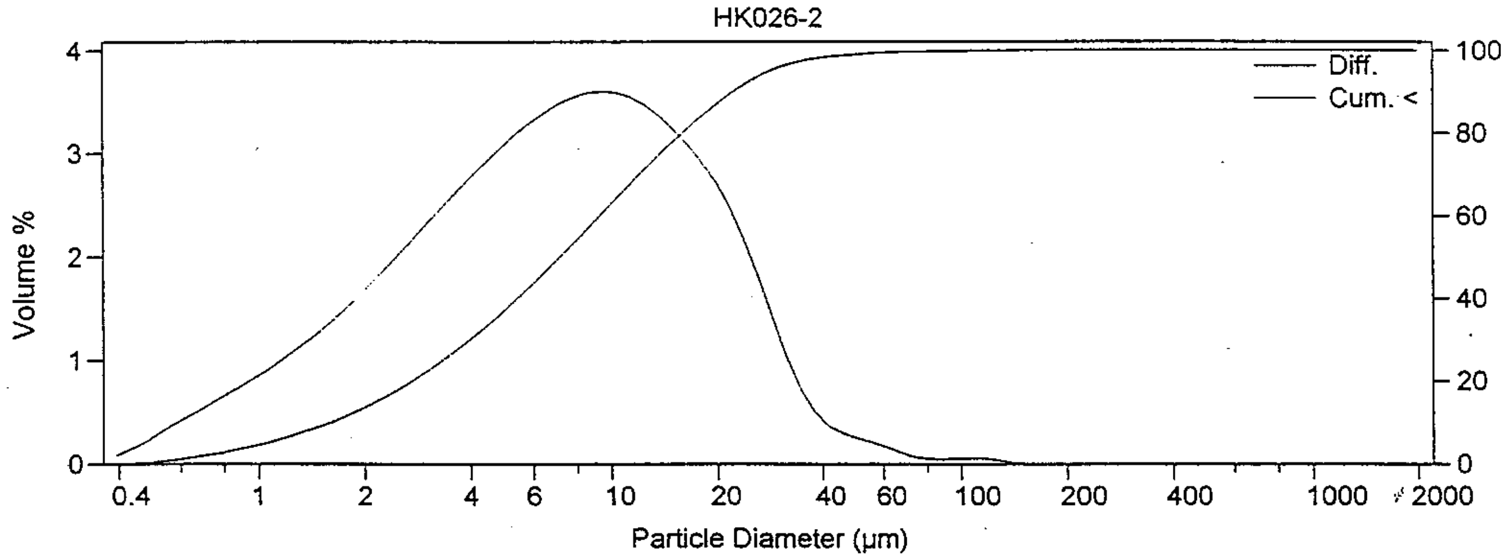
Volume	100.0%		
Mean:	19.21 µm	S.D.:	19.5 µm
Median:	12.19 µm	C.V.:	101%
D(1,0):	0.847 um	Skewness:	1.75 Right skewed
Mode:	23.81 µm	Kurtosis:	3.99 Leptokurtic

% <	10	25	50	75	90
Size µm	2.152	4.897	12.19	27.69	46.84

hk024-1.$01

Channel Diameter (Lower) µm	Diff. Volume %	Cum. < Volume %	Channel Diameter (Lower) µm	Diff. Volume %	Cum. < Volume %
0.375	0.055	0	39.77	2.50	85.73
0.412	0.098	0.055	43.66	2.37	88.24
0.452	0.144	0.153	47.93	2.18	90.60
0.496	0.207	0.297	52.63	1.92	92.78
0.545	0.261	0.504	57.77	1.60	94.70
0.598	0.311	0.764	63.41	1.24	96.29
0.657	0.359	1.07	69.62	0.882	97.53
0.721	0.410	1.43	76.43	0.581	98.41
0.791	0.460	1.84	83.90	0.364	98.99
0.869	0.509	2.30	92.09	0.230	99.36
0.953	0.559	2.81	101.1	0.155	99.58
1.047	0.613	3.37	111.0	0.112	99.74
1.149	0.674	3.99	121.8	0.080	99.85
1.261	0.740	4.66	133.7	0.046	99.93
1.385	0.812	5.40	146.8	0.019	99.98
1.520	0.890	6.21	161.2	0.004	100.00
1.669	0.978	7.10	176.8	0.0031	100.00
1.832	1.07	8.08	194.2	0	100.00
2.010	1.18	9.15	213.2	0	100.00
2.207	1.28	10.33	234.1	0	100.00
2.423	1.40	11.61	256.8	0	100.00
2.660	1.51	13.01	282.1	0	100.00
2.920	1.63	14.52	309.6	0	100.00
3.206	1.75	16.15	339.8	0	100.00
3.519	1.86	17.90	373.1	0	100.00
3.862	1.98	19.76	409.6	0	100.00
4.241	2.09	21.74	449.7	0	100.00
4.656	2.20	23.83	493.6	0	100.00
5.111	2.30	26.03	541.9	0	100.00
5.611	2.39	28.33	594.9	0	100.00
6.158	2.48	30.73	653.0	0	100.00
6.761	2.55	33.21	716.9	0	100.00
7.421	2.61	35.76	786.9	0	100.00
8.147	2.66	38.37	863.9	0	100.00
8.944	2.69	41.03	948.2	0	100.00
9.819	2.71	43.72	1,041	0	100.00
10.78	2.72	46.44	1,143	0	100.00
11.83	2.72	49.15	1,255	0	100.00
12.99	2.72	51.87	1,377	0	100.00
14.26	2.73	54.60	1,512	0	100.00
15.65	2.77	57.33	1,660	0	100.00
17.18	2.82	60.10	1,822	0	100.00
18.86	2.88	62.92	2,000		100.00
20.70	2.94	65.80			
22.73	2.97	68.74			
24.95	2.96	71.71			
27.38	2.90	74.67			
30.07	2.82	77.57			
33.00	2.72	80.39			
36.24	2.62	83.11			

File name:	HK026-2.$01	Group ID:	HK026-2
Sample ID:	HK026-2		
Operator:	Gao	Run number:	19
Comments:	ALS TE chnichem (HK) Pty Ltd ,normal run		
Optical model:	Fraunhofer		
LS 230	Hazardous Fluids Module		
Start time:	12:16 10 Sep 1995	Run length:	61 Seconds
Pump speed:	60		
Obscuration:	11%		
Fluid:	Water		
Software:	2.05	Firmware:	2.02 2.02



Volume Statistics (Arithmetic) hk026-2.$01

Calculations from 0.375 µm to 2000 µm

Volume	100.0%		
Mean:	10.25 µm	S.D.:	10.7 µm
Median:	7.161 µm	C.V.:	104%
D(3,2):	3.815 um	Skewness:	3.54 Right skewed
Mode:	9.371 µm	Kurtosis:	24 Leptokurtic

% <	10	25	50	75	90
Size µm	1.591	3.318	7.161	13.84	22.26

hk026-2.$01

Channel Diameter (Lower) µm	Diff. Volume %	Cum. < Volume %
0.375	0.078	0
0.412	0.139	0.078
0.452	0.205	0.217
0.496	0.295	0.422
0.545	0.375	0.717
0.598	0.451	1.09
0.657	0.527	1.54
0.721	0.607	2.07
0.791	0.688	2.68
0.869	0.768	3.37
0.953	0.851	4.13
1.047	0.940	4.98
1.149	1.04	5.92
1.261	1.14	6.96
1.385	1.25	8.10
1.520	1.37	9.35
1.669	1.49	10.71
1.832	1.62	12.21
2.010	1.76	13.83
2.207	1.91	15.59
2.423	2.05	17.50
2.660	2.20	19.55
2.920	2.35	21.76
3.206	2.50	24.11
3.519	2.65	26.61
3.862	2.79	29.25
4.241	2.93	32.04
4.656	3.06	34.97
5.111	3.18	38.03
5.611	3.29	41.21
6.158	3.39	44.50
6.761	3.48	47.89
7.421	3.54	51.37
8.147	3.59	54.91
8.944	3.60	58.50
9.819	3.59	62.10
10.78	3.55	65.70
11.83	3.48	69.25
12.99	3.38	72.73
14.26	3.25	76.10
15.65	3.10	79.35
17.18	2.92	82.44
18.86	2.72	85.37
20.70	2.48	88.09
22.73	2.17	90.57
24.95	1.80	92.74
27.38	1.41	94.54
30.07	1.04	95.96
33.00	0.727	96.99
36.24	0.504	97.72
39.77	0.368	98.23
43.66	0.293	98.59
47.93	0.251	98.89
52.63	0.213	99.14
57.77	0.166	99.35
63.41	0.114	99.52
69.62	0.071	99.63
76.43	0.048	99.70
83.90	0.043	99.75
92.09	0.049	99.79
101.1	0.055	99.84
111.0	0.052	99.90
121.8	0.034	99.95
133.7	0.015	99.98
146.8	0.003	100.00
161.2	0.0025	100.00
176.8	0	100.00
194.2	0	100.00
213.2	0	100.00
234.1	0	100.00
256.8	0	100.00
282.1	0	100.00
309.6	0	100.00
339.8	0	100.00
373.1	0	100.00
409.6	0	100.00
449.7	0	100.00
493.6	0	100.00
541.9	0	100.00
594.9	0	100.00
653.0	0	100.00
716.9	0	100.00
786.9	0	100.00
863.9	0	100.00
948.2	0	100.00
1,041	0	100.00
1,143	0	100.00
1,255	0	100.00
1,377	0	100.00
1,512	0	100.00
1,660	0	100.00
1,822	0	100.00
2,000		100.00

ALS Technichem (HK) Pty

HOKLAS
Registration No. 6

Test Report

Client Name: Electronic & Geophysical Services Ltd.
12/F, Park Commercial Centre
2-12 Shelter Street, Causeway Bay
Hong Kong

Attention: Mr. Matthew W. C. Lai

Report No: HK036

Location: C - Kai Tak Nullah

Date Received: 24th August 1995

Date Completed: 6th September 1995

Test Methods: Sediments for : -
Particle sizing to 63 microns by in-house method HK/P008
Total Organic Carbon by in-house method HK/EP005
Total Inorganic Carbon by in-house method HK/EP006
Total Carbon by in-house method HK/EP007
Metals by ICPMS using in-house method HK/EG020
Ammonia (as N) by in-house method HK/EK055
Total nitrogen by in-house method HK/EK062
Total phosphorus by in-house method HK/EK067
Particle sizing 63 to 2 microns by Coulter Analyser

****

Authorised by: Mr. R. Fung
Manager - Environmental

Date issued: 13th October 1995

Unit 6, G/F, Trans Asia Centre, 18 Kin Hong Street, Kwai Chung, N.T. Hong Kong. Tel : 2610 1044 Fax : 2610 2021

ALS TECHNICHEM (H.K.)
ANALYTICAL REPORT

Contact :	Mr. Matthew Lai	Batch No.:	HK036
Client :	Electronic & Geophysical Services Ltd	No. of samples:	4
Address :	12/F, Park Commercial Centre 2-12 Shelter Street, Causeway Bay Hong Kong		
		Date received :	24/08/95
Sample type :	Sediment	Date completed :	06/09/95

Method	Analysis description	Units	LOR	C-7/W	C-8/W	C-9/W	C-10/W
	Internal Sample Number			HK036-1	HK036-2	HK036-3	HK036-4
	Metals by ICPMS						
EG020	Cadmium	mg/kg	0.02	0.25	0.14	0.17	0.08
EG020	Chromium	mg/kg	0.1	20.6	15.4	51.3	36.1
EG020	Copper	mg/kg	0.1	122.9	28.6	92.5	110.6
EG020	Mercury	mg/kg	0.1	<LOR	<LOR	<LOR	<LOR
EG020	Nickel	mg/kg	0.1	7.5	7.8	16.2	8.3
EG020	Lead	mg/kg	0.1	11.7	13.6	13.7	12.4
EG020	Zinc	mg/kg	1.0	64	58	72	41
	Nutrients						
EK055	Ammonia Nitrogen	mg/kg	1	3.0	2.7	3.0	2.8
EK062	Total Nitrogen	mg/kg	10	47.1	87.5	168	89.6
EK067	Total Phosphorus	mg/kg	1	58	296	2333	129
	Organic Constituents						
EP007	Total Carbon	%	0.01	0.10	0.39	0.09	0.17
EP006	Total Inorganic Carbon	%	0.01	0.08	0.11	<LOR	0.03
EP005	Total Organic Carbon	%	0.01	0.01	0.28	0.09	0.14

Comments:
Samples analysed on an as received basis. Results reported on a dry weight basis.

[redacted]

ALS Technichem (HK) Pty

HOKLAS

Registration No. 66

Test Report

Client Name: Electronic & Geophysical Services Ltd.
12/F, Park Commercial Centre
2-12 Shelter Street, Causeway Bay
Hong Kong

Attention: Mr. Matthew W. C. Lai

Report No: HK023

Location: K - So Kwun Wat

Date Received: 26th July 1995

Date Completed: 8th August 1995

Test Methods: Sediments for : -
Particle sizing to 63 microns by in-house method HK/P008
Total Organic Carbon by in-house method HK/EP005
Total Inorganic Carbon by in-house method HK/EP006
Total Carbon by in-house method HK/EP007
Metals by ICPMS using in-house method HK/EG020
Ammonia (as N) by in-house method HK/EK055
Total nitrogen by in-house method HK/EK062
Total phosphorus by in-house method HK/EK067
Particle sizing 63 to 2 microns by Coulter Analyser

****

Authorised by: R. Fung

Mr. R. Fung
Manager - Environmental

Date issued: 13th October 1995

Unit 6, G/F, Trans Asia Centre, 18 Kin Hong Street, Kwai Chung, N.T. Hong Kong. Tel : 2610 1044 Fax : 2610 2021

ALS TECHNICHEM (H.K.)
ANALYTICAL REPORT

Contact :	Mr. Matthew Lai		Batch No.:	HK023
Client :	Electronic & Geophysical Services Ltd		No. of samples:	5
Address :	12/F, Park Commercial Centre 2-12 Shelter Street, Causeway Bay Hong Kong			
			Date received :	26/07/95
Sample type :	Sediment		Date completed :	08/08/95

Method	Analysis description	Units	LOR	K-1W	K-2W	K-3W	K-4W	K-5W
	Internal Sample Number			HK023-1	HK023-2	HK023-3	HK023-4	HK023-5
	Metals by ICPMS							
EG020	Cadmium	mg/kg	0.02	<LOR	<LOR	<LOR	0.18	0.30
EG020	Chromium	mg/kg	0.1	2.7	1.4	4.0	10.0	12.7
EG020	Copper	mg/kg	0.1	8.9	4.6	13.0	35.2	43.5
EG020	Mercury	mg/kg	0.1	<LOR	<LOR	<LOR	<LOR	<LOR
EG020	Nickel	mg/kg	0.1	2.0	1.0	5.5	7.0	7.4
EG020	Lead	mg/kg	0.1	19.4	15.6	74.0	97.3	126
EG020	Zinc	mg/kg	1.0	33	10	284	293	178
	Nutrients							
EK055	Ammonia Nitrogen	mg/kg	1	<LOR	<LOR	13	22.5	5.4
EK062	Total Nitrogen	mg/kg	10	<LOR	39.9	149	932	900
EK067	Total Phosphorus	mg/kg	1	64	102	247	379	302
	Organic Constituents							
EP007	Total Carbon	%	0.01	0.11	0.11	0.87	1.71	1.36
EP006	Total Inorganic Carbon	%	0.01	<LOR	<LOR	0.23	<LOR	<LOR
EP005	Total Organic Carbon	%	0.01	0.11	0.11	0.64	1.71	1.36

Comments:
Samples analysed on an as received basis. Results reported on a dry weight basis.

ALS TECHNICHEM (H.K.)
ANALYTICAL REPORT

Contact : Mr. Matthew Lai
Client : Electronic & Geophysical Services Ltd
Address : 12/F, Park Commercial Centre
2-12 Shelter Street, Causeway Bay
Hong Kong

Batch No.: HK036
No. of samples: 4

Date received : 24/08/95
Date completed : 6/9/95

Sample type : Sediment

Particle Size Analysis

Percent Retained

Sample No.	Lab. No.	Total dry weight (%)	Sieve Size							
			+2mm	+710um	+300um	+150um	+106um	+75um	+63um	-63um
C-7/W	HK036-1	100.0	31.6	49.7	17.6	0.9	0.1	0.0	0.0	0.0
C-8/W	HK036-2	100.0	33.8	45.8	18.9	1.2	0.1	0.1	0.1	0.0
C-9/W	HK036-3	100.0	50.5	39.3	9.6	0.4	0.0	0.0	0.0	0.3
C-10/W	HK036-4	100.0	13.4	51.1	33.4	1.8	0.1	0.0	0.0	0.3

Cumulative Percent Retained

Sample No.	Lab. No.	Total dry weight (%)	Sieve Size							
			+2mm	+710um	+300um	+150um	+106um	+75um	+63um	-63um
C-7/W	HK036-1		31.6	81.4	99.0	99.9	100.0	100.0	100.0	100.0
C-8/W	HK036-2		33.8	79.6	98.5	99.7	99.8	99.9	100.0	100.0
C-9/W	HK036-3		50.5	89.8	99.3	99.7	99.7	99.7	99.7	100.0
C-10/W	HK036-4		13.4	64.5	97.9	99.7	99.7	99.7	99.7	100.0

ALS TECHNICHEM (H.K.)
ANALYTICAL REPORT

Contact : Mr. Matthew Lai
Client : Electronic & Geophysical Services Ltd
Address : 12/F, Park Commercial Centre
2-12 Shelter Street, Causeway Bay
Hong Kong

Batch No.: HK023
No. of samples: 5

Date received : 26/07/95
Date completed : 8/8/95

Sample type : Sediment

Particle Size Analysis

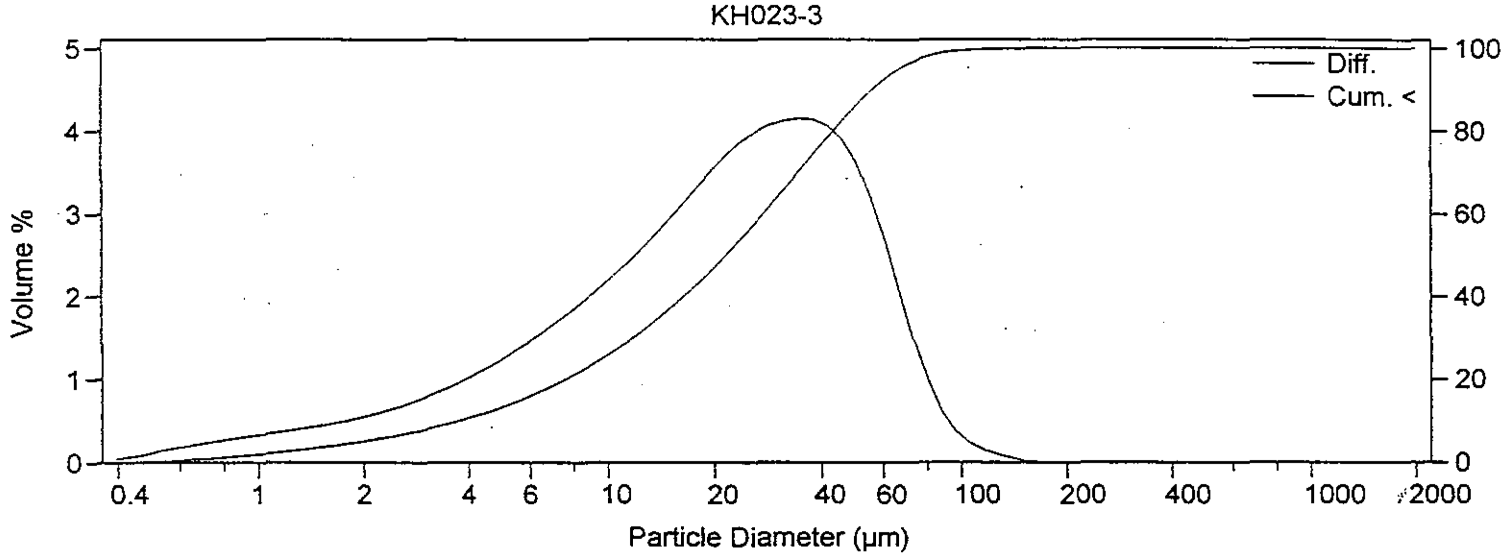
Percent Retained

Sample No.	Lab. No.	Total dry weight (%)	Sieve Size							
			+2mm	+710um	+300um	+150um	+106um	+75um	+63um	-63um
K-1/W	HK023-1	100.0	39.1	44.8	10.6	2.8	0.6	0.4	0.2	1.5
K-2/W	HK023-2	100.0	58.9	30.5	6.4	1.9	0.4	0.4	0.2	1.2
K-3/W	HK023-3	100.0	21.9	34.3	21.6	11.0	2.3	2.7	1.2	5.0
K-4/W	HK023-4	100.0	7.6	16.7	9.3	20.0	11.3	7.5	4.2	23.5
K-5/W	HK023-5	100.0	21.7	15.6	20.3	19.3	3.7	4.3	2.1	13.1

Cumulative Percent Retained

Sample No.	Lab. No.	Total dry weight (%)	Sieve Size							
			+2mm	+710um	+300um	+150um	+106um	+75um	+63um	-63um
K-1/W	HK023-1		39.1	83.9	94.6	97.4	98.0	98.4	98.5	100.0
K-2/W	HK023-2		58.9	89.4	95.8	97.8	98.2	98.6	98.8	100.0
K-3/W	HK023-3		21.9	56.2	77.8	88.8	91.1	93.8	95.0	100.0
K-4/W	HK023-4		7.6	24.3	33.6	53.6	64.9	72.4	76.5	100.0
K-5/W	HK023-5		21.7	37.2	57.5	76.8	80.5	84.8	86.9	100.0

File name:	HK023-3.$01	Group ID:	hk023-3
Sample ID:	KH023-3		
Operator:	Gao	Run number:	7
Comments:	ALS Technichem (HK) Pty Ltd , normal run		
Optical model:	Fraunhofer		
LS 230	Hazardous Fluids Module		
Start time:	11:56 9 Sep 1995	Run length:	61 Seconds
Pump speed:	60		
Obscuration:	10%		
Fluid:	Water		
Software:	2.05	Firmware:	2.02 2.02



Volume Statistics (Arithmetic) hk023-3.$01

Calculations from 0.375 µm to 2000 µm

Volume	100.0%		
Mean:	26.43 µm	S.D.:	21.1 µm
Median:	21.61 µm	C.V.:	79.9%
D(1,0):	0.827 um	Skewness:	1.18 Right skewed
Mode:	34.58 µm	Kurtosis:	1.75 Leptokurtic

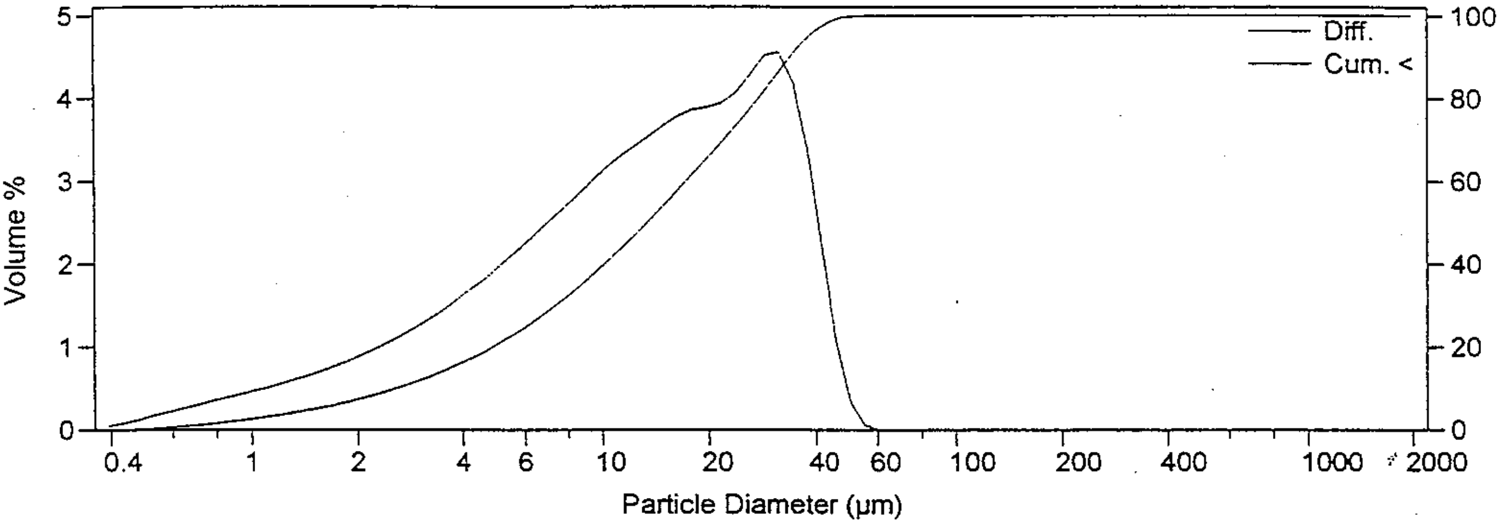
% <	10	25	50	75	90
Size µm	3.763	9.616	21.61	38.57	55.83

hk023-3.$01

Channel Diameter (Lower) µm	Diff. Volume %	Cum. < Volume %	Channel Diameter (Lower) µm	Diff. Volume %	Cum. < Volume %
0.375	0.034	0	39.77	4.07	76.40
0.412	0.061	0.034	43.66	3.91	80.47
0.452	0.090	0.095	47.93	3.62	84.38
0.496	0.128	0.184	52.63	3.21	88.00
0.545	0.161	0.313	57.77	2.68	91.21
0.598	0.191	0.474	63.41	2.09	93.89
0.657	0.220	0.665	69.62	1.50	95.98
0.721	0.250	0.886	76.43	0.997	97.48
0.791	0.277	1.14	83.90	0.619	98.48
0.869	0.302	1.41	92.09	0.374	99.10
0.953	0.326	1.71	101.1	0.229	99.47
1.047	0.350	2.04	111.0	0.145	99.70
1.149	0.375	2.39	121.8	0.090	99.84
1.261	0.401	2.76	133.7	0.046	99.93
1.385	0.428	3.16	146.8	0.017	99.98
1.520	0.458	3.59	161.2	0.003	100.00
1.669	0.492	4.05	176.8	0.0022	100.00
1.832	0.530	4.54	194.2	0	100.00
2.010	0.572	5.07	213.2	0	100.00
2.207	0.619	5.64	234.1	0	100.00
2.423	0.672	6.26	256.8	0	100.00
2.660	0.731	6.93	282.1	0	100.00
2.920	0.796	7.66	309.6	0	100.00
3.206	0.868	8.46	339.8	0	100.00
3.519	0.946	9.33	373.1	0	100.00
3.862	1.03	10.27	409.6	0	100.00
4.241	1.12	11.31	449.7	0	100.00
4.656	1.22	12.43	493.6	0	100.00
5.111	1.33	13.65	541.9	0	100.00
5.611	1.44	14.98	594.9	0	100.00
6.158	1.56	16.42	653.0	0	100.00
6.761	1.68	17.97	716.9	0	100.00
7.421	1.81	19.65	786.9	0	100.00
8.147	1.94	21.46	863.9	0	100.00
8.944	2.08	23.40	948.2	0	100.00
9.819	2.23	25.48	1,041	0	100.00
10.78	2.39	27.71	1,143	0	100.00
11.83	2.56	30.11	1,255	0	100.00
12.99	2.74	32.67	1,377	0	100.00
14.26	2.93	35.41	1,512	0	100.00
15.65	3.13	38.34	1,660	0	100.00
17.18	3.34	41.47	1,822	0	100.00
18.86	3.54	44.80	2,000		100.00
20.70	3.72	48.34			
22.73	3.87	52.06			
24.95	3.99	55.93			
27.38	4.07	59.91			
30.07	4.13	63.99			
33.00	4.15	68.11			
36.24	4.14	72.26			

File name:	hk023-4.$03	Group ID:	hk023-4
Sample ID:	KH023-4		
Operator:	Gao	Run number:	11
Comments:	ALS Technichem (HK) Pty Ltd , normal run		
Optical model:	Fraunhofer		
LS 230	Hazardous Fluids Module		
Start time:	13:32 9 Sep 1995	Run length:	60 Seconds
Pump speed:	60		
Obscuration:	9%		
Fluid:	Water		
Software:	2.05	Firmware:	2.02 2.02

KH023-4



Volume Statistics (Arithmetic) hk023-4.$03

Calculations from 0.375 µm to 2000 µm

Volume	100.0%		
Mean:	16.13 µm	95% Conf. Limits:	0-39.3 µm
Median:	13.48 µm	S.D.:	11.8 µm
D(1,0):	0.864 um	Variance:	140 μm^2
Mean/Median Ratio:	1.197	C.V.:	73.4%
Mode:	31.50 µm	Skewness:	0.657 Right skewed
Specific Surf. Area	10061 cm^2/ml	Kurtosis:	-0.516 Platykurtic

% <	10	25	50	75	90
Size µm	2.572	6.064	13.48	24.73	33.94

hk023-4.$03

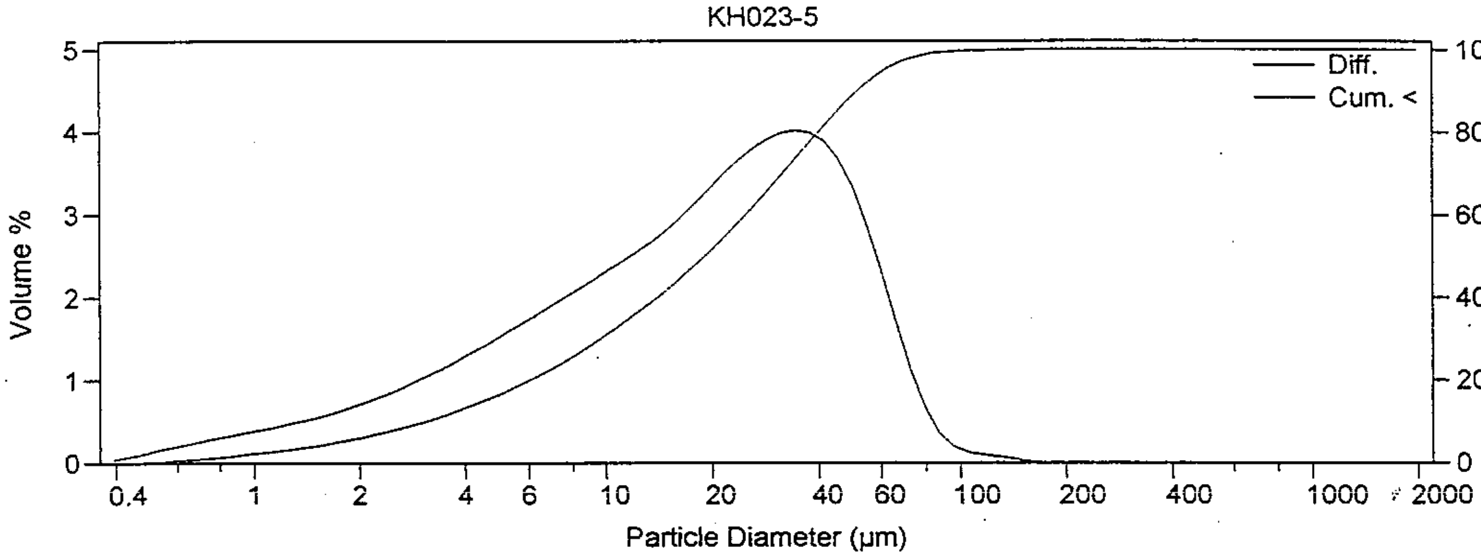
Channel Diameter (Lower) µm	Diff. Volume %	Cum. < Volume %	Channel Diameter (Lower) µm	Diff. Volume %	Cum. < Volume %
0.375	0.042	0	39.77	2.20	96.33
0.412	0.075	0.042	43.66	1.07	98.54
0.452	0.112	0.118	47.93	0.335	99.61
0.496	0.161	0.230	52.63	0.053	99.94
0.545	0.205	0.391	57.77	0.003	100.00
0.598	0.246	0.596	63.41	0	100.00
0.657	0.288	0.842	69.62	0	100.00
0.721	0.332	1.13	76.43	0	100.00
0.791	0.374	1.46	83.90	0	100.00
0.869	0.417	1.84	92.09	0	100.00
0.953	0.460	2.25	101.1	0	100.00
1.047	0.506	2.71	111.0	0	100.00
1.149	0.554	3.22	121.8	0	100.00
1.261	0.605	3.77	133.7	0	100.00
1.385	0.659	4.38	146.8	0	100.00
1.520	0.717	5.04	161.2	0	100.00
1.669	0.781	5.75	176.8	0	100.00
1.832	0.849	6.54	194.2	0	100.00
2.010	0.923	7.38	213.2	0	100.00
2.207	1.00	8.31	234.1	0	100.00
2.423	1.09	9.31	256.8	0	100.00
2.660	1.19	10.40	282.1	0	100.00
2.920	1.29	11.59	309.6	0	100.00
3.206	1.40	12.88	339.8	0	100.00
3.519	1.51	14.28	373.1	0	100.00
3.862	1.64	15.79	409.6	0	100.00
4.241	1.77	17.43	449.7	0	100.00
4.656	1.91	19.20	493.6	0	100.00
5.111	2.06	21.12	541.9	0	100.00
5.611	2.21	23.17	594.9	0	100.00
6.158	2.37	25.38	653.0	0	100.00
6.761	2.52	27.75	716.9	0	100.00
7.421	2.68	30.27	786.9	0	100.00
8.147	2.83	32.94	863.9	0	100.00
8.944	3.00	35.78	948.2	0	100.00
9.819	3.15	38.77	1,041	0	100.00
10.78	3.30	41.93	1,143	0	100.00
11.83	3.42	45.22	1,255	0	100.00
12.99	3.54	48.64	1,377	0	100.00
14.26	3.67	52.19	1,512	0	100.00
15.65	3.78	55.85	1,660	0	100.00
17.18	3.86	59.64	1,822	0	100.00
18.86	3.90	63.50	2,000		100.00
20.70	3.95	67.40			
22.73	4.07	71.34			
24.95	4.29	75.41			
27.38	4.52	79.70			
30.07	4.56	84.22			
33.00	4.20	88.78			
36.24	3.36	92.97			

COULTER

LS Particle Size Analyzer

9 Sep 199

File name:	HK023-5.$01	Group ID:	hk023-5
Sample ID:	KH023-5		
Operator:	Gao	Run number:	16
Comments:	ALS Technichem (HK) Pty Ltd , normal run		
Optical model:	Fraunhofer		
LS 230	Hazardous Fluids Module		
Start time:	15:37 9 Sep 1995	Run length:	60 Seconds
Pump speed:	50		
Obscuration:	11%		
Fluid:	Water		
Software:	2.05	Firmware:	2.02 2.02



Volume Statistics (Arithmetic) hk023-5.$01

Calculations from 0.375 µm to 2000 µm

Volume	100.0%		
Mean:	24.00 µm	S.D.:	20 µm
Median:	19.18 µm	C.V.:	83.2%
D(1,0):	0.845 um	Skewness:	1.24 Right skewed
Mode:	34.58 µm	Kurtosis:	2.19 Leptokurtic

% <	10	25	50	75	90
Size µm	3.068	7.752	19.18	35.74	51.90

hk023-5.$01

Channel Diameter (Lower) µm	Diff. Volume %	Cum. < Volume %
0.375	0.037	0
0.412	0.067	0.037
0.452	0.099	0.104
0.496	0.142	0.203
0.545	0.179	0.345
0.598	0.214	0.524
0.657	0.247	0.737
0.721	0.283	0.984
0.791	0.316	1.27
0.869	0.349	1.58
0.953	0.381	1.93
1.047	0.415	2.31
1.149	0.452	2.73
1.261	0.490	3.18
1.385	0.532	3.67
1.520	0.577	4.20
1.669	0.627	4.78
1.832	0.682	5.41
2.010	0.742	6.09
2.207	0.806	6.83
2.423	0.877	7.64
2.660	0.953	8.51
2.920	1.03	9.46
3.206	1.12	10.50
3.519	1.21	11.62
3.862	1.30	12.83
4.241	1.40	14.13
4.656	1.50	15.53
5.111	1.60	17.03
5.611	1.71	18.63
6.158	1.81	20.34
6.761	1.92	22.16
7.421	2.03	24.08
8.147	2.13	26.10
8.944	2.24	28.23
9.819	2.34	30.47
10.78	2.45	32.81
11.83	2.56	35.26
12.99	2.68	37.82
14.26	2.82	40.51
15.65	2.97	43.33
17.18	3.14	46.30
18.86	3.32	49.43
20.70	3.49	52.75
22.73	3.66	56.24
24.95	3.80	59.90
27.38	3.91	63.70
30.07	3.99	67.61
33.00	4.02	71.60
36.24	4.00	75.62
39.77	3.89	79.62
43.66	3.68	83.51
47.93	3.33	87.19
52.63	2.86	90.52
57.77	2.29	93.37
63.41	1.68	95.66
69.62	1.11	97.34
76.43	0.654	98.45
83.90	0.350	99.10
92.09	0.187	99.45
101.1	0.117	99.64
111.0	0.091	99.75
121.8	0.076	99.85
133.7	0.051	99.92
146.8	0.023	99.97
161.2	0.005	99.99
176.8	0.0043	100.00
194.2	0	100.00
213.2	0	100.00
234.1	0	100.00
256.8	0	100.00
282.1	0	100.00
309.6	0	100.00
339.8	0	100.00
373.1	0	100.00
409.6	0	100.00
449.7	0	100.00
493.6	0	100.00
541.9	0	100.00
594.9	0	100.00
653.0	0	100.00
716.9	0	100.00
786.9	0	100.00
863.9	0	100.00
948.2	0	100.00
1,041	0	100.00
1,143	0	100.00
1,255	0	100.00
1,377	0	100.00
1,512	0	100.00
1,660	0	100.00
1,822	0	100.00
2,000		100.00

ALS Technichem (HK) Pty

HOKLAS
Registration No. 6

Test Report

Client Name: Electronic & Geophysical Services Ltd.
12/F, Park Commercial Centre
2-12 Shelter Street, Causeway Bay
Hong Kong

Attention: Mr. Matthew W. C. Lai

Report No: HK021

Location: L - Tai Lam Chung

Date Received: 26th July 1995

Date Completed: 8th August 1995

Test Methods: Sediments for : -
Particle sizing to 63 microns by in-house method HK/P008
Total Organic Carbon by in-house method HK/EP005
Total Inorganic Carbon by in-house method HK/EP006
Total Carbon by in-house method HK/EP007
Metals by ICPMS using in-house method HK/EG020
Ammonia (as N) by in-house method HK/EK055
Total nitrogen by in-house method HK/EK062
Total phosphorus by in-house method HK/EK067
Particle sizing 63 to 2 microns by Coulter Analyser

****

Authorised by: [signature]

Mr. R. Fung
Manager - Environmental

Date issued: 13th October 1995

Unit 6, G/F, Trans Asia Centre, 18 Kin Hong Street, Kwai Chung, N.T. Hong Kong. Tel : 2610 1044 Fax : 2610 2021

ALS TECHNICHEM (H.K.)
ANALYTICAL REPORT

Contact :	Mr. Matthew Lai	Batch No.:	HK021
Client :	Electronic & Geophysical Services Ltd	No. of samples:	9
Address :	12/F, Park Commercial Centre 2-12 Shelter Street, Causeway Bay Hong Kong		
		Date received :	26/07/95
Sample type :	Sediment	Date completed :	08/08/95

Method	Analysis description	Units	LOR	L1/W	L2/W	L3/W	L4/W	L5/W	L6/W	L7/W
	Internal Sample Number			HK021-9	HK021-8	HK021-7	HK021-6	HK021-5	HK021-4	HK021-3
	Metals by ICPMS									
EG020	Cadmium	mg/kg	0.02	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
EG020	Chromium	mg/kg	0.1	2.6	5.2	2.2	1.5	1.6	2.8	22.1
EG020	Copper	mg/kg	0.1	3.1	6.3	2.1	0.8	1.3	24.6	18.8
EG020	Mercury	mg/kg	0.1	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
EG020	Nickel	mg/kg	0.1	2.2	3.3	1.5	1.1	1.2	2.4	15.2
EG020	Lead	mg/kg	0.1	15.9	39.1	42.1	3.9	9.0	10.5	65.7
EG020	Zinc	mg/kg	1.0	30	45	23	1	4	11	84
	Nutrients									
EK055	Ammonia Nitrogen	mg/kg	1	22.9	8.6	5.2	<LOR	8.0	1.8	18.3
EK062	Total Nitrogen	mg/kg	10	700	204	118	13.9	54.3	83.8	526
EK067	Total Phosphorus	mg/kg	1	24	118	61	16	35	32	171
	Organic Constituents									
EP007	Total Carbon	%	0.01	<LOR	0.29	0.18	1.47	0.07	0.07	0.93
EP006	Total Inorganic Carbon	%	0.01	<LOR	0.03	<LOR	<LOR	<LOR	<LOR	0.23
EP005	Total Organic Carbon	%	0.01	<LOR	0.26	0.17	1.47	0.07	0.07	0.71

Method	Analysis description	Units	LOR	L8/W	L9/W
	Internal Sample Number			HK021-2	HK021-1
	Metals by ICPMS				
EG020	Cadmium	mg/kg	0.02	<LOR	<LOR
EG020	Chromium	mg/kg	0.1	12.2	18.1
EG020	Copper	mg/kg	0.1	13.3	17.0
EG020	Mercury	mg/kg	0.1	<LOR	<LOR
EG020	Nickel.	mg/kg	0.1	7.9	12.1
EG020	Lead	mg/kg	0.1	53.1	99.5
EG020	Zinc	mg/kg	1	60	63
	Nutrients				
EK055	Ammonia Nitrogen	mg/kg	1	2.0	2.1
EK062	Total Nitrogen	mg/kg	10	354	430
EK067	Total Phosphorus	mg/kg	1	89	115
	Organic Constituents				
EP007	Total Carbon	%	0.01	0.82	0.61
EP006	Total Inorganic Carbon	%	0.01	0.08	0.22
EP005	Total Organic Carbon	%	0.01	0.74	0.39

Comments:
Samples analysed on an as received basis. Results reported on a dry weight basis.

ALS TECHNICHEM (H.K.)
ANALYTICAL REPORT

Contact : Mr. Matthew Lai
Client : Electronic & Geophysical Services Ltd
Address : 12/F, Park Commercial Centre
2-12 Shelter Street, Causeway Bay
Hong Kong

Batch No.: HK021
No. of samples: 9

Date received : 26/07/95
Date completed : 08/08/95

Sample type : Sediment

Particle Size Analysis

Percent Retained

Sample No.	Lab. No.	Total dry weight (%)	Sieve Size							
			+2mm	+710um	+300um	+150um	+106um	+75um	+63um	-63um
L-1/W	HK021-9	100.0	97.4	1.7	0.4	0.2	0.1	0.0	0.0	0.3
L-2/W	HK021-8	100.0	22.9	25.7	18.9	11.3	2.5	3.4	1.5	13.8
L-3/W	HK021-7	100.0	86.1	10.3	2.5	0.5	0.1	0.1	0.0	0.4
L-4/W	HK021-6	100.0	24.5	49.6	23.1	1.5	0.2	0.2	0.1	0.8
L-5/W	HK021-5	100.0	28.1	43.0	22.2	4.1	0.5	0.4	0.2	1.6
L-6/W	HK021-4	100.0	53.4	38.5	6.3	0.7	0.1	0.1	0.1	0.8
L-7/W	HK021-3	100.0	29.1	33.9	14.1	7.5	0.1	0.7	0.3	14.2
L-8/W	HK021-2	100.0	14.8	38.0	16.5	8.8	0.7	1.2	0.9	19.0
L-9/W	HK021-1.	100.0	10.9	25.8	27.5	18.0	2.0	1.8	0.5	13.4

Cumulative Percent Retained

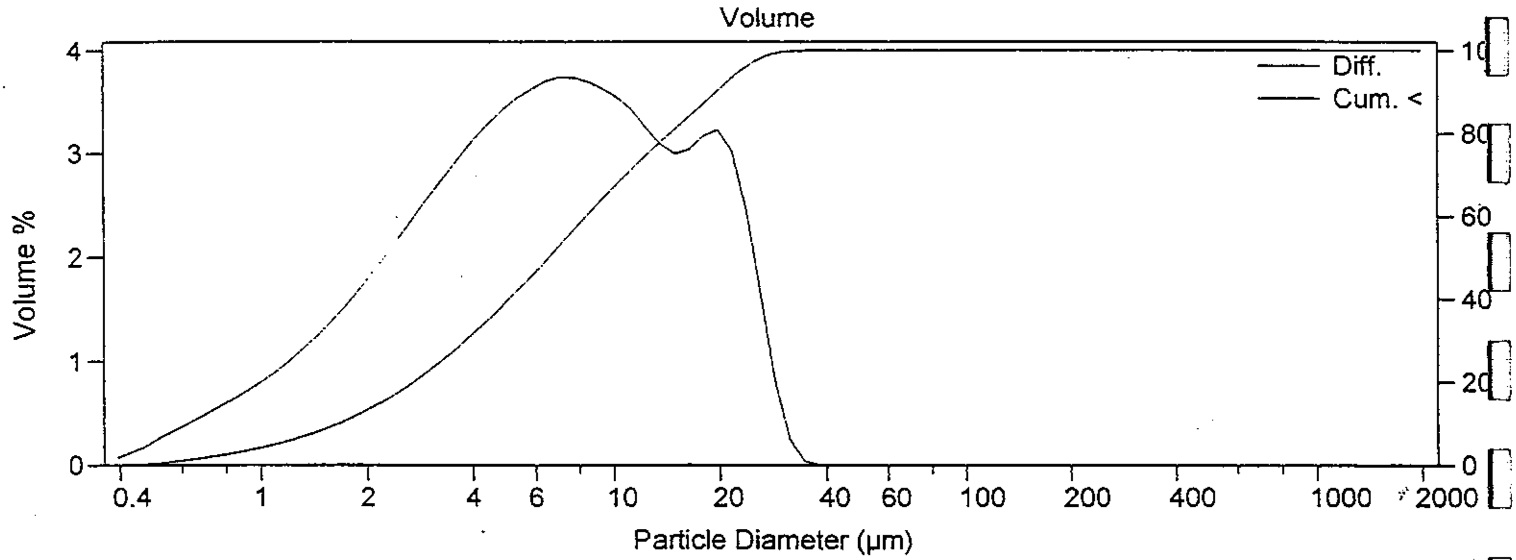
Sample No.	Lab. No.	Total dry weight (%)	Sieve Size							
			+2mm	+710um	+300um	+150um	+106um	+75um	+63um	-63um
L-1/W	HK021-9		97.4	99.0	99.4	99.6	99.7	99.7	99.7	100.0
L-2/W	HK021-8		22.9	48.6	67.4	78.7	81.2	84.7	86.2	100.0
L-3/W	HK021-7		86.1	96.4	98.9	99.3	99.5	99.6	99.6	100.0
L-4/W	HK021-6		24.5	74.1	97.2	98.7	99.0	99.2	99.2	100.0
L-5/W	HK021-5		28.1	71.0	93.2	97.3	97.9	98.3	98.4	100.0
L-6/W	HK021-4		53.4	91.9	98.2	98.8	99.0	99.1	99.2	100.0
L-7/W	HK021-3		29.1	63.0	77.1	84.7	84.8	85.5	85.8	100.0
L-8/W	HK021-2		14.8	52.8	69.4	78.1	78.9	80.1	81.0	100.0
L-9/W	HK021-1		10.9	36.8	64.3	82.3	84.3	86.2	86.6	100.0

COULTER

LS Particle Size Analyzer

11 Sep 199

File name:	hk021-1.$01	Group ID:	HK021-1
Sample ID:			
Operator:	Gao	Run number:	9
Comments:	ALS		
Optical model:	Fraunhofer		
LS 230	Hazardous Fluids Module		
Start time:	0:33 6 Sep 1995	Run length:	61 Seconds
Pump speed:	60		
Obscuration:	10%		
Fluid:	Water		
Software:	2.05	Firmware:	2.02 2.02



Volume Statistics (Arithmetic) hk021-1.$01

Calculations from 0.375 µm to 2000 µm

Volume	100.0%		
Mean:	8.678 µm	95% Conf. Limits:	0-22.2 µm
Median:	6.557 µm	S.D.:	6.9 µm
D(1,0):	0.885 um	Variance:	47.6 μm^2
Mean/Median Ratio:	1.324	C.V.:	79.5%
Mode:	7.083 µm	Skewness:	1.03 Right skewed
Specific Surf. Area	15906 cm^2/ml	Kurtosis:	0.258 Leptokurtic

% <	10	25	50	75	90
Size µm	1.647	3.234	6.557	12.53	19.66

bk021-1.$01

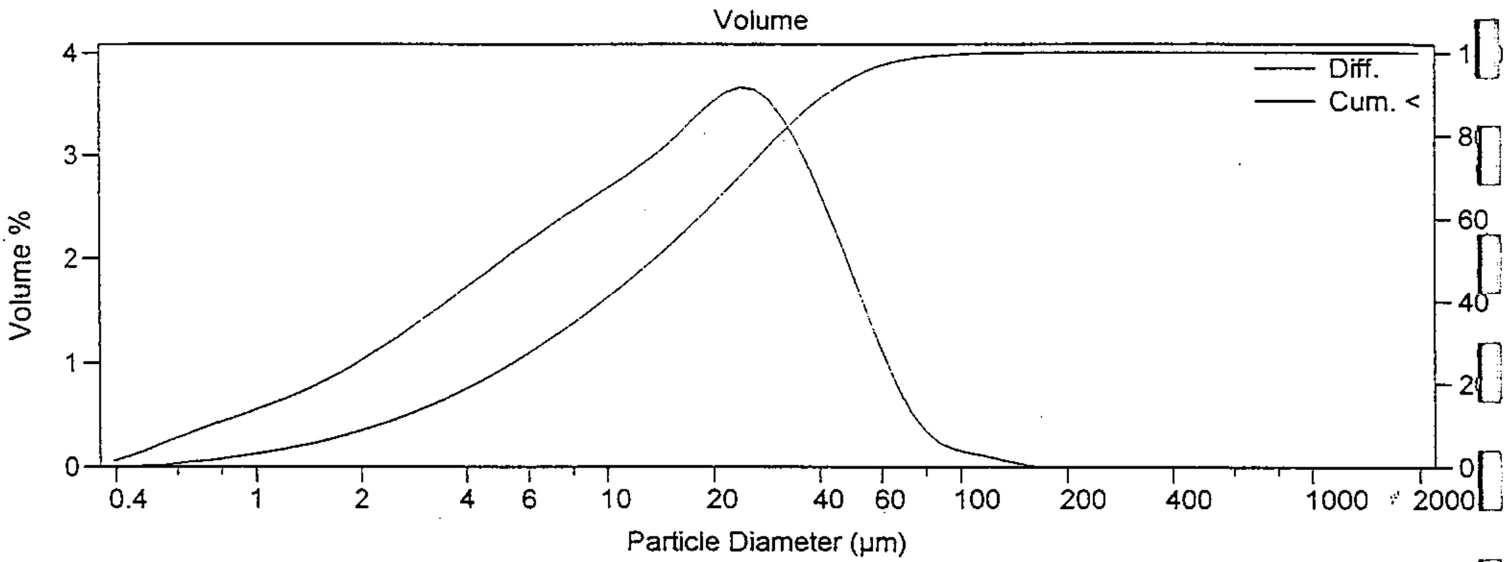
Channel Diameter (Lower) µm	Diff. Volume %	Cum. < Volume %	Channel Diameter (Lower) µm	Diff. Volume %	Cum. < Volume %
0.375	0.069	0	39.77	0	100.00
0.412	0.122	0.069	43.66	0	100.00
0.452	0.182	0.191	47.93	0	100.00
0.496	0.262	0.373	52.63	0	100.00
0.545	0.333	0.634	57.77	0	100.00
0.598	0.403	0.968	63.41	0	100.00
0.657	0.474	1.37	69.62	0	100.00
0.721	0.551	1.84	76.43	0	100.00
0.791	0.629	2.39	83.90	0	100.00
0.869	0.710	3.02	92.09	0	100.00
0.953	0.799	3.73	101.1	0	100.00
1.047	0.897	4.53	111.0	0	100.00
1.149	1.01	5.43	121.8	0	100.00
1.261	1.12	6.43	133.7	0	100.00
1.385	1.25	7.56	146.8	0	100.00
1.520	1.40	8.81	161.2	0	100.00
1.669	1.55	10.21	176.8	0	100.00
1.832	1.72	11.76	194.2	0	100.00
2.010	1.89	13.47	213.2	0	100.00
2.207	2.07	15.36	234.1	0	100.00
2.423	2.25	17.43	256.8	0	100.00
2.660	2.44	19.68	282.1	0	100.00
2.920	2.62	22.12	309.6	0	100.00
3.206	2.80	24.75	339.8	0	100.00
3.519	2.98	27.55	373.1	0	100.00
3.862	3.14	30.52	409.6	0	100.00
4.241	3.30	33.67	449.7	0	100.00
4.656	3.43	36.96	493.6	0	100.00
5.111	3.54	40.39	541.9	0	100.00
5.611	3.63	43.92	594.9	0	100.00
6.158	3.70	47.55	653.0	0	100.00
6.761	3.74	51.25	716.9	0	100.00
7.421	3.74	55.00	786.9	0	100.00
8.147	3.70	58.73	863.9	0	100.00
8.944	3.63	62.43	948.2	0	100.00
9.819	3.55	66.06	1,041	0	100.00
10.78	3.43	69.61	1,143	0	100.00
11.83	3.26	73.04	1,255	0	100.00
12.99	3.09	76.29	1,377	0	100.00
14.26	3.00	79.38	1,512	0	100.00
15.65	3.04	82.38	1,660	0	100.00
17.18	3.17	85.41	1,822	0	100.00
18.86	3.23	88.59	2,000		100.00
20.70	3.02	91.82			
22.73	2.45	94.84			
24.95	1.62	97.29			
27.38	0.795	98.91			
30.07	0.253	99.70			
33.00	0.041	99.96			
36.24	0.002	100.00			

COULTER

LS Particle Size Analyzer

11 Sep 199

File name:	hk021-2.$15	Group ID:	HK021-2
Sample ID:			
Operator:	Gao	Run number:	15
Comments:	ALS, feed in samples the third time		
Optical model:	Fraunhofer		
LS 230	Hazardous Fluids Module		
Start time:	0:06 7 Sep 1995	Run length:	60 Seconds
Pump speed:	60		
Obscuration:	12%		
Fluid:	Water		
Software:	2.05	Firmware:	2.02 2.02



Volume Statistics (Arithmetic) hk021-2.$15

Calculations from 0.375 µm to 2000 µm

Volume	100.0%		
Mean:	18.71 µm	95% Conf. Limits:	0-53.2 µm
Median:	13.63 µm	S.D.:	17.6 µm
D(1,0):	0.839 um	Variance:	310 μm^2
Mean/Median Ratio:	1.373	C.V.:	94.1%
Mode:	23.81 µm	Skewness:	1.83 Right skewed
Specific Surf. Area	10833 cm^2/ml	Kurtosis:	5.37 Leptokurtic

% <	10	25	50	75	90
Size µm	2.246	5.432	13.63	26.91	41.93

hk021-2.$15

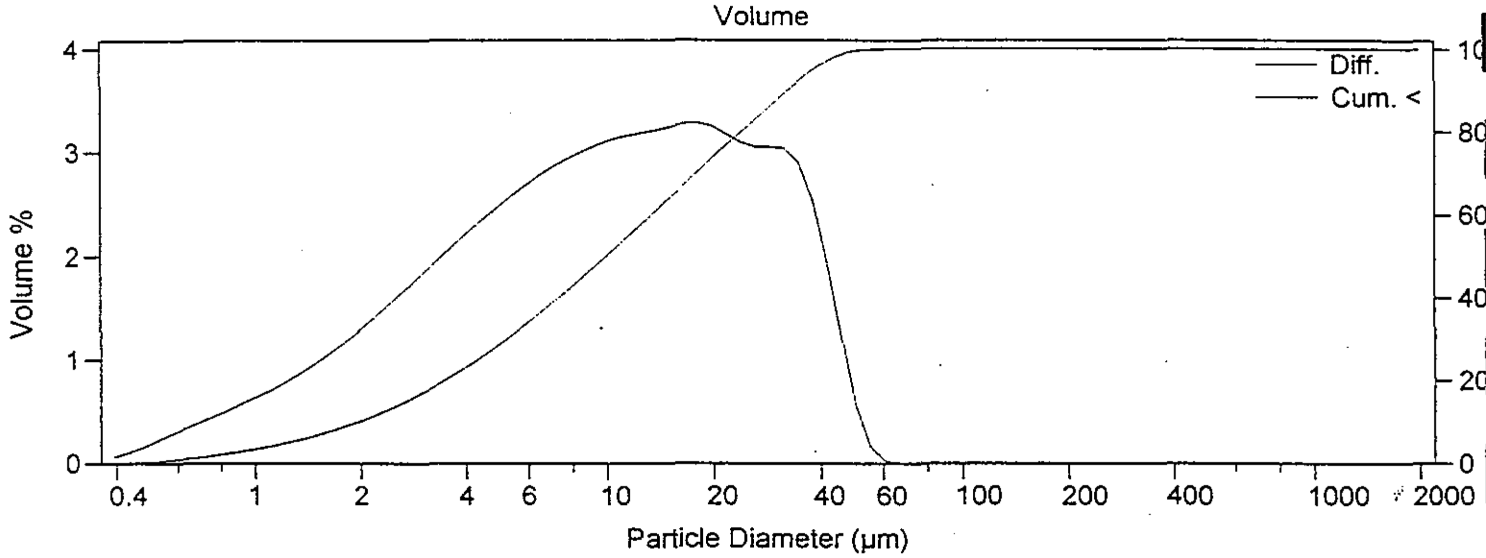
Channel Diameter (Lower) µm	Diff. Volume %	Cum. < Volume %	Channel Diameter (Lower) µm	Diff. Volume %	Cum. < Volume %
0.375	0.053	0	39.77	2.52	88.60
0.412	0.094	0.053	43.66	2.17	91.12
0.452	0.139	0.147	47.93	1.80	93.29
0.496	0.200	0.286	52.63	1.44	95.09
0.545	0.252	0.485	57.77	1.09	96.53
0.598	0.301	0.738	63.41	0.770	97.62
0.657	0.350	1.04	69.62	0.516	98.39
0.721	0.400	1.39	76.43	0.335	98.90
0.791	0.449	1.79	83.90	0.224	99.24
0.869	0.496	2.24	92.09	0.164	99.46
0.953	0.544	2.73	101.1	0.132	99.63
1.047	0.595	3.28	111.0	0.106	99.76
1.149	0.650	3.87	121.8	0.076	99.86
1.261	0.707	4.52	133.7	0.042	99.94
1.385	0.769	5.23	146.8	0.015	99.98
1.520	0.835	6.00	161.2	0.003	100.00
1.669	0.907	6.83	176.8	0.0021	100.00
1.832	0.985	7.74	194.2	0	100.00
2.010	1.07	8.73	213.2	0	100.00
2.207	1.15	9.79	234.1	0	100.00
2.423	1.25	10.95	256.8	0	100.00
2.660	1.34	12.19	282.1	0	100.00
2.920	1.44	13.53	309.6	0	100.00
3.206	1.54	14.97	339.8	0	100.00
3.519	1.64	16.51	373.1	0	100.00
3.862	1.74	18.15	409.6	0	100.00
4.241	1.84	19.89	449.7	0	100.00
4.656	1.95	21.74	493.6	0	100.00
5.111	2.05	23.68	541.9	0	100.00
5.611	2.15	25.73	594.9	0	100.00
6.158	2.25	27.89	653.0	0	100.00
6.761	2.35	30.14	716.9	0	100.00
7.421	2.44	32.48	786.9	0	100.00
8.147	2.53	34.93	863.9	0	100.00
8.944	2.62	37.46	948.2	0	100.00
9.819	2.71	40.08	1,041	0	100.00
10.78	2.80	42.79	1,143	0	100.00
11.83	2.90	45.60	1,255	0	100.00
12.99	3.00	48.49	1,377	0	100.00
14.26	3.12	51.50	1,512	0	100.00
15.65	3.25	54.62	1,660	0	100.00
17.18	3.39	57.87	1,822	0	100.00
18.86	3.52	61.25	2,000		100.00
20.70	3.62	64.77			
22.73	3.67	68.39			
24.95	3.65	72.06			
27.38	3.55	75.71			
30.07	3.37	79.26			
33.00	3.13	82.63			
36.24	2.84	85.76			

8 + 11

COULTER LS Particle Size Analyzer

11 Sep 199[illegible]

File name:	hk021-3.$01	Group ID:	HK021-3
Sample ID:			
Operator:	Gao	Run number:	1
Comments:	ALS Technichem (HK) Pty Ltd		
Optical model:	Fraunhofer		
LS 230	Hazardous Fluids Module		
Start time:	12:54 7 Sep 1995	Run length:	300 Seconds
Pump speed:	62		
Obscuration:	10%		
Fluid:	Water		
Software:	2.05	Firmware:	2.02 2.02



Volume Statistics (Arithmetic) hk021-3.$01

Calculations from 0.375 µm to 2000 µm

Volume	100.0%		
Mean:	13.79 µm	95% Conf. Limits:	0-37 µm
Median:	9.974 µm	S.D.:	11.8 µm
D(1,0):	0.865 um	Variance:	140 μm^2
Mean/Median Ratio:	1.382	C.V.:	85.7%
Mode:	18.00 µm	Skewness:	1.05 Right skewed
Specific Surf. Area	12643 cm^2/ml	Kurtosis:	0.324 Leptokurtic

% <	10	25	50	75	90
Size µm	1.958	4.289	9.974	20.56	32.35

k021-3.$01

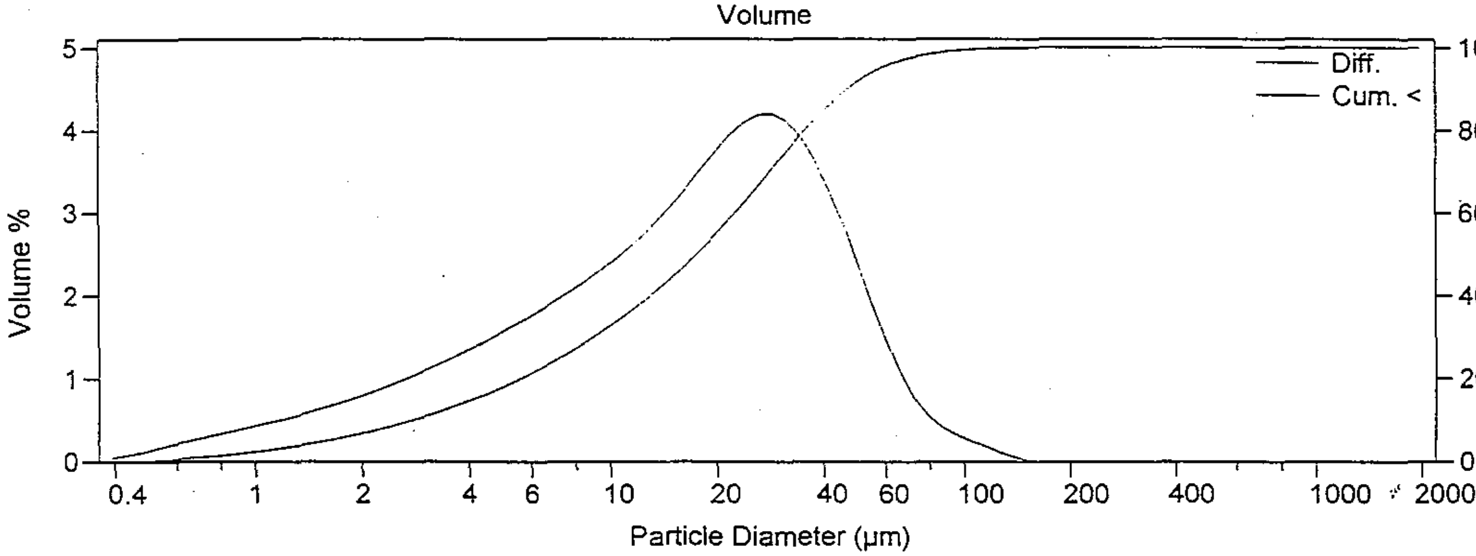
Channel Diameter (Lower) µm	Diff. Volume %	Cum. < Volume %	Channel Diameter (Lower) µm	Diff. Volume %	Cum. < Volume %
0.375	0.057	0	39.77	1.94	96.12
0.412	0.101	0.057	43.66	1.21	98.06
0.452	0.149	0.158	47.93	0.551	99.27
0.496	0.215	0.307	52.63	0.157	99.82
0.545	0.274	0.522	57.77	0.022	99.98
0.598	0.330	0.796	63.41	0.001	100.00
0.657	0.386	1.13	69.62	0	100.00
0.721	0.446	1.51	76.43	0	100.00
0.791	0.506	1.96	83.90	0	100.00
0.869	0.567	2.46	92.09	0	100.00
0.953	0.631	3.03	101.1	0	100.00
1.047	0.700	3.66	111.0	0	100.00
1.149	0.775	4.36	121.8	0	100.00
1.261	0.856	5.14	133.7	0	100.00
1.385	0.944	5.99	146.8	0	100.00
1.520	1.04	6.94	161.2	0	100.00
1.669	1.14	7.97	176.8	0	100.00
1.832	1.25	9.11	194.2	0	100.00
2.010	1.36	10.36	213.2	0	100.00
2.207	1.48	11.72	234.1	0	100.00
2.423	1.61	13.21	256.8	0	100.00
2.660	1.73	14.81	282.1	0	100.00
2.920	1.86	16.54	309.6	0	100.00
3.206	1.98	18.40	339.8	0	100.00
3.519	2.11	20.39	373.1	0	100.00
3.862	2.23	22.50	409.6	0	100.00
4.241	2.35	24.73	449.7	0	100.00
4.656	2.47	27.08	493.6	0	100.00
5.111	2.58	29.55	541.9	0	100.00
5.611	2.68	32.13	594.9	0	100.00
6.158	2.78	34.81	653.0	0	100.00
6.761	2.87	37.59	716.9	0	100.00
7.421	2.94	40.46	786.9	0	100.00
8.147	3.01	43.41	863.9	0	100.00
8.944	3.08	46.42	948.2	0	100.00
9.819	3.13	49.50	1,041	0	100.00
10.78	3.16	52.62	1,143	0	100.00
11.83	3.19	55.79	1,255	0	100.00
12.99	3.21	58.97	1,377	0	100.00
14.26	3.24	62.18	1,512	0	100.00
15.65	3.28	65.43	1,660	0	100.00
17.18	3.29	68.70	1,822	0	100.00
18.86	3.26	71.99	2,000		100.00
20.70	3.18	75.25			
22.73	3.10	78.43			
24.95	3.05	81.53			
27.38	3.06	84.58			
30.07	3.04	87.63			
33.00	2.90	90.68			
36.24	2.54	93.58			

COULTER

LS Particle Size Analyzer

9 Sep 19[illegible]

File name:	HK021-8.$01	Group ID:	hk021-8
Sample ID:	KH021-8		
Operator:	Gao	Run number:	1
Comments:	ALS Technichem (HK) Pty Ltd, normal run		
Optical model:	Fraunhofer		
LS 230	Hazardous Fluids Module		
Start time:	7:29 9 Sep 1995	Run length:	61 Seconds
Pump speed:	60		
Obscuration:	10%		
Fluid:	Water		
Software:	2.05	Firmware:	2.02 2.02



Volume Statistics (Arithmetic) hk021-8.$01

Calculations from 0.375 µm to 2000 µm

Volume	100.0%		
Mean:	22.12 µm	S.D.:	19.3 µm
Median:	17.59 µm	C.V.:	87.3%
D(1,0):	0.848 um	Skewness:	1.62 Right skewed
Mode:	28.69 µm	Kurtosis:	4.04 Leptokurtic

% <	10	25	50	75	90
Size µm	2.785	7.217	17.59	31.62	47.02

hk021-8.$01

Channel Diameter (Lower) µm	Diff. Volume %	Cum. < Volume %	Channel Diameter (Lower) µm	Diff. Volume %	Cum. < Volume %
0.375	0.040	0	39.77	3.27	84.49
0.412	0.071	0.040	43.66	2.84	87.76
0.452	0.106	0.112	47.93	2.38	90.61
0.496	0.153	0.218	52.63	1.90	92.98
0.545	0.193	0.370	57.77	1.45	94.89
0.598	0.232	0.564	63.41	1.06	96.34
0.657	0.270	0.796	69.62	0.756	97.40
0.721	0.311	1.07	76.43	0.538	98.16
0.791	0.351	1.38	83.90	0.399	98.70
0.869	0.389	1.73	92.09	0.310	99.10
0.953	0.428	2.12	101.1	0.243	99.41
1.047	0.469	2.54	111.0	0.178	99.65
1.149	0.512	3.01	121.8	0.109	99.83
1.261	0.557	3.53	133.7	0.048	99.94
1.385	0.605	4.08	146.8	0.013	99.99
1.520	0.655	4.69	161.2	0.002	100.00
1.669	0.709	5.34	176.8	4.5E-5	100.00
1.832	0.768	6.05	194.2	0	100.00
2.010	0.829	6.82	213.2	0	100.00
2.207	0.893	7.65	234.1	0	100.00
2.423	0.962	8.54	256.8	0	100.00
2.660	1.03	9.50	282.1	0	100.00
2.920	1.11	10.54	309.6	0	100.00
3.206	1.19	11.65	339.8	0	100.00
3.519	1.27	12.84	373.1	0	100.00
3.862	1.36	14.11	409.6	0	100.00
4.241	1.45	15.46	449.7	0	100.00
4.656	1.54	16.91	493.6	0	100.00
5.111	1.64	18.45	541.9	0	100.00
5.611	1.74	20.08	594.9	0	100.00
6.158	1.84	21.82	653.0	0	100.00
6.761	1.95	23.66	716.9	0	100.00
7.421	2.06	25.60	786.9	0	100.00
8.147	2.17	27.66	863.9	0	100.00
8.944	2.30	29.83	948.2	0	100.00
9.819	2.43	32.13	1,041	0	100.00
10.78	2.57	34.56	1,143	0	100.00
11.83	2.73	37.13	1,255	0	100.00
12.99	2.90	39.86	1,377	0	100.00
14.26	3.09	42.76	1,512	0	100.00
15.65	3.30	45.85	1,660	0	100.00
17.18	3.52	49.15	1,822	0	100.00
18.86	3.74	52.67	2,000		100.00
20.70	3.94	56.41			
22.73	4.10	60.34			
24.95	4.19	64.44			
27.38	4.20	68.63			
30.07	4.11	72.82			
33.00	3.92	76.93			
36.24	3.64	80.85			

APPENDIX B4

SEDIMENT CORE SAMPLING ANALYTICAL RESULTS
(DRY-SEASON SURVEY)

Channel	Station	Date	Depth mm	Class	Moisture Content	Cd mg/kg	Cr mg/kg	Cu mg/kg	Ni mg/kg	Pb mg/kg	Zn mg/kg	Hg mg/kg
Staunton Creek	B1/D	12/12/95	0-195	C	20.70	0.30	45.3	236.0	32.0	59.8	291.0	0.1
Staunton Creek	B1/D	12/12/95	195-390	C	20.00	0.40	24.8	103.0	13.4	88.2	240.0	0.1
Staunton Creek	B2/D	12/12/95	SURFACE	C	64.50	1.00	41.1	229.0	14.3	127.0	623.0	0.3
Kai Tak Nullah	C1/D	14/12/95	SURFACE	A	45.90	0.20	17.7	50.2	9.4	17.3	86.7	0.1
Shing Mun River	D1/D	8/12/95	0-290	A	19.10	0.20	8.0	1.9	5.4	36.0	85.8	0.1
Shing Mun River	D1/D	8/12/95	290-580	C	43.90	0.30	12.2	53.1	13.2	70.9	245.0	0.1
Shing Mun River	D1/D	8/12/95	580-870	A	19.60	0.10	3.6	12.6	2.3	21.9	42.2	0.1
Shing Mun River	D2/D	8/12/95	0-240	C	56.90	0.50	22.0	79.8	22.0	109.0	309.0	0.2
Shing Mun River	D2/D	8/12/95	240-480	C	55.00	0.40	23.9	81.4	26.1	84.3	255.0	0.1
Shing Mun River	D2/D	8/12/95	480-720	C	40.50	0.40	16.9	69.3	16.4	108.0	297.0	0.1
Shing Mun River	D2/D	8/12/95	720-970	A	15.50	0.10	4.7	23.6	3.8	22.5	38.2	0.1
Shing Mun River	D3/D	8/12/95	0-260	C	52.80	0.50	12.3	42.1	9.5	91.9	273.0	0.1
Shing Mun River	D3/D	8/12/95	260-520	C	54.80	0.50	20.3	68.6	17.1	87.1	259.0	0.2
Shing Mun River	D3/D	8/12/95	520-780	B	32.00	0.30	20.9	64.9	16.9	70.3	192.0	0.1
Shing Mun River	D3/D	8/12/95	780-1040	C	44.40	0.50	23.1	67.1	20.4	105.0	223.0	0.1
Shing Mun River	D4/D	8/12/95	0-240	C	71.10	0.80	23.3	87.8	22.5	160.0	406.0	0.2
Shing Mun River	D4/D	8/12/95	240-480	C	65.90	0.70	35.1	127.0	31.3	104.0	311.0	0.1
Shing Mun River	D4/D	8/12/95	480-730	C	57.30	0.50	43.0	182.0	38.8	107.0	275.0	0.2
Shing Mun River	D5/D	8/12/95	0-240	C	51.50	0.50	19.6	73.2	19.0	82.9	308.0	0.2
Shing Mun River	D5/D	8/12/95	240-480	C	42.30	0.40	23.8	79.8	25.8	78.1	282.0	0.1
Shing Mun River	D5/D	8/12/95	480-720	C	39.30	0.50	31.6	94.1	27.9	115.0	317.0	0.1
Shing Mun River	D5/D	8/12/95	720-960	B	29.90	0.30	16.0	55.0	16.3	53.1	194.0	0.1
Shing Mun River	D6/D	8/12/95	0-240	C	73.50	0.80	25.6	92.1	25.1	182.0	432.0	0.3
Shing Mun River	D6/D	8/12/95	240-480	C	71.60	0.70	36.4	118.0	33.9	126.0	351.0	0.2
Shing Mun River	D6/D	8/12/95	480-720	C	64.80	0.60	39.9	146.0	40.6	108.0	328.0	0.2
Shing Mun River	D6/D	8/12/95	720-950	C	55.10	0.70	74.7	286.0	91.3	137.0	879.0	0.1
Shing Mun River	D7/D	8/12/95	0-240	C	62.75	0.70	36.3	199.0	32.2	169.0	347.0	0.2
Shing Mun River	D7/D	8/12/95	240-480	C	55.20	0.60	37.9	174.0	29.4	136.0	392.0	0.1
Shing Mun River	D7/D	8/12/95	480-720	B	40.80	0.40	23.7	49.6	18.2	68.8	167.0	0.1
Shing Mun River	D7/D	8/12/95	720-940	A	25.70	0.20	10.6	32.6	6.2	38.1	59.0	0.1
Shing Mun River	D8/D	8/12/95	0-250	C	52.80	0.50	15.8	45.7	10.6	81.6	150.0	0.1
Shing Mun River	D8/D	8/12/95	250-490	A	25.00	0.30	10.5	25.3	7.6	38.7	94.2	0.1
Shing Mun River	D9/D	8/12/95	0-280	C	53.60	0.80	239.0	1630.0	106.0	142.0	409.0	0.4
Shing Mun River	D9/D	8/12/95	280-560	C	33.00	0.50	136.0	1120.0	61.6	104.0	232.0	0.2

B4 Results of Sediment Core Analysis

Channel	Station	Date	Depth mm	NH3 mg/kg	TN mg/kg	TP mg /kg	TOC	TIC %	TC %
Staunton Creek	B1/D	12/12/95	0-195	2.5	416	2040	0.25	0.25	0.60
Staunton Creek	B1/D	12/12/95	195-390	30.0	825	608	1.70	0.25	1.80
Staunton Creek	B2/D	12/12/95	SURFACE	11.0	268	552	4.50	0.25	4.50
Kai Tak Nullah	C1/D	14/12/95	SURFACE	28.0	259	226	0.90	0.25	0.90
Shing Mun River	D1/D	8/12/95	0-290	60.0	952	379	0.25	0.25	0.25
Shing Mun River	D1/D	8/12/95	290-580	118.0	695	554	1.10	0.25	1.10
Shing Mun River	D1/D	8/12/95	580-870	34.0	50	83	0.50	0.25	0.60
Shing Mun River	D2/D	8/12/95	0-240	94.0	1440	974	2.20	0.25	2.20
Shing Mun River	D2/D	8/12/95	240-480	163.0	2020	1240	2.00	0.25	2.00
Shing Mun River	D2/D	8/12/95	480-720	73.0	941	645	0.90	0.25	1.00
Shing Mun River	D2/D	8/12/95	720-970	38.0	154	86	0.25	0.25	0.60
Shing Mun River	D3/D	8/12/95	0-260	131.0	1610	642	2.20	0.25	2.20
Shing Mun River	D3/D	8/12/95	260-520	121.0	2010	951	2.30	0.25	2.30
Shing Mun River	D3/D	8/12/95	520-780	126.0	721	285	0.90	0.25	0.90
Shing Mun River	D3/D	8/12/95	780-1040	261.0	1600	869	1.60	0.25	1.60
Shing Mun River	D4/D	8/12/95	0-240	173.0	2980	1070	3.30	0.25	3.30
Shing Mun River	D4/D	8/12/95	240-480	221.0	2610	1110	2.20	0.25	2.30
Shing Mun River	D4/D	8/12/95	480-730	211.0	2010	1040	1.90	0.25	2.00
Shing Mun River	D5/D	8/12/95	0-240	235.0	1940	996	2.20	0.25	2.20
Shing Mun River	D5/D	8/12/95	240-480	224.0	1840	1200	1.70	0.25	1.80
Shing Mun River	D5/D	8/12/95	480-720	203.0	1170	751	1.20	0.25	1.20
Shing Mun River	D5/D	8/12/95	720-960	101.0	742	545	0.70	0.25	0.80
Shing Mun River	D6/D	8/12/95	0-240	155.0	2600	1460	3.80	0.25	3.80
Shing Mun River	D6/D	8/12/95	240-480	262.0	2990	1750	2.80	0.25	2.80
Shing Mun River	D6/D	8/12/95	480-720	474.0	2530	1580	2.40	0.25	2.40
Shing Mun River	D6/D	8/12/95	720-950	195.0	2670	2300	2.60	0.25	2.60
Shing Mun River	D7/D	8/12/95	0-240	142.0	1800	1000	2.40	0.25	2.40
Shing Mun River	D7/D	8/12/95	240-480	86.0	1230	754	1.50	0.25	1.50
Shing Mun River	D7/D	8/12/95	480-720	115.0	1080	639	0.80	0.25	0.90
Shing Mun River	D7/D	8/12/95	720-940	52.0	557	291	0.90	0.25	0.90
Shing Mun River	D8/D	8/12/95	0-250	7.0	1060	430	2.10	0.25	2.20
Shing Mun River	D8/D	8/12/95	250-490	7.0	520	260	0.90	0.25	0.90
Shing Mun River	D9/D	8/12/95	0-280	610.0	2630	1260	3.20	0.25	3.20
Shing Mun River	D9/D	8/12/95	280-560	473.0	1220	552	1.30	0.25	1.40

B4 Results of Sediment Core Analysis

Channel	Station	Date	Depth mm	Class	Moisture Content	Cd mg/kg	Cr mg/kg	Cu mg/kg	Ni mg/kg	Pb mg/kg	Zn mg/kg	Hg mg/kg
Lam Tsuen/ Tai Po	E1/D	1/12/95	0-280	C	29.10	0.30	20.6	103.0	8.9	178.0	150.0	0.1
Lam Tsuen/ Tai Po	E1/D	1/12/95	280-560	C	20.90	0.30	14.1	34.0	9.4	200.0	124.0	0.1
Lam Tsuen/ Tai Po	E2/D	1/12/95	0-240	C	26.10	0.20	9.6	18.6	5.4	120.0	108.0	0.1
Lam Tsuen/ Tai Po	E2/D	1/12/95	240-480	A	17.90	0.05	5.0	12.7	1.8	46.1	36.1	0.1
Lam Tsuen/ Tai Po	E2/D	1/12/95	480-720	A	17.70	0.05	5.6	12.1	1.7	38.0	34.9	0.1
Lam Tsuen/ Tai Po	E2/D	1/12/95	720-960	A	17.30	0.10	3.5	12.0	1.7	31.8	32.0	0.1
Lam Tsuen/ Tai Po	E3/D	1/12/95	0-220	C	0.00	0.30	9.5	31.5	4.3	175.0	97.5	0.1
Lam Tsuen/ Tai Po	E3/D	1/12/95	220-440	C	21.00	0.30	8.1	30.1	3.8	146.0	105.0	0.1
Lam Tsuen/ Tai Po	E3/D	1/12/95	440-650	B	16.20	0.30	4.1	12.4	2.1	70.8	56.6	0.1
Lam Tsuen/ Tai Po	E4/D	1/12/95	0-260	C	21.70	0.50	15.8	29.3	6.4	163.0	104.0	0.1
Lam Tsuen/ Tai Po	E4/D	1/12/95	260-520	A	16.20	0.10	3.9	14.3	2.0	37.1	51.7	0.1
Lam Tsuen/ Tai Po	E4/D	1/12/95	520-780	A	18.50	0.40	9.6	27.5	5.8	61.4	111.0	0.1
Lam Tsuen/ Tai Po	E5/D	1/12/95	0-230	C	18.90	0.20	8.3	71.2	4.0	42.9	105.0	0.1
Lam Tsuen/ Tai Po	E5/D	1/12/95	230-460	C	27.90	0.80	63.6	114.0	20.3	83.3	267.0	0.3
Lam Tsuen/ Tai Po	E5/D	1/12/95	460-690	C	25.50	0.50	43.1	102.0	12.6	97.8	202.0	0.2
River Indus	F1/D	5/12/95	0-230	C	24.30	0.10	7.9	28.5	2.6	36.7	263.0	0.1
River Indus	F1/D	5/12/95	230-460	A	14.60	0.05	1.0	10.0	0.5	11.6	13.1	0.1
River Indus	F1/D	5/12/95	460-700	A	19.20	0.05	1.6	24.8	0.7	15.9	4.4	0.1
River Indus	F2/D	5/12/95	0-240	A	15.90	0.05	3.3	31.0	1.6	15.8	57.4	0.1
River Indus	F2/D	5/12/95	240-480	A	13.40	0.05	3.8	38.5	1.4	23.4	31.7	0.1
River Indus	F2/D	5/12/95	480-720	A	12.80	0.05	1.8	17.6	0.7	20.8	6.8	0.1
River Indus	F3/D	5/12/95	0-230	C	35.90	0.40	31.0	90.8	12.9	53.5	1200.0	0.1
River Indus	F3/D	5/12/95	230-460	C	19.80	0.10	8.7	22.7	3.7	26.2	237.0	0.1
River Indus	F3/D	5/12/95	460-680	A	12.80	0.50	2.2	18.9	1.0	14.0	20.4	0.1
River Indus	F4/D	5/12/95	0-240	C	30.80	0.50	19.2	88.0	12.3	57.7	1120.0	0.1
River Indus	F4/D	5/12/95	240-480	C	18.90	0.20	10.6	27.5	5.3	52.6	257.0	0.1
River Indus	F4/D	5/12/95	480-710	A	15.20	0.10	3.9	17.5	2.4	14.8	33.1	0.1
San Tin	G1/D	6/12/95	0-310	B	15.20	0.20	4.6	32.3	3.1	45.5	172.0	0.1
San Tin	G1/D	6/12/95	310-620	C	17.80	0.30	4.3	70.4	3.6	42.2	211.0	0.1
San Tin	G2/D	6/12/95	0-250	C	83.90	1.70	22.5	334.0	24.1	216.0	1150.0	0.2
San Tin	G2/D	6/12/95	250-500	C	52.50	0.40	23.5	49.3	16.1	66.5	245.0	0.1
San Tin	G2/D	6/12/95	500-750	A	46.70	0.10	27.4	15.0	15.9	50.3	72.5	0.1
San Tin	G2/D	6/12/95	750-990	A	38.40	0.10	18.9	10.9	9.5	58.2	46.5	0.1
San Tin	G3/D	6/12/95	0-270	C	48.10	0.30	27.2	17.8	13.6	116.0	65.5	0.1
San Tin	G3/D	6/12/95	270-540	A	46.30	0.10	25.6	15.2	12.7	56.1	58.9	0.1
San Tin	G3/D	6/12/95	540-810	A	45.70	0.50	23.2	13.2	11.6	59.2	53.2	0.1
San Tin	G3/D	6/12/95	810-1070	A	41.60	0.10	19.3	13.2	8.9	41.0	46.8	0.1

B4 Results of Sediment Core Analysis

Channel	Station	Date	Depth mm	NH3 mg/kg	TN mg/kg	TP mg /kg	TOC %	TIC %	TC %
Lam Tsuen/ Tai Po	E1/D	1/12/95	0-280	21.0	649	604	0.80	0.25	0.80
Lam Tsuen/ Tai Po	E1/D	1/12/95	280-560	27.0	316	473	0.25	0.25	0.50
Lam Tsuen/ Tai Po	E2/D	1/12/95	0-240	6.0	203	333	0.25	0.25	0.50
Lam Tsuen/ Tai Po	E2/D	1/12/95	240-480	2.5	50	129	0.25	0.25	0.25
Lam Tsuen/ Tai Po	E2/D	1/12/95	480-720	2.5	50	115	0.25	0.25	0.60
Lam Tsuen/ Tai Po	E2/D	1/12/95	720-960	2.5	50	96	0.25	0.25	0.50
Lam Tsuen/ Tai Po	E3/D	1/12/95	0-220	0.0	0	280	0.90	0.25	0.90
Lam Tsuen/ Tai Po	E3/D	1/12/95	220-440	2.5	241	289	0.25	0.25	0.25
Lam Tsuen/ Tai Po	E3/D	1/12/95	440-650	2.5	50	146	0.25	0.25	0.50
Lam Tsuen/ Tai Po	E4/D	1/12/95	0-260	13.0	294	483	0.25	0.25	0.25
Lam Tsuen/ Tai Po	E4/D	1/12/95	260-520	2.5	50	136	0.25	0.25	0.25
Lam Tsuen/ Tai Po	E4/D	1/12/95	520-780	2.5	110	206	0.25	0.25	0.25
Lam Tsuen/ Tai Po	E5/D	1/12/95	0-230	35.0	234	363	0.25	0.25	0.25
Lam Tsuen/ Tai Po	E5/D	1/12/95	230-460	198.0	1100	620	1.10	0.25	1.10
Lam Tsuen/ Tai Po	E5/D	1/12/95	460-690	191.0	980	632	1.10	0.25	1.30
River Indus	F1/D	5/12/95	0-230	13.0	476	554	0.70	0.25	0.70
River Indus	F1/D	5/12/95	230-460	2.5	50	68	0.25	0.25	0.25
River Indus	F1/D	5/12/95	460-700	9.0	136	42	0.60	0.25	0.60
River Indus	F2/D	5/12/95	0-240	2.5	166	174	0.80	0.25	0.90
River Indus	F2/D	5/12/95	240-480	2.5	104	73	0.25	0.25	0.25
River Indus	F2/D	5/12/95	480-720	2.5	50	24	0.25	0.25	0.25
River Indus	F3/D	5/12/95	0-230	303.0	2420	1760	2.30	0.25	2.30
River Indus	F3/D	5/12/95	230-460	75.0	474	328	0.60	0.25	0.60
River Indus	F3/D	5/12/95	460-680	9.0	50	5	0.25	0.25	0.25
River Indus	F4/D	5/12/95	0-240	126.0	2080	1800	2.20	0.25	2.20
River Indus	F4/D	5/12/95	240-480	38.0	456	382	0.50	0.25	0.50
River Indus	F4/D	5/12/95	480-710	16.0	212	78	0.25	0.25	0.25
San Tin	G1/D	6/12/95	0-310	71.0	920	2960	1.10	0.25	1.10
San Tin	G1/D	6/12/95	310-620	88.0	1480	4150	1.30	0.25	1.30
San Tin	G2/D	6/12/95	0-250	776.0	12	5240	13.00	0.25	13.00
San Tin	G2/D	6/12/95	250-500	274.0	2340	1080	2.30	0.25	2.30
San Tin	G2/D	6/12/95	500-750	85.0	1300	422	1.70	0.25	1.70
San Tin	G2/D	6/12/95	750-990	13.0	584	175	0.70	0.70	1.50
San Tin	G3/D	6/12/95	0-270	128.0	1430	343	1.60	0.25	1.60
San Tin	G3/D	6/12/95	270-540	96.0	1300	451	1.30	0.25	1.60
San Tin	G3/D	6/12/95	540-810	67.0	1120	396	1.30	0.25	1.40
San Tin	G3/D	6/12/95	810-1070	39.0	428	173	0.90	0.25	0.90

B4 Results of Sediment Core Analysis

Channel	Station	Date	Depth mm	Class	Moisture Content	Cd mg/kg	Cr mg/kg	Cu mg/kg	Ni mg/kg	Pb mg/kg	Zn mg/kg	Hg mg/kg
San Tin	G4/D	6/12/95	0-250	A	40.90	0.10	22.3	15.4	13.2	37.4	62.7	0.1
San Tin	G4/D	6/12/95	250-500	A	41.80	0.20	25.3	16.5	15.8	38.8	66.1	0.1
San Tin	G4/D	6/12/95	500-750	A	39.80	0.10	24.9	12.1	14.7	51.4	59.2	0.1
San Tin	G4/D	6/12/95	750-990	A	34.80	0.10	17.0	9.1	8.1	36.2	39.0	0.1
San Tin	G5/D	6/12/95	0-250	C	51.90	0.50	49.7	129.0	24.2	81.6	294.0	0.1
San Tin	G5/D	6/12/95	250-500	C	46.40	0.60	51.0	67.7	40.1	67.6	331.0	0.1
San Tin	G5/D	6/12/95	500-760	A	37.20	0.20	28.9	26.2	18.6	52.7	111.0	0.1
San Tin	G6/D	6/12/95	0-290	C	57.80	1.20	46.3	147.0	34.1	83.0	539.0	0.2
San Tin	G6/D	6/12/95	290-580	A	39.70	0.20	35.5	33.2	17.1	58.2	137.0	0.1
San Tin	G6/D	6/12/95	580-890	A	38.40	0.10	29.6	42.4	15.3	50.8	62.7	0.1
San Tin	G7/D	6/12/95	0-240	B	54.50	0.20	29.5	45.3	21.1	54.5	181.0	0.1
San Tin	G7/D	6/12/95	240-480	A	47.90	0.20	30.7	19.1	17.4	56.5	82.7	0.1
San Tin	G7/D	6/12/95	480-720	A	42.50	0.20	28.4	15.0	16.4	56.8	72.3	0.1
San Tin	G7/D	6/12/95	720-940	A	39.70	0.10	26.3	17.0	17.5	54.6	78.5	0.1
Tin Shui Wai	I1/D	11/12/95	0-270	A	32.40	0.10	21.1	13.5	12.4	42.6	63.6	0.1
Tin Shui Wai	I1/D	11/12/95	270-540	A	42.30	0.10	19.2	10.5	8.9	55.5	40.7	0.1
Tin Shui Wai	I1/D	11/12/95	540-810	A	42.20	0.10	19.3	14.0	8.7	45.0	39.8	0.1
Tin Shui Wai	I1/D	11/12/95	810-1060	A	40.30	0.10	18.8	12.0	8.1	40.3	37.8	0.1
Tin Shui Wai	I2/D	11/12/95	0-270	C	59.20	0.60	126.0	115.0	53.5	71.5	422.0	0.1
Tin Shui Wai	I2/D	11/12/95	270-540	A	46.20	0.50	39.4	27.2	20.0	50.6	89.0	0.1
Tin Shui Wai	I2/D	11/12/95	540-810	A	14.80	0.05	7.5	40.8	4.3	28.1	19.3	0.1
Tin Shui Wai	I3/D	11/12/95	0-290	A	50.30	0.30	28.6	26.5	15.2	59.0	94.0	0.1
Tin Shui Wai	I3/D	11/12/95	290-580	A	34.70	0.20	21.1	15.6	11.4	49.7	56.2	0.1
Tin Shui Wai	I3/D	11/12/95	580-870	C	26.50	0.20	19.7	38.5	16.4	37.4	215.0	0.1
Tin Shui Wai	I3/D	11/12/95	870-1140	A	41.40	0.10	20.3	15.4	10.0	43.4	51.0	0.1
Tin Shui Wai	I4/D	11/12/95	0-290	A	21.70	0.10	9.7	9.8	5.2	19.9	29.6	0.1
Tin Shui Wai	I4/D	11/12/95	290-580	A	41.30	0.10	19.0	11.6	9.3	45.4	42.4	0.1
Tin Shui Wai	I4/D	11/12/95	580-890	A	44.20	0.10	18.7	9.3	8.3	48.9	38.1	0.1

B4 Results of Sediment Core Analysis

Channel	Station	Date	Depth mm	NH3 mg/kg	TN mg/kg	TP mg /kg	TOC %	TIC %	TC %
San Tin	G4/D	6/12/95	0-250	250.0	1220	399	1.80	0.25	1.80
San Tin	G4/D	6/12/95	250-500	148.0	1010	210	1.70	0.25	1.70
San Tin	G4/D	6/12/95	500-750	31.0	930	282	2.70	0.25	2.70
San Tin	G4/D	6/12/95	750-990	2.5	491	193	1.10	0.25	1.10
San Tin	G5/D	6/12/95	0-250	241.0	3140	1940	3.20	0.25	3.20
San Tin	G5/D	6/12/95	250-500	113.0	2090	2120	2.10	0.25	2.10
San Tin	G5/D	6/12/95	500-760	23.0	971	403	1.30	0.25	1.30
San Tin	G6/D	6/12/95	0-290	303.0	2630	1440	2.30	0.25	2.30
San Tin	G6/D	6/12/95	290-580	138.0	1460	706	1.40	0.25	1.40
San Tin	G6/D	6/12/95	580-890	86.0	1090	414	0.90	0.25	1.20
San Tin	G7/D	6/12/95	0-240	181.0	2640	1490	3.60	0.25	3.60
San Tin	G7/D	6/12/95	240-480	105.0	1730	893	2.00	0.25	2.00
San Tin	G7/D	6/12/95	480-720	36.0	1170	228	1.20	0.25	1.20
San Tin	G7/D	6/12/95	720-940	16.0	1080	363	2.00	0.25	2.00
Tin Shui Wai	I1/D	11/12/95	0-270	36.0	947	543	1.00	0.25	1.00
Tin Shui Wai	I1/D	11/12/95	270-540	29.0	589	196	0.25	0.70	0.70
Tin Shui Wai	I1/D	11/12/95	540-810	7.0	467	209	0.25	0.25	0.60
Tin Shui Wai	I1/D	11/12/95	810-1060	2.5	419	157	0.50	0.25	0.70
Tin Shui Wai	I2/D	11/12/95	0-270	170.0	2260	1880	2.30	0.25	2.30
Tin Shui Wai	I2/D	11/12/95	270-540	129.0	911	662	0.90	0.25	0.90
Tin Shui Wai	I2/D	11/12/95	540-810	18.0	164	81	0.25	0.25	0.25
Tin Shui Wai	I3/D	11/12/95	0-290	86.0	905	746	1.20	0.25	1.20
Tin Shui Wai	I3/D	11/12/95	290-580	24.0	459	531	0.60	0.25	0.60
Tin Shui Wai	I3/D	11/12/95	580-870	33.0	449	220	0.70	0.25	0.70
Tin Shui Wai	I3/D	11/12/95	870-1140	74.0	631	196	0.80	0.25	0.90
Tin Shui Wai	I4/D	11/12/95	0-290	15.0	204	138	0.25	0.25	0.25
Tin Shui Wai	I4/D	11/12/95	290-580	51.0	784	380	1.00	0.25	1.00
Tin Shui Wai	I4/D	11/12/95	580-890	37.0	609	179	0.70	0.25	0.70

B4 Results of Sediment Core Analysis

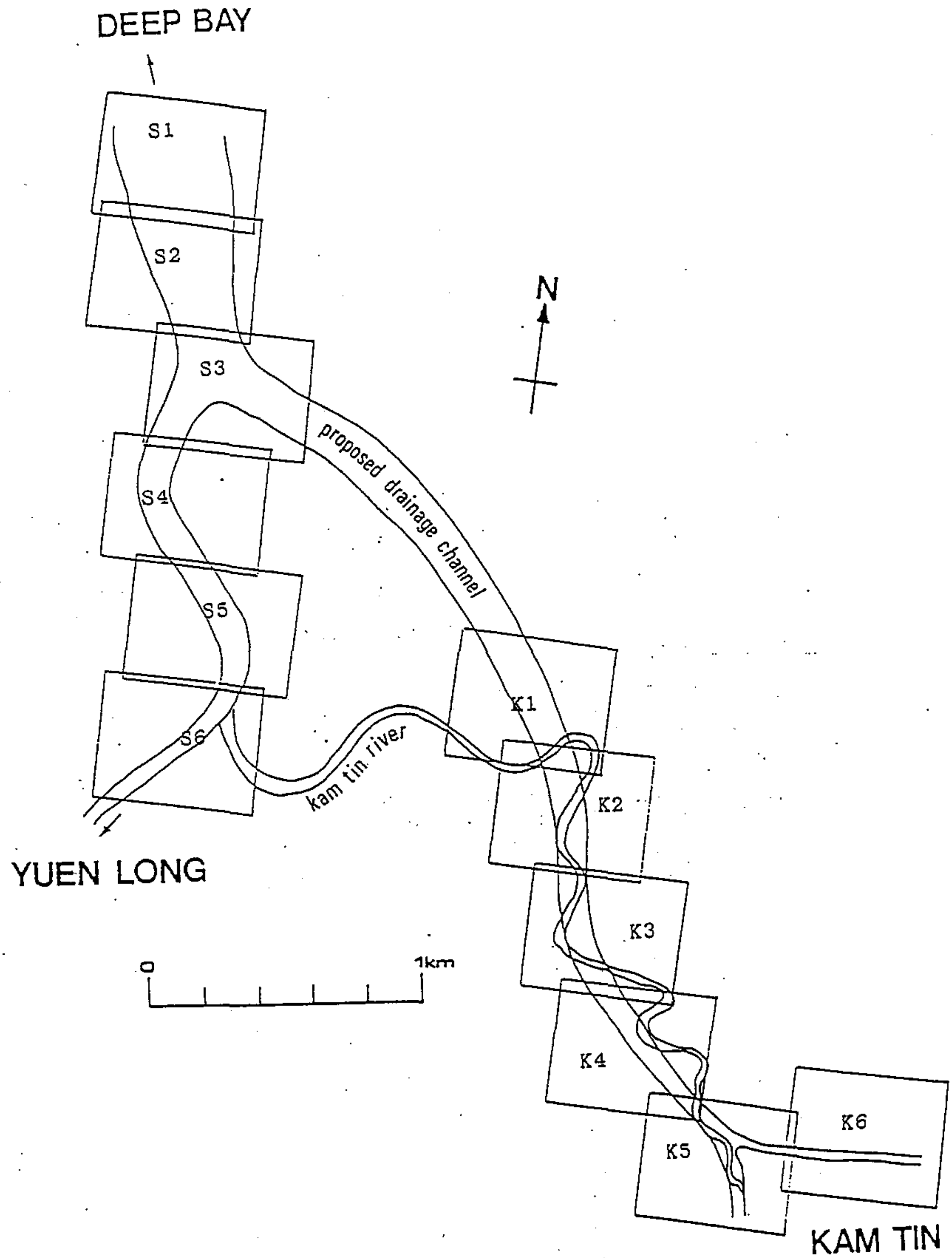
Channel	Station	Date	Depth mm	Class	Moisture Content	Cd mg/kg	Cr mg/kg	Cu mg/kg	Ni mg/kg	Pb mg/kg	Zn mg/kg	Hg mg/kg
Tsuen Mun	J1/D	2/12/95	0-240	C	69.90	0.70	108.0	100.0	20.4	110.0	362.0	0.2
Tsuen Mun	J1/D	2/12/95	240-480	C	59.80	0.50	50.8	83.4	15.7	99.8	207.0	0.1
Tsuen Mun	J1/D	2/12/95	480-710	C	49.40	1.20	177.0	833.0	129.0	1650.0	336.0	0.1
Tsuen Mun	J2/D	2/12/95	0-290	C	54.40	0.70	130.0	251.0	42.1	227.0	412.0	0.1
Tsuen Mun	J2/D	2/12/95	290-580	C	43.60	0.60	120.0	371.0	70.8	79.8	219.0	0.1
Tsuen Mun	J2/D	2/12/95	580-870	A	43.10	0.20	31.5	35.2	19.5	35.6	64.6	0.1
Tsuen Mun	J3/D	2/12/95	0-260	C	55.80	0.90	300.0	420.0	60.7	100.0	386.0	0.6
Tsuen Mun	J3/D	2/12/95	260-520	C	51.90	1.00	394.0	255.0	31.8	95.2	433.0	0.1
Tsuen Mun	J3/D	2/12/95	520-780	C	52.50	0.90	661.0	146.0	35.2	137.0	441.0	0.3
Tsuen Mun	J4/D	2/12/95	0-220	C	48.70	0.50	203.0	93.0	20.5	71.8	221.0	0.1
Tsuen Mun	J4/D	2/12/95	220-440	C	46.60	0.50	234.0	93.9	23.4	75.4	222.0	0.1
Tsuen Mun	J4/D	2/12/95	440-660	C	38.10	0.40	134.0	57.4	15.3	63.9	163.0	0.1
So Kwun Wat	K1/D	5/12/95	0-240	A	22.60	0.10	11.3	42.6	4.1	41.2	52.6	0.1
So Kwun Wat	K1/D	5/12/95	240-480	A	15.30	0.05	3.0	19.1	1.4	20.6	20.5	0.1
So Kwun Wat	K1/D	5/12/95	480-720	A	9.10	0.05	1.7	23.0	1.3	36.7	13.6	0.1
So Kwun Wat	K1/D	5/12/95	720-940	A	15.30	0.10	3.2	27.4	1.4	48.3	45.5	0.1
So Kwun Wat	K2/D	5/12/95	0-260	A	19.60	0.10	4.4	10.5	1.6	51.0	54.8	0.1
So Kwun Wat	K2/D	5/12/95	260-520	A	19.10	0.05	2.3	8.0	1.1	31.7	37.0	0.1
So Kwun Wat	K2/D	5/12/95	520-790	A	11.60	0.05	1.5	15.9	0.5	12.9	8.3	0.1
Sham Tseng	M1/D	11/12/95		A	21.70	0.10	3.4	7.6	1.4	6.2	63.3	0.1
Sham Tseng	M2/D	11/12/95		A	18.10	0.10	4.8	4.9	0.6	13.3	20.5	0.1

Channel	Station	Date	Depth mm	NH3 mg/kg	TN mg/kg	TP mg /kg	TOC %	TIC %	TC %
Tsuen Mun	J1/D	2/12/95	0-240	174.0	2290	1470	2.80	0.25	2.80
Tsuen Mun	J1/D	2/12/95	240-480	180.0	1690	828	2.20	0.25	2.20
Tsuen Mun	J1/D	2/12/95	480-710	76.0	1820	1660	2.20	0.25	2.20
Tsuen Mun	J2/D	2/12/95	0-290	248.0	2430	1430	2.90	0.25	3.10
Tsuen Mun	J2/D	2/12/95	290-580	104.0	1010	996	4.00	0.25	4.30
Tsuen Mun	J2/D	2/12/95	580-870	17.0	721	255	0.70	0.50	1.20
Tsuen Mun	J3/D	2/12/95	0-260	814.0	3890	1900	4.10	0.25	4.20
Tsuen Mun	J3/D	2/12/95	260-520	2120.0	6340	2300	5.70	0.25	5.70
Tsuen Mun	J3/D	2/12/95	520-780	1940.0	7580	2820	5.90	0.25	6.00
Tsuen Mun	J4/D	2/12/95	0-220	458.0	2710	2170	1.90	0.25	1.90
Tsuen Mun	J4/D	2/12/95	220-440	699.0	2880	1620	2.10	0.25	2.10
Tsuen Mun	J4/D	2/12/95	440-660	439.0	2120	1400	1.50	0.25	1.50
So Kwun Wat	K1/D	5/12/95	0-240	2.5	129	149	0.50	0.25	0.60
So Kwun Wat	K1/D	5/12/95	240-480	2.5	50	73	0.25	0.25	0.25
So Kwun Wat	K1/D	5/12/95	480-720	2.5	50	33	0.25	0.25	0.25
So Kwun Wat	K1/D	5/12/95	720-940	2.5	50	67	0.25	0.25	0.25
So Kwun Wat	K2/D	5/12/95	0-260	2.5	199	160	0.25	0.25	0.25
So Kwun Wat	K2/D	5/12/95	260-520	6.0	235	167	0.25	0.25	0.25
So Kwun Wat	K2/D	5/12/95	520-790	2.5	50	50	0.25	0.25	0.25
Sham Tseng	M1/D	11/12/95		2.5	319	106	0.25	0.25	0.25
Sham Tseng	M2/D	11/12/95		2.5	183	82	0.25	0.25	0.25

B4 Results of Sediment Core Analysis

APPENDIX B5

VEGETATION SAMPLING ZONES ALONG
SHAN PUI RIVER AND KAM TIN RIVER



Source: Binnie Consultants Ltd. (1992)

Hyder Consulting

Vegetation Sampling Zones along the Shan Pui River (S1 - S6) and the Kam Tin River (K1 - K6).

COMMENTS & RESPONSES

DEPARTMENT / COMPANY NAME	REFERENCE	DATE
Environmental Protection Department	(22) in EP1/G142 Annex (1) III	25 February 1997
Environmental Protection Department	(22) in EP1/G142 Annex (1) III	25 February 1997
Planning Department	(17) in NBQ 4/3/89 VI	21 February 1997
Drainage Service Department, Chief Engineer / Drainage Project	( ) in DP/12/HK&M/2 IV	20 February 1997
District Officer (Tuen Mun)	(3) in TM121/7/13X	19 February 1997
District Officer (Sha Tin)	(3) in ST 1/1/60V	19 February 1997
District Officer (Tsuen Wan)	(24) in TWD/13/79	17 February 1997
Civil Engineering Department, Chief Geotechnical Engineer / Fill Management	() GCFM 5/6/20-84	13 February 1997
Drainage Service Department	(20) in LD 7/4/57/10 Pt.2	27 February 1997
Drainage Service Department	(35) in DSD HK 7/4/28/1 VII	4 February 1997
Drainage Services Department	( ) in MN 8/0/CE2794/0	5 March 97
Home Affairs Department	(8) in HAD/D/28/20 Pt.19	28 February 97
Environmental Protection Department	(29) in EP 1/G/142 Annex (1) III	8 March 1997
Agriculture and Fisheries Department	(28) in AF ADM 16/12 PT.24 ANNEX A	14 March 1997
Civil Engineering Department	( ) in TS DT/GEN1/08 PT06	2 March 1997

COMMENTS		RESPONSES
Environmental Protection Department **Ref.: (22) in EP1/G142 Annex (1) III**		
3.	Also, Please be advised that the following departments/offices have expressed no comment on the report: CES/EM, Lands D CE/P, WSD DO (Kwai Tsing) DO (North) DO (Sai Kung) DO (Yuen Long) DO (Tai Po)	Noted

COMMENTS		RESPONSES
Environmental Protection Department **Ref.: (22) in EP1/G142 Annex (1) III** EPD's Comments on the EIA Draft Final Report (LCO(Urban West) - E (UW) 31, 14/2/97)		
1.	We note no dredging works are recommended for the highly polluted Sham Tseng nullah. The major sources of pollutants to the nullah are from the squatter areas upstream of the nullah, as such, the consultant suggestion to monitor the pollutants at source would be very difficult if not unfeasible to be implemented and to provide an accurate measure of the pollution loading going into the nullah. Furthermore, the suggested approach to minimise future contamination of sediments by enforcement actions seems rather ineffective in comparison with other options such as the clearance	We note your comments, however, EPD enforcement of water quality controls does not require specific discussion here unless pertinent to maintenance dredging.

COMMENTS	RESPONSES
Environmental Protection Department **Ref.: (22) in EP1/G142 Annex (1) III**	
of illegal squatters.	
(LCO(Territory East) - E (TE) 42, 20/2/97)	
2. Section 9.3, General Specification clause vi on pages 8-9: when a complaint of air or noise arising from dredging work is registered, according to this draft report, the relevant contractor shall employ suitable qualified staff to undertake performance monitoring. Indeed, the contractor shall ensure that suitable staff be available immediately to undertake performance monitoring as well as mitigation measures. While complaints may normally be directed to LCOs or EPD's hotlines, our hotline or enforcement staff will need to know how to relay the relevant complaint to the responsible co-ordinator or the concerned contractor and its qualified staff for prompt action.	Noted. This reporting and liaison will be detailed in the Dredging Contract Manuals to be prepared under task 5.
3. The clause vi should be properly phrased in the EIA report and included in the contract (Task 7 report), and EPD/LCOs staff are informed in due course of the channel to activate the responsible party for quick action.	Noted. All clauses will be written up in contractual form for inclusion in the Task 7 report.
(LCO(Territory North) - E (TN) 51, 20/2/97)	
4. Section 7.2.2, page 3, last paragraph last sentence: Please elaborate why EVS considered that the $ISQV_{high}$ values should not be used yet or this sentence should be omitted/revised. For your consultant's information, the $ISQV_{high}$ values have been taken into consideration in the study on environmental improvement of Shing Mun River currently being conducted by Aspinwall Clouston Limited.	EVS recommend that the $ISQV_{high}$ values need to be confirmed through biological testing on local species; the text will be revised to include this. As agreed through the Steering Group Meeting, the Task 6 report has also taken into consideration the EVS report findings, however, until they are endorsed the values can not be used specifically to define EIA conclusions for this study.
5. Section 7, page 8, 3rd paragraph: The consultant has presumed that all materials from capital restoration dredging will not fall into Class 3 and therefore disposal of the dredged mud to East Sha Chau is possible. This may not be true and further tests may be needed to ascertain the degree of contamination of the material from capital restoration dredging before disposal to East Sha Chau is permitted.	This report assumes that capital restoration dredging will occur prior to the endorsement of the new standards. Clearly if this is not the case further testing will be required.
6. Section 7, page 11, 3rd paragraph, 4th line: "Shek" is missing from the "Pak Shek Kok".	Noted. This will be amended in the final report.

COMMENTS	RESPONSES
Environmental Protection Department **Ref.: (22) in EP1/G142 Annex (1) III**	
7. Figure 7.7: Please check the exact location of the East Sha Chau CMPs.	The figure will be revised to show the complete ESC CMP for the final report (currently the mark is above the proposed CMP IV extension).
8. Section 13, page 4, paragraph 2, line 5: Please note that discharges from the Fo Tan Nullah and the Siu Lek Yuen Nullah were not covered under the Storm Drain Surveillance conducted in 1993. As such, please amend the sentence as "...2,800 kg BOD/day excluding those from Fo Tan Nullah and Siu Lek Yuen Nullah", or otherwise, simply replace the sentence with "In summer 1993, the organic pollution load to the river was estimated to be 3,600 kg BOD/day."	Noted. This will be amended in the final report.
9. Section 13, page 4, paragraph 2, line 7: Please replace "WPCO" with "WDO".	Noted. This will be amended in the final report.
(LCO(Territory South) - E (TS) 44, 20/2/97)	
10. For the regular desilting of Staunton Creek, works agent/department should keep EPD informed of cleaning schedules and program.	Noted. We can recommend this in the final report.
11. Staunton Creek is currently excluded from EPD routine monitoring but the receiving water at Aberdeen Typhoon Shelter is a sensitive water body. We propose monitoring program be extended to cover Staunton Creek.	It is a recommendation of the EIA (see 9.4.2) that all channels subject to maintenance works be included in the EPD monthly water quality monitoring programme.
12. As the sediment at Staunton Creek is highly polluting, precaution measures are required to prevent contamination of receiving water body down-stream; dredging is allowed in dry weather only.	Dredging is only feasible in the dry season and controls have been recommended to minimise both odour and water quality pollution.
13. Odour control at the concrete lined upper part of the Creek was not mentioned in the report. This need to be considered.	Practical mitigation measures are recommended in Section 11.6 to minimise odour generated from clearing works and this will be incorporated into contract clauses.
14. Removal of odorous material should be undertake under cool conditions to reduce the odour impact. Any temporary sediment storage should be away from sensitive receivers. Sediment dredged should be transported to final disposal place as soon as possible.	Agreed. This agrees with the recommendations in the report.
15. Sediment unloaded onto barges should be well covered and should avoid coming near sensitive receivers.	Covering the open-water barges used to transport the material may not be feasible. Transport routes for the barges are relatively inflexible, however any sensitive receiver near the route will only be subject to a very transitory effect.

COMMENTS		RESPONSES
Environmental Protection Department **Ref.: (22) in EP1/G142 Annex (1) III**		
16.	Vehicles wheel washing facilities should be provided at the dredging sites for leaving vehicles.	Unless there is a specific works site, with vehicles operating within the channel, wheel-wash facilities will not be necessary.
17.	All dredging machinery should be well maintained to prevent emission of dark smoke.	Noted. This is a requirement of the Air Pollution Control Ordinance.
18.	Temporary tarpaulin barriers may be required to mitigate odour emission due to wind-whipping effect.	Given the extremely short duration of the works it is considered unnecessary to adopt such a measure.
(LCO(Territory East) - E (TE) 42, 20/2/97)		
19.	We note that the dredging volumes for the channels/nullahs have decreased dramatically and the potential for significant odour impacts has declined for recurrent dredging programme. Also, initial conclusion for odour mitigation from EPD's environmental improvement study for Shing Mun Channel will be incorporated in the Final EIA Report.	Noted. We are aware that the raw data from odour monitoring on the Shing Mun study has been submitted to EPD and that the report detailing the modelling and its interpretation will be submitted to EPD at the end of March. The findings of this study can therefore be included in the final Task 6 report.
20.	Regarding the 7 consecutive days baseline dust survey for 24-hour TSP levels that had been carried out at the number of sites, it is not in line with the minimum requirement of at least weeks as recommended in EPD's Generic EM&A Manual. Please clarify.	The baseline surveys have been agreed by EPD. Due to the low risk of dust impacts 1 weeks baseline was considered sufficient.
21.	Appendix A14 does not give details of odour monitoring.	Odour monitoring is considered unnecessary given the limited extent of the dredging. Practical control measures to limit odour production are given in the report.
22.	It is recommended that no recurrent or restoration dredging is necessary at present for the Sham Tseng Nullah. However, the site inspection (S.22.2.2) has revealed significant odour form domestic sewage and organic waste. Would the Consultant please clarify what actions and measures would be undertaken to mitigate the potential odour impact from the nullah to nearby sensitive receivers.	This EIA is concerned with impacts of maintenance dredging only. The EIA does however recommend pollutant control at source to improve the undesirable conditions at Sham Tseng nullah.
(Waste Policy and Services Group - E(WS)4, 24/2/97)		
23.	Section 7.3.3, Suitability of Materials, 1st paragraph: The second sentence should be amended to read as "That is, material should have a moisture content of no greater than 70% and should contain no dripping water and the material must be contaminated and unsuited for marine disposal in order to prevent using capacity unnecessarily."	This represents a significant change in EPD policy from that which we were previously advised. The reduction in required solids content from 70% (as previously advised) to 30% (as per this revised statement) has significant implications in terms of the

COMMENTS	RESPONSES
Environmental Protection Department **Ref.: (22) in EP1/G142 Annex (1) III**	
	requirement for de-watering prior to disposal to landfill. Most mechanically excavated material will satisfy the revised requirements without any requirement for de-watering. This revision does not change the conclusions or recommendations of Task 6, since disposal to strategic landfill is only recommended for material too contaminated for disposal via other routes. However, it does have significant implications for Task 5 in terms of the requirement for de-watering facilities and the associated disposal cost forecasts.
24. Table 7.6 Dewatering Methods and their Efficiency: Of the 8 dewatering methods mentioned in the table, only the settling ponds (40% solid achievable), filter press (30-50%) and evaporation (30-45%) methods are considered as applicable. However, the water content achievable by these 3 methods is much lower than that by vacuum filter (60-65%), solid bowl centrifuge (65-68%), basket centrifuge (65-68%) and gravity thickening (80-85%). The latter 4 methods seem to be more applicable in terms of efficiency of reducing water content.	The figures given in Table 7.6 are erroneous and will be corrected. They should read as follows: settling pond - up to 60%, belt filter press - 45-70%, chamber filtration - 50-80%, vacuum filtration -35-40%, solid bowl centrifuge - 15-35%, basket centrifuge - 15-35%, gravity thickening - 15-20%, evaporation - up to 100% (see Table 3.1 of Task 5 Draft Final Report). These data indicate that only the very expensive forced evaporation method would result in solids contents sufficient to meet the originally stated requirements for disposal in landfills and is the only technique which would actually reduce the water content of mechanically-dredged materials. For these reasons, Task 5 recommended the use of lime stabilisation. Given the change in EPD policy (see comment 23 above), the requirement for de-watering has been substantially removed.
25. Also, for dewatering methods which will inevitably result in the production of waste water, please give estimates of cost to collect and treat the wastewater.	It is not possible to provide costs for treatment of expelled water without tests and trials to establish the degree of contamination and the treatment processes which are required. In any event, de-watering will not be recommended and the question of cost does not, therefore, arise.
26. Section 7.3.3 Lime Stabilisation, last para.: Please provide details of the mobile solidification plant (e.g., size of the plant, cost figures (including one-off, operational & maintenance), operational space requirement, handling capacity, types and costs of chemicals to be used, etc.)	The Task 5 team are obtaining further details of these aspects of lime stabilisation which will be included in the Task 5 Final Report. However, a mobile plant for use at the dredging site is not recommended (see response to 27 below).
27. Section 7.3.3 Key advantages of the process are, p.16 of 20:	

COMMENTS		RESPONSES
Environmental Protection Department **Ref.: (22) in EP1/G142 Annex (1) III**		
	1st indent: Please provide information on the reduction in water content achievable by lime stabilisation process.	The process effectively eliminates all free water. The Task 5 team are obtaining further details which will be made available soon.
	2nd indent: Presumably, the process will increase the mass of waste and will not significantly reduce the volume of waste to be disposed of.	There may be a slight change of mass (and volume) depending on the amount of lime which is required and the amount of water which is driven off as vapour. These changes are likely to be small and of no significance with respect to the impacts on disposal resources. They can only be established after trials and will vary depending on the details of the sediments dredged from the various channels.
	4th & 5th indents: As the mobile stabilisation plant is capable of working at awkward location, it would be economically and environmental preferable for the plant to be located in the vicinity of the dredging site given that there are only 3 rivers which may contain highly polluted sediments for which dewatering would be necessary. Doing so may also increase the opportunities for beneficial use of the treated sediments.	Although mobile plants could potentially be used in some areas, they are not be recommended due to the anticipated disadvantages, including greater noise, odour and air pollution at the dredging site; greater damage to bankside vegetation; more road and site traffic movements; greater costs due to repeated mobilisations/movements; and likely adverse public reaction to the perceived problems arising from the treatment of contaminated dredged materials in populated areas. Furthermore there would not be any cost savings in transport due to the minimal volume changes which take place during stabilisation. The recommendation of Task 5 (and Task 7) is that temporary plants be established at the landfill where disposal is to take place, although this may be changed due to the reduced requirement for de-watering (see above).
28.	Table 7.7: The river Indus was identified as one of rivers possibly containing highly contaminated sediments.	Noted. This is due to high levels of copper and zinc.
(Noise Management and Policy Group - E(NP)5, 25/2/97)		
29.	The consultant's recommendation not to carry out dredging works for all channels during the restricted hours (i.e. from 7 pm to 7 am on the next day and at any time on a general holiday) is highly supported from environmental protection point of view. However, the consultant should note that those remarks in the report pertaining to the issue of Construction Noise Permit (CNP) would by no means bound the Noise Control Authority's future decisions. The Authority would take into consideration the whole spectrum of factors stipulated in the relevant TM for determining the issue of CNPs.	Noted.

COMMENTS		RESPONSES
Environmental Protection Department **Ref.: (22) in EP1/G142 Annex (1) III**		
30.	The consultant should note that ASR is determined according to the procedures described in the relevant TM and is independent of the baseline noise levels. Furthermore, the duration of construction work is only one of the considering factors for determining the ANL.	Noted.
31.	In some sections of Volume B, the term "ANL" was used to represent the daytime noise limit. It is considered inappropriate and the consultant is advised to replace it with "daytime assessment criteria for establishing noise mitigation measures".	Noted. This will be amended in the final report.
32.	For any less noisy plant or equipment proposed in the report as noise mitigation measures, the consultant should ensure that they are available in the market and gather information on their noise performance to support his claim that the use of these plant and equipment may bring down the noise the meet the relevant requirements. Therefore, the consultant should delete the 2nd sentence of the 2nd para. under the heading "Suggested Mitigation Measures" in S.20.5.1.	Noted. This will be amended in the final report.
33.	Lastly, appropriate EPD's recommended Pollution Control Clauses for Construction Contracts should be incorporated into contract documents.	Noted. Please supply relevant clauses for inclusion in the Task 7 report.

COMMENTS		RESPONSES
Planning Department **Ref.: (17) in NBQ 4/3/89 VI**		
(a)	Section 4.4.2. Impact on Protected Areas	
	Please also take into account the impact on fish ponds which are considered as a kind of wetland habitat with ecological value.	Noted. All possible types of existing wetland have been taken into account.
(b)	Section 16.2.1. Existing and Future Land Uses. 1st paragraph, 4th sentence	Noted.
	This sentence should read as follows:	
	"The remainder of the land is mainly used for rural development, container storage	

COMMENTS	RESPONSES
Planning Department **Ref.: (17) in NBQ 4/3/89 VI**	
and other port back-up uses."	
(c) Figure 17.1 This figure is misplaced.	Noted. This will be amended in the final report.
(d) Section 17.5.1. Noise Impact Assessment, Noise Impact Assessment Criteria, last paragraph, 1st sentence This sentence should read as follows: "Part of the proposed dredging works in Yuen Long, Kam Tin and Ngau Tam Mei River Channels falls within the Deep Bay Buffer Zone 2, whilst the proposed works along the Wo Sang Wai channel falls within the Deep Bay Buffer Zone 1".	Noted. This will be amended in the final report.

COMMENTS	RESPONSES
Drainage Service Department, Chief Engineer / Drainage Project **Ref.: ( ) in DP/12/HK&M/2 IV**	
I refer to Hyder's above report circulated in DEP's (4) in EP 1/G/142 Annex (1) III dated 3.2.97. We have the following comments for your co-ordination.	
GENERAL	
2. The EIA Report should have an Executive Summary for easy consideration by consultees such as District Boards and the Advisory Council for the Environment.	This is a requirement of the brief and will be issued in due course.
3. The environmental legislative background should be extended to incorporate the Environmental Impact Assessment Ordinance which has been newly enacted. Programming and costing of proposed maintenance dredging and other improvement works should take into account the stringent requirements of the new ordinance, which may add to the cost and prolong the programming of engineering works.	This is an interesting one since no EIA study is required under the EIA ordinance for dredging less than 500,000 m^3, unless within 500m of an SSSI site, a site of cultural heritage etc.. Thus, no impact on the maintenance dredging programme is anticipated except for works in the vicinity of for example, Mai Po Marshes SSSI.
4. Since the options for disposal of dredged spoil are closely related to the policy on	Agreed. We are aware that DEP and CED have maintained a close dialogue on all

COMMENTS		RESPONSES
Drainage Service Department, Chief Engineer / Drainage Project Ref.: ( ) in DP/12/HK&M/2 IV		
	marine disposal of contaminated mud which is under review via the EVS study. DEP may like to consult CGE/FM, who is managing that study to ensure compatibility between the two studies.	aspects of the EVS study.
5.	The Occupational Health & Safety aspects do not seem to have been addressed. The maintenance dredging operators are exposed to polluted/contaminated sediments with odour/contact problems.	This issue was considered under Task 5, however Snr. Eng / Safety Advisor (Ag.) Safety Advisory Unit of DSD has advised that such issues are outside the scope of the study (DSD T 5/35/3/17 dated 27th February 1997 refers).
<u>SPECIFICS</u>		
6.	Specific comments are tabulated below: -	
Para. 2.2	The mean annual rainfall at OR HQ is about 2200 mm.	Noted. This will be amended in the final report.
Table 2.1	Add "HEADQUARTERS" after "ROYAL OBSERVATORY".	Noted. This will be amended in the final report.
Para. 2.3.1	- Although triggered by flood control, this study should be fully integrated with plans for water pollution control and waste management. After all, the poor water quality in the study channels is a result of ineffective pollution control at sources and sediments arising from erosion are storage cells of organic pollutants and inorganic contaminants due to agriculture, residential wastewater & waste discharges.	Agreed.
	- It has been assumed by Hyder that the marine sediments are in a state of dynamic equilibrium. Even if one is to believe this assumption, the feasibility of raising the banks must be clearly demonstrated by Hyder if the marine sediments are to be left undredged since the equilibrium cross-section is unlikely able to pass the design floods. Also, bank raising may adversely affect the local drainage connections as well as transport systems.	This issue has been addressed in the Task 4 report.
Table 2.2	Confidence limits or ranges should be given against the predicted dredging requirements to reflect the reliability of the predictions as well as natural fluctuation between years.	This information is not available from the Task 4 report.
Table 2.5 Para. 2.6.8	For channels G&H, marine access by shallow-draught vessels through Deep Bay is still viable though constrained by the Ramsar Site	Marine access is not recommended for these reasons.

COMMENTS		RESPONSES
Drainage Service Department, Chief Engineer / Drainage Project Ref.: ( ) in DP/12/HK&M/2 IV		
	around Mai Po. Having said that, maintenance of navigation channel is required if marine access is adopted for maintaining the channels.	
Para. 2.6.12	Text is incomplete.	Noted. This will be amended in the final report.
Para. 3.2.3	- SOBEK is a 1-dimensional river model. It is not known how it takes salt intrusion into account.	This issue is addressed in the Task 3 and Task 4 reports. The phrase relates to the intrusion of the tidal wave, not to vertically stratified intrusion.
	- Presumably, the water quality during high flows is not critical. Otherwise, modelling the high flow conditions are also required.	No dredging is proposed during high flow conditions.
	- The calibrations of the baseline scenario water quality modelling are not clearly demonstrated.	As stated in the report, the paucity of available pollutant load data precludes the development of a calibrated baseline model scenario. The upstream and downstream water quality boundary conditions were adjusted to force the model to reproduce conditions similar to the baseline condition (section 3.2.3 Model Configuration para. 5 on page 7 refers).
	- Suggest to include an appendix to illustrate the scientific principles of DELWAQ software.	Including a technical description of the full DELWAQ model in all copies of the report is considered unnecessary, especially as very few of the model processes are actually utilised.
Para. 8.2.2	The environmental auditor should report to the Engineer of the Contract. To require the environmental auditor to be fully independent of the Engineer will necessitate changes to the standard contract forms approved by Works Branch.	Noted. This will be amended in the final report.
Para. 8.3.1	Suspended Solids (SS) should be used rather that turbidity (NTU) in the trigger-action-target levels compliance decision-making processes. For local sediments, suspended solids measurements may not be well correlated with turbidity measurements.	Due to the delay in obtaining results we do not recommend suspended solids testing and consider turbidity measurements to be adequate for such small maintenance contracts.
Para. 8.7.2	The EM&A team is not a party to the Contract according to the standard contract forms approved by Works Branch. Suggest replacing "the EM&A team" with "the Engineer" who can engage an EM&A team to help with the	Agreed. This will be amended in the final report.

COMMENTS		RESPONSES
Drainage Service Department, Chief Engineer / Drainage Project **Ref.: ( ) in DP/12/HK&M/2 IV**		
	environmental monitoring & auditing work.	
Section 12	How is the strategic planning for the redevelopment of Kai Tak and its surrounding areas taken into account?	The scope of the Study does not extend to consideration of future redevelopment of the Kai Tak nullah.

COMMENTS		RESPONSES
District Officer (Tuen Mun) **Ref.: (3) in TM 121/7/13 X dated 19 February 1997**		
1.	It is noted that dredging is likely for Tuen Mun River Channel, So Kwun Wat Drainage Channel and Tai Lam Chung River Channel within the Tuen Mun district, and that dredging operations will generate possible environmental impacts, particularly on noise level and air quality, on the local community. In this respect, I support that good practice and control/monitoring for maintenance dredging and sediment disposal be in place to minimise the potential impacts.	Noted.
2.	It is noted that marine disposal to East Sha Chau is one of the options to deal with the contaminated material dredged from the Tuen Mun Channel. However, you may wish to note that the Environmental Improvement and District Development Committee of Tuen Mun District Board (TMDB), at its meeting on 10.1.1997, has raised objection against the establishment of the 4th mud pit at East Shau Chau for environment reasons. I enclose a copy of the relevant minutes for your reference.	Noted. However, as long as this disposal route remains acceptable to EPD, it remains a viable disposal option for these sediments.
3.	TMDB has also expressed great concern on the improvement works to Tuen Mun River Channel. A Working Group has been set up to pursue the issue. Departments concerned have been urged to take appropriate actions to prevent sedimentation and to ameliorate the negative impact to surrounding areas. As such, should dredging of the Tuen Mun Channel be recommended, I consider it prudent to consult the Working Group for comments on the operation and mitigation measures.	Dredging works in all of the channels will be relatively minor and of short duration. The establishment of local liaison arrangements is subject to CED/DSD departmental policy and is not a specific requirement of the EIA.
4.	I am given to understand from page 7 of Section 9 that consultation with the local community to weigh up the impacts with and without noise barrier for dredging in So	Agreed. Further to discussions with DSD we propose to revise the final report to state more strongly our view that the noise barrier would present a greater impact

COMMENTS	RESPONSES
District Officer (Tuen Mun) **Ref.: (3) in TM 121/7/13 X dated 19 February 1997**	
Kwun Wat drainage channel is recommended. I totally agree with this and would however suggest that the same should be done to Tai Lam Chung River for PR sake, although it is assured in the EIA report that the dredging works would be of a very short duration and environmental impacts would be minimal.	or nuisance than the short duration noise impact.
5. To sum up, I gather from the report that negative environmental impacts, (e.g. noise, air, etc.) of various degrees are anticipated to arise from the dredging of the 3 channels mentioned in paragraph 2 of this memo. While I also understand that mitigation measures will be in place to deal with such impacts, consultation with the TMDB is considered appropriate and necessary as works concerning the 3 channels and issues associated with them have always been DB member's concern.	The primary conclusion of the EIA is that subject to reasonable mitigation measures and site management, the limited scale of the anticipated works is unlikely to result in significant impacts. Some short-term nuisance is inevitable in certain areas due either to their proximity to the anticipated dredging areas or due to the level of contamination of the sediments.

COMMENTS	RESPONSES
District Officer (Sha Tin) **Ref.: (3) in ST 1/1/60 v dated 19 February 1997**	
Table 2.5 Row D should read '... to lower equipment from Che **Kung** Mui road ...' I have no other comment on the captioned Draft Final Report.	Noted. This will be amended in the final report.

COMMENTS	RESPONSES
District Officer (Tsuen Wan) **Ref : (24) TWD/13/79 dated 17 February 1997**	
I understand that your department is conducting a territory-wide study on nullah decking and Sham Tseng nullah is one of the nullahs under study. Since dredging is not recommended for Sham Tseng nullah (as concluded in the above report) and yet pollutants are envisaged to deposit in the channel; and this may increase the risk of flooding, I would appreciate it if your department could duly consider the option of decking the nullah in that study.	This comment should be directed to the relevant department.

COMMENTS	RESPONSES
Chief Geotechnical Engineer/Fill Management, CED **Ref : ( ) GCFM 5/6/20-84 dated 13 February 1997**	
I refer to your MUR and the draft Final Report of the EIA. My main comment relates to the characterisation of the sediment for disposal purposes and the resulting conclusions which have been drawn as to likely disposal problems and solutions. On the one hand, the study has used the existing heavy metal chemical screening criteria to classify the sediment to be dredged, while on the other hand it has assumed that some form of the EVS recommended Tiered Testing Scheme (Fig 7.2 of the draft EIA) and classification scheme will eventually be implemented. Because EVS recommendations are still under consideration, this approach is necessary. However, the report should be fuller in its coverage of the possible implications of implementing a scheme such as EVS have recommended. For example, it is likely to be misleading to assume that were the "Class C" sediments to be subjected to the Tier III biological screening that a significant portion would fail the acute lethal tests and then be deemed unsuitable for marine disposal. Similarly, it must be remembered that some of the material which fails the initial chemical screening could pass acute sub-lethal testing and then be classified as suitable for open sea disposal. A further range of possibilities could clearly follow on from any increase in the scope of the initial chemical screening to include organic contaminants.	Noted. We propose to clarify the points you have raised in the final report. However, we wish to state that the focus is on the existing classification as there are many unknowns associated with any future classification, consideration of which is outside of the scope of this study.
2. It has also to be borne in mind that the Tier III acute biological testing proposed by EVS is a screening process. The results of such tests will always need careful interpretation before a decision on disposal is made. In relation to this aspect, EVS will soon be submitting their interpretative report on the strategic sampling and testing exercise, the factual results of which they reported on late last year. *Inter alia*, this report will discuss the role played in the biological testing by "rapidly rendered harmless" chemicals. This could be a key issue for any riverine sediments which fail the acute lethal screening tests because of chemicals such as hydrogen sulphide and ammonia which could be "rapidly rendered harmless" if lost in small quantities into the marine environment during contained marine disposal.	A copy of the interpretative report was provided by DSD on 6th March 1997 and we understand that the results from the initial biological testing from the Shing Mun River will be available in the near future.
3. In summary, my suggestion is therefore simply to revise the wording of the draft EIA, where appropriate, so as to give a fuller coverage of the range of possible outcomes of implementing biological testing.	Agreed. Thank you for the above comments we will as requested provide a fuller coverage of the potential implications of the biological testing approach on disposal issues in the final report.

COMMENTS	RESPONSES
Drainage Services Department **Ref.: (20) in LD 7/4/57/10 Pt.2**	
1. Focus of the Report	
(a) This Final EIA forms part of the Sedimentation Study, and is Task 6 of its 8 inter-related tasks. It is not to be isolated from other tasks of the Study and therefore it is not necessary to repeat arguments or assessments of other tasks. This report should only focus on the following: (i) summarise concisely the recommendations wrt dredging and disposal strategy worked out under Task 5; (ii) assess the environmental impacts of the recommendations under subpara (i) above; (iii) propose any necessary mitigation measure; (iv) confirm if the proposed works under subpara (i) and (iii) above are environmentally acceptable.	It is a specific requirement of the EIA brief that the EIA be a stand alone document, whilst we agree that some of the sections could be shortened this would complicate the readers task in understanding the environmental implications of the proposed works.
(b) In case the recommendations under Task 5 need to be revised in order that they can be environmentally acceptable, please point out them explicitly so that they can be incorporated under the Final Task 5 Report. The final EIA Report should then take into account such revised Task 5 recommendations.	As you are aware, the Task 4 and Task 5 reports have been subject to extensive comments and responses, which were not finalised at the time the EIA was being prepared. The EIA was undertaken in close liaison with Task 5 to identify the most environmentally acceptable approach to the proposed works and these form the basis for the EIA.
(c) Many subjects such as raising of bank, option of not dredging, dredging only when channel bed reaches trigger level, proper control of sediment/pollution at source, erosion control, construction of sediment trap, minimising dredging, etc., have been fully discussed and addressed under other tasks of the study. There is no need to repeat all such arguments in a loose and superficial manner and then consider them as primary recommendations under this EIA.	We do not consider the arguments in the EIA to be presented in either a loose or superficial way. The recommendations in the other task reports are in part the outcome of liaison between all of the study team and do represent primary recommendations of the environmental assessment of the issues associated with maintenance dredging. As discussed with yourselves we will clarify as far as possible the recommendation which arise from other tasks and state whether these are considered acceptable on environmental grounds.
(d) An argument has been put up for some of the channels that, because dredging would not alleviate flooding, the concerned channels should not be dredged in order to avoid possible environmental problem. Such an argument is	The EIA fully recognises that accumulation of sediment in the channels is undesirable. It therefore places a significant emphasis on preventing sediment which may accumulate in the area from entering the system, through local site

COMMENTS	RESPONSES
Drainage Services Department **Ref.: (20) in LD 7/4/57/10 Pt.2**	
fundamentally wrong. Task 4 only concludes that dredging would not alleviate flooding during extreme flood events of 1 in 50-200 years. Obviously dredging would reduce the impact of flooding during minor events that occur more frequently. Task 4 therefore proposes that recurrent dredging is necessary, and has laid down the dredging requirements accordingly. You should base upon such dredging requirements to carry out the EIA. There is no point to put up loose arguments and subjective conclusions without solid and detailed assessment. Many of these have detrimental impact on the final conclusion of this study. Please provide more detailed assessment and justification to support your arguments / conclusions, or drop them out in your Final EIA Report. In the former you might like to demonstrate conclusively that the damage and threat to life, property, and other economic and social activities during such less severe events are less important than the possible environmental impact. Based on your loose and subjective arguments, we have great difficulty to convince the public that their flood damage is of less importance.	control and the use of sediment traps. Pending the effective control of catchment derived material, the EIA endorses the latest recommendations from Tasks 4 and 5. That is, dredging in any channel should only be undertaken when there is clear evidence from monitoring surveys that sediment has accumulated to a level representing a clear increase in flood risk, as defined from the Task 4 modelling work. This means that dredging will be of limited spatial extent and only in areas where the bed level has reached the trigger level or, where the trigger level and the design or natural bed level coincide, 0.5m in excess of the trigger level (sufficient to allow practical operation of the dredging plant). Task 4 anticipates circa 5,000 m^3 per year of dredging in the Indus and circa 4,500 m^3 per year in San Tin based on the estimated natural sediment inputs. However, the dredging requirement will in practice depend on the pattern of accumulation observed in the annual bed level surveys. For the Indus the trigger level is generally 0.5 to 2m above the current bed level in the main channel and the Sutlej and Beas tributaries. Similarly for the San Tin west and east drainage channels and the Yan Shau Wai tributary, the surveyed bed levels were generally well below the proposed trigger level. Therefore the areas of sediment accumulation in which the trigger level is exceeded, as identified through the annual surveys, are anticipated to be extremely restricted. It is possible that for some years the annual survey will not indicate any areas of accumulation above the trigger level and therefore no maintenance dredging will be required. The EIA recommendation to protect the habitats provided by the vegetation cover in the channels is therefore achieved since extensive dredging will not be required. .Furthermore, the implementation of the Shenzhen River Regulation scheme, by reducing downstream bed levels during storm events, should increase flow velocities and reduce deposition in both the Indus and San Tin.
(e) This draft report should therefore be substantially revised to reflect our comments above.	We do not consider a substantial re-write to be required to achieve the points mentioned, which we consider to be primarily issues of clarification. A substantial re-write would lead to inevitable delays and would not result in substantially

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	changed recommendations.
2. General Approach wrt Mitigation Measures and Environmental Monitoring	
(a) Task 4 & 5 of the Sedimentation Study conclude that we should minimise dredging in future mainly on cost-effectiveness and environmental reasons. Under this guiding principle we would dredge only when necessary, and as confirmed by future monitoring. Such maintenance requirements in future have been detailed under Task 4; the volume involved are small (20,000 - 40,000 m3 per year), the frequency of dredging are sometimes up to once every 10 year, and the sediments to be dredged are widely spatially scattered. Most of the environmental impacts would only last for a short duration when dredging is being carried out.	The anticipated annual maintenance dredging requirement stated in Task 4 is around 60,000 m^3 per year, which we recognise to be a relatively minor quantity. In addition to the recurrent dredging requirements, Task 4 identifies the requirement for circa 148,000 m^3 of restoration dredging in the Shing Mun.
(b) What we have is therefore typically some minor maintenance dredging in future, and we are not talking about major capital works projects. Any proposed mitigation measures and subsequent environmental monitoring should be in line with the standard adopted for other similar maintenance works such as road maintenance, drainage maintenance, or even rubbish collection and dumping.	The recurrent dredging is considered minor, however mitigation and monitoring impacts are dependant upon the potential for adverse impacts, not the scale of the works *per se*. The recommended environmental controls are considered to be appropriate to the proposed works.
(c) We therefore hope that a set of standard mitigation measures could be proposed as a framework for all maintenance dredging in future. For example, we might be able to conclude that, as far as noise impacts are concerned, the proposed maintenance dredging should be environmentally acceptable along most of the channels during normal working hours. For a named few, we might want to recommend plants to be shut off when they are not needed, and/or plants employing noise reduction features. In all cases, we should aim at confirming the environmental acceptability of the maintenance works (together with any necessary mitigation measures). The EIA should not end with some open ended recommendation to further assess or monitor the impact in future. The latter is the main objective of this EIA, and should be fully and conclusively addressed.	Agreed and the EIA does adopt this approach, concluding in most cases that there is no noise impact issue and recommending noise monitoring only in the event of a complaint being received. The final report will clarify these conclusions and recommendations for all channels and issues. The existing Technical Memorandum for the Noise Control Ordinance does not include accepted Sound Power Levels for the type of equipment proposed. Our recommendation that such standard values be determined does not represent an open ended recommendation with respect to the EIA.

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(d) Once the necessary mitigation measures are identified, we would incorporate such measures as standard requirements under future maintenance contracts. This Final EIA Report should be specific wrt such requirements so that they could be incorporated into the Final Task 7 Report as draft Particular Specification clauses. Thereafter we would ensure compliance with such measures through normal supervision of engineering works. In general I do not consider special independent EM&A team is necessary for such minor maintenance works.

Response: The environmental protection clauses drafted will form part of the general specifications and any additional requirements will be defined in particular specifications in the usual manner.

(e) If the approach discussed above could be adopted, we are already very much environmentally pro-active. I guess such an approach is already a pioneer in EIA wrt minor maintenance works.

Response: Agreed. For such scale of works the environment is afforded suitable protection.

3. Contents of Chapter 3 – 7

In addition to the existing contents of these chapters on the key environmental issues, they should provide a summary of the assessments and necessary mitigation measures of the individual channels detailed under Chapter 10-22. It should also confirm the acceptability of the proposed maintenance dredging and disposal works. Preferably a table could be added for this purpose under each chapter, an example being given below:

Response: Agreed. Draft versions of these tables for noise, air, water and ecology are attached.

Key Issue – Noise Impact				
Channel	Mitigation Measures	Mechanism to implement Mitigation Measures	Environmental Acceptability	Remarks
Channel A	Work within 7am – 7pm, shut down plants not in use	Contract clauses	Ok	

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Comment	Response
4. Chapter 3 - Maintenance Dredging Strategy	
(a) This chapter should provide a concise summary of the recommended maintenance dredging strategy as given in Final Task 4 & 5 Reports. There should be scope to shorten this chapter.	Noted, see also response to comment 1 above.
(b) Para 2.1, 2nd para onwards – Para 2.2 - it appears that they are extracted from previous TEL 1 and TEL 2 studies and some of the facts given are outdated. Please delete them as the content is not directly relevant to this EIA.	Noted, we will delete this text as suggested.
(c) Para 2.3.2, 2nd subpara – Please note that, under Task 4, the severity of flooding, and the potential impact on flooding due to dredging, is related only to extreme events of 1 in 50-200 years. It is quite obvious that dredging would reduce the severity of flooding during more frequent and minor flood events. This subpara should be amended to avoid any possible mis-interpretation.	See the response to comment 1(d) above. The text will be clarified in the final report to avoid mis-understanding.
(d) Para 2.3.2 – the explanation wrt recurrent dredging and restoration dredging is confusing and misleading, and should be amended to avoid mixing them up.	The explanations reflect our understanding of recurrent and restoration dredging. We will attempt to distinguish this more clearly in the final report.
(e) Dredging requirements as given in Tables 2.2 – 2.4 are not in accordance with those endorsed in the 4th Steering Committee Meeting. Please take note of my previous comments on Table 7.1 and 7.3 of the Draft Task 4 Report. Your response to the comments is still outstanding. Any changes to the dredging requirements may affect the assessment under this EIA. You are therefore urged to respond to this comment ASAP.	The referenced tables were produced under Task 4 and have been subject to extensive discussion, although the anticipated recurrent dredging volumes have remained relatively stable. We have now received updated tables which we are assured will not be amended from this point forward. These will be included and used in the final report.
5. Chapter 4 - Water Quality Impact Assessment	
(a) It appears that water quality impact assessment has not been adequately addressed. Please note my comments 1 a) & b) and comments 2 above. You should end up your assessment by confirming the acceptability of the recommended maintenance dredging works (together with any mitigation measures). It appears from some of your discussion that WQ impact is confined to the immediate vicinity of the dredging site, and should not be a major concern. If this is the case, please spell this out and include it as a	We do not agree that the water quality modelling has been inadequately addressed. Within the bounds of practicality, as described in the report, the modelling has been used to establish the nature and extent of potential impacts. The conclusions in section 3.3 state that the impacts will be minimal except for suspended sediment concentrations in the area of the dredging and general monitoring requirements are indicated. The final report will incorporate a more specific table of conclusions as discussed above to reinforce these conclusions with respect to the acceptability of

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conclusion of the impact assessment.	the proposed works.
(b) Para 3.2.3 – there should be some detailed discussions on the result of the water quality modelling of the dredging works. The result should enable some conclusion to be drawn on the impact on water quality arising from dredging works, and then the need for any mitigation measure.	The modelling results are discussed in some detail in Appendix A2 and the conclusions are given in the main text. Since only the three main channels are suitable for modelling, generalised conclusions have to be drawn in order that the results can be extrapolated to the other channels. As stated above the firm conclusions of the assessment will be clarified on a channel by channel basis.
(c) Table 3.2 - refer to Comment 3 e) above, the figures may need to be adjusted in accordance with the final figures in Table 7.1/Table 7.3 of the Task 4 Report.	Noted.
(d) Para 3.2.3, subpara 3 just below Table 3.2 – the information is basically wrong and should be amended to adequately reflect the information in Table 3.2.	Present: Indus 5,000; San Tin 4,500; Yuen Long 7,460 (included since construction is ongoing); Tin Shui Wai 3,100; collectively 20,060 m^3 per year or approximately 30% of the total annual estimate. Future: Indus 5,900; San Tin 420; Yuen Long 7,460; Tin Shui Wai 3,100; collectively 16,880 m^3 per year or approximately 25% of the total annual estimate. Please clarify what is "basically wrong" with this information.
(e) Para 3.2.3, last subpara on p7/10 – If water quality impact is found acceptable environmentally, I have no objection to the assumption that dredging would be carried out at more than 1 location concurrently. Otherwise dredging should be limited to 1 location only.	Agreed. Modelling was undertaken with both inputs as a worst case scenario.
(f) Para 3.3 – this para is too inconclusive. Please refer to comment a) above.	Please refer to response to comment 5(a) and (b) above. The conclusions and recommendations will be expressed more explicitly in the final report.
(g) Para 3.3 – some WQ monitoring and auditing has been proposed. Please note my comments 2 d) above and revise this para accordingly. In case WQ monitoring is inevitable, please lay down the reasons and the future controlling framework including detailed criteria and corresponding actions for such monitoring.	The details of the water quality monitoring requirements are included in section 8 on EM&A. The recommended measures are considered practical and appropriate given the proposed works.
6. Chapter 5 - Ecological Impact Assessment	

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(a) Para 4.4.2, 2nd subpara – Please refer to Comments 1 d) above. You might like to delete the last sentence, or provide more detailed cost benefit analysis to support the arguments that some of the recommended dredging works under Task 4 and 5 should not be carried out. Please also be specific wrt which stretch of the channels that dredging should not be carried out. Please also delete the 2nd sentence, which is not in line with Task 4 recommendations.	Please see response to comment 1(d) above.
(b) Para 4.4.2, 3rd subpara - The dredging requirements under Task 4 is confined to the stretch of channel upstream of the fabric dam, and the latter part of this subpara from the 3rd sentence onwards could be deleted from this summary chapter.	Noted. This will be deleted and replaced with. "No dredging requirement has been identified downstream of the fabridam in the area of the channel which has greater ecological value".
(c) Para 4.4.3, last sentence – what are the mitigation measures being referred to? They should be given under Para 4.5.	The last sentence in 4.4.3 merely informs the reader that mitigation measures have been proposed which leads in to section 4.5 on mitigation.
(d) Para 4.5, 1st & 2nd subpara - please refer to the EIA study report for the Shenzhen River Regulation Project. Dredging works within the winter period (November to March) could be allowed as far as the relevant noise requirements are being complied with. You might like to revise the 1st subpara accordingly, and taking into account the recommendation under Task 4 & 5 to dredge during the dry season, please work out a specific period during which maintenance could be carried out.	Noted. This issue will be reviewed for the final report.
(e) Bank side damage arising from maintenance dredging and its ecological impact has not been properly and fully assessed. Presumably, bank side habitats of ecological importance are channel specific and their location should be identified and highlighted on the plan. Focus should be on avoiding damage from dredging works as far as practicable, rather than to blindly set this as a constraint to dredging operation.	Through encouraging good practice our objective is to minimise the damage to bankside vegetation which has occurred in previous dredging and channel improvement projects. This is both vegetation that has a specific ecological value in itself, and general vegetation that provides habitat and prevents soil erosion, but has no particular ecological value on its own merit.
(f) Para 4.5, 3rd – 5th subpara – It cannot be understood why there is an assessment on construction of access ramps. Unless access ramps are to be constructed as part of the maintenance works recommended under Task 5,	Noted.

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this 3 subpara should be deleted.	
(g) Para 4.5, 6th – 8th subpara – Please note Comment 1 c) above, and delete these 2 subpara.	These paragraphs will be revised to reflect the response detailed above.
(h) Para 4.5, 9th subpara – Please be specific on what mitigation measures are necessary, and on which channels.	This provides a summary of the mitigation measures recommended. The channel specific details are provided in Sections 10 to 22 of the report.
(i) Para 4.6 – Please note Comments 2 above. This para is too vague and not specific, and is far from satisfactory.	Noted. This will be amended in the final report.
7. Chapter 6 – Noise Impact Assessment	
(a) Para 5.2, - Construction works outside the restricted hours are not subject to NCO requirements. The more stringent additional EPD's daytime guideline of 75 dB(A) has been adopted in this study. Referring to Comments 2 above, it appears that relaxation to this guideline should be considered for the channels under the following circumstances: (ii) minimal dredging requirement, e.g. duration of a short period at a frequency of 1 in 4 years for So Kwun Wat Drainage Channel; (iii) where the NSRs are only a short distance (e.g. 9 metres for So Kwun Wat Drainage Channel) away from the dredging areas and mitigation such as use of acoustic barriers may not be practical and effective (needs to take longer period to construct and create greater impact to the NSRs during construction of barriers).	Noted. We agree that the construction of a noise barrier for So Kwun Wat would probably represent a greater nuisance than the proposed dredging works. This will be clarified in the final report.
(b) Para 5.4, last subpara - the discussion on Kai Tak does not agree with para 12.5.1 which suggests that noise is not considered as a key issue and dredging using mechanical method will not create unacceptable additional noise impact. In light of the high background noise level due to the operation of Hong Kong International Airport, it is doubtful to state that the noise impact arising from dredging work along Kai Tak Nullah during the daytime will be significant.	Noted. This para will be deleted and state " manual methods of channel clearance will be used at Kai Tak, thus mechanical operations which could have a noise impact on local schools have not been addressed in this EIA".

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(c) Para 5.5 -	
(i) 3rd subpara – the proposed mitigation measures are not specific enough for actual implementation. Please provide more specific measures, with justification.	The specific clauses are detailed in Section 8 of the EIA. Again this is a summary of the issues raised in the channel specific assessments in sections 10 to 22.
(ii) 4th subpara – Please be more specific wrt phasing of works. In view of small dredging quantities involved, phasing of works is normally not applicable.	Noted. This paragraph will be re-written to provide clarification.
(iii) 4th subpara – If the assumed equipment cannot pass the noise assessment, please propose specific noise reduction measures or new equipment. Please also note Comments a). This Report should not end at recommending the contractor to look for an unknown piece of equipment. Such a suggestion would render the required noise assessment incomplete.	It is not the equipment which is unknown (this is defined in Task 5) but the sound power level for this equipment; see response to comment 2(c) above.
(iv) 5th subpara - new table(s) is needed to summarises the relevant acceptable against the predicted noise levels for dredging works along channels within the Deep Bay areas and the Inner Deep Bay Special Measures Zone (for both with and without mitigation measures). Also, San Tin Drainage Channels should be excluded from Table 5.1 and Table 5.2 as the channels are under more stringent noise requirement.	Noted. These tables will be incorporated in the final report.
(v) On Tai Po/ Lam Tsuen – Please carry out the further investigation asap to complete your duty under this Task.	The further investigation refers to clarification of the sound power level of the equipment and is outside the scope of this study.
(vi) On San Tin – Again please carry out the further calculation asap to complete your duty under this Task. Please also note Comment a) above, and it is really doubtful if the anticipated short term noise impact at a very localised and confined space would have any detrimental impact on the birds. Please be more specific on which months dredging should be carried out.	See response to comment 7(v). It is unclear on what basis the statement that short-term noise impact would not have any detrimental impact on birds is made. Given their acknowledged ecological value it is appropriate to be conservative when considering potential impacts. Recommendations for timing of the works will be provided in the final report.

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		(vii) On So Kwun Wat and Tai Lam Chung – Please carry out the outstanding assessment asap, if necessary. Please take note of Comment a) above to revise your assessment.	See response to comment 7(v).
	(d)	Para 5.6 – Please note Comment 2 above and revise this section accordingly.	The final report will be revised as per our responses above.
8.	Environmental Monitoring and Auditing		
	a)	Task 4 and 5 have recommended regular bathymetric survey to determine the need for dredging, and regular sediment survey to classify sediment for the purpose of disposal. Any additional monitoring should be fully justified.	Noted. We fully agree that all monitoring should be justified and should provide effective information for the purposes of managing the proposed works and ensuring that environmental impacts are acceptable.
	b)	Please refer to Comment 2 especially on 2d) above. We doubt very much if there is a genuine need for a formal and comprehensive EM&A framework for minor maintenance dredging and disposal works. It appears its importance has been over-stressed without reference to the scale and magnitude of the problem in hand. Most of the recommendations under this chapter should be trimmed away. Sufficient justification must be provided for any additional monitoring to be recommended.	We do not agree that the EM&A requirements are over-stressed, nor that they require trimming. The basic requirements are extremely minor. The incorporation of a well defined EM&A framework is good environmental practice for works of any scale and does not of itself generate any significant workload. Rather it ensures that in the event of a complaint being received there is a pre-defined procedure for resolving whether the complaint is justified and for implementing appropriate remedial measures.
	c)	For any additional monitoring recommended, the criteria against which the results of monitoring are to be assessed, and the actions to be taken, should be provided and fully justified. This draft report has recommended many monitoring in future, but without the corresponding criteria and courses of actions. Without the latter, there is simply no purpose to carry out any monitoring.	We do not agree that extensive monitoring has been recommended, nor that criteria and courses of action have not been defined. We will ensure that the requirements are further clarified in the final report.
	d)	Audit by independent consultant for minor maintenance works are not desirable. We should aim at laying down all requirements on environmental mitigation measures and monitoring in the contract conditions. This will enable the Engineer-in-charge to supervise the maintenance works in accordance with contract conditions. Please refer to Comment 2 d) & e) above.	Agreed. For such minor works the responsibility will be with the Engineer unless he chooses to delegate.
9.	Conclusion and Recommendation		

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	Revision to this chapter in light of comments given is necessary. As this is a strategic study, a strategic framework of generally applicable environmental mitigation measures for minor maintenance dredging should be provided, followed by conclusive statements wrt environmental acceptability of the proposed works. Too detailed elaboration on channel specific issues appears not necessary. Perhaps the tables we requested for under Comment 3 can be repeated here as a starting point for the strategic framework to be worked out.	Volume A is intended as a separate document and needs to contain sufficient detail of the channel specific conclusions to satisfy that purpose. The chapter will be revised to provide clarification of the conclusions and recommendations as detailed above.
	Other Comments	
10	Para 1.1, 2nd paragraph -	
	a) line 13 - add "and disposal" after "... dredging".	Agreed.
	b) line 14 - what is "... the optunisation of contractual arrangements ..." meant?	Optimisation.
	c) line15 - should read "Task 8 considers erosion control and maintenance provision.".	Agreed.
11	Para 2.3.1, 5th paragraph, line 6 - delete "time".	Agreed
12	Para 2.6 - strategies for Sham Tseng Nullah is missing.	Noted, the final report will be amended.
13	Para 2.6.12 - this paragraph is incomplete.	Noted, the final report will be amended.
14	Para 3.2.3 (Page 7 of 10), last paragraph - please elaborate on how the sediment release rates are derived.	Advised by Task 5 team leader.
15	Table 3.5 - could standards in Table 6 of the Technical Memorandum be included in the table for comparison?	Noted. This can be updated in the Final Report.
16	Para 3.3 (ii) - our focus is on sections of channels subject to influence of tidal currents. The reason given is therefore not convincing.	This refers to the upstream boundary water depth, where a pollutant load was defined for the water quality modelling. The lack of water depth resulted in highly artificial concentrations in the area.
17	Para 3.3 (v) - the impact resulting from the dredging work should be quantified, based on the WQ modelling results undertaken under this study.	See response to comment 5(a0 and (b) above. The final report will contain more specific conclusions and recommendations.

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18		Para 4.3 - Kai Tak Nullah and Staunton Creek Nullah should also be included under this section. Presumably, ecology is not considered to be key issue for these two channels.	Agreed.
19		Para 4.4.2, 1st paragraph - please delineate Works Exclusion Zone (WEZ) in Figure 4.2.	Agreed.
20		Para 4.4.3 - the last sentence of the 1st paragraph and the whole 2nd paragraph are confusing. Whilst you conclude the effect of dredging is "...incurring minimal ecological / environmental disturbance." and ".. the ecological consequences of these direct impacts will in most cases be less significant due to ..." , it is not understood how the channels in the NWNT are exceptions to this rule.	The issue will be further elaborated in the final report.
21		Para 5.4 -	
	a)	Table 5.1 - results in Appendix A5 indicate that the predicted noise levels for Tuen Mun River Channel (67 - 71 dB(A)) and San Tin Drainage Channels (60 - 75 dB(A)) do not exceed the daytime noise guidelines 75 dB(A).	Noted. For San Tin this is due to the stricter noise standard applying to the Inner Deep Bay Buffer Zone. For Tuen Mun one of the identified NSRs is a school therefore in the worst case scenario an exceedance is recorded. This will be clarified in the final report.
	b)	2nd paragraph - please indicate the eight channels identified as an issue of concern.	The eight channels in Table 5.1 (Tai Po and Lam Tsuen Count as 2) in the worst case scenario could exceed daytime noise guidelines. In the worst cases e.g. so kwun wat and Tai Lam Chung this is due to short distances of <15m to the nearest NSR. This is not considered to be a major issue and practical mitigation is recommended.
	c)	7th paragraph - Table 5.1 indicates 7 channels only. Please clarify.	see above
22		Para 6.4.1, 1st paragraph - the second point on recommended construction associated with the works appears outside the scope of this study, and therefore should be deleted.	Noted.
23		Para 7.2 -	
	a)	total of dredged volume for River Indus (4,100 m^3 under Potential Class 2 and 5,000 m^3 under Potential Class 3) does not agree with Table 2.4.	Noted, this will be amended in the final report.

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	b)	as some material could be classified as Class 2 if they pass the Tier IV testing, the total volume given under Potential Class 3 materials should be highlighted as upper range estimates. Similar comments on the volume given for Potential Class 2 materials.	Noted.
24	Para 7.3.1, 6th paragraph - transport by marine access through Deep Bay may not be cost-effective option for Yuen Long/Kam Tin Drainage Channels as considered under Task 5.		Noted, this will be amended in the final report.
25	Para 7.3.3, 3rd paragraph -		
	a)	presumably, most of the dredged sediment should be disposed of to marine disposal sites as much as practicable, and that the maximum possible annual volume that needs to be sent to landfill should be not more than 8,320 m^3 indicated in Table 7.2.	Recent results on the Shing Mun River suggest this figure is likely to be higher, although still a small volume i.e. <50,000m^3.
	b)	delete "and annual restoration dredging".	Noted.
26	Para 7.5.1, 2nd paragraph, line 1 - to replace "EM&A" by "monitoring", as only monitoring is required. Please also add that the proposed monitoring and testing programme are to be confirmed later when EPD formalise the new classification for implementation.		We do not agree, please see response to ....At the very least any monitoring needs to be checked to ensure its effectiveness, this is auditing.
27	Table 7.7 -		
	a)	for Fo Tan Nullah and Tuen Mun River Channel - should contamination status better be classified as " Class 2 or Class 3" than "Class 2 (highly contaminated)" ?	Agreed. This will be amended in the final report.
	b)	for Lam Tsuen River - add "/East Sha Chau" under short term option.	Agreed. This will be amended in the final report.
	c)	For Yuen Long, Kam Tin, Ngau Tam Mei, Wo Sang Wai and Tin Shui Wai Drainage Channels - to add "Land" under access, as transhipment to barge in Tuen Mun and then to ESC appears to be a more cost-effective option than transport by marine access (the option that needs to maintain a navigation channel) through Deep Bay. Cost-effectiveness of these two transport options	This issue has been progressed under Task 5 since the EIA report was prepared. The final report will be amended to reflect the recommended transport route.

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	should be fully addressed under Task 5 Report and the final recommendation here may need to be adjusted, if necessary.	
	d) For So Kwun Wat and Tai Lam Chung Drainage Channels - as the contamination status is the same for these two channels which are close to each other, it is not understood why they have different disposal options. Also, disposal to redundant MBA N Lantau would require marine access and appears not a preferred option.	Noted. We will revise this table in the final report.
28	Figure 7.2 and 7.3 - no major difference of these two figures, except for the titles.	Agreed, figure 7.2 will be removed from the final report.
29	Figure 7.7 - please modify legends to distinguish the existing and potential future disposal sites.	Agreed, this will be amended in the final report.
30	Para 8.3.2 - most of the contents here are repeated in Appendix A12. Please consider delete unnecessary repetition in Appendix 12. But note our Comment 2 above.	The section and the appendix will be rationalised for the final report as discussed in previous responses.
31	Para 8.3.3 (i) - what if the baseline DO level (e.g. refer to WQ monitoring results in Table 15.1) falls below the limits? Also, Section 3.5 is not found.	As discussed subsequently, the limit will be revised to reflect existing dry season conditions. The reference will be amended in the final report.
32	Para 8.3.3 (v) - I doubt the effectiveness and practicality of the requirement to execute works with due regard to the tidal cycle.	Noted, the practicality of and requirement for this approach will be reviewed for the final report.
33	Para 8.4 (ii) - what is the purpose to establish geotechnical characteristics of sediments?	This is an error in the wording of the text and should refer only to sediment characteristics such as particle size.
34	Para 8.5.3 (iv) - refer to my comment on para 4.5 above regarding works in sensitive breeding and nesting seasons. Please also make reference to figures which show the ecologically sensitive areas, and their respective noise limits. The limits should also be included in Table 8.3.	Noted, the final report will include clarification as described above.
35	Para 8.5.3 (vi) - needs to elaborate the terms of "performance monitoring". Will it be more appropriate to have the Engineer to carry out the performance monitoring? Refer to Comment 2 above.	This simply refers to the noise monitoring required in the event of a complaint being received and is detailed in Appendix A13. The final report will be amended to clarify this. The monitoring is the responsibility of the Engineer and can either be undertaken directly or delegated to an appointed specialist.

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36	Para 8.6.2 (vi) - refer to comment on Para 8.5.3 (vi) above.	Appendix A14 describes the monitoring which may be required. See response to previous comment.
37	Para 8.7.2 (i) & (v) - to replace "EM&A team" by "Engineer".	This depends on the Engineer being suitably qualified and would require agreement from EPD / AFD.
38	Para 8.7.2 - refer to Comment 9 above.	Noted.
39	Para 9.2 - refer to Comment 9 above and to trim away most of the texts.	See response to comment 9.
40	Para 9.3 - refer to Comment 2 and 9 above. A framework for necessary mitigation measures should be worked out.	The framework will be clarified in the final report.
41	Para 9.4 – refer to Comment 2 and 9 above. Any EM&A proposed should be specific and fully justified taking into account the nature of minor maintenance dredging works in hand.	See response to comments 2 and 9.
42	Para 9.5, 1st paragraph - channels at which the sediments may not be acceptable for marine disposal do not agreed with Table 7.2 and 7.7. Please clarify.	This will be amended in the final report.
43	Chapter 10 - River Silver	
	a) Para 10.3.1, 4th subpara, 2nd sentence – This is not a Task 4/5 recommendation, and should be deleted.	Agreed. This will be amended in the final report.
	b) Para 10.5.1, subpara just on top of Table 10.7, and Para 10.6.1– Please be specific if you want to recommend any mitigation measures. It is the objective of this Report to specific any "appropriate mitigation measure" necessary.	The recommended mitigation measures will be clarified in the final report.
	c) Para 10.7 – please confine your summary to those related to EIA only.	As discussed at the ad hoc meeting on the 13th March this text will be revised.
	d) Figure 10.1 - no restoration dredging is required for River Silver. You should refer to Task 4 Report. Also, use different shadings to represent sensitive receiver and recurrent dredging location.	Agreed. This will be amended in the final report.
44	Chapter 11 – Staunton Creek	

COMMENTS			RESPONSES
Drainage Services Department **Ref.: (20) in LD 7/4/57/10 Pt.2**			
	a)	Para 11.3.1, last 2nd subpara – this appears not a Task 4/5 recommendation and should be deleted.	Noted. This will be revised in accordance with the Task 4/5 recommendation.
	b)	Para 11.7, last subpara – this has been covered by Task 5, and should be deleted.	As discussed at the ad hoc meeting on the 13th March this text will be revised.
	c)	Figure 11.1 (Also Figure 12.1) - the key for "Restoration Dredging Location" should be replaced by "Recurrent Dredging Location". Also, use different shadings to represent sensitive receiver and recurrent dredging location.	Agreed.
45	Chapter 12 – Kai Tak		
	a)	Para 12.2.3, last subpara, 2nd last sentence – please report what is the current practice instead of what was once intended from 1995 onwards.	Noted. this will be revised in the final report.
	b)	Para 12.6 – Please be specific on the 1st bullet point.	Noted. this will be revised in the final report.
	c)	Para 12.7 - as para 12.5.1 suggests that no noise impact will be observed, it appears not appropriate to recommend manual techniques to remove dry sediment.	Noted. This will be rephrased to state that provided manual techniques are used no noise impact is predicted.
46	Chapter 13 – Shing Mun		
	a)	Para 13.2.2, last subpara (also refer to Para 9.4.4) - Major dredging requirement for Shing Mun River has been identified under Task 4 (approx. 148,000 m^3 for one-off restoration dredging and 20,000 m^3 per annual for recurrent dredging). This draft report advised that the strategy to tackle the potential odour problems arising from dredging is still hinged on the other environmental improvement study on Shing Mun River by EPD. EPD has advised that the main findings of the latter study is expected to be not earlier than Jun-Jul 1997, and in light of the timing of submission of these two report, I doubt very much if the relevant findings could be incorporated into our Final EIA Report, which is expected to be finalised in April 1997. Although we have no objection in principle to incorporate any further additional mitigation measures that will be given under EPD's study, you are	As discussed in the ad hoc meeting on the 13th March (EPD,DSD,CED,HYDER), the raw data from the EPD study is available and its interpretation will be reported in a Working Paper and forwarded to HYDER prior to submission if the final report. Without this information we are restricted to practical controls to minimise odour.

COMMENTS		RESPONSES
Drainage Services Department **Ref.: (20) in LD 7/4/57/10 Pt.2**		
	still required to carry out the necessary assessment under this study to conclusively confirm the acceptability of the odour impact from dredging in Shing Mun.	
b)	Para 13.1, 1st paragraph, line 1 - to replace "central" to "East".	Noted.
c)	Figure 13.1 - latest estimates indicates approx. 20,000 m^3 recurrent dredging volume per year along the Main Channel, which has not been indicated in the figure.	Noted. this will be revised in the final report.
d)	Para 13.2.4, 1st subpara – Please quote source and be specific on the history of flooding in Shing Mun Main Channel. I guess you are quoting outdated information.	This is not a quote but rather our understanding of the flood history.
e)	Para 13.4, last 2nd subpara – I doubt very much if bank side vegetation is a key issue. Please delete this unless it has been subsequently discussed as a key issue.	Agreed.
f)	Para 13.5.1, subparas on mitigation measures – please be specific on what you like to recommend. You should take into account the nature of minor maintenance dredging works in hand.	Noted. This will be revised in the final report.
g)	Para 13.5.2. last subpara – It is clearly within the scope of this study to assess odour impact conclusively. Please carry out any outstanding assessment asap.	In line with your comment above the works are minor and do not necessitate detailed odour assessment.
h)	Para 13.5.3 – Please be specific wrt the conclusion of your ecological assessment. Is the proposed maintenance dredging works ecologically acceptable?	Noted. this will be revised in the final report.
i)	Para 13.6.2 – Please note Comment g) above. Also, some recommended measures appear not related to the assessment under Para 13.5.2.	See response to G above. The focus of odour mitigation for such minor works is on practical mitigation and operational improvement.
j)	Para 13.6.3 – From the assessment of Para 13.5.4 (last 2 subpara), perhaps you should conclude that the proposed maintenance dredging works are acceptable from a WQ viewpoint, and the proposed monitoring should be	As discussed at the ad hoc meeting on the 13th March referred to above, the approach to water quality monitoring will be clarified in the final report.

		COMMENTS	RESPONSES
Drainage Services Department **Ref.: (20) in LD 7/4/57/10 Pt.2**			
		omitted. Otherwise the proposed monitoring should be fully justified, and assessment criteria and courses of actions be proposed.	
	k)	Para 13.7, 1st subpara – this is Task 4/5 recommendation, and could be deleted.	Noted this will be revised accordingly.
47	Tai Po & Lam Tsuen		
	a)	Para 14.1, last subpara & Para 14.2.4, 1st sentence - Please quote source and be specific on the history of flooding. I guess you are quoting outdated information.	See response to (d) above.
	b)	Para 14.2.1, 2nd subpara – Please rewrite the last 2 sentences which are basically wrong interpretation of Task 2 results.	Noted.
	c)	Para 14.5.1, last 4th subpara, last sentence – please delete this sentence, and be more specific (similarly for the last 2 subpara, and also Para 14.6.1) on what are the equipment you like to recommend.	The equipment is an excavator, but smaller than those documented in the noise TM and therefore emits less noise. There are no SPL levels available for this equipment. We will discuss with Task 5 to identify the specific plant.
	d)	Para 14.7 1st subpara, last sentence – please delete this sentence as they belongs to Task 4/5.	This will be revised in accordance with discussions held with EPD/DSD since the report issue.
	e)	Tables 14.5, 14.6, 22.2 and 22.3 - to add unit for Current Velocity.	Noted.
	f)	Figure 14.1, 15.1, 15.2, 16.1, 16.2 - use different shadings to represent sensitive receiver and recurrent dredging location (same comment applies for other relevant figures).	Noted. this will be revised in the final report.
48	River Indus		
	a)	There are 2 scenarios, one for the existing channel, and one after river training. Please try to differentiate the two whenever necessary. It is very confusing to have lumped them together in the discussion.	Noted.
	b)	Para 15.3.1, 2nd subpara – Add "during extreme event of 1 in 200 years" after "not prevent flooding" of 2nd sentence, and delete the 3rd sentence.	Noted.

COMMENTS	RESPONSES
Drainage Services Department **Ref.: (20) in LD 7/4/57/10 Pt.2**	
c) Para 15.5.1, 2nd paragraph - to replace the 2nd sentence by "No NSRs were found near the dredging locations for existing River Indus."	Noted.
d) Para 15.5.3, 1st paragraph - the 1st sentence to be replace by "The river training of Shenzhen River, from Lo Wu to the river mouth, is under construction…".	Noted.
e) Para 15.6 – The 2nd and 3rd subpara should be deleted unless fully justified, in which case the measures should be more specific. Also, River Indus may need to be dredged on a regular basis (subject to monitoring) before river training works are completed. I doubt very much if the short term and localised impact is so severe to warrant plant reinstatement. In general they recover fairly quickly.	Noted. We will make these recommendations more specific. Please also note AFDs comments on this subject.
f) Para 15.7 – this section is out of focus wrt to the objective of this EIA. Please refer to Comment 1 above.	Please clarify what is meant by this comment.
49 Chapter 16 - San Tin	
a) Para 16.3.1 – Please note Comment 1 d) above, and revise 1st subpara accordingly.	Noted. this will be revised in the final report.
b) Para 16.4, 2nd subpara - Without solid ground and proof, I cannot agree to address, as a key issue for this EIA, whether the limited benefits from dredging outweigh the negative environmental impacts incurred from the dredging operations.	Noted. this text will be deleted.
c) Para 16.5.1, the last 2 subpara – in view of the assessment given in the last 2nd subpara, no mitigation measures should be necessary. The last subpara should be revised.	We do not agree. 75dB(A) is recorded at NSR G1, since this is only a predicted noise level mitigation is necessary to ensure this guideline is not exceeded. The EIA has recommended general noise mitigation which applies to works in all of the channels.
d) Para 16.5.4, last 2nd subpara – The 1st sentence to be amended, as it is basically wrong.	Agreed. This will be deleted.
e) Para 16.6.1 – delete the last sentence, see Comment c) above.	see response to c above.

COMMENTS			RESPONSES
Drainage Services Department Ref.: (20) in LD 7/4/57/10 Pt.2			
	f)	Para 16.6.2 - Without solid ground and proof, I cannot agree to recommend not to dredge in order to conserve wildlife habitat and maintain the benefits of periodic flooding and biological treatment of polluted waste water. Your argument is based on a fraud assumption that dredging offer little help in alleviating flooding, which is true only during a 1 in 50 years rarely occurring event, and a highly subjective judgement that ecological impact is significant.	We note your comments, however we do not concur with your view that the ecological assessment is based on a highly subjective judgement. It is very clear from past operations in similar channels that severe damage or loss of bankside vegetation has resulted. The text will be revised in line with agreements in recent ad hoc meetings i.e. that dredging will only take place when the trigger level is exceeded as shown from the monitoring data.
	g)	Para 16.7 – Please confine your summary on issues related to the EIA.	Noted.
50	Chapter 17 – 22		
	a)	Based on the above comments, you should have appreciated what comments we would give for the other channels. We would therefore not repeating them in a systematic manner here, but some ad-hoc comments are nevertheless listed below.	
	b)	Figure 17.1 - should be moved under Section 17.	Fig. 17.1 is located at the end of the section 17.
	c)	Para 17.1, 3rd paragraph, line 6 - add "TELADFLOCOSS" after "..Phase 2 of the".	Noted.
	d)	Para 17.2.3, last paragraph - the 1st sentence is confusing and needs to be re-worded.	Noted. this will be revised in the final report.
	e)	Para 17.3.2 (i) - the navigation channel stated is only a temporary marine access constructed and maintained for the construction of the main drainage channel works.	Noted. this will be revised in the final report.
	f)	Para 17.6.1, 3rd paragraph - it is not understood on the restriction of not to work during the migration period even when noise level to within 60 dB(A) is complied with.	Noted. We are seeking advice form the Wetland Advisory Service on this matter. Our findings will be included in the final report.
	g)	Para 18.5.1, 4th paragraph (iii) - reference to "...Tai Po/Lam Tsuen Rivers..." and "...NSR1..." is wrong. Please clarify.	Noted. this will be revised in the final report.
	h)	Para 18.5.3 - whilst the key sites of ecological value is near the river mouth, it is not convincing to conclude that the dredging work at the predicted	Noted. this text will be revised in line with our discussions at the recent ad hoc

COMMENTS		RESPONSES
Drainage Services Department **Ref.: (20) in LD 7/4/57/10 Pt.2**		
	dredging location which is just above the existing fabridam where the channel bed is concrete lined (refer to Fig. 18.1) would cause any significant impact on ecology and to suggest to avoid dredging within this area.	meeting.
i)	Para 20.5.1 and 21.5.1, last sentence - use of acoustic barrier to reduce noise is not effective for dredging works of short duration.	Use of the noise barrier is effective, however, it is not considered to be practical. This will be clarified in the final report.
j)	Para 20.5.2, 2nd paragraph, 1st sentence - as stated in paragraph 20.2.5, sediment are predominantly of coarse sand.	Noted. this will be revised in the final report.
k)	Para 20.5.3 - existing channel walls are engineered (concrete lined/ riprap). It is not understood how the land access may result in damage to bank side vegetation and will be necessary to recognise this as a potential constraint. Also, please refer to para 20.2.6 which states that "No terrestrial flora or fauna of significance was observed during the river inspections and ....".	Noted. However, not all vegetation was lost in retraining the channel, therefore access may still result in damage or loss of vegetation. As stated in the EIA this is not only vegetation that has specific ecological significance. See also AFD comments on this subject.
m)	Para 21.2.4, 2nd paragraph, line 1 - delete "by Delft Hydraulics".	Noted.
	Para 21.5.1, 4th paragraph (iii) - should "NSR1" be read "L1". Also, it appears that L1 is not a school.	Agreed. This will be revised in the final report.
<u>Typographic Errors</u>		
Table 2.5 -		
l)	row 6 - "Sui Lek Yuen" should read "Siu Lek Yuen".	Agreed.
m)	row 7 - "Fotan" should read "Fo Tan".	Agreed.
Para 3.2.3 (Page 7 of 10), last paragraph, line 1 - "a" should read "an".		Agreed.
Para 22.1, line 1 - "Tuen Wan" should read "Tsuen Wan".		Agreed.
Appendix A2, Para A2.2.2, 5th paragraph, 3rd bullet point - "Yen" should read "Yuen".		Agreed.
Appendix A2, Table A2.1 -		
n)	"Sui Lek Yuen" should read "Siu Lek Yuen".	Agreed.

COMMENTS	RESPONSES
Drainage Services Department **Ref.: (20) in LD 7/4/57/10 Pt.2**	
o) to add "Hang" after "Tai Shui".	Agreed.

COMMENTS	RESPONSES
Drainage Services Department **Ref.: (35) in DSD HK 7/4/28/1/VII**	
(1) 1st bullet point of section 11.6 - replace " previously in early 1995" by "yearly".	Agreed. Please note that the removal of odorous material is not a recommendation of the EIA and the report is not intended as an endorsement of present practices. The mitigation measure refers to the removal of material which has accumulated to a level exceeding the criteria defined in Tasks 4 and 5 as representing a potential flood risk.

COMMENTS	RESPONSES
Drainage Services Department **Ref: () in MN 8/0/CE2794/0** 2	
(a) Section 9.2E & 14.7 - The feasibility of the proposal for raising the bank levels to increase the river capacity should be subject to separate study prior to implementation.	Agreed, DSD to note.
(b) Section 15.7 - PM/NTN's attention should be drawn on avoiding the contaminated sediment entering Indus River from Shenzhen River and minimising the upstream sediment accumulation, as mentioned in the 3rd para. of Section 15.7, in their design of the downstream Indus channel.	Agreed DSD to note.

COMMENTS	RESPONSES
Home Affairs Department	
Ref: (8) in HAD/D/28/20 Pt.19	
Nil Return.	Noted.

COMMENTS	RESPONSES
Environmental Protection Department	
Ref: (29) in EP 1/G/142 Annex (1) III	
(Facilities Management Group - Ag.S (FM)1, 26/2/97)	
1. Section 7.3.3:	
(a) Please provide further details of the TCLP Elutriate tests before we could comment on the validity of the conclusion of no implication to the leachate treatment facilities.	Details will be forwarded to EPD separately.
(b) Which Strategic Sludge Strategy (or Disposal) Study are referring to? Any agreement number or responsible department.	EPD, Agreement No. CE 5/96 Sludge Treatment and Disposal Strategy Study
(c) We have strong reservation on the dewatering proposal of using lime to dewater the waste, because large volume of lime might be added to the dredged materials that in effect substantially increase the amount of wastes. This is against our policy of reserving landfill void space.	Please see our response to comment 23 ref. EPD (22) in EP1/G142 Annex (1) III from Waste Policy and Services Group above. It now appears unlikely that any dewatering will be required. If required, adding lime will reduce the volume of water and result in the addition of lime and is expected to result in +5% or - 5% of the original volume Given the small volumes for disposal (1-5,000m^3) this is not deemed significant given the landfill capacity.
Therefore, please re-consider the physical process of dewatering the dredged materials in Table 7.6, e.g. gravity thickening can achieve 80-85% solid content. Of course, the merit of these physical process is the corresponding reduction of waste volume.	Please refer to our response to comments 23 to 27 ref. EPD (22)in EP1/G142 Annex (1) III.
The consultant may consider and make reference to similar changes adopted in Stonecutter Sewage Treatment Works.	Noted.
(d) Please note that as landfills have been planned and developed for operational needs, we did not have sufficient space to accommodate the mobile solidification plant.	Noted. See response to comments 24 to 27 as above.

COMMENTS	RESPONSES
Environmental Protection Department	
Ref: (29) in EP 1/G/142 Annex (1) III	
2. Section 9.5: The conclusion of dewatering sediments should be revised taking into account the above comments.	Noted. This will be amended in the final report.
(LCO (Territory West) - Ag.S (TW) 3, 28/2/97)	
3. Section 19.2.4, page 3 third paragraph: In the first sentence, please replace "WPCO in 1992" with "livestock waste control scheme in 1988". In the second sentence, please replace "revision of the livestock waste control scheme in 1995" with "implementation and enforcement of WPCO in 1992". In the last sentence, "WCO" should read "WDO".	Noted, this will be revised in the final report.
4. Section 19.5.3, first sentence: The water quality of the main river channel has been rated as "fair" to "good" since 1994. The description "poor quality of both water and sediment" is wrong and misleading as far as water quality is concerned.	We do not agree, please refer to p54 of the River Water Quality in Hong Kong for 1994, the quality falls between very bad and fair in most cases.
5. Section 16.2.4, last paragraph under "San Tin Future" : It is anticipated that polluting sediments depositing on the Channel should be significantly reduced one or two years after the implementation of control on the livestock farms in San Tin and Ngau Tam Mei areas commencing in 1 July 1997. Would the Consultants please comment on the report whether there are any environmental benefits in carrying out a major cleanup dredging of the channel by then.	There may be environmental benefits but they are outweighed in our opinion by the potential for impact on bird life and habitat loss associated with such works.
6. Section 17.2.3, last paragraph: It is suggested to change the last sentence to " By the end of 1994, BOD loads from livestock waste were reduced to 51%."	Noted, this will be amended in the final report.
(Water Policy and Planning Group - E (WP)16, 7/3/97)	
<u>S.3 Key Issue - Water Quality</u>	
7. Referring to the table of contents, there should be sections on Areas of concern, Impact Assessment, Mitigation measures and EM&A in this chapter. However, they are found missing.	Noted. This is an error in the contents listings and will be amended in the final report.
8. S.3.2.3, P.5, para.4 & 5: Although the poor water quality of some channels restricted the usefulness of modelling then at the present stage, the objective of the study is still aimed at providing a long term strategy for these work. Therefore given that only	Given the scale of the predicted impacts and the similarity of the proposed works in the various channels, extrapolating the conclusions is considered reasonable. This will be described in greater detail in the final report.

COMMENTS		RESPONSES
Environmental Protection Department		
Ref: (29) in EP 1/G/142 Annex (1) III		
	three channels have been modelled, the consultant should advise how these results can be extrapolated, as suggested in the report, to indicate the potential effects of the other channels.	
9.	S.3.2.4: It is noted that the elutriate test results indicate that ammonia release would be a potential concern in terms of water quality. While it is agreed that great care should be taken in handling the sediment to minimise any potential impacts it may results, it would be useful to point out that in some cases the elutriate test could "over-predict" the site dissolved chemical concentrations by more than an order of magnitude, e.g. for ammonia and TKN, although the elutriate test is in general a conservation predictor (within an order of magnitude) of dredging site dissolved chemical concentrations for most chemicals ("A Preliminary Evaluation of Contaminant Release at the point of dredging" - Environmental Effects of Dredging - Technical Notes # EEDP 09-3 April 1988 refers).	Noted.
10.	S.3.3, item (vi): To follow up the conclusion that the actual sediment concentration will depend heavily on the sediment release rate, please confirm whether the assumed release rate is already the most conservative or that the actual dredging rate will be limited to the assumed rate. Please also provide details on how the sediment release rates in Table 3.4 are worked out.	The sediment release rates were advised by the Task 5 Team Leader on the basis of extensive practical experience and are considered to be upper limits. Good operational practice should result in lower release rates.
11.	S.3.3 item (ix): Since ammonia concentrations may exceed the TM standards, mitigation measures such as reducing the dredging rate should be considered.	Noted. See also response to 9 above.
<u>Appendix A2 Water Quality Modelling</u>		
12.	Table A.2.1 - A.2.3: These tables provide the assumed boundary values of various parameters at the upstream and downstream ends of the three modelled channels. The modelled results at the boundary therefore should reproduce these values. However this is not always so. For example, Fig.A.2.1a indicates assumed DO concentration of 6.4 and 5 mg/l at the upstream and downstream boundaries but the model only simulated 4 mg/l for both.	The upstream limit of the plotted data is at chainage 110m. The model shows rapid concentration gradients in this area reflecting the artificial boundary conditions and the low water volumes.
13.	We note that the SS value of Upstream Boundary Conditions used in Table A.2.1 - 3 are very high i.e. 420,1100,920 mg/l for Shing Mun, Tai Po/Lam Tsuen and Tuen Mun	As stated in the report, the boundary conditions were used to "force" the model to reproduce conditions over the length of the river which were comparable to EPD

COMMENTS	RESPONSES
Environmental Protection Department	
Ref: (29) in EP 1/G/142 Annex (1) III	
River respectively. Please explain how such values are derived.	routine monitoring results. See also response to comment 12.
14. From the modelling results, e.g. for Fig.A.2.1b & c, there is a difference (sometimes positive and sometimes negative) in predicted contaminant level (ammonia, Pb, Cd) for 'baseline' and 'adjusted bed levels'. Please explain. In addition, it is not understood why different level of Pb (sediment) and Cd (sediment) is predicted for the two scenarios.	The baseline and adjusted bed level scenarios reflect the change in water quality resulting from the reduction in channel volume arising from the increase in bed levels to the trigger levels identified in Task 4. The change in bed sediment concentration reflects the effect of the change in water quality arising from the reduced mixing volume, but please note that the predicted changes are extremely small and the uncertainty in the boundary conditions far outweighs this effect. The purpose was to demonstrate that the change in bed levels had a negligible effect except potentially on DO which would be improved due to reduced residence time in the channel.
15. The dredging input load locations used do not match with the mentioned in Table 2.3 or Table 2.4. Presumably the recommended dredging locations had been revised after the completion of the modelling work. If that is the case, the 'predicted' results may need to be revised accordingly. Please advise the details regarding the assumed dredging locations and mud volume used in the modelling exercise.	Given the scale of the water quality impacts predicted it is not considered necessary to revise the modelling work.
16. Before the above modelling issues are adequately addressed, the WQ impacts of the proposed dredging works could not be established.	Noted.
<u>S.7. Management of Dredged Material</u>	
17. In respect of dumping, the proposals seem generally reasonable and in line with our policy position, e.g. - marine dumping should be pursued if it is the only realistic option and it has been demonstrated to be environmentally acceptable in according with the requirements of the London Convention, and - decisions on disposal options for specific projects should be made on the basis of the relevant guidelines and standards in force at the time.	Noted.
18. The suggestions to look for possible beneficial uses is supported and should be encouraged in all cases. Landfill and particularly marine dumping should be	Noted.

COMMENTS		RESPONSES
Environmental Protection Department		
Ref: (29) in EP 1/G/142 Annex (1) III		
	considered as the last resort.	
19.	We recognise the need to protect landfill capacity and restrict the acceptance of uncontaminated material for which other disposal option exists. However, we strongly support the consultants' reasoning that if, at some future data, criteria are developed which would define material as unacceptable for marine disposal then some other land based option will have to be found.	Noted.
20.	It is proposed to dispose of contaminated mud at Pak Shek Kok Public Dump in S.7.3.2. Although a very preliminary study had been conducted by the consultant, it should be pointed out that public dump is in general not designed for contaminated mud disposal (e.g. in terms of limiting contaminants release to the marine environment) and this proposal is not in line with our existing policy. It appears that the acceptability of the proposal in terms of water quality impacts would need to be examined in more details. We cannot offer our support to this proposal at this stage.	Noted. It is our opinion that his site located on sediments similar to those found in the main Shing Mun River Channel will prove to be an acceptable disposal option. However, we agree that further study on potential water quality impacts is merited to provide added confidence.
S.8 EM&A and related section on EM&A matters		
21.	Chlorophyll-a is not the appropriate parameter for long term monitoring. the reasons are as below:	Noted. Agreed, Chlorophyll a will be deleted from the monitoring parameters as the focus is on rapid response to results from hand-held meters.
(a)	There are several factors limiting the occurrence of algal blooms in a water body, e.g. temperature, nutrient levels, flow rate, transparency and light penetration characteristics of the water body.	
(b)	Streams are generally not static. If dredging work causes an elevation of nutrient levels, algal blooms will possibly occur at the receiving water rather than in the stream itself.	
(c)	Chlorophyll-a is not on the list of the EPD stream water quality monitoring programme and had not been measured by the captioned project during the baseline survey. Accordingly, information collected during the dredging period may not be enough to explain the change on chlorophyll-a level.	
(d)	Chlorophyll-a also needs to be measured in the laboratory and thus time lag condition	

	COMMENTS	RESPONSES
	Environmental Protection Department	
	Ref: (29) in EP 1/G/142 Annex (1) III	
	will occur.	
22.	The proposed baseline monitoring programme is not comprehensive enough to collect sufficient background data to set the Action Limit levels. If dredging work is less than two months, baseline monitoring shall be conducted at a frequency of once per day, 3 times per week for two weeks prior to commencement of work. For those contracts with more than two months of dredging, baseline monitoring shall be conducted at a frequency of once per day, 3 times per week for three weeks prior commencement of works.	We do not concur with this view. The intention of the monitoring is not to set Action and Limit values but to avoid dredging during periods of reduced DO levels. Under the new legislation drafted by EPD no monitoring would be required unless the dredging location is within 500m of an SSSI or Site of Cultural Heritage etc. Please note that this is small scale maintenance dredging for periods of 2 to 3 weeks only.
23.	Water samples shall be collected at the mid water depth and at the same time of the day during each sampling. If the site is affected by the tide, water samples shall be collected during the ebb tide period.	Noted.
24.	If there are particular sensitive receivers close to the work area, additional monitoring stations shall be added at those locations.	No particular water quality sensitive receivers have been identified, hence the scope of the monitoring recommended.
25.	Suspended solids and salinity should be added onto the list of recommended monitoring parameters.	We agree that salinity is a useful measurement, but for reasons stated in your comment 21d we do not recommend suspended solid sampling.
26.	The Action Limit levels for DO, SS and turbidity should be based on results from the baseline survey and upstream control station.	see response to 22 above.
27.	The metal concentration reported in the baseline water quality monitoring results in Appendix A1 are all rounded up, instead of the original results provided by the laboratory, ALS Technichem. Please provide the original data so this information can be used in the future as a site specific background.	Noted.
28.	The consultants should refer to the above comments to amend Chapter 8, Section 9.42 and Appendix A12 of the captioned report.	Noted.
	<u>S9.3.p.9 item i</u>	
29.	It is recommended that dredging activities should be suspended if DO levels fall below 4 mg/l in the surface/middle waters and/or 2 mg/l in the bottom water. Given the 'poor quality' of the some of the subject river (with ambient DO less than the above	Noted. This recommendation will be revised to consider the average annual water quality in the subject channel. This will avoid suspension of dredging in very poor water quality when this is in fact average.

COMMENTS	RESPONSES
Environmental Protection Department	
Ref: (29) in EP 1/G/142 Annex (1) III	
recommended level), we have doubts on the 'practicality' of this recommendation.	
S.14.2.4.p5 & S.15.2.3.p4	
30. A mercury concentration of "1 mg/l" was reported. Should it be "1 µg/l" or the actual concentration of mercury in water is really so high?	Noted. This is an error and should be ug/l.

COMMENTS	RESPONSES
Agriculture & Fisheries Department **Ref.: (28) in AF ADM 16/12 PT.24 ANNEX A**	
General In the Report, there were no discussion on benthic communities of all channels and the avian fauna data were only provided for part of the sites for assessment of potential ecological impacts. It is obvious that dredging would create direct and indirect impacts to these components of various extents. It had been identified in the report that bird communities might be affect by dredging because of the loss of foraging ground (e.g. Section 18.4). Would there be any detailed study to address the ecological implications of dredging on benthic communities and avian fauna in the later stage? In addition, clearance of bankside vegetation is a key concern for the dredging of a number of rivers. It has been mentioned in the Report that should this is unavoidable, replanting or compensatory replanting should be undertaken to the satisfaction of this Department (Section 8.7.2v), 9.3.1.v), 10.6.1., 15.6). Please recommend guidelines or criteria for contractors to follow to ensure replanting will be satisfactory.	Noted. This report follows on from both the initial assessment report and the key issues report. These report have detailed why there is no discussion on benthic communities. With regard to loss of bird foraging areas no further assessment will be undertaken. The channels in question have been designed to specific capacities and the maintenance work purely restores this flood capacity. This point has been discussed at length throughout the project and the emphasis is on flood protection. Having said that the study has established an approach that limits dredging to such times that the bed levels are shown to exceed flood trigger levels. This will significantly reduce the amount of maintenance dredging necessary. Guidelines for replanting will be recommended and included in the Task 7 dredging contract manuals. If AFD have any specific requirements please let inform
Section 4 4.4.2 It should be noted that besides mudflat/mangrove/gei wai, "fish ponds" are also a significant environmental resources in supporting the Deep Bay Ecosystem.	Noted.

COMMENTS	RESPONSES
Agriculture & Fisheries Department **Ref.: (28) in AF ADM 16/12 PT.24 ANNEX A**	
4.5 (Para.2) - As the replanting is supposed to mitigate the loss of bankside vegetation, the species chosen should be those found in riparian or coastal habitats rather than frugivorous ones. Hence, species such as those listed in Table 17.1 should be used. Species such as *Cerbera manghas, Cleistocalyx operculata, Hibiscus tiliaceus, Litsea glutinosa*, etc. shall also be considered.	Noted. We will incorporate this information into the Task 7 contract manuals.
4.5 (Para.4) - It was mentioned that "If it is not practical to replant in areas where loss has occurred, compensatory planting should be undertaken. Please indicate where would the "compensatory planting" be implemented.	Clearly this needs to be assessed on a case by case basis and overseen by AFD. What we have done is to provide a framework within which such compensatory planting is possible.
Table 4.1 Row4 Would "Fiches microcarpa" be "Ficus microcarpa" ?	Agreed.
4.5 (Para.2) - Line 4 "...Tin Shui Wai and San Tin..." should read "... Tin Shui Wai and San Tin..."	Noted.
Section 7 7.3 The environmental aspect of the disposal of dredged mud at the East Sha Chau should be briefly mentioned to let readers know the current status.	It is not clear what is meant by this comment. East Sha Chau is currently a Government approved disposal option for contaminated mud, recent studies concerning its environmental performance have been submitted and endorsed by Government.
7.3.1 Para.3 - It was mentioned that "The distance over which material has to be transported before disposal is considerable and would have to be via the areas in Hong Kong which, in terms of coral and marine life., are probably most diverse and sensitive	The journey from Tolo harbour to East Sha Chau by sea passes through some of the best coastline, past some of the best beaches and areas with the best water quality. For your information examples include, Hoi Ha Wan, Kei Ling Ha Hoi

COMMENTS		RESPONSES
Agriculture & Fisheries Department Ref.: (28) in AF ADM 16/12 PT.24 ANNEX A		
	ecologically." Please indicate which areas were under discussion in this text.	and Tai Long Wan.
Section 8		
8.7	Would the consultant recommend to include fauna (terrestrial, aquatic and /or avian) and flora (terrestrial and /or aquatic) indicators in the ecological monitoring and audit programme to check if any potential ecological impacts would result from dredging?	No. This requirement was ruled out at the key issues stage of the project. Subsequently the focus is on practical mitigation to minimise impacts on birds and avoid unnecessary clearance of bankside vegetation.
Section 9		
9.2	(Para.1) - What does "flood plain" in line 4 refer to ? There is no such designation/recognition under the existing statutory or administrative system. Moreover, how could the "associated planning" reflect this?	A Flood Plain is an area of land which due to its topography and location is regularly submerged with water. We agree that this is not reflected in the current planning framework. However, we have made a recommendation and would hope that this can be followed up in Government.
9.3	A few of the study channels mentioned in the Reports, e.g. San Tin, River Indus, are in areas where fish ponds are located. Fish ponds may therefore be affected permanently or temporarily (i.e. as temporarily occupied areas for drainage works). In view of this, there should be mentioned amongst contractual specifications, that temporarily occupied fish ponds should be returned to fish pond operators in good conditions, after construction works have been completed. Fishponds should be refilled with freshwater of good water quality and fertility for farmers to continue with their fish culture activities. In addition, pond bunds should be reformed. Furthermore, mitigation measures to prevent causing damage/disturbances to fish ponds in the vicinity of the project works should be taken. This should also be included in the General Mitigation Clauses for all the study channels.	In no circumstances will maintenance works of this scale require temporary use of fish ponds. In fact it is stated that there should be no bankside storage of dredged material and this will be contractually binding.
Section 16		

COMMENTS	RESPONSES
Agriculture & Fisheries Department **Ref.: (28) in AF ADM 16/12 PT.24 ANNEX A**	
16.5.3 (Para.1) - Would "Fig. 16.4" be "Fig. 16.5" or "Fig. 16.6" ?	16.5, this will be revised in the final report.
16.6.2 (Para.2)Line4 - How would the fish ponds gain from flooding?	Noted. We will delete fish ponds from the text here.

COMMENTS	RESPONSES
Civil Engineering Department **Ref.: ( ) in TS DT/GEN1/08 PT06**	
(a) Section 1.1 page 1 of 4, last two lines "optunisation" should be "optimisation".	Noted. this be revised in the final report.
(b) Section 2.3.2, page 5 of 22 para. 7 "Tsuen Mun Channel" should be "Tuen Mun Channel".	Noted. this be revised in the final report.
(c) Section 2.3.2 page 6 of 22, para.2 The difference between 65,000 cu.m and 62,000 cu.m is meaningless as it is much smaller than the accuracy of the sounding equipment and method.	Noted. this be revised in the final report.
(d) Table 2.2 The term "negligible" used by the consultants in the report is misleading. Some channels, such as Sing Mun River, Shiu Lek Yuen, and Tuen Mun Nullah which have large siltation quantity have been marked as "negligible, but vice versa for some channels with very small quantity (e.g. 320 cu.m for Fotan Nullah and 460 cu.m. for Tai Shiu Hang Channel). The consultants has to clarify clearly how small the quantity can be considered as "negligible".	This is the table prepared by Task 5 and is not a comment on the EIA.

	Comment	Response
(e)	Table 2.4 There appears to be contradiction between Table 2.2 and Table 2.4. On one hand the consultants advised in Table 2.2 that some channels have negligible sediment input., but advised in Table 2.4 that there are large annual dredging requirements for the same channels. Please ask the consultants to clarify.	This is the table prepared by Task 5 and is not a comment on the EIA.
(f)	Section 2.6.4 - Siu Lek Yuen Nullah The quoted annual dredging requirements of approx. 7,000 cu.m. (4,000 cu.m. from natural derived sediment and 3,000 cu.m. from construction works) contradicts with the figures in Table 2.2.	This is the table prepared by Task 5 and is not a comment on the EIA.
(g)	Section 2.6.10 - Tuen Mun Channel The 10,000 cu.m. of sediment just upstream of Hoi Wong Road Bridge near the Sun Tuen Mun Centre is not construction related sediment but mainly derived from natural slope eroded materials form Area 19. Again, this quoted figure cannot be considered as "negligible" as quoted in Table 2.2	as above.
(h)	Section 2.6.12 - tai Lam Chung The report for this section is incomplete.	Noted . This will be revised in the final report.
(I)	Section 8.2.2 - Environmental Auditing Due to the relatively small dredging quantity for most of the channels, I consider that the present arrangement requiring the Contractor to employ an independent environmental audit for all maintenance dredging works is satisfactory. The consultants' proposal to employ independent auditing consultant is not supported.	The choice is with the engineer appointed for the works. In most cases we suspect he will manage the EM&A works internally.
(j)	Section 8.3.2 - Water Quality Monitoring The determination of Trigger, Action and Target (TAT) level can either be based on the baseline measurement or control stations upstream and downstream of the dredging section. The method to be chosen depends highly on the site situation. For examples, the water quality at Tai Po and Lam Tsuen River can be worst in some seasons whether there are any dredging activities or not. The use of percentile above the designated control upstream or downstream of dredging site is a better option to take account of the tidal effect and/or flow direction. In addition, mitigation needs to be taken immediately rather than 3 working days in sensitive areas, especially in Tolo Harbour.	Please note that TAT levels have been superceded by Action and Limit levels. The modelling has demonstrated that dredging will have little impact on existing water quality. Monitoring using hand held meters is recommended to encourage good practice and facilitate rapid response to results. The predicted impacts do not merit a detailed or comprehensive monitoring programme. The objective is to avoid dredging during periods of low DO. Annual data will also be considered to avoid constraining dredging operations in water which typically has very low DO levels.

(k)	Section 8.3.3(I) Please refer to my comments in (j) above.	See response above.
(l)	Section 8.3.3 (ii) Usually, various types of solid debris are trapped and embedded in side the sediment. I doubt how the contractor can identify and remove the solid debris manually prior to mechanical dredging without disturbing the existing sediment, causing more turbidity and releasing pollutants to the water body. Please request the consultants to clarify.	The text refers to large objects such as construction waste, bicycles etc. which will prevent efficient dredging operations.
(m)	Section 8.4 There are other reasons for desilting, rather than flood prevention. The needs for recreational use and environmental improvement are examples. As such, I do not support the consultants' proposal that the task of sediment monitoring should best be managed by one department as different departments have their scope of responsibilities.	This study is concened only with flood prevention.
(n)	Section 8.6.2 (ii) The proposed specification of "no storage or drying of contaminated dredged material in the immediate vicinity of the channel" may not be practical. for some channels, temporary storage may be required and dewatering may also be required to lower the water content to an acceptable value before disposal of at landfill site.	The EIA has recommended that material be removed as soon as practicable from the site. Thus, temporary controlled storage within trucks etc. is acceptable. Dewatering will only be required for a % of the material disposed to landfill, subject to the new classification system being endorsed. The EIA has recommended lime stabilisation to be undertaken at the landfill.
(o)	Section 8.6.2 (iv) This proposed specification has to be totally re-written, as overflow of wet dredged material will still occur during transportation on an inclined road even the contractor follows every word as specified. All we need to do is to specify that "the contractor should ensure that there is no discharge of dredged sediments along the route of transportation".	Noted. This will be ammended in the final report.

(p)	Section 9.2, D: Shing Mun River The restoration dredging requiring the removal of 148,000 c.m. of riverbed material to avoid blockage of any drainage outfall will certainly upset the so-called "dynamic equilibrium". The consultants are requested to clarify whether there is any improvement in water quality after the restoration dredging operation. In addition, maintenance dredging is definitely required for the section downstream of Siu Lek Yuen Nullah for recreational use, such as rowing and dragon boat racing.	Please address the first comment to Task 5. The second comment is beyond the scope of this EIA, but should be determined by the recommended water monitoring. The final comment is also beyond the scope of this study which is concerned with flood protection.
(q)	Section 9.2, D: Siu Lek Yuen Nullah From our observation and dredging records, most sediment at Siu Lek Yuen Nullah derived from construction site, which is the reason why DSD has to desilt the box culvert near the Tat Cairn Tunnel Bridge regularly and CED has to desilt the nullah mouth near the gas pigging station to avoid blockage of the outfall. the submerged hump found at the confluence of the Shing Mun River main channel and Siu Lek Yuen Nullah is mainly due to accumulation of material overflowed form the outfall discharge near this gas pegging station. I agree totally that the best solution is to control the discharge at source.	Noted.
(r)	Section 9.3, para 3 (ii), page 8 of 11 Please refer to my comments in (n) above.	see our response above.
(s)	Section 9.3, para.3 (iv), page 8 of 11 Please refer to my comments in (o) above.	Noted.
(t)	Section 9.3, para 4(I), page 9 of 11 Please refer to my comment in (j) above.	see our reponse above.
(u)	Section 9.3, para.4(ii), page 9 of 11 Please refer to my comment in (I) above.	see our reponse above.
(w)	Section 13.3.1, Siu Lek Yuen Nullah, Line 3, page 7 of 18 The Nullah bed of Siu Lek Yuen Nullah is not lined with concrete. According to the as-constructed drawing, this bed has rubble lining overlaid a layer of geotextile on natural bed.	Noted.

(x)	Section 14.3.2, Dredging Strategy of Tai Po/Lam Tsuen Rivers, page 8 of 14 I have reservation that the proposed maintenance works take only 7 working days, judging frrm our past experience with more that three term contractors.	Agreed. This will be ammended in the final report to four weeks, being the typical time for the maintenance dredging identified.
(y)	Section 17.3.2, Dredging Strategy of Yuen Long, Kam Tin and Ngau Tam Mei Main drainage Channel The implication of maintaining such an unstable navigation channel with marine access through the mud flat of Inner Deep Bay needs to be addressed.	Please refer to comment 50 above.
(z)	Section 17.3.2, Dredging Strategy of Tin Shui Wai River Channel If marine access through the flat mud of Inner Deep Bay is required, please refer to my comments in (y) above.	This is not required.