7 WATER QUALITY IMPACT ASSESSMENT

7.1 Introduction

The main difference between Scheme 1 and Scheme 2 in terms of water quality assessment is the additional sewage arising from Scheme 2. The outfall proposed in Scheme 1 is also adopted for Scheme 2. A mixing zone approach is adopted for this purpose making use of the effluent flow and quality data given Sewage Impact Assessment Chapter 6 above. Impacts from shoreline marine structure proposed in Scheme 2 are also addressed. Results of assessment of other water quality impacts during construction and operation phases assessed given in the Scheme 1 EIA report are applicable to Scheme 2

7.2 Assessment Criteria

The assessment criteria given in Section 7.2 of the Scheme 1 EIA report are applicable to Scheme 2.

7.3 Sensitive Receivers

The water quality receivers given in Section 7.3 of the Scheme 1 EIA report are applicable to Scheme 2.

7.4 Description of Environmental Baseline Conditions

The water quality baseline conditions described in Section 7.4 of the Scheme 1 EIA report are applicable to Scheme 2.

7.5 Assessment Methodology

The assessment methodology given in Section 7.5 of the Scheme 1 EIA report has been adopted in the Scheme 2 water quality assessment.

7.6 Construction Phase Impacts

The construction phase impacts described in Section 7.6 of the Scheme 1 EIA report are applicable to Scheme 2. With the recommended mitigation measures, no unacceptable residual impacts are expected.

The proposed Cyber Port Deveopment includes some shoreline marine facilities such as piers, jetties and a marina. The piers and jetties will be constructed on piles in order to minimise the construction phase impact and to maintain the water flow along the shoreline during operation phase. Limited dredging and filling may be required for the construction of the possible breakwater, the total length of which is expected to be less than 1 km. With the implementation of the recommended mitigation measures as Scheme 1, no adverse marine

water quality impact would be expected. Quantitative assessment will be carried out in a separate EIA study.

7.7 Cumulative Water Quality Impact from Route 7

The cumulative water quality impacts from Route 7 given in Section 7.7 of the Scheme 1 EIA report are applicable to Scheme 2. No unacceptable residual impacts are expected after mitigation.

7.8 Operation Phase Impacts

7.8.1 Impact of Sewage Outfall Discharge on Water Quality in the East Lamma Channel:

The sewage generated from the proposed Cyber Port Development together with, the sewage from Baguio Villa and Telegraph Bay Village, subject to the treatment processes of preliminary treatment, Chemical Enhanced Primary Treatment (CEPT) and disinfection before discharging through a submarine outfall. The sewage flows given in the Sewage Impact Assessment Chapter 6 refer to the final completion of the proposed Cyber Port Development. By the end of 2002 when the sewage treatment plant is commissioned, only part of the Cyber Port Development will be completed. In addition to the flows from Baguio Villa and Kong Sin Wan Village, the development population will only include residential population of 746 and working population of 5390. The estimated peak effluent flow will be 0.11 m^3/s at the end of 2002. At the final phase of the development, the peak effluent flow will be 0.24 m^3/s. In order to check the sensitivity of a range of sewage flow on the impacts to the receiving marine waters, both the phases at end of 2002 and final completion have been assessed. With the effluent quality given in Table 6.3, the required dilution factors for the relevant parameters are:

Suspended solid	:	60
E. coli	:	21
Un-ionized ammonia	:	77
Total inorganic nitrogen	:	137

To comply with the Water Quality Objectives for Western Buffer Water Control Zone, the dilution factor of 137 for total inorganic nitrogen needs to be achieved. With this dilution factor, the BOD concentration in the receiving water will be less than 1 mg/l. At this low BOD level, there is unlikely to have any dissolved oxygen problem in the receiving water. The worst case scenario of ambient current speed of 0.1 m/s and with a Type 3 salinity stratification (a pcynocline at 11.7m above the seabed, uniform salinity of 1015 kg/m^3 above the pcynocline and a linear salinity gradient below the pcynocline with salinity at bottom salinity of 1023 kg/m^3), as given in the Scheme 1 EIA report has been adopted. The outfall alignment and configuration is also taken as the same as Scheme 1.

Assuming the raw sewage BOD concentration of 250 mg/l and the CEPT removal rate of 35%, with the mixing zone dilution of 137, the BOD concentration will be less than 1.2 mg/l

above ambient (less than 2 mg/l including ambient). Again at the level of BOD, no dissolved oxygen problem is expected.

At the Final Phase of the development, all diffuser ports will be assumed to be operational. By the end of 2002, since the effluent flow will only be about 44% of the final development flow, it is taken that only 5 diffuser openings will be in operation with the other openings capped. The purpose for this arrangement is to maintain a reasonable exit velocity of the effluent at each of the diffuser ports.

To assess the sewage outfall impact for Scheme 2, an expert system for hydrodynamic mixing zone analysis of multiport diffuser discharges - CORMIX2 model is used. The CORMIX2 model has been verified by extensive experimental and field data and is considered to be reliable in predicting initial mixing processes for situation of internal layer formation. Following the assessment for Scheme 1, the input parameters for Phase IC and Final Phase discharge cases are listed as follows:

Average water body depth	:	17.60 m
Water depth at discharge	:	14.3 m
Diffuser length	:	90 m
Total no. of openings	:	10 nos.
Port diameter	:	0.111 m
Port height	:	3.3 m
Alignment angle to the ambient current	:	90°
Vertical angle to the ambient current	:	90°
Effluent density	:	1000 kg/m^3
Ambient velocity	:	0.1 m/s
Diffuser type	:	unidirectional diffuser
Water density profile	:	Type 3

Table 7.1 summarises the modelling results for Phase IC and Final Phase discharge cases and Figure 7.1 shows the dilution plotted against the distance downstream from the outfall. The modelling results show that as a result of a higher exit velocity of the discharged effluent, a jet-like motion is formed in the linear stratification layer. Merging of individual jets will not occur until the trapping layer has been reached. Effective dilution of the discharged effluent can therefore be achieved. The mixing is eventually dominated by buoyant spreading of the effluent plume in the linearly stratified ambient water.

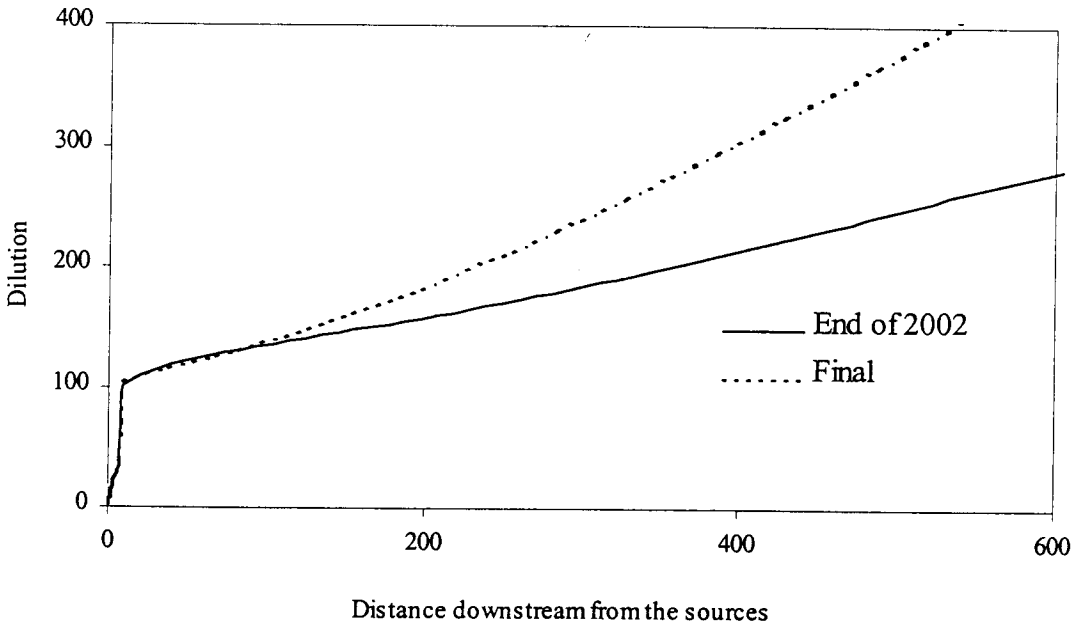
Based on the modelling results, the outfall length will be 300m offshore. With the maximum mixing width of 274m, the mixing zone will not be attached to the development shoreline. In addition, a proposed saltwater intake will be located at Telegraph Bay near the Waterfall Golf Centre. The distance between this seawater intake point and the outfall is over 500m. With reference to the modelling results for dilution in Figure 7.1, it is considered that the existing water quality near the seawater intake will not be affected by the outfall discharge. It is therefore concluded that the proposed sewage discharge through the 300m offshore outfall will be acceptable in terms of marine water quality.

Table 7.1 Modelling Results for End of Year 2002 and Final Phase Discharge Cases

Phase	Outfall Length (m)	Mixing Zone Length Downstream from the Outfall (m)	Dilution[1]	Width of Mixing Zone[2] (m)	Trapping Depth above Bottom (m)
End of year 2002	300	96	137	185	7.53
Final	300	107	137	274	7.74

Notes
1. Hydrodynamic average dilution of the discharged effluent
2. The width of mixing zone is calculated based on the top-hat half-width in the horizontal plane.

Figure 7.1 Dilution Plotted against the Downstream Distance from the Outfall



7.8.2 Water Quality Impact from Shoreline Facilities

The proposed Scheme 2 includes some shoreline marine facilities such as piers, jetties and a marina. The piers and jetties will be constructed on pile in order to minimise the construction phase impact and to maintain the water flow along the shoreline during operation phase. No adverse marine water quality impact would be expected.

It is expected that the proposed marina will provide mooring for less than 30 vessels Any wastewater or storm drain discharges will be designed to discharge outside the marina. Therefore, the proposed marina is unlikely to cause any unacceptable marine water quality impact. A breakwater may be required and a separate further study would be carried out at a later stage if this were considered necessary. For the size of the proposed marina, the breakwater, if constructed, is not expected to affect the tidal flow and water quality of the marine water outside the breakwater. Provided that there are no polluted storm drains or foul sewers discharging into the enclosed waters, no insurmountable water quality problem within the enclosed water is expected. Water quality impacts arising from the marina and breakwater will be quantified in a separate EIA study.

7.9 Conclusions and Recommendations

Comparing the proposed Scheme 2 with Scheme 1, in terms of water quality impacts, the key issues are sewage treatment discharge and shoreline facilities. The potential impacts have been assessed and the influence of the discharged effluent from the proposed outfall has been examined using a mixing zone model. The modelling results indicate that no unacceptable adverse water quality impacts is expected. Other elements in common between the two schemes have been addressed in the EIA for Scheme 1 and are also applicable to Scheme 2