6 SEWERAGE IMPACT ASSESSMENT

6.1 Background and Review of Options

6.1.1 The Telegraph Bay area is currently unsewered, hence preliminary design for sewage treatment & disposal is a vital task under this Feasibility Study.

6.1.2 In accordance with the Aberdeen, Apleichau & Pokfulam Sewerage Master Plan Study, it was proposed that STW (Sewage Treatment Work) would be required at Telegraph Bay to cater for the flow arising from the entire Telegraph Bay catchment, and that the treated sewage would be conveyed via a rising-main along Route 7 for connection to an SSDS shaft at Sandy Bay.

6.1.3 However, population-intake for the Telegraph Bay Development is planned to take place around 2004/2005, by which time neither the SSDS nor Route 7 is available, with SSDS Stage III/IV programmed for completion 2007.

6.1.4 The study has therefore addressed both short-term and long-term sewage treatment & disposal arrangements for the Telegraph Bay Development.

6.1.5 For the long-term sewage treatment, the sewage produced by TBD will have preliminary treatment/screening and will be discharged into the new SSDS deep sewer, which is scheduled to be completed late 2006. For the short term the treated sewage will be discharged to the Lamma Channel via a temporary submarine outfall already partly constructed during the initial reclamation of Telegraph Bay.

6.1.6 During the course of the study, several options for the sewage treatment and at the interim stage were assessed.

6.1.7 The potential disposal options for sewage were assessed in conjunction with the various levels of treatment which would be required for the short term sewage treatment. The treatment and disposal options at interim stage considered were:-

(1) Preliminary Treatment with Disinfection
(2) Temporary Sewage Storage Tank at TBD and Pumped to Sandy Bay STW at non-peak hour.
(3) Chemically Enhanced Primary Treatment (CEPT) with Disinfection

6.1.1 Sewage Treatment and Disposal Options

(1) <u>Preliminary Treatment with Disinfection</u>

The preliminary treatment process consists of coarse screening, fine screening, and grit removal by means of detritor. After the preliminary treatment the sewage is then immediately disinfected by ozone, or other means of disinfection method, to reduce the bacteria content. The effluent would ultimately discharge into East Lamma Channel through a temporary submarine outfall until completion of SSDS Stage III/IV when the discharge would be directed to the new deep sewer.

However, considering that it has been the Government effort to upgrade the level of sewage treatment with a view to achieving higher environmental standards, it will not be acceptable for new STW elsewhere in the Territory to discharge screened sewage even with disinfection.

(2) Temporary Sewage Storage Tank at TBD and Pumped to Sandy Bay STW at non-peak hour

At the commencement of occupation phase of the TBD, low flows of sewage will arise for treatment and disposal. The net sewage production is low such that temporary storage in TBD before pumped to the sewage treatment plant at Sandy Bay was considered. If the drop shaft of SSDS Stage III/IV was to be completed before the full population intake, then this scheme could be adopted.

The untreated sewage stored in the collection tank would be conveyed via a rising-main along the northern access road for connection to the Sandy Bay Sewage Treatment Plant, with the sewage only being discharged to the Sandy Bay STW at the non-peak hour through the rising main. It is estimated that a very large storage tank of about 50m x 50m x 7m would be required in order to collect the sewage discharge on a daily flow about 17625m^3/day.

This option is not considered viable due to the huge size of the storage tank required. Also the sewage will become septic and can generate odour gas.

(3) Chemically Enhanced Primary Treatment (CEPT) with Disinfection

The chemically enhanced primary treatment process comprises of preliminary treatment process in association with coagulation, flocculation and sedimentation plus disinfection together with submarine outfall. With the use of CEPT plus disinfection it is likely that the level of treatment will comply with the WQOs despite that a certain amount of sludges will be produced and have to be disposed.

6.1.2 Preferred Disposal Option

6.1.2.1 Options (1) and (2) will not be acceptable. The level of treatment required to render the sewage complying with the WQOs for discharge to the East Lamma Channel would require extensive treatment plant for CEPT with disinfection.

6.2 Extent Of Sewage Catchment

6.2.1 The extent of sewage catchment for the Telegraph Bay STW is shown on Figure No. 6.1. The sewage catchment was identified in the study brief and the information given by the Final Report of the Sewage Master Plan Study had been considered and listed as follows:-

(a) The Telegraph Bay area was referred to as Basin 3(2/2) in the SMP Study.
(b) Effluent from developments on the uphill side of Baguio Villa is taken up by existing sewers running along Pokfulam Road.
(c) Effluent from development north of Telegraph Bay is taken up by sewers in the Sandy Bay area.
(d) Effluent from development south of Telegraph Bay is taken up by sewerage in Wah Fu Estate.

6.3 Basic Design Information & Parameters

6.3.1 The technical aspects of this chapter will be based upon the following information/ parameters:-

Item	Information/ Parameter	Source of Information (PPJV=PYPUN/PBA Joint Venture)
Population intake date of Telegraph Bay Development	Around 2004/2005	HOUSCOM & TDD/HKI&Is
Target date for commissioning of the section of SSDS Sewer covering Telegraph Bay and Sandy Bay	2006/2007	DEP & DSD
Construction phase of Route 7	August 2003	HyD
Population of Telegraph Bay Development	10,504	PPJV
Population of Baguio Villa	6,000	
Population of Kong Sin Wan Village	233	
Estimated sewage flow from Telegraph Bay Development	Global Unit Flow Factor =0.37 m^3/day Global Peaking Factor=2.5 Peak flow=0.37*2.5 m^3/day =0.0107 l/s	Sewerage Manual
Estimated sewage flow from Baguio Villa	Peak flow = 0.37*3.5m^3/day = 0.015l/s	Sewerage Manual
Estimated sewage flow from Kong Sin Wan Village	Peak flow = 0.24*3.5m^3/day = 0.0097l/s	Sewerage Manual

6.4 Sewage Flow From The Catchment

6.4.1 The extent of sewage catchment and peak flow to be considered for this Feasibility Study are therefore limited to the following:-

Source of Effluent	Estimated Peak Flow (l/s)
Telegraph Bay Development itself	10504*0.0107=112 l/s
Baguio Villa	6000*0.015=90 l/s
Kong Sin Wan Village	233*0.0097=2.2 l/s
Pokfulam Kennels & Veterinary	Negligible which is compensated by the future reduction in population in Kong Sin Wan Village
	Total Peak Flow= 204 l/s

6.4.2 The conceptual alignment of the sewer network is shown in Figure No. 6.2. The main sewer collects sewage from each of the four housing areas plus the G/IC area with a connection available for Baguio Villa and conveys the sewage along the distributor road, D1, to Telegraph Bay Treatment Works.

6.5 Possible Sewage Treatment Schemes Location

6.5.1 Based on the Sewage Treatment Disposal Options as discussed in section 6.1.2, a number of possible sewage treatment and disposal locations were considered.

6.5.2 Two sewerage schemes were subsequently proposed namely Telegraph Bay Treatment Scheme and Sandy Bay Treatment Scheme.

6.5.3 In the Telegraph Bay Scheme, the sewage is collected and treated by a sewage treatment plant within Telegraph Bay GI/C site.

6.5.4 In the Sandy Bay Treatment Scheme, the TBD sewage is collected and pumped to the existing Sandy Bay preliminary treatment works for treatment via a twin pressurised main between Telegraph Bay and Sandy Bay. The existing Sandy Bay preliminary treatment plant must be extended to accommodate the increase of flow from Telegraph Bay, together with the increased flows from the Sandy Bay area. An area of land adjacent to the existing plant has previously been allocated for this extension, lot GLA-THK 1103.

6.5.1 Constraint of Sandy Bay Treatment Scheme

6.5.1.1 The investigation indicates that the Telegraph Bay treatment scheme is technically favourable. Reviewing the Sandy Bay treatment scheme there are concerns from other Government Departments that this might compromise other future projects including Route 7 and SSDS Stage III/IV.

6.5.1.2 HyD, MWPMO have objected to a proposal to install a twin pressurized main, under Sandy Bay treatment scheme, between Telegraph Bay and Sandy Bay on the basis that any such service might restrict the design and construction of the proposed Route 7 strategic highway.

6.5.1.3 The recent retention of Lot GLA-THK 1103 for SSDS Stage III/IV tunnel construction purpose now prohibit the early construction of any extension to the existing Sandy Bay Treatment Works before 2008/9, thereby ruling out the transfer of Telegraph Bay sewage to Sandy Bay in the interim. This option is further invalidated with the consideration that the discharge of sewage from any new development to a marine outfall is no longer permissible with preliminary treatment/screening only in order to be in line with the Government effort to upgrade the level of sewage treatment to achieve higher environmental standards.

6.5.1.4 Due to these various technical reasons, Sandy Bay treatment scheme has been abandoned, with only Telegraph Bay treatment scheme considered feasible.

6.5.2 Telegraph Bay Treatment Scheme

6.5.2.1 This scheme is to provide a treatment plant at Telegraph Bay within its G/IC Site as shown in Figure No. 6.2, with the treated sewage discharged via a temporary submarine outfall (part of which was already constructed under CED's Telegraph Bay Reclamation contract previously), for the short-term period between population-intake at Telegraph Bay and commissioning of the SSDS Sewer. The treated sewage flow will subsequently be reverted to the SSDS Sewer when it has been commissioned.

6.5.2.2 The Telegraph Bay Development will be responsible for providing the treatment plant for the Telegraph Bay catchment area together with disposal arrangement for the pre-SSDS stage, whereas the SSDS project will be responsible for the disposal works from the Telegraph Bay treatment plant when the future SSDS deep sewer is commissioned.

6.5.2.3 Figure No. 6.3 shows the conceptual layout of the foregoing scheme.

6.5.2.4 The Telegraph Bay Treatment Plant comprises of preliminary treatment, chemically enhanced primary treatment and disinfection processes. The preliminary treatment process consists of coarse screening, fine screening, grit removal by means of detritor which is a permanent arrangement. The chemically enhanced primary treatment process comprises of coagulation, flocculation and sedimentation. Prior to disposal, the sewage is disinfected by ozone, or other means determined in the detail design, to reduce the bacteria content. However, chlorine should be minimised as far as practicable in view of the possible formation of toxic by products. The treatment plant process and layout are shown in Figure Nos. 6.4, 6.5 and 6.6. The section of the treatment plant comprising the CEPT will become redundant once SSDS is commissioned and it is proposed that this section of the plant be dismantled and the land be made available for further use in the G/IC area. Existing land adjacent to the plant plus the area of land released from the treatment plant can provide an area of suitable size for the construction of a private school, as requested by Education Department and Planning Department during the TBD study.

6.5.2.5 The influent sewage water quality is assumed as the typical values

BOD: 250mg/l (BOD-Biochemical oxygen demand)
SS: 250mg/l (SS-Suspended solid)
E.coli: 10^8count/100mL

6.5.2.6 The CEPT treatment plant overall treatment efficiency is as follows:

6.5.2.7 From the final report "Strategic Sewage Disposal Scheme Stage 1 Pilot Plant Study on Chemical Dosing and Disinfection", CEPT can achieve SS removal efficiency of 85% and BOD removal efficiency of 50%. However, it is a more conservative estimation for the Telegraph Bay CEPT's removal efficiency of 50% for SS and 50% for BOD respectively.

6.5.2.8 Finally, with disinfection process, the removal efficiency of E.coli can achieve 4 log kill which comprises 1 log kill by natural die off and 3 log kill by disinfection process.

6.5.2.9 Therefore, the effluent water quality is estimated as

BOD: 125mg/l
SS: 125mg/l
E.coli: 10^4count/100mL

In response to DSD’s concerns on the removal rate at 35% of BOD concentration at 250mg/L, it is estimated that the effluent BOD level is equal to 162.5 mg/L.

6.5.2.10 The following is the calculation of the size of equipment for chemically enhanced primary treatment.

Average sewage from Telegraph Bay = 10504*0.00428 l/s=44,957 l/s
Average sewage flow from Baguio Villa = 6000*0.00428 l/s = 25.68 l/s
Average sewerage flow from Kong = 233*0.00278 l/s
Sin Wan Village (Modern Village) = 0.648
Total average sewerage flow = 44.957 + 25.68 + 0.648 = 71.285 l/s (DWF)
Peak sewerage flow = 204 l/s (2.86 DWF)
Combined Peak factor $= \frac{204}{71.285} = 2.86$
Design equalized flow=17,206*0.0042824*2=148 l/s (2.5*DWF)

(i) Revised CEPT Design Parameters

Peak Flow=204 l/s
Equalized Flow=148 l/s

(a) Screened Sewage Storage Tank (For flow equalization)

No.:	1
Size:	12x12x2m
Excess flow to tank:	2.86*DWF – 2.5*DWF 0.36*DWF=26 l/s
Retention Time at Maximum Excess Flow:	3.08 hrs >2hrs as required in "Guidelines for the Design of Small Sewage Treatment Plants"

(b) Rapid Mixing Tank (For coagulation)

No.:	2 (1 Duty and 1 Standby)
Size:	2x3.5x2.5m
Flow:	179 l/s (2.5*DWF)
Retention Time:	98 sec.
Coagulant Dosage:	9.0 mg/l $FeCl_3$ (as suggested from the Final Report of "SSDS Stage 1 Pilot Plant Study on Chemical Dosing and Disinfection" for 85% SS removal and 50% BOD removal. The final value of dosage will be determined during detail design stage.

(c) Flocculation Tank (For flocculation)

Nos.:	3 (2 Duty and 1 Standby)
Size:	12x3.0x3.5m
Flow:	179 l/s (2.5*DWF)
Retention Time:	23.5 min.
Focculant Dosage:	0.1 mg/l polymer (as suggested in Final Report of "SSDS Stage 1 Pilot Plant Study on Chemical Dosing and Disinfection" for 85% SS removal and 50% BOD removal. The final value of dosage will be determined during detail design stage.

(d) Primary Sedimentation Tank (For sedimentation)

Nos.:	3 (2 Duty and 1 Standby)
Size:	18x7x3.5m
Flow:	179 l/s (2.5*DWF)
Retention Time:	82.1 min.

(e) Effluent Balancing Tank (For effluent temporary storage)

No.:	1
Size:	18 m^3
Flow:	179 l/s (2.5*DWF)
Number of start/hr of the pump:	10

6.5.2.11 The treatment plant is an enclosed building having an approximate area of 78mx35m at ground level, with only a very small part of the building extending to first floor level. In addition, a service building of size 35mx10m is also required. The final layout and location of the plant within the G/IC site will be refined to ensure minimal impact.

6.5.2.12 Since the effluent is temporarily discharged into East Lamma Channel before the commissioning of SSDS Stage III/IV, it is necessary to assess the impact in the nearby marine water. The assessment is shown in Section 6.7.

6.5.2.1 Sludge Dewatering and Disposal

6.5.2.1.1 The sludge produced during sedimentation will be pumped to the sludge storage tank for onward pumping to the dewatering room for centrifuging dewatering process. The resulting sludge cake is then conveyed to and stored in a de-watered solid storage tank in the Solid Handling Area. The de-watered sludge will be removed at regular intervals and transported by sludge collection vehicles to selected landfill sites for disposal. The proposed landfill site is at SENT landfill which require de-watered sludge from sewage and water treatment works with a water content not exceeding 70% by weight, which may contain metals in the form of metal oxides. It is emphasised that sludge disposal must comply with all requirements stipulated in the Waste Disposal Ordinance.

6.6 Discussion On The Proposed Telegraph Bay Treatment Scheme

6.6.1 Advantages

(a) Disinfection equipment is smaller in scale for treating sewage from Telegraph Bay

(b) No extra pumping facilities are required to dispose the effluent from treatment plant to East Lamma Channel via Telegraph Bay submarine outfall.

(c) This option satisfies the principle pointed out by EPD that the treatment plant should be located within its own catchment area.

(d) This option conforms with the original proposal in the Pokfulam/Aberdeen SMP Study which is understood to be already endorsed by Government.

6.6.2 Disadvantages

(a) The plant will initially take up a large portion of the usable area of the G/IC, which is already tight in space given the government facilities to be accommodated.

(b) A new submarine outfall at Telegraph Bay will be needed.

(c) The CEPT section of the plant and the marine outfall will become redundant once

SSDS stage III/IV is commissioned.

6.6.2.1 Based on the above comparison, it is noted that the advantages of the proposed TB treatment scheme outweigh its disadvantages,. Hence, it is considered acceptable to employ this scheme.

6.7 Assessment Of Temporary Discharge Via Submarine Outfall

6.7.1 The subsequent assessment is a preliminary assessment for the dilution effect of the disposal of sewage to East Lamma Channel under Telegraph Bay treatment option. The results are shown summarized in the form of table and figure indicating the mixing zone regions and plume trapping depths under all the assessed scenarios. From the results, the impact of sewage to the surrounding environment and water sensitive receivers can be addressed.

6.7.2 To carry out the assessment, a computer package "CORMIX" is employed to simulate the dilution effect of sewage in East Lamma Channel. It is a software system for the analysis, prediction, and design of aqueous conventional pollutant discharges into diverse water bodies. This software is emphasis in its predicting capacity for the geometry and dilution characteristics of the mixing zone so that compliance with water quality constraints may be judged.

6.7.1 Physical System Description

6.7.1.1 Outfall Configuration

6.7.1.1.1 The proposed Telegraph Bay submarine outfall is approximate 300m in length and the layout will be perpendicular to the cope line of the seawall. It is proposed that the submarine outfall will be HDPE pipe with nine diffuser pipes at its open end.

6.7.1.1.2 A set of as-built drawings for the reclamation have been obtained from the Pork Works Division of CED. The drawing indicates that a submarine outfall pipe of 450mm diameter has been constructed through the seawall and it is reserved for the future development. It is suggested that the proposed sewage pipe at landward side can be connected to the existing outfall pipe through the seawall. The open end of outfall can then be extended to the East Lamma Channel. The as-built submarine pipe is about 75m in length measured for the cope line to the open end and the invert level at its open end is at -18 mPD.

6.7.1.2 Ambient Water Density Profile

6.7.1.2.1 Water quality data for 1997 from EPD for sampling stations WM1 and WM2 indicates that various ambient sea water density profiles occur during the year. The water density profile is summarised in Figure no. 6.7.

6.7.1.3 Ambient Current Flow Velocity

6.7.1.3.1 Ambient current flow velocity data from CED for 1990, latest available indicates that the ambient current flow velocity for E3 and E4 is nearest to Sandy Bay and Telegraph Bay. Thus, current speed data is taken from these sampling sites for the assessment. From the data, it is reasonable to classify the current speed into three categories, fast, medium and slow.

Fast-0.5m/s
Medium-0.35m/s
Slow-0.1m/s

6.7.1.3.2 Assessment is carried out for these three current speeds.

6.7.2 Mixing Zones

6.7.2.1 It is the first step to identify and investigate the critical pollutant among various key pollutants stated in Water Quality Objectives, which include suspended solid, dissolved oxygen, un-ionized ammonia, total inorganic nitrogen and E.coli, for which the required dilution factor is the maximum.

6.7.2.2 For the ambient condition, "Marine Water Quality for Hong Kong in 1996" provides the latest information. The sampling stations WM1 and WM2 is the nearest stations in the investigating site.

6.7.2.3 Water Quality Objectives for Western Buffer Water Control Zone, Cap. 358, section 5, serves the guideline for the requirements of ambient water quality. The subsequent assessment is also based on this objective criteria.

6.7.2.4 Criteria are selected based on the compliance of the assessment with the key Water Quality Objectives.

6.7.2.5 For suspended solid, the ambient concentration is 6.0 mg/l. In accordance with Water Quality Objectives, human activity should neither cause the natural ambient level to be raised by more than 30% nor give rise to accumulation of suspended solid which may adversely affect aquatic communities. In this case the increase of suspended solid due to disposed sewage is 1.8 mg/l. Therefore, the required dilution factor can be calculated as follows:

Let X be the volume of sewage disposed to East Lamma Channel
Y be the volume of ambient water mixed with the sewage

6.7.2.6 By the conversation of mass for suspended solid

$$125*X+6*Y=(6+1.8)*(X+Y)$$
$$Y/X=65$$

6.7.2.7 Therefore, the required dilution factor is 65.

6.7.2.8 For E.coli concentration, "Marine Water Quality for Hong Kong in 1996" stated that the background average E.coli concentration in ambient water is 150 count/100mL. In accordance with water quality objectives, E.coli count for ambient water quality should be remained within 610 count/100ml. Therefore, the required mixing zone can be defined as the region in which E.coli concentration due to sewage is greater than 460 count/ml. By adopting similar approach in suspended solid, the required dilution factor for E.coli is 21.

6.7.2.9 For Un-ionized ammonia, from Water Quality Objectives, the level should not exceed 0.021 mg/l. Thus, the respective total free ammonia concentration is 0.4 mg/L with the assumption of typical range pH value from 7.8 to 8.3 for ambient receiving water from Figure no. 6.8. In addition, the ambient ammoniacal nitrogen concentration is 0.08 mg/L and the typical value of ammoniacal nitrogen concentration for the untreated sewage is 25 mg/L. Therefore, to achieve the water quality objectives in respect to free ammonia and un-ionized ammonia, the required dilution factor for ammonia is 77.

6.7.2.10 For total inorganic nitrogen, the ambient concentration is 0.22 mg/l. From Water Quality Objectives, the level should not exceed 0.4 mg/l. The increase of inorganic nitrogen due to the disposed sewage is 0.18 mg/l. The concentration of inorganic nitrogen for the disposed sewage is 25 mg/L. The required dilution factor can be calculated, similar to suspended solid, as 137.

6.7.2.11 For dissolved oxygen, the ambient concentration for sea is 5 mg/L which is over 90% of the sampling occasions during the whole year. In accordance with Water Quality Objectives, the level should not fall below 4 mg/L. Since the time for the dilution of discharge sewage to meet the DO requirement as stipulated in WQO is short, DO can be viewed as conservative substance which has the same characteristics as other pollutant such as suspended solid. Therefore, similar to the calculation adopted in suspended solid, the required dilution factor is 4 by assuming DO is 0 mg/L in effluent sewage.

6.7.2.12 In addition, the consumption of dissolved oxygen in receiving water by BOD is also consider as below:

6.7.2.13 The decay of organic matter at time t is calculated base on the equation

$$BOD_t = BOD_0 * e^{-kt}$$

where BOD_t be the BOD concentration in time t, day
BOD_0 be the BOD concentration initially, ie t=0 day
k be the decay constant=0.23/day (typical value for domestic sewage)

6.7.2.14 It can be noted that the decay constant, k, is small and the thus the decaying process of organic matters is very slow in comparison with the dilution process. Therefore, it is reasonable to consider the dilution effect dominates dissolve oxygen content in mixing zone while the decay of organic matter is insignificant.

6.7.2.15 The following table is the summary of the assessing criteria

Item	**WQO required**	**Ambient level**	**Required dilution factor**
Suspended solid	Should not cause the natural ambient level to be raised by more than 30%	6.0 mg/l	65
E.coli	Not to exceed 610 count per 100mL	150 count/100 mL	21
Un-ionized ammonia	Not more than 0.021 mg/l	0.01 mg/l	77
Total inorganic nitrogen	Not to exceed 0.4 mg/l	0.22 mg/l	137
Dissolved Oxygen	Not less than 4 mg/l	5 mg/l	4

6.7.2.16 From Section 7.7.4.4.6, the required dilution factors with the incorporation of the effect of ambient concentrations of the water quality parameters are indicated. It can be noted that the greatest required dilution factor is 137 for the pollutant of total inorganic nitrogen. Therefore, this case is thus regarded as the critical which is further analysed by CORMIX.

6.7.2.17 The analysed results are tabulated as follows.

Mixing Zone For Inorganic Nitrogen				
Required Dilution Factor : 137				
Flow Current, m/s	**Type of Ambient Water Density Profile**	**Mixing Zone Length (ie Downstream distance from outfall), m**	**Width of Mixing Zone, m**	**Plume Trapping Depth from Bottom, m**
0.1	Type 1	Immediate	N/A	N/A
0.1	Type 2	11	178	8.17
0.1	Type 3	96	210	7.34
0.35	Type 1	Immediate	N/A	N/A
0.35	Type 2	12	182	5.94
0.35	Type 3	95	200	5.48
0.5	Type 1	Immediate	N/A	N/A
0.5	Type 2	16	174	5.57
0.5	Type 3	20	190	5.16

6.7.2.18 From the above results, the largest mixing zone occurs under the conditions of current flow velocity of 0.1m/s and type 3 density profile. The length and width of mixing zone are 96m and 210m respectively. The mixing zone region is plotted in Figure No. 6.9. In view of this small mixing zone region, there is a large buffer distance exists between the mixing zone region and the water sensitive receivers.

6.7.3 Validity of Assessment

6.7.3.1 CORMIX is a simplified computer model. Some assumptions have been made during the simulation such as uniform unidirectional ambient flow velocity. However, due to the small mixing zone and a large buffer distance between the mixing zone and the water sensitive receivers, the results can still serve the purpose. In addition, in the determination of mixing zones, water quality in sampling stations WM1 and WM2, extracted from "Marine Water Quality in Hong Kong for 1996", has incorporated the cumulative effects due to other nearby sewage treatment plants since the stated background data is the results of field measurement with Wah Fu, Apleichau and Aberdeen treatment plants in operation. Therefore, the assessment has incorporated the cumulative effect due to Wah Fu STW's discharge, etc.. Consequently, it is not necessary to have other additional assessment for the cumulative effect due to discharge from other sewage treatment plants.

6.8 Space Constraints with Provision of the STW at G/IC Site

6.8.1 As there are no obvious alternative locations for the STW to serve TBD, making the G/IC site the favoured location, particularly in the absence of the Sandy Bay plant as a viable alternative option.

6.8.2 Demands for other facilities within the G/IC site (schools and nursery) necessitate that the STW must occupy the least possible space within the G/IC. The STW must also be as unobtrusive as possible, located within a quality housing development, and must not present any unfavourable environmental impacts e.g. odour and noise.

6.8.3 With the anticipated occupation of housing at TBD between mid 2004 and mid 2005 and the completion of SSDS Stage III/IV now quoted as 2006/7 it is clear that any level of treatment beyond fine screening plus degritting provided at the TBD STW will be a temporary/interim measure, as only fine screening plus degritting is required prior to discharge to SSDS. While additional costs and landtake will be required with the use of CEPT during the temporary stage, considerations should be given to ensure the sewage will comply with the WQOs in order to be in line with the Government effort to achieve higher environmental standards.

6.8.4 In an effort to minimise the land occupied by the STW, consideration was given to the provision of the temporary CEPT facility within a basement below the preliminary treatment works. However the major problems with the basement option were the increased construction costs, increased maintenance liabilities, operator safety within the basement and the need to incorporate substantial additional equipment to cater for CEPT in the basement. These problems could all be addressed but at considerable expense and at the cost of increasing the size of the basement, effectively then occupying the same area as a conventional ground level plant.

6.8.1 Comparison of STW Layout Options at G/IC

6.8.1.1 The STW layouts of CEPT with Basement Layout and CEPT at Ground Level within the G/IC area were considered. The following table gives relevant comparisons:-

	CEPT with Basement Layout	**CEPT at Ground Level**
Land Requirement	75 x 60m	110 x 45m
Estimated Construction Cost (Temporary +Permanent)	\$65M (\$40M + \$25M)	\$50M (\$25M + \$25M)
Maintainability	CEPT equipment in basement level	Maintenance work can be carried out at ground level

* The estimated costs have excluded the cost for submarine outfall.

6.8.1.2 The construction of a STW with basement would result in the permanent occupation of a large area of land within the G/IC, even when the CEPT is abandoned following commissioning of SSDS Stage III/IV in 2006/7. The construction of a STW with CEPT all at ground level will initially occupy a larger area within the G/IC but upon commissioning of SSDS the CEPT becomes redundant and can be dismantled, with the previously occupied land becoming available for use as a site for a future private school.

6.8.1.3 The operation of the temporary CEPT is not considered to present a significant potential for land contamination. This assessment is based upon both the nature of site operations (contained within the CEPT facility) and the likely type / quantities of treatment chemicals to be used (e.g. $FeCl_3$ coagulant, polymer flocculant). The area of the CEPT should be covered by hardstanding and provided that all materials / treatment chemicals are handled and stored appropriately within these areas, the potential for ground contamination is considered to be low.

6.8.1.4 During the subsequent decommissioning of the CEPT an investigation to assess the potential for ground contamination is therefore not considered necessary. All waste materials generated during the CEPT decommissioning must comply with all requirements stipulated in the Waste Disposal Ordinance.

6.8.1.5 The provision of a STW in the G/IC area will require a Section 16 application to the Town Planning Board, and with the anticipated strength of local feeling regarding the Telegraph Bay Development, such an application could be objected to and there would be a risk of the application being rejected. The alternative to this would be to rezone the land for the STW, but the rezoning exercise would take between 15 and 21 months, delaying the whole development during that time.

6.9 Conclusions

6.9.1 The present circumstances are such that the only feasible proposal is to provide a Sewage Treatment Works with preliminary treatment/screening and CEPT plus disinfection at ground level within the G/IC area. Disposal of effluent from this STW in the interim period will be via a temporary submarine outfall. Upon commissioning of the SSDS Stage III/IV scheme (2006/7) the submarine outfall can be abandoned and the CEPT facility should be removed, leaving the land available for other uses within the G/IC area.

Figures

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