5. WATER QUALITY

5.1 Introduction

5.1.1 This chapter describes the assessment of water quality impacts associated with the proposed development. The assessment is based on the worst case scenario (i.e. the preliminary Preferred Development Option) which includes residential development, commercial centre, roads, schools and recreational facilities. The baseline conditions of the Study Area as well as nearby water-receiving bodies are reviewed. Sensitive receivers are identified and potential impacts during construction and operation phase are assessed. Cumulative impacts and interface with concurrent projects are reviewed and practical mitigation measures are recommended.

5.2 Relevant Legislation and Assessment Methodology

5.2.1 This assessment is conducted in accordance with the EIA Ordinance, the Technical Memorandum on EIA Process (TMEIA) Annexes 6 and 14 and the EIA Study Brief.

5.2.2 The principal legislation for protecting water quality in Hong Kong is the Water Pollution Control Ordinance (WPCO) [Cap 358], which defines Water Control Zones (WCZs), Water Quality Objectives (WQOs) for each zone, and standards for effluent discharges.

5.2.3 The marine waters around Whitehead lie within Tolo Harbour & Channel WCZ. This WCZ is further subdivided into three sub-zones, namely Harbour Subzone, Buffer Subzone and Channel Subzone. This WCZ is a semi-enclosed bay with a gradient of improving water quality from densely populated inner Harbour Subzone to the outer Channel Subzone. The western coast of Whitehead belongs to Harbour Subzone while the remaining coastal waters (including Starfish Bay) belongs to the Buffer Subzone.

5.2.4 The details of legislation and guidelines relating to water quality control are presented in Annex B.

5.3 Baseline Conditions

Description of Sensitive Receivers

5.3.1 The Study Area covers the Whitehead peninsula in the north, the area on both sides of Sai Sha Road and the lowlying area near Lok Wo Sha. The whole Study Area is mainly fed by two streamcourses in the south, collecting runoff from the upstream hilly catchment in Ma On Shan Country Park. These streamcourses, originally flowed across Sai Sha Road and discharged to Starfish Bay, will be box-culverted by two ongoing projects under construction, namely the construction of Road T7 and KCRC

Ma On Shan (MOS) Railway. Both projects are due to be completed in 2004. There is a small low-flow channel at the Whitehead peninsula flowing from west to east towards Starfish Bay. It is almost dry at the time of observation in September 2001. The existing streamcourses in the Study Area are shown in Figure 5.1.

5.3.2 Most of the Study Area has already been filled up to a level of about 7-8 mPD. The northern part, which was previously the Whitehead Detention Camp area, has now been turned into a golf centre and seaside barbecue area. The southern part of Whitehead is now a huge carpark mainly for container trucks, lorries and passenger coaches. Some agricultural activities still remain in the southeastern part of Whitehead, along the road near Starfish Bay.

5.3.3 At the northern end of Starfish Bay, there is a little low-flow channel about 1.5m wide at the beach. This channel receives water from the small ditch at the middle of Whitehead (See Para.5.3.1) and will be flooded by seawater during high tide.

5.3.4 Whitehead is bounded by Tolo Channel to the north which is the major receiving waterbody of the development. According to the Marine Water Quality of Hong Kong published by EPD, the water quality in the area is good and has improved slightly during the past 5 years and all parameters in the monitoring station TM6 are within the WQOs. The location of the monitoring station TM6 is shown in Figure 5.2.

Table 5.1
Water Quality of EPD Monitoring Station (TM6) from 1995 to 1999

Parameter/Year	95	96	97	98	99	WQO
Dissolved Oxygen (DO) (mg/L) - Surface	7.6 (5.0-10.9)	7.4 (2.2-9.7)	7.3 (5.4-9.4)	6.3 (3.5-12.8)	5.8 (2.6-7.8)	4
Dissolved Oxygen (DO) (mg/L) - Bottom	6.8 (3.0-10.2)	7.4 (1.7-10.0)	5.9 (2.3-9.1)	5.2 (0.6-11.9)	4.9 (1.1-6.9)	3
pH	8.2 (8.0-8.4)	8.2 (7.9-8.7)	8.2 (7.9-8.7)	8.2 (7.8-8.6)	8.2 (7.8-8.5)	Normal $\pm$ 0.3
Turbidity (NTU)	3.4 (0.1-8.0)	5.8 (1.0-50.3)	2.8 (0.3-5.3)	3.4 (0.4-4.8)	5.3 (2.8-9.5)	N/A
Suspended Solids (SS) (mg/L)	5.1 (1.6-19.5)	3.9 (1.1-18.6)	2.7 (1.2-5.8)	2.4 (1.1-7.0)	2.7 (1.0-5.6)	N/A
5-day BOD (mg/L)	2.0 (0.6-3.4)	2.3 (0.6-3.7)	1.6 (0.9-4.0)	1.8 (0.5-3.2)	1.5 (0.9-2.2)	N/A
Ammoniacal Nitrogen (mg/L)	0.07 (0.01-0.29)	0.07 (<0.01-0.67)	0.08 (<0.01-0.26)	0.10 (0.01-0.29)	0.06 (0.01-0.14)	N/A

Parameter/Year	95	96	97	98	99	WQO
Total Phosphorus (mg/L)	0.10 (0.04-0.38)	0.13 (0.07-0.21)	0.08 (0.04-0.16)	0.05 (0.03-0.08)	0.03 (0.02-0.05)	N/A
E.coli (cfu/100ml)	11 (1-300)	10 (1-783)	8 (1-307)	6 (1-180)	3 (1-20)	610

Source: Marine Water Quality in Hong Kong 1995,1996,1997,1998,1999 (EPD)
Data presented are depth-average, except as specified
Data presented are annual arithmetic means except for *E.coli* which are geometric means
N/A: Not appropriate

5.3.5 As shown in Table 5.1, despite an increase of population in Ma On Shan and Tai Po, most parameters (including 5-day BOD, *E-coli* and Total Phosphorus) have been improving during the past 5 years while surface and bottom DO are on a slightly deteriorating trend.

5.3.6 The sediment quality of the area is monitored by EPD at Station TS4 (Figure 5.2). The monitoring results of the station during 1995 to 1999 are shown in Table 5.2 which indicates that the heavy metal concentrations are generally low in the area. With the exception of lead, all heavy metal concentrations are in Class A.

Table 5.2
Sediment Quality of Monitoring Station TS4 from 1995 to 1999

Parameter/Year	Range	Classification
Cadmium (mg/kg)	0.0 - 0.9	A
Chromium (mg/kg)	0 - 49	A
Copper (mg/kg)	0 - 54	A
Lead (mg/kg)	65 - 74	B
Mercury (mg/kg)	0 - 0.7	A
Nickel (mg/kg)	0-34	A
Zinc (mg/kg)	0 –140	A
Arsenic (mg/kg)	0 –14	A

Source: Marine Water Quality in Hong Kong 1999 (EPD)

5.3.7 Starfish Bay is the major water sensitive receiver of the Study Area because of its intertidal habitats and associated fauna. The relatively large sandflat at Starfish Bay is not a common habitat in Hong Kong. It receives much of the runoff from Whitehead and Lee On area. The beach at Starfish Bay is a popular place for nearby residents during holidays. During a site visit in September 2001, some people were sun-bathing and swimming at the beach although no showering and other beach facilities are available. Starfish Bay is close to the Nai Chung SSSI to the east. Increase of

stormwater runoff, if any, from the proposed development may potentially affect the water quality of the bay.

5.3.8 A Water Recreation Centre is proposed at the west coast of Whitehead. The total area will be about 0.9 ha. This will be a potential sensitive receiver during the operational phase of the proposed development as stormwater runoff discharged to the north and west shore of Whitehead may potentially affect the water quality around the Recreation Centre.

5.4 Potential Impacts from Construction Activities

Evaluation of Construction Impacts

5.4.1 The proposed development will involve various construction activities. The following section summarises the activities likely to be undertaken during the proposed development and describes the potential impacts on water quality from each activity.

Site Formation

5.4.2 Preparation of a designated area of land for subsequent development involves levelling of the ground surface, removal of vegetation, stockpiling and generation of construction waste. Construction of temporary infrastructure such as drainage culverts may be required. The site formation process may produce large quantities of run-off with high suspended solids (SS) loading in the absence of appropriate mitigation measures. This potential problem may be aggravated during wet conditions. Erosion of soil enriched in organic matter may release nutrients into the watercourses.

5.4.3 The former Whitehead Detention Centre is currently being used as a golf driving range. It is estimated that only 1/3 of the area (approximately) is covered by maintained grass while the remaining areas is occupied by buildings, car park, and barbecue areas. Information at a similar facility at Telegraph Bay (Waterfall Golf Driving Range) indicated that pesticides / herbicides are applied sparingly, only when needed (i.e. approximately once per every four months). The natures of these agrochemicals are such that they will either be bound to the soils, biodegraded or immobilised. In view of the very small dose and the nature of the chemicals, it is unlikely that they would cause any contamination to the water quality during construction phase.

Concrete Washing

5.4.4 Construction of drainage, roads and building uses concrete, a highly alkaline material. Washings from spill, concrete lorry mixer cleaning and waste concrete may enter nearby waterbodies during wet conditions. This may cause a potential impact because

the high pH of concrete washings which increase the toxic unionized component of ammonia in the receiving waters, a potential problem if the level of ammonia is high.

Bored Piling

5.4.5 Bored piling may be carried out for building construction. Bore piling requires the use of chemical lubricants which generate a wastewater stream requiring treatment before discharge. If the untreated wastewater is drained into a nearby waterbody, the water quality will deteriorate.

Construction of Roads

5.4.6 The impacts from road construction depend on both the construction practices used and the type of material used for the road. Impacts for concrete roads will be similar to that for concrete based construction works. Bitumen and asphalt runoff contains minimal soluble contaminants. An increase in SS levels will arise from excavation works for road construction and runoff from stockpiles of gravel and sand used in the road base.

5.4.7 For this Project, two proposed roads will be constructed next to Starfish Bay and the western coastal area. The discharge of the untreated wastewater will potentially affect the water quality of the area.

Construction of Residential Buildings

5.4.8 According to the Preliminary Preferred Development Option, residential housing of various densities will be built in the Study Area. This includes low rise housing (3-7 storeys) at Whitehead Sites 2 and 3; medium rise housing (10-32 storeys) at Lok Wo Sha and high-rise housing (42-50 storeys) at Wu Kai Sha Station development. The total population will be about 18,000.

5.4.9 During the construction period, the site runoff resulting from large scale development may create a significant impact on the receiving waterbodies. For high rise buildings, construction activities include site formation, bored piling and concreting works. A large volume of concrete washings may be generated and appropriate mitigation measures should be taken. The potential impacts for low and medium-rise buildings are likely to be similar but smaller in scale.

Site Workshop

5.4.10 Workshops will be set up to provide maintenance and repair services for the equipment on site. The use of engine oil and lubricants, and their storage as waste materials has the potential to create impacts if spillage occurs. Waste oil may infiltrate into the surface soil layers, or runoff into local watercourses, increasing hydrocarbon levels.

Presence of Additional Workers

5.4.11 During construction, the workforce on site is estimated to be about 800, although the number will vary over the construction period. Impacts from the workers include waste and wastewater generated from eating areas, and sewage from temporary sanitary facilities. Sewage is characterised by high levels of BOD, ammonia and *E.coli*. Significant water quality impact will happen only if the sewage is discharged directly to receiving water without any prior treatment.

Cumulative Impacts

5.4.12 The ongoing projects under construction within and around the Study Area include the construction of Ma On Shan Railway, Sai Sha Road Widening and Road T7 as well as the Public Transport Interchange (PTI) adjoining Wu Kai Sha Station development.

5.4.13 The proposed Wu Kai Sha Station residential development is to be built on top of the PTI which is to be constructed by other proponents. The 1st level of future property development carpark will be constructed under the PTI project so that construction of the residential development above the PTI can take place in future without affecting the operation of the PTI. The foundation of the PTI has also been designed to accommodate a residential development above the PTI.

5.4.14 Most of the PTI will be covered by the 1st level of future property development carpark and a small area of it will be open area. The stormwater runoff from the non-covered area of the PTI will be discharged via stormwater drains to Starfish Bay whereas effluent collected from the covered area of the PTI and approximately 3,000 m^2 of proposed future commercial use and building services plant spaces located on the PTI level will be discharged to the public sewerage system of Ma On Shan. A kindergarten of approximately 1,000 m^2, carparks, residential clubhouse and swimming pool are also to be constructed in the future property development or above the said future 1st carpark level.

5.4.15 The construction period of the proposed residential development may overlap the ongoing projects. Piling works would be required to Tower 1 as it is outside the PTI area. Potential cumulative impacts such as silty runoff, concrete washings, oil and grease may affect the water quality of the area. The ProPECC PN 1/94 requirements on the water mitigation during the construction phase of the residential development should be strictly followed. Provided that all mitigation measures are implemented, the cumulative impacts would not be significant.

5.4.16 The two natural streams discharging into Starfish Bay will be diverted into box

culverts under the currently ongoing projects. As all projects should implement their mitigation measures, cumulative impacts are not expected. The baseline hydrology would remain unchanged, as no additional runoff due to the proposed Wu Kai Sha Station development would be resulted.

Mitigation Measures during Construction

5.4.17 All of the impacts identified above can either be eliminated or mitigated to minimize impacts on the nearby aquatic environment. Generally based on ProPECC PN 1/94, the following mitigation measures are designed to be practical and cost-effective in achieving compliance with water quality standards and should be undertaken by the construction contractor during the construction period.

5.4.18 Suspended solids in runoff should be reduced by the provision of a good surface drainage system with suitably designed catchpits to retain sediment. Silt removal devices should be well-maintained. For areas where no drainage is present or prior to drainage being constructed, sediment should be collected by excavating a pit into which surface runoff is directed and where settlement and/or infiltration can occur. A mobile sedimentation tank should also be provided to reduce the SS level of the wastewater.

5.4.19 It should be noted that Starfish Bay is a water and ecological sensitive receiver. Any construction activities close to it should be regarded as of particular concern. Silt traps should be installed and well-maintained to prevent any silty runoff from entering Starfish Bay. All wastewater generated during construction must be monitored and treated as necessary prior to discharging into the north and west shore of Whitehead.

5.4.20 Stockpiles should be covered during wet season to avoid generating silty runoff. A surrounding drainage system and the use of flat and exposed permeable area should be provided to facilitate control and infiltration of site runoff.

5.4.21 Site cleanliness and immediate cleanup / remedial action in case of chemical spill (such as fuel) are the most effective mitigation measures to minimize water quality impacts from general site run-off and should be adhered to in all construction sites. In addition, adequate sanitary facilities for workers on site should be provided and grease trap facilities should be installed for any canteen facilities.

5.4.22 Concrete washings will increase pH in receiving waterbodies. Close monitoring of pH should be conducted to avoid damage to the marine ecology. Buffer agents should be added where necessary to neutralise concrete wastewaters before its discharge to stormdrains or watercourses. A particular location within the site away from any water receiver should be selected for washing the concrete mixer. Infiltration/sedimentation pits should be used to settle out washings before discharge/treatment. Bored-pile suspension should also be settled in

infiltration/sedimentation pits.

5.4.23 Oil interceptors should be installed for maintenance workshop and storage areas. These should be emptied regularly and should have a by-pass to prevent flushing during periods of heavy rain.

5.4.24 A section of road between the wheel washing bay and the public road should be paved, with backfall, to prevent wash water or other site runoff from entering public road drains. Sand and grit from wheel washing bays should be settled out and removed before the water is discharged into storm drains. The wheel washing bay should be designed to reuse settled wheel washing water.

5.4.25 For general construction works, mitigation measures and site practice for construction site drainage as stated in ProPECC PN 1/94 should be followed.

Summary

5.4.26 The potential construction impacts and recommended mitigation measures are summarised in Table 5.3.

Table 5.3
Summary of Potential Construction Impacts and Mitigation Measures

Potential Impacts	Mitigation Measures
Increase of Suspended Solids from silty runoff associated with site formation and construction activities	Provision of temporary drainage system with catchpits Stockpiles covered in particular during wet season Installation and good maintenance of silt traps
Elevation of pH in water through discharge of concrete washings	Use of infiltration/sedimentation pits to settle out washings before treatment, re-use or discharge
Bentonite slurry enters watercourses during bored piling operation	Settle bored piling suspension liquid in sedimentation/infiltration pit until supernatant is clear
Oil and grease from maintenance workshops	Oil interceptors should be installed and maintained regularly
Increase of sewage and wastewater from site workers	Provision of underground septic tank or chemical toilets to store sewage Discharge from site canteen via grease traps and collected by licensed collector.

Note:
All the above mentioned mitigation measures are to be undertaken by the construction contractor during the construction period.

Evaluation of Residual Impacts

5.4.27 Following the effective implementation of all the mitigation measures described above, the residual impacts on the water quality of receiving water bodies will not be significant.

5.5 Potential Impacts from Operation

Evaluation of Operational Impacts

Generation of Sewage

5.5.1 Sewage will be generated from various uses of the proposed development including residential area, commercial area, schools, indoor recreation centre, water recreation centre, and themed restaurant park.

5.5.2 The volume of sewage that will be generated by the development has been estimated in accordance with the Sewerage Manual published by Drainage Services Department. The details are shown in Table 5.4.

Table 5.4
Estimated Sewage Flows

Site	Use	Global Unit Flow Factor	No. of Residents/ Employers	ADWF (m^3/day)
Site 1	**Recreation**			
Water Recreation Centre		0-35	30	11
Open Coach Parking			*Nominal**	5
Cycle Park		0.35	30	11
Public Carpark			*Nominal**	5
Visitor/Heritage/ Ecological Centre		0.35	20	7
Themed Restaurant Park		0.35	1,000	350
Botanical Garden		0.06	50	3
Site 2	**R3**	0.37	518	192
Site 3	**R3**	0.37	458	170
School Site	**E**			
Primary School		0.025	1,250	31
Secondary School		0.025	1,420	36
IRC		0.35	15	5
Lok Wo Sha	**R2**	0.3	10,008	3,003
	C	0.35	400	140
Wu Kai Sha Station Development	**R1/2**	0.24	7,560	1,815
	C	0.35	140	49
			TOTAL	**5,833**

Notes:
*Nominal sewage flows to take account of possibility of having public latrine / RCPs
ADWF = Average Dry Weather Flow

5.5.3 The sewage generated will be discharged to Ma On Shan Area 108 Sewage Pumping Station and then through the sewerage network in Ma On Shan to Shatin Sewage Treatment Works. These public sewerage facilities will be upgraded/expanded before occupation of the proposed developments. No sewage will be discharged to Tolo Harbour and therefore no adverse impact on the water quality is expected. Details of the sewage impact assessment are described in Annex E.

Stormwater Runoff

5.5.4 During operation, the stormwater runoff will be from roads and urban development. Runoff from railway will also be discussed here as the future Ma On Shan Rail will pass through the Study Area and the Wu Kai Sha Station Residential Development will be built on top of the future Wu Kai Sha Station. Station runoff from the railway will therefore potentially impact on the waterbodies in the area.

5.5.5 Development of an urban area will lead to an increase in the extent of impermeable surfaces. This will occur as a result of land formation, road construction, housing construction and other facilities.

5.5.6 An increase in impermeability reduces the opportunity of infiltration of runoff into the ground and therefore increases the volume and speed of runoff. Pollutants collected by surface runoff will also be transported into the surface drainage system more quickly, eliminating the opportunity for preliminary removal of pollutants through absorption and filtration processes.

5.5.7 At present, the northern part of Whitehead consists of a public golf club, and some restaurants and barbecue areas. For the rest of Whitehead, many areas have been filled and turned into parking areas. There is a low flow channel in the middle of Whitehead which feeds into Starfish Bay.

5.5.8 Urban stormwater runoff will normally include suspended solids, oil and grease, and BOD from organic matter. *E.Coli*, ammonia, and even heavy metals. Road runoff will contain a number of pollutants that result from the normal wear and tear of road vehicles, including suspended solids, absorbed and complexed chemicals (especially heavy metals) and hydrocarbons. The significance of the potential water quality impact from the runoff depends on the level of cleanliness within the development area and the retention of permeable surfaces for infiltration before discharge.

Railway Track Runoff

5.5.9 Although KCRC Ma On Shan Rail is not part of this development, it will pass through the Project Boundary and by the time the construction of the proposed development completes (in 2008), MOS Rail will be operational (scheduled from 2004). The section of railway leading to Wu Kai Sha Station will be on viaduct. The issue of railway runoff is discussed below as potential cumulative impacts with the Whitehead development.

5.5.10 The subject of urban stormwater runoff is a relatively new study. Most of the data on stormwater quality have been collected from roads, residential and commercial areas. There is very little information available on the quality of stormwater runoff from railways.

5.5.11 Potential pollutants contained in railway runoff include metal grindings, lubricants, suspended solids and oil and grease.

5.5.12 Metal grindings (mainly iron) will be present after the train runs on the track. They may have toxic effect on some species in the receiving waters after they are washed

into the drainage system. When track grinding is being carried out, a proportion of metal dust will be deposited between the tracks. The impact will be minimal during dry season, but there is a potential to impact receiving water during storm events. However, the cumulative impact is likely to be small compared to runoff from roads and other development areas.

5.5.13 Lubricants will be used at the switch points on the track. Cleaning materials will also be used on train and the railway station. Dust will be generated from train and railway station. Depending on the design of the Wu Kai Sha Station, cooling water discharge may be generated if water-cooled air conditioning system is adopted. Provided that proper stormwater management measures including catchpits, and oil and grease trap are adopted, the cumulative impacts on Tolo Harbour waters will be minimal.

Recreation Zone

5.5.14 A Water Recreation Centre will be built at the western coast of Whitehead. The level of *E.coli* is of particular concern in waters to be used for secondary contact recreation, as it is an indicator of faecal pollution and the presence of other potentially pathogenic organisms. Under the Water Pollution Control Ordinance, the level of *E.coli* should not exceed 180 cfu/100ml for bathing beaches and 610 cfu/100ml for secondary contact recreation purposes.

5.5.15 The *E.coli* and faecal coliform levels near Whitehead (EPD Station TM6) have been low in the past 5 years and well within the limit for bathing and recreational purposes, as shown in Table 5.5.

Table 5.5
***E.Coli* and Faecal Coliform Levels at EPD Monitoring Station TM6**

Parameter/Year	95	96	97	98	99
E.coli (cfu/100ml)	11 (1-300)	10 (1-783)	8 (1-307)	6 (1-180)	3 (1-20)
Faecal Coliforms	26 (2-922)	25 (1-1711)	39 (2-846)	160 (4-1500)	12 (1-94)

Source: Marine Water Quality in Hong Kong 1995, 1996, 1997, 1998, and 1999.

5.5.16 These data indicate that the water quality near Whitehead is suitable for the proposed Water Recreation Centre.

5.5.17 The Water Recreation Centre consists of a land-based area of 0.6 ha and shore-based

area of 0.3 ha. Land-based facilities will include an overnight accommodation building for about 100 persons, and a building for lecture, administration, canteen and storage etc. These facilities will not pose any threat to the receiving water as the sewage and runoff generated will be transported through the sewerage system to Shatin and drainage networks of the area.

5.5.18 Shore-based area will mainly be used for landing and storage of boats and other water sports facilities. It is expected that only non-motorised water sports will be provided at the recreation centre such as rowing boats, canoes and wind-surfing. The number of motorised boats will be minimised. There is a potential impact from the use of chemicals for washing, but this is expected to be small. The pollutants generated from these water sports will therefore be minimal. The disposal of chemical for washing is controlled under the Waste Disposal Ordinance.

5.5.19 Other recreational facilities include a heritage and ecological centre, themed restaurant park, botanical garden, and a cycle park. Runoff from these facilities will include suspended solids, oil and grease, BOD, ammonia nitrogen from fertilisers. Provided that the mitigation measures are implemented as described below, the potential impacts of these facilities are minimal.

Mitigation Measures during Operation

Sewage

5.5.20 Sewage generated from the development should be discharged through sewerage network in Ma On Shan and transported to Shatin Sewage Treatment Works. No sewage should be discharged to Tolo Harbour. Hence, no adverse impact on the water quality is expected.

Stormwater Runoff

5.5.21 All stormwater runoff from the proposed development north of Sai Sha Road will be collected and discharged at the outfalls at the northern and western coast of Whitehead (Figure 5.3). No stormwater runoff due to the development to the north of Sai Sha Road will be discharged to Starfish Bay.

5.5.22 The box culvert being constructed under the Road T7 project will receive stormwater runoff from the areas south of Sai Sha Road and upstream in Ma On Shan Country Park. It will discharge to Starfish Bay. Stormwater runoff collected from the proposed Wu Kai Sha Station residential development above the PTI will also be discharged via the box culvert to Starfish Bay. As discussed in para 5.4.14, stormwater runoff from the covered part of the PTI will be discharged to public sewerage.

5.5.23 The residential development above the PTI comprises a number of high-rise blocks. Stormwater runoff will mainly originate from the roof of the tower blocks, a landscaped podium and an access road leading to the residential development. Pollution arising from the residential development is likely to be minor. Standard pollution control measures such as catchpits and oil & grease traps should be incorporated into the drainage system subject to the future design of the property development in accordance with the relevant statutory requirements.

5.5.24 Impacts from stormwater runoff should be mitigated through preventative and control measures. Prevention measures include sweeping of roads, minimising the use of excessive volumes of chemicals such as bleaching and cleaning materials in buildings, controlling the use of fertilisers in parks and maintaining a clean environment through raising public awareness.

5.5.25 It is proposed that in the Lok Wo Sha and Whitehead areas, infiltration chambers should be installed as part of the stormwater management system. Construction of the chamber is similar to a conventional manhole except that the solid base slab of the former is replaced by a sand layer in the infiltration chamber. It is designed as a combination of a sand and gravel filter that permits infiltration of low stormwater flows. The chamber utilises a porous filter material, such as gravel, over a second filter of sand, through which stormwater can drain. The larger suspended solids are trapped in the upper gravel layer and finer silt and clay particles are trapped in the sand below.

5.5.26 The installation of infiltration chamber will remove considerable quantities of suspended solids and BOD_5, up to 80% and 60% respectively. The effectiveness of the chamber will depend on the maintenance of the system. The chamber should be inspected and tested every 6-12 months. Any rubbish or debris that has accumulated in the chamber should be removed on a periodic basis.

5.5.27 The locations suitable for installation of infiltration chambers will depend on the depth of permeable layer underneath and should be determined in the detailed design stage.

Summary

5.5.28 The potential operational impacts and recommended mitigation measures are summarised in Table 5.6.

Table 5.6
Summary of Potential Operational Impacts and Mitigation Measures

Potential Impacts	Mitigation

Generation of sewage	Sewage transported through sewerage network to Shatin Sewage Treatment Works for treatment. No sewage discharge from development to Tolo Harbour.
Urban stormwater runoff	All stormwater runoff collected and discharged at the outfalls at the northern and western coast of Whitehead. No additional stormwater discharge from development to Starfish Bay. Minimise pollutants by maintaining cleanliness. Installation and maintenance of infiltration chamber to remove SS and BOD.

Residual Impacts

5.5.29 With the implementation of both preventative and control measures for stormwater runoff, as well as the construction of new sewerage network, the residual operational impacts on water quality will be minimal.

Cumulative Impacts

5.5.30 As part of the Road T7 construction, the box-culverted stream will continue to receive water from the area south of Sai Sha Road and upstream in Ma On Shan Country Park. It will be discharged through the existing box culvert to Starfish Bay. The proposed development will generate no additional runoff discharge to Starfish Bay.

5.5.31 With the implementation of mitigation measures for this project, as well as the ongoing projects of Ma On Shan Railway and Road T7, the cumulative impacts on water quality during operation will be insignificant.

5.6 Environmental Monitoring and Audit Requirements

5.6.1 Water quality monitoring should be carried out during construction phase to audit the sufficiency of the mitigation measures incorporated into the contractors' design and evaluate their efficiency in mitigating against pollutants entering the aquatic environment.

5.6.2 In general, the monitoring locations should be upstream and downstream of potential drainage locations. For this project, some of the drainage culverts, which Whitehead discharges will flow into, lie within the site boundary of concurrent projects. This makes it difficult to distinguish impacts of this project from those of concurrent projects (Figure 5.1).

5.6.3 Although site runoff from all projects in the area flow to Starfish Bay will be controlled and mitigated, it is recommended that baseline monitoring should be

conducted at Starfish Bay to establish existing conditions against which to measure potential impacts. Two stations should be located near the box culvert outfall and the natural stream outfall. At least two other stations should be located further offshore, near the Tolo Channel.

5.6.4 Based on the possible sources of pollution identified in this chapter, the parameters to be monitored should include pH, dissolved oxygen, suspended solids and ammoniacal nitrogen. oil and grease should be monitored where there is a workshop and BOD_5 should be monitored where canteen or workers facilities are set up.

5.6.5 Some site runoff will be discharged through stormwater drainage systems to the north and west shore of Whitehead development once they are constructed. If construction work continues after the stormwater drainage systems are built, the water quality near the discharge outfalls should also be monitored. The EPD Monitoring Station TM6 should be used as a baseline for comparison with monitoring data at the stormwater discharge outfalls.

5.6.6 The locations, monitoring frequencies and monitoring parameters will be detailed in the EM&A Manual. Action Plans in case of exceedances will also be described in the EM&A Manual.

5.6.7 Operational phase monitoring will not be required as stormwater discharges are not subject to specific standards under the WPCO and the sewerage infrastructure will adequately meet the sewage requirements of the development.

5.7 Conclusion

5.7.1 This chapter has presented a review of the current situation in the Study Area, the potential impacts of the Whitehead development, the cumulative impacts of concurrent projects, and recommended a range of practical mitigation measures.

5.7.2 The proposed development provides an opportunity for improving the water quality of the area by installation of sewerage and drainage networks. Starfish Bay, a sensitive receiver, will benefit as no additional stormwater will be discharged into it in future. The waterfront at Whitehead will be preserved and better managed for visitors. All stormwater runoff from the proposed development to the north of Sai Sha Road will be discharged to the north and west of Whitehead at Tolo Harbour where stronger current could dilute and assimilate pollutants more effectively.

5.7.3 Full implementation of recommended mitigation measures during construction and operational phases will ensure that the proposed development will not have adverse impacts on the water quality.

5.8 References

Binnie Black and Veatch (2000). *Planning and Development Study on North West New Territories Technical Paper No.13, Environmental Impact Assessment.*

Environmental Protection Department. *Marine Water Quality in Hong Kong 1995, 1996, 1997, 1998, 1999.*