5. WATER QUALITY

5.1 Introduction

The construction and operation of the MOS Extension could generate wastewater which may cause adverse water quality impacts if not properly controlled or mitigated. This section assesses the potential water quality impacts arising from both the construction and operational phases of the MOS Extension, based on the latest engineering information. Appropriate mitigation measures are also recommended.

5.2 Environmental Standards and Legislation

The criteria for evaluating water quality impacts are described in the Technical Memorandum on Environmental Impact Assessment Process (Environmental Impact Assessment Ordinance), (EIAO-TM). The relevant criteria to this EIA Study are provided in the following sections.

5.2.1 Water Pollution Control Ordinance

The Water Pollution Control Ordinance (WPCO) is the legislation for the control of water pollution and water quality in Hong Kong. Under the WPCO, Hong Kong waters are divided into 10 Water Control Zones (WCZs). Each WCZ has a designated set of statutory Water Quality Objectives (WQOs). The proposed development areas fall within the Tolo Harbour and Channel WCZ which was declared in 1982. The WPCO WQOs set limits for different parameters that should be achieved in order to maintain the water quality within the Tolo Harbour and Channel WCZ. The parameters of most concern during the construction phase will be suspended solids (SS) and dissolved oxygen (DO) levels. The associated WQOs against which impacts will be assessed are as follows:

- SS levels: For construction near Tolo Harbour and Channel, human activity should not cause the annual median SS levels to exceed 20 mg l^{-1}.
- DO levels: DO levels should remain above 4 mg l^{-1} in Tolo Harbour at all times.

5.2.2 Technical Memorandum Standards for Effluent Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters

All discharges during both the construction and operational phases of the MOS Extension are also required to comply with the *Technical Memorandum for Effluents discharged into Drainage and Sewerage Systems, Inland and Coastal Waters* (TM) issued under Section 21 of the WPCO, which defines acceptable discharge limits to different types of receiving waters. Under the TM, effluents discharged into the drainage and sewerage systems, inshore and coastal waters of the WCZs are subject to pollutant concentration standards for particular volumes of discharge. These are defined by the Environmental Protection Department (EPD) and specified in licence conditions for any new discharge

within a WCZ. The pertinent discharge limits for Tolo Harbour and Channel WCZ are listed in *Table 5.2a*.

Table 5.2a Standards for Effluents Discharged into the Coastal Waters of Tolo Harbour and Channel Water Control Zone

Flow Rate (m^3day^{-1})	10	>10 & 200	>200 & 400	>400 & 600	>600 & 800	>800 & 1000	>1000 & 1500	>1500 & 2000	>2000 & 3000	>3000 & 4000	>4000 & 5000	>5000 & 6000
Determinant												
pH (pH units)	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9
Temperature (C)	45	45	45	45	45	45	45	45	45	45	45	45
Colour (lovibond units) (25 mm cell length)	1	1	1	1	1	1	1	1	1	1	1	1
Suspended Solids	30	30	30	30	30	30	15	15	15	15	15	15
Biochemical Oxygen Demand	20	20	20	20	20	20	10	10	10	10	10	10
Chemical Oxygen Demand	80	80	80	80	80	80	50	50	50	50	50	50
Oil & Grease	20	20	20	20	20	20	10	10	10	10	10	10
Iron	10	10	10	7	5	4	2.7	2	1.3	1	0.8	0.6
Boron	5	4	3	2.5	2	1.6	1.1	0.8	0.5	0.4	0.3	0.2
Barium	5	4	3	2.5	2	1.6	1.1	0.8	0.5	0.4	0.3	0.2
Mercury	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Cadmium	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Other toxic metals individually	1	1	0.8	0.5	0.5	0.4	0.1	0.1	0.1	0.1	0.1	0.1
Total Toxic Metals	2	2	1.6	1	1	0.8	0.2	0.2	0.2	0.2	0.14	0.1
Cyanide	0.1	0.1	0.1	0.1	0.1	0.1	0.05	0.05	0.03	0.02	0.02	0.01
Phenols	0.5	0.5	0.5	0.25	0.25	0.25	0.1	0.1	0.1	0.1	0.1	0.1
Sulphide	5	5	5	5	5	5	2.5	2.5	1.5	1	1	0.5

Flow Rate (m^3day^{-1})	10	>10 & 200	>200 & 400	>400 & 600	>600 & 800	>800 & 1000	>1000 & 1500	>1500 & 2000	>2000 & 3000	>3000 & 4000	>4000 & 5000	>5000 & 6000
Total Residual Chlorine	1	1	1	1	1	1	1	1	1	1	1	1
Total Nitrogen	20	20	20	15	15	15	15	15	10	10	10	10
Total Phosphorus	8	8	5	5	5	5	5	5	5	5	5	5
Surfactants (total)	15	15	15	15	15	15	10	10	10	10	10	10
E. coli (count per 100 mL)	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000

Note: All units in mg l^{-1} unless otherwise stated; all figures are upper limits unless otherwise stated

5.2.3 Construction Site Drainage Guidelines

The Practical Note for Professional Persons on *Construction Site Drainage* (PN 1/94) issued by the EPD provides basic environmental guidelines for the handling and disposal of construction site discharges to minimise impacts on water quality.

The Practical Note for Professional Person on *Drainage Plans subject to Comment by the Environmental Protection Department* (PN 5/93) issued by the EPD also provides guidelines for handling the discharge of storm water and sewage from the development.

5.2.4 Regulations of Marine Sediment Disposal

Marine disposal of any dredged materials from rivers under the currently proposed alignment of the MOS Extension is controlled under the *Dumping at Sea Ordinance 1995*, which has recently replaced the *Dumping at Sea Act 1974 (Overseas Territories) Order 1975 (App. III, p.DK1)* in its application to Hong Kong.

Dredged sediments destined for marine disposal are classified according to their level of contamination by seven toxic metals, as stipulated in the EPD Technical Circular (EPD-TC) No. 1-1-92, *Classification of Dredged Sediments for Marine Disposal*. These are shown in *Table 5.2b*.

Table 5.2b EPD Classification of Sediments by Heavy Metal Content (mg/kg dry weight)

Class	Cd	Cr	Cu	Hg	Ni	Pb	Zn
A	0.0 - 0.9	0 - 49	0 - 54	0.0 - 0.7	0 - 34	0 - 64	0 - 149
B	1.0 - 1.4	50 - 79	55 - 64	0.8 - 0.9	35 - 39	65 - 74	150 - 190
C	1.5 or more	80 or more	65 or more	1.0 or more	40 or more	75 or more	200 or more

The contamination levels presented in the EPD-TC serve as criteria for determining the disposal requirements of the dredged sediments. Definition of the classification is as follows:

Class A: Uncontaminated material, for which no special dredging, transport or disposal methods are required beyond those which would normally be applied for the purpose of ensuring compliance with EPD's WQOs, or for protection of sensitive receptors near the dredging or disposal areas.

Class B: Moderately contaminated material, which requires special care during dredging and transport, and which must be disposed of in a manner which minimises the loss of pollutants either into solution or by re-suspension.

Class C: Seriously contaminated material, which must be dredged and transported with great care, which cannot be dumped in the gazetted marine disposal

grounds and which must be effectively isolated from the environment upon final disposal.

For sediments to be identified within a particular class, only the concentration of one metallic species need be exceeded. For Class B or Class C contamination, the final determination of disposal options, routing and issue of a permit to dispose of material at the designated disposal site will be made by the EPD and Fill Management Committee (FMC) in accordance with the Works Branch Technical Circular (WBTC) No. 22/92 and No. 6/92, and Building Ordinance Office, Practice Note for Authorised Persons and Registered Structural Engineers 155 (PNAP 155) Marine Disposal of Dredged Mud.

It should be noted that *Appendix I* Item (c) of *Works Branch Technical Circular* (WBTC) No. 22/92 stipulates that the concentrations of organic pollutants such as polychlorinated biphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs), and tributyl tin (TBT) should also be tested, if suspected to be present. However, EPD has not specified criteria for any of these parameters.

A new set of regulatory guidelines for contaminated sediments are under development by the EPD and the Civil Engineering Department (CED) which may be promulgated in mid-1999. These guidelines will include a new set of sediment quality criteria which includes organic pollutants and other toxic substances, with a revised classification system of contamination levels for highly contaminated sediment not suitable for marine disposal. The new sediment guidelines will apply to the constructions that commence after 2001.

5.3 Description of the Environment

5.3.1 From Tai Wai Depot to Chevalier Garden Station

The proposed alignment of the MOS Extension from Tai Wai Depot to Chevalier Garden Station falls within the catchment of Shing Mun River. The construction sites will comprise mostly urbanised areas. The MOS Extension alignment will pass through a section of the Shing Mun River near Tai Wai, and through the Siu Lek Yuen and Tai Shui Hang Nullahs near City One Shatin and Chevalier Garden, respectively.

There are three EPD river water quality sampling stations at the Tai Wai Nullah (TR19), main channel of the Shing Mun River (TR19I) and at Siu Lek Yuen Nullah (TR23A) upstream of the proposed MOS Extension bridge crossings (*Figure 5.3a*). Their river water quality monitoring results are presented in *Table 5.3a*. Since the implementation of the WPCO and Livestock Waste Control Scheme, major pollution sources are under control and livestock waste was eliminated from the catchment. The improvement in the river water quality since the early 1990s is reflected by the upward Water Quality Index trend at most of the stations, including TR19, TR19I and TR23A. In 1997, the water quality at the station TR19 was classified as "fair", whereas the water quality at the other two stations was classified as "good". According to the *River Water Quality in Hong Kong in 1997*, pollution at Tai Wai Nullah, Shing Mun River and Siu Lek Yuen Nullah has been on a steady decline since the mid-1980s. This is reflected by the decrease in

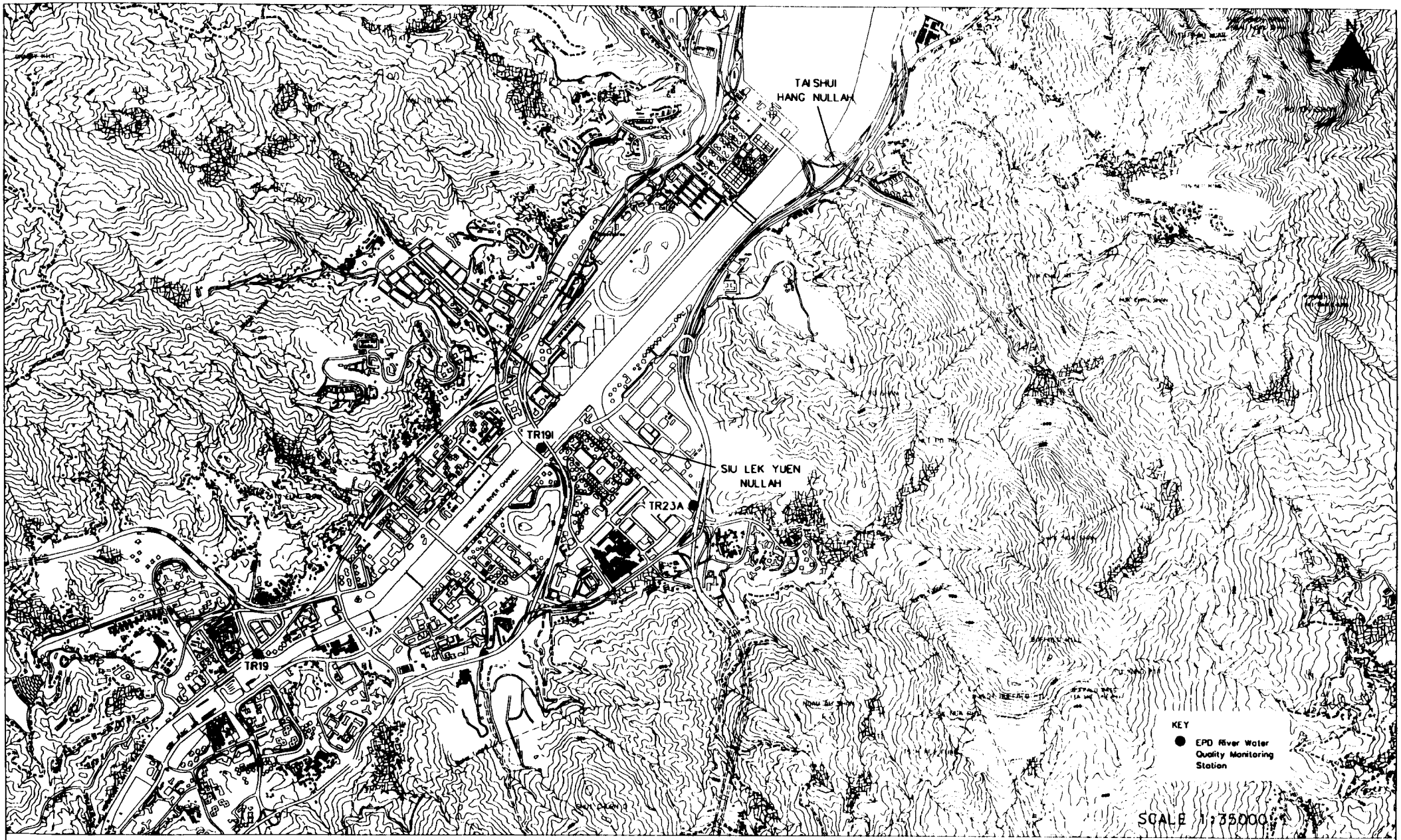

FIGURE 5.3a

LOCATIONS OF THE EPD RIVER WATER QUALITY STATIONS NEAR THE MOS ALIGNMENT

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dissolved oxygen (DO) and increases in suspended solids, aggregate organics, and nutrients at these stations.

Table 5.3a Summary of Water Quality Monitoring Results for the Shing Mun River and Siu Lek Yuen Nullah in 1997

Parameter	Sampling Station		
	Tai Wai Nullah	Shing Mun River	Siu Lek Yuen
	TR19	TR19I	TR23A
Dissolved oxygen (mg L^{-1})	10.4	8.9	7.3
	(7.1 - 16.0)	(4.6 - 12.5)	(3.0 - 9.4)
pH	7.5	7.7	7.9
	(6.2 - 8.9)	(7.3 - 8.8)	(7.0 - 8.8)
Suspended solids (mg L^{-1})	6	5	11
	(4 - 30)	(3 - 15)	(3 - 26)
5-day Biochemical Oxygen Demand (mg L^{-1})	7	4	4
	(2 - 25)	(1 - 8)	(1 - 13)
Chemical Oxygen Demand (mg L^{-1})	19	120	75
	(7 - 66)	(22 - 240)	(6 - 180)
Oil and Grease (mg L^{-1})	1.0	0.5	0.5
	(0.5 - 3.6)	(0.5 - 0.9)	(0.5 - 1.2)
Faecal coliforms (cfu per 100 mL)	20 394	27 267	150 267
	(1200 - 87 000)	(6700 - 370 000)	(42 000 - 360 000)
E coli (cfu per 100 mL)	11 042	8575	32 030
	(800 - 66 000)	(1400 - 120 000)	(12 000 - 180 000)
Ammoniacal Nitrogen (mg L^{-1})	1.20	0.27	0.35
	(0.16 - 3.70)	(0.10 - 0.47)	(0.11 - 0.90)
Nitrate-nitrogen (mg L^{-1})	1.35	0.06	0.45
	(1.10 - 2.00)	(0.01 - 0.79)	(0.01 - 0.94)
Total Kjeldahl nitrogen, SP (mg L^{-1})	1.90	0.80	0.87
	(0.40 - 5.00)	(0.32 - 1.20)	(0.24 - 1.40)
Ortho-phosphate (mg L^{-1})	0.33	0.02	0.07
	(0.05 - 0.63)	(0.01 - 0.07)	(0.01 - 0.17)
Total phosphorous, SP (mg L^{-1})	0.52	0.09	1.75
	(0.09 - 1.30)	(0.03 - 0.39)	(0.50 - 3.60)
Sulphide, SP (mg L^{-1})	0.02	0.02	0.16
	(0.02 - 0.02)	(0.02 - 0.02)	(0.05 - 0.55)
Aluminium (µg L^{-1})	170	65	175
	(100 - 280)	(50 - 350)	(50 - 400)

Parameter	Sampling Station		
	Tai Wai Nullah	Shing Mun River	Siu Lek Yuen
	TR19	TR19I	TR23A
Cadmium (μg L^{-1})	0.20	0.10	0.10
	(0.10 - 0.40)	(0.10 - 0.10)	(0.10 - 0.10)
Chromium (μg L^{-1})	1.0	2.0	2.0
	(1.0 - 3.0)	(1.0 - 5.0)	(1.0 - 5.0)
Copper (μg L^{-1})	69.5	5.0	1.0
	(25.0 - 150.0)	(1.0 - 8.0)	(1.0 - 5.0)
Lead (μg L^{-1})	1.0	1.0	1.0
	(1.0 - 3.0)	(1.0 - 3.0)	(1.0 - 2.0)
Zinc (μg L^{-1})	50	25	15
	(10 - 70)	(10 - 40)	(10 - 40)
Flow (L s^{-1})	62	NM	NM
	(19 - 1500)		

Notes:

1. Data presented are annual medians of monthly samples; except those for faecal coliforms and *E. coli* which are annual geometric means.
2. Figures in brackets are annual ranges.
3. NM indicates no measurement taken.
4. cfu - colony forming unit
5. SP - soluble and particulate fractions (that is, total value)
6. Equal values for the annual medians and ranges indicate that all data are equal to or below the laboratory reporting limits.

Source: *River Water Quality in Hong Kong in 1997*, EPD, 1998.

5.3.2 From Chevalier Garden Station to Lee On Station

The proposed alignment of the MOS Extension from Chevalier Garden Station to Lee On Station falls within the Tolo Harbour and Channel WCZ. The construction site is a mostly urbanised area beside Ma On Shan. There are no fresh water gathering grounds for fresh water supplies adjacent to the MOS Extension. The major water bodies along the alignment include:

- a number of small streams / nullahs being crossed by the proposed MOS Extension that run from Ma On Shan Country Park and drain towards the inner Tolo Harbour: and
- Tolo Harbour.

There are no EPD river water quality monitoring stations for these streams / nullahs.

There are three EPD marine water quality sampling stations (TM2, TM4 and TM6) at the Tolo Harbour near the proposed MOS Extension (*Figure 5.3b*). The water quality monitoring results for these stations for 1997 are presented in *Table 5.3b*. The water

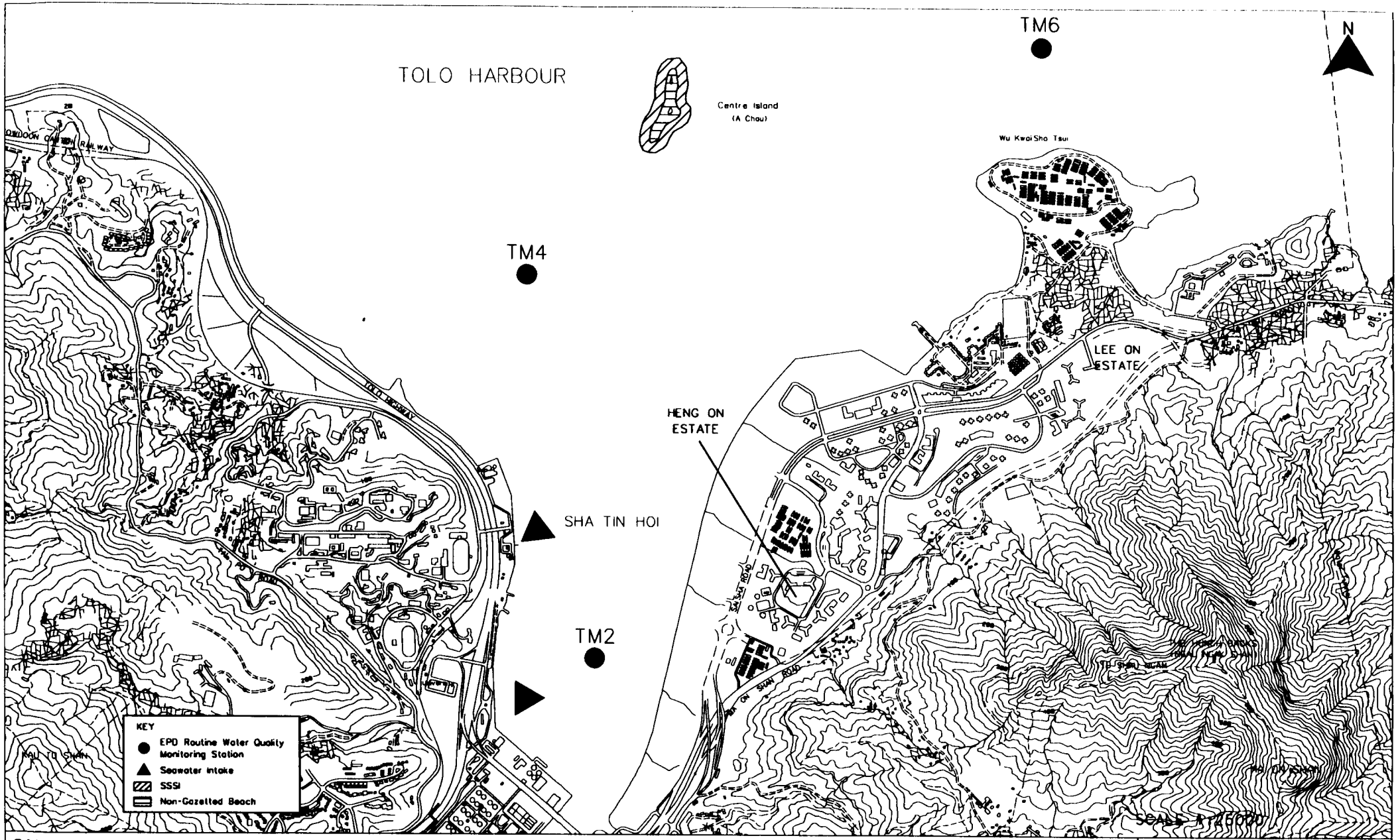

FIGURE 5.3b

LOCATIONS OF THE EPD MARINE WATER QUALITY MONITORING STATIONS AND THE WATER SENSITIVE RECEIVERS AT THE TOLO HARBOUR NEAR THE MOS ALIGNMENT

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quality at TM2 within the Harbour Subzone, being closest to Shing Mun River and the Shatin Sewage Treatment Works, was relatively more turbid, richer in nutrient contents (high in total nitrogen and phosphorus) and higher in chlorophyll-*a* and *E. coli* levels. The water quality at TM4, which is further away from the mouth of Shing Mun River, was better than that at TM2. The water quality at TM6 within the Buffer Subzone was better than TM2 and TM4.

Table 5.3b Summary of Marine Water Quality Monitoring Results for the Tolo Harbour and Channel Water Control Zone in 1997

Parameter	Sampling Station		
	Tolo Harbour Subzone		Tolo Harbour Buffer Subzone
	TM2	TM4	TM6
Temperature (°C)	23.7	23.3	23.1
	(16.0 - 28.8)	(16.1 - 28.0)	(16.4 - 27.5)
Dissolved oxygen (mg L^{-1})	6.5	7.6	7.3
Surface	(3.2 - 10.1)	(4.1 - 10.5)	(3.0 - 9.4)
Bottom	6.4	6.3	5.9
	(3.3 - 11.0)	(3.4 - 9.0)	(2.3 - 9.1)
pH	7.4	8.0	8.2
	(6.2 - 8.6)	(7.3 - 8.7)	(7.9 - 8.7)
Suspended solids (mg L^{-1})	18.0	2.8	2.7
	(1.8 - 135.0)	(1.4 - 4.7)	(1.2 - 5.8)
5-day Biochemical Oxygen Demand (mg L^{-1})	2.1	1.7	1.6
	(0.8 - 4.8)	(0.5 - 4.1)	(0.9 - 4.0)
Ammoniacal nitrogen (mg L^{-1})	0.15	0.11	0.08
	(0.01 - 0.33)	(0.02 - 0.31)	(< 0.01 - 0.26)
Unionised Ammonia (mg L^{-1})	0.004	0.005	0.005
	(0.001 - 0.023)	(0.001 - 0.022)	(0 - 0.018)
Nitrite Nitrogen (mg L^{-1})	< 0.01	0.01	0.01
	(< 0.01 - 0.08)	(< 0.01 - 0.05)	(< 0.01 - 0.08)
Nitrate Nitrogen (mg L^{-1})	0.08	0.04	0.03
	(< 0.01 - 0.21)	(< 0.01 - 0.20)	(< 0.01 - 0.14)
Total Inorganic Nitrogen (mg L^{-1})	0.24	0.17	0.12
	(0.02 - 0.50)	(0.02 - 0.38)	(0.01 - 0.30)
Total Kjeldahl Nitrogen (mg L^{-1})	1.01	0.98	0.93
	(0.57 - 1.55)	(0.47 - 1.60)	(0.41 - 1.50)
Total Nitrogen (mg L^{-1})	1.16	1.04	0.97

Parameter	Sampling Station		
	Tolo Harbour Subzone		Tolo Harbour Buffer Subzone
	TM2	TM4	TM6
	(0.58 - 1.76)	(0.48 - 1.66)	(0.42 - 1.53)
Orthophosphate Phosphorus	0.04	0.03	0.02
(mg L^{-1})	(0.01 - 0.09)	(< 0.01 - 0.08)	(0.01 - 0.05)
Total Phosphorus (mg L^{-1})	0.13	0.09	0.08
	(0.07 - 0.28)	(0.04 - 0.20)	(0.04 - 0.16)
Silica (as SiO_2) (mg L^{-1})	1.5	1.2	1.0
	(0.1 - 2.9)	(0.2 - 2.6)	(0.1 - 2.0)
Chlorophyll-*a* (µg L^{-1})	14.5	10.0	9.1
	(2.9 - 33.5)	(2.3 - 33.2)	(1.1 - 21.3)
Phaeo-pigment (µg L^{-1})	11.8	7.6	6.5
	(1.7 - 37.8)	(0.2 - 25.2)	(0.5 - 29.7)
E coli (cfu per 100 mL)	486	44	8
	(39 - 12 100)	(2 - 997)	(1 - 307)
Faecal coliforms (cfu per 100 mL)	1311	161	39
	(107 - 18 950)	(8 - 2447)	(2 - 846)

Notes:

1. Data presented are annual medians of monthly samples; except those for faecal coliforms and *E. coli* which are annual geometric means.
2. Figures in brackets are annual ranges.
3. cfu - colony forming unit
4. Except as specified, data presented ae depth-averaged data.

Source: *Marine Water Quality in Hong Kong in 1997*. EPD. 1998.

Full compliance with the WQO for dissolved oxygen was achieved at TM4 in 1997. The other two stations achieved 98% to 99% compliance. Overall, the level of DO compliance in 1997 is higher than that of 1996. While the WQO of *E. coli* was achieved at all stations in 1997, none of these stations could achieve the WQO of chlorophyll-*a*.

Between 1988 and 1997, increasing trends in depth-averaged DO were observed at stations TM4 and TM6. Conversely, no significant increase of nitrogen and phosphorus nutrients were detected during this period. A range of pollution reduction measures have been implemented under the Tolo Harbour Action Plan and the water quality deterioration trends observed in late 1970s and later 1980s were subsequently reversed. Greater improvement in water quality is expected when the Tolo Harbour Effluent Export Scheme is in full operation in early 1998.

5.4 Description of Assessment Methodology

The potential impacts may comprise direct and indirect water quality impacts. Thus, the water quality assessment study areas encompass both local and directly affected waters and water sensitive receivers (WSRs) located downstream and remote from the proposed works. Sewerage and drainage impact assessments (SDIA) have been conducted by the engineering design consultant to establish engineering solutions to reduce impacts of the proposed MOS Extension construction and operation on downstream drainage and sewerage systems.

5.4.1 Construction Phase

The design of the proposed MOS Extension was reviewed to assess the proximity of the construction activities to the existing and committed WSRs. All WSRs were identified in accordance with the guidelines provided in the EIAO-TM and Hong Kong Planning Standards and Guidelines (HKPSG), supplemented by site visits.

The construction of the MOS Extension is programmed to commence in early 2000 and finish in 2004. Construction activities at-grade and along the viaduct are expected to be similar to those of the West Rail project. The activities likely to impact upon the identified WSRs and water courses were identified.

Following the identification of WSRs and potential sources of water quality impacts, the scale, extent and severity of potential net (that is, unmitigated) construction impacts were evaluated, taking into account all potential cumulative effects including those of adjacent projects, with reference to the WPCO criteria.

Where net water quality impacts were predicted to exceed the appropriate WPCO criteria, practical water pollution control measures / mitigation proposals were recommended to ensure compliance with reference to the WPCO criteria for the beneficial uses of the water bodies.

5.4.2 Operational Phase

It is currently expected that water quality impacts during the operation of the proposed MOS Extension will be mainly from domestic sewage discharge from the stations and industrial sewage discharge from the Tai Wai Depot. The impact assessment considered the findings and recommendations of the SDIA reported in the Final Technical Report[1] in terms of the adequacy of the existing sewage and drainage systems.

The current proposals of all operational infrastructure and activities were reviewed to identify activities likely to impact upon identified water bodies, including water courses, ponds and wetlands.

[1] *Kowloon Canton Railway Corporation* - Ma On Shan to Tai Wai Expansion. Final Technical Report. August 1998. Maunsell Consultants Asia Ltd.

Following the review of the operation of the proposed development, the potential adverse effects, scale, extent and severity of potential net (that is, unmitigated) impacts were assessed and evaluated, taking into account all potential cumulative effects, with reference to the WPCO criteria.

5.5 Water Sensitive Receivers

In order to evaluate the water quality impacts resulting from the construction and operation of the MOS Extension, the proximity of Water Sensitive Receivers (WSRs) must be considered. WSRs have been identified in accordance with the HKPSG as well as the EIAO-TM, which provide criteria for identifying environmental factors influencing development planning.

The receiving water body during the construction and operation of the works will be the Tolo Harbour. The Shing Mun River is also considered as a WSR, as construction of the MOS Extension, particularly the section across the Shing Mun River near Tai Wai, could potentially affect this waterway.

The alignment will pass across the curve of the Shing Mun River near Tai Wai (for a length of approximately 180 m), and over a 20 m wide section of the Siu Lek Yuen Nullah and a 30 m wide section of the Tai Shui Hang Nullah. Columns will be located within the Shing Mun River and the nullahs to support the bridge crossings. Dredging may therefore be required to remove the bottom sediment and this may impact the river water quality both within, and downstream of the Shing Mun River and the nullahs.

Tolo Harbour is a partially enclosed water body, with a relatively low rate of water exchange and prone to eutrophication. It is used for a range of commercial and recreational activities including fisheries and designated mariculture zones. There are a number of sites of special scientific interest (SSSIs) and an area of mangroves in the Tolo Harbour. There are also non-gazetted beaches along the coasts of Ma On Shan and Tai Po. The nearest non-gazetted beach, at Centre Island, is about 1.5 km away from the MOS Extension, whilst the mangrove areas at Three Fathoms Cove and Plover Cove are more than 2.5 km and 4 km away from the MOS Extension respectively. The nearest mariculture zone at Three Fathoms Cove is also more than 2.5 km away. As the potential water quality impact is expected to be locally confined within the Shing Mun River and along the coast of Ma On Shan / Wu Kai Sha, direct impact upon these sensitive receivers are not anticipated.

The Water Services Department (WSD) Sha Tin seawater intake located offshore from the Sha Tin Sewage Treatment Works and the seawater intake of Hong Kong Chinese University Marine Science Laboratory near Sha Tin Hoi are also considered as WSRs which may be potentially affected by the construction and operation of the MOS Extension.

5.6 Construction Impact Assessment

5.6.1 Potential Sources of Impact

The extent of water quality impacts associated with the works will depend upon the construction method chosen, the type of land use that the alignment passes through, and distance from the sensitive receivers. It is considered that the more remote the construction site is from the receiving water bodies, in this case the Tolo Harbour and the Shing Mun River, the lower the likelihood of the construction having a direct impact on the receiving water quality.

With the exception of the sections through the Shing Mun River and across the Siu Lek Yuen and Tai Shui Hang Nullahs, the construction of MOS Extension will involve land-based construction activities comprising site formation and preparation, construction of the standard and special long span viaduct sections, track-laying, and the construction of nine stations, and a depot at Tai Wai. The MOS Extension is characterised by long lengths of structure with limited access from ground level and works areas largely confined to a narrow strip along the length of the alignment. Potential sources of water quality impacts arising from the construction of the MOS Extension will be similar to those of other predominantly land-based construction activities and will include:

- construction run-off including dewatering operations;
- drainage;
- runoff from station construction works;
- excavated and demolition materials;
- dredging of riverine deposits
- marine disposal of dredged riverine deposits;
- sewage effluent from the construction work force; and
- general construction activities.

5.6.2 Evaluation of Impacts

Construction Runoff

Runoff from construction sites may contain increased sediment loads, SS and various contaminants. Potential sources of water pollution from the MOS Extension site runoff include:

- runoff and erosion from site surfaces, drainage channels and earth working areas;
- bentonite slurries and other grouting materials (used for the construction of diaphragm walls);
- wash water from dust suppression sprays and wheel washing facilities; and

- fuel, oil and lubricants from construction vehicles and equipment.

Construction runoff may cause physical, chemical and biological effects. Physical effects could result from the increase in SS from the site leading to siltation, blocked channels, and associated flooding when heavy rainfall occurs. The increased SS in the water column combining with a number of other factors could reduce DO concentrations in the water column, as follows:

- high SS (and turbidity) reduces sunlight penetration, lowers the rate of photosynthesis of phytoplankton (primary productivity) and thus lowers the rate of oxygen production in the water column; and
- high SS causes increased energy retention from sunlight, resulting in higher temperatures, and lowering the solubility of oxygen in water. Under extreme conditions this could lead to hypoxia.

Chemical and biological effects could also arise, depending upon the chemical and nutrient levels in construction runoff. Primary chemical effects may result from liquors containing significant quantities of concrete and cement derived materials. These may include localised increases in turbidity and discolouration, localised elevations in pH, and accretion of pH solids. A number of secondary effects may also result in toxic effects to marine biota due to elevated pH values, reduced decay rates of faecal micro-organisms due to decreased light penetration, and localised increase in the proportion of un-ionised ammonia.

Drainage

Drainage along the alignment of the MOS Extension comprises stormwater pipes, local road drainage and foul sewers. Since there are numerous existing stormwater drains, highway drains and sewers located along the alignment including 13 main channels and culverts and some small natural channels in the Sai Sha Road area, the potential impact upon local drainage systems is a key concern. Material accumulation within drains and nullahs would make adjacent flood-prone areas highly susceptible to flooding.

The Final Technical Report[1] considered that the impacts upon the existing drainage system would be minor, as the rail link would be mainly above ground and routed through developed areas. The impacts are mainly from the locations of the columns and foundations that conflict with the existing drainage system and from the Tai Wai Depot and Sha Tin Tau Station development that require the diversion of existing culverts crossing the sites. In addition the rail bridge crossings of the Siu Lek Yuen and Tai Shui Hang Nullahs will require columns to be located within the channels. These columns will be positioned in line with the existing and future bridge crossings to minimise the impact upon the existing design flow paths. These columns reduce the flow area that will result

[1] *Kowloon Canton Railway Corporation* - Ma On Shan to Tai Wai Expansion. Final Technical Report. August 1998. Maunsell Consultants Asia Ltd.

in small additional head losses which in turn will only have a local impact on the flow. The impact is therefore considered to be acceptable.

The construction of the proposed rail alignment is in conflict with some existing sewers and drains. Diversion and reconstruction of these drains and sewers are required. The potential water quality impact during the reprovision and re-alignment of drainage pipes and culverts will be limited to runoff and erosion from site surfaces and earth working areas. A small amount of waste water may also be released during pipe disconnectings.

For any Government watermains and waterworks installations affected by the proposed mitigation measures defined in this EIA, the diversion of the watermains and waterworks installations shall only be considered when all other mitigation options have been considered. If diversion is required, the Engineer / Contractor will identify areas of conflict and provide design and alternative / feasible routing of the diverted watermain for the consideration and agreement of the Water Services Department.

Excavated and Demolition Materials

Potential water quality impact may arise from surface runoff from any temporary on-site storage of excavated material. However, water quality impacts associated with the land disposal of material from excavation and demolition during site formation will be minimal. The excavated material will mainly comprise rock, soil and rubble and no insurmountable water quality impacts are expected to arise from this material. Solid waste management is discussed in *Section 6*.

Dredging of Riverine Sediment

Depending upon the construction methodology used, construction of the bridge crossings through the Shing Mun River Channel, and across the Siu Lek Yuen and Tai Shui Hang Nullahs may involve dredging of riverine deposits that may be contaminated by heavy metals and organic pollutants. Water quality impact resulting from dredging is directly related to the resuspension of riverine sediment which results in an increase in suspended solid (SS) levels within the water column. Increased amounts of SS in the water column will increase the turbidity of water thus leading to a reduction in light penetration and an increase in heat retention.

High oxygen demands associated with the suspension of sediment may be exacerbated by elevated temperatures and the increased oxygen demand exerted by algae at night in response to elevated nutrient levels. In addition, reduced light penetration may lead to diminished photosynthesis in the lower water column, thus reducing the rate of oxygen production. As dredging will only be undertaken at a few locations within the rivers, it is predicted that sediment plume dispersion will be largely confined to within the dredging areas, and to river sections downstream of the dredging areas. Mitigation measures should be implemented to control plume dispersion thereby minimising the extent of any potential impact upon river water quality downstream of the dredging areas.

Marine Disposal of Riverine Sediment

The major impact of the marine disposal of dredged riverine materials will be the elevation of SS in the marine water near disposal grounds. The extent of impact will depend on the rate of excavation and material disposal. Deposits excavated from the Shing Mun River and the nullahs during construction should be classified according to the EPD's Technical Circular No. 1-1-92, and specific handling, disposal methods and designated location of marine disposal should be identified as required in WBTC No. 6/92 and No. 22/92.

For the marine disposal of mud, a sediment quality report (SQR) shall be prepared as part of the application for a dumping permit under the Dumping at Sea Ordinance. The SQR for marine mud disposal should be prepared and submitted to EPD for approval after a comprehensive site investigation.

Sewage Effluent

Sewage effluents will arise from sanitary facilities provided for the on-site construction work force along the MOS Extension. Sewage is characterised by high levels of biochemical oxygen demand (BOD), ammonia and *E. coli.* These effluents may cause water pollution. It is estimated that about 1600 construction workers will be working on site simultaneously during construction. Owing to the lack of established guidelines of sewage generation from construction sites, the recommended design rate for offices, specified in the *Guidelines for the Design of Small Sewage Treatment Plants, EPD Solid Waste Control Group, March 1990* has been used for this assessment. About 736 m^3 of sewage will be generated by the workers working along the alignment. Significant water quality impact will happen only if the sewage is discharged directly to the receiving water body without any treatment.

Construction work force sewage is expected to be connected to the existing trunk sewer or sewage treatment facilities. However, there are no public sanitary facilities on some parts of the MOS Extension and construction workers are likely to be dispersed along the alignment. Therefore, the installation of portable chemical toilets, septic tanks and the proper disposal of sewage from the construction work force may be necessary to ensure that TM standards are met.

General Construction Activities

Construction activities have the potential to cause water pollution from debris and rubbish such as food packaging and used construction materials, entering the water column and resulting in floating refuse in the vicinity of the site that reduces the aesthetic quality of the water body. Spillages of liquids stored on site, such as oil, diesel and solvents, could also result in water quality impacts if they enter surrounding water bodies and soils. However, the effects on water quality from construction activities are likely to be minimal, provided that site boundaries are well maintained and good construction practices are implemented to ensure that litter, fuels and solvents are managed, stored and handled properly.

5.6.3 Mitigation Measures

Construction phase mitigation measures, in accordance with the Practice Note for Professional Persons on Construction Site Drainage, EPD, 1994 (ProPECC PN 1/94) include the use of sediment traps, wheel washing facilities for vehicles leaving the site, adequate maintenance of drainage systems to prevent flooding and overflow, sewage collection and treatment, and comprehensive waste management (collection, handling, transportation, disposal) procedures.

Construction Runoff and Drainage (Erosion Control Plan)

At the start of site establishment, perimeter cut-off drains to direct off-site water around the site should be constructed and internal drainage works and erosion and sedimentation control facilities implemented. Channels, earth bunds or sand bag barriers should be provided on site to direct stormwater to silt removal facilities. The design of efficient silt removal facilities should be based on the guidelines in Appendix A1 of ProPECC PN 1/94. All the surface runoff or extracted ground water contaminated by silt and suspended solids should be collected by the on-site drainage system and diverted through the silt traps prior to discharge into foul sewer.

Ideally, construction works should be programmed to minimise surface excavation works during the rainy season (April to September). All exposed earth areas should be completed as soon as possible after earthworks have been completed, or alternatively, within 14 days of the cessation of earthworks where practicable. If excavation of soil cannot be avoided during the rainy season, or at any time of year when rainstorms are likely, exposed slope surfaces should be covered by tarpaulin or other means.

The overall slope of the site should be kept to a minimum to reduce the erosive potential of surface water flows, and all trafficked areas and access roads protected by coarse stone ballast. An additional advantage accruing from the use of crushed stone is the positive traction gained during prolonged periods of inclement weather and the reduction of surface sheet flows.

Sediment tanks of sufficient capacity, constructed from pre-formed individual cells of approximately 6 to 8 m^3 capacity, are recommended as a general mitigation measure which can be used for settling waste water prior to disposal. The system capacity is flexible and able to handle multiple inputs from a variety of sources and particularly suited to applications where the influent is pumped.

All drainage facilities and erosion and sediment control structures should be regularly inspected and maintained to ensure proper and efficient operation at all times and particularly following rainstorms. Deposited silt and grit should be removed regularly and disposed of by spreading evenly over stable, vegetated areas.

Measures should be taken to minimise the ingress of site drainage into excavations. If the excavation of trenches in wet periods is necessary, they should be dug and backfilled in

short sections wherever practicable. Water pumped out from trenches or foundation excavations should be discharged into storm drains via silt removal facilities.

Open stockpiles of construction materials (for example, aggregates, sand and fill material) of more than 50 m^3 should be covered with tarpaulin or similar fabric during rainstorms. Measures should be taken to prevent the washing away of construction materials, soil, silt or debris into any drainage system.

Manholes (including newly constructed ones) should always be adequately covered and temporarily sealed so as to prevent silt, construction materials or debris being washed into the drainage system and storm runoff being directed into foul sewers.

Precautions to be taken at any time of year when rainstorms are likely, actions to be taken when a rainstorm is imminent or forecasted, and actions to be taken during or after rainstorms are summarised in Appendix A2 of ProPECC PN 1/94. Particular attention should be paid to the control of silty surface runoff during storms events, especially for areas located near steep slopes.

All vehicles and plant should be cleaned before leaving a construction site to ensure no earth, mud, debris and the like is deposited by them on roads. An adequately designed and sited wheel washing bay should be provided at every site exit and wash-water should have sand and silt settled out and removed at least on a weekly basis to ensure the continued efficiency of the process. The section of access road leading to, and exiting from, the wheel-wash bay to the public road should be paved with sufficient backfall toward the wheel-wash bay to prevent vehicle tracking soil and silty water to public roads and drains.

Oil interceptors should be provided in the drainage system and regularly emptied to prevent the release of oil and grease into the storm water drainage system after accidental spillages. The interceptor should have a bypass to prevent flushing during periods of heavy rain.

All temporary and permanent drainage pipes and culverts provided to facilitate runoff discharge should be adequately designed for the controlled release of storm flows. All sediment traps should be regularly cleaned and maintained. The temporary diverted drainage should be reinstated to the original condition when the construction work has finished or the temporary diversion is no longer required.

Drainage

Although it is considered that MOS Extension works will not have a significant impact on drainage, all of the contractors employed will be required to ensure that the existing drainage arrangements will not be adversely affected during construction and that any flow from the construction site must pass through settling traps/ponds before discharge into public drains.

Sewage Effluent

Since there are predicted to be about 1600 construction workers working along the railway alignment simultaneously, appropriate disposal facilities in the form of chemical toilets and septic tanks will be required. Appropriate numbers of portable toilets should be provided by a licensed contractor to serve the construction workers. The contractor should also be responsible for maintenance practices and sewage disposal at an appropriate sewage treatment works.

General Construction Activities

Debris and rubbish on site should be collected, handled and disposed of properly to avoid entering the water column and causing water quality impacts. The waste management requirement on site to prevent such impact is detailed in *Section 6*.

Temporary on-site storage of excavated materials from station and depot construction works should be covered with tarpaulin or similar fabric during rainstorms. Any washout of construction or excavated materials should be diverted to the drainage system via appropriate sediment traps. Stockpiling of the excavated material can be minimised by scheduling the construction programme in a way that one section of the alignment can be constructed and completed before the excavation works of the next section commence.

Dredging and Marine Disposal of Dredged Sediment

The following mitigation measures should be implemented to minimise the potential water quality impact during dredging:

- contaminated sediments shall be dredged using grabs of no more than 8 m^3;
- disturbance to the sediments shall be minimised by ensuring care when manoeuvring the grab;
- all vessels used shall be sized to allow adequate clearance of the seabed;
- barges shall be fitted with tight fitting seals to their bottom openings to prevent leakage of material;
- barge loading shall be accurate to avoid splashing dredged material into the surrounding water;
- specialised water tight grabs shall be used to control sediment loss and hoist speeds shall be suitably low during operation;
- overflow of materials or polluted water shall be prevented during loading or transportation. Adequate freeboard shall be maintained to ensure that the decks are not washed by wave action;
- large objects and debris shall be manually removed prior to mechanical dredging to minimise losses from partially closed grabs;

- construction works shall cause no visible foam, oil, grease, scum, litter or other objectionable matter to be present in the water within the site or dumping grounds;
- appropriate water quality monitoring shall be implemented during dredging works;
- transport of contaminated mud to marine disposal sites should, wherever possible, be by split barges of not less than 750 m^3 capacity, well maintained and capable of rapid opening and discharge at the disposal site;
- monitoring of the barge loading shall be carried out to ensure that loss of material does not take place during transportation;
- stockpiling of any moderately or seriously contaminated (Class B and Class C) marine sediment at the site shall be prohibited, and there shall be careful control in relation to the stockpiling of any uncontaminated (Class A) sediment to prevent runoff, resuspension and odour nuisances; and
- on-site auditing of the equipment and plant is essential to ensure that it is used in the appropriate manner.

5.6.4 Residual Impact

The construction activities associated with the proposed MOS Extension could lead to site runoff containing elevated concentration of SS and associated contaminants that may enter into the drains, and impact the downstream water quality and aquatic ecology along the coast of Tolo Harbour and Channel. However, with proper implementation of the mitigation measures, all construction site discharges should comply with the TM standards of the WPCO and no residual water quality impact will result from the construction phase of the proposed development. These mitigation measures include:

- implementation of an on-site drainage system, silty runoff collection facilities, and local flood prevention measures during heavy rainfall;
- diversion of drainage pipes or channels is constructed to allow flow to the discharge point without overflow or washout;
- reinstatement of all temporary drainage diversions to their original condition after the construction works are completed (any practical options for the diversion and re-alignment of drainage should comply with both engineering and environmental requirements); and
- adequate temporary sewage collection, disposal facilities, and temporary treatment facilities to handle sewage from the construction site.

The mitigation measures proposed for dredging along the rivers / nullahs (*Section 5.6.3*) should confine water quality impact within the local areas and should not create unacceptable water quality impact further downstream. In order to help ensure compliance with the WPCO, appropriate water quality monitoring, as defined in Section *12.6.3*, shall be implemented during the dredging works.

Overall, no residual water quality impact will result from the construction phase of the proposed development.

5.7 Operational Impact Assessment

5.7.1 Potential Sources of Impact

This section reviews potential impacts against the relevant environmental legislation with regard to identified sensitive receivers in accordance with the HKPSG. Legislation and WSRs have been defined and detailed in *Sections 5.2* and *5.5* respectively.

Potential sources of water quality impact during the operation of the MOS Extension and the Depot include:

- cooling water discharge;
- runoff from rail tracks;
- station runoff;
- sewage effluent from Workforce;
- sewage from Tai Wai Depot; and
- operational drainage.

5.7.2 Evaluation of Impacts

Cooling Water Discharge

It is currently understood that Environmental Control Systems proposed for the nine MOS Extension stations will comprise either natural ventilation if the platforms and concourses have an open environment (eg SKS, CIO, SHG, HEO and MOS), or mechanical ventilation if the station design is covered or enclosed (eg TAW, STT, SHM and LEO). Similarly, the current proposals for the depot comprise the use of air cooled chillers to provide air conditioning. As a consequence it is not anticipated that there will be any cooling water discharges, apart from possibly the minimal amount of cooling water generated by the infrequent normal maintenance practices. Such discharges are likely to be minimal in quantity and therefore unlikely to cause any water quality impacts.

However, if water cooled air conditioning systems are adopted, water quality impact may arise from the discharge of the cooling water. According to the TM, cooling water discharges of less than 6000 m^3 per day must be not higher than 45 °C. If water cooled systems are used, then appropriate treatment facilities such as oil interceptors and silt traps may be required to control the discharge of any oil / grease and SS that may be released from the facilities into the cooling water in order to comply with the TM standards.

Runoff from Rail Tracks

Discharge from rail tracks is expected to contain limited amounts of oil and grease. Where oils and lubricating fluids could be spilt, runoff should be diverted to silt traps and oil / grease interceptors before discharge to the existing public storm water drain system.

Sewage Effluent from Work Force

The operation of Depot and stations will generate sewage effluents from toilet / sanitary facilities. The sewage effluent is usually associated with elevations of biochemical oxygen demand and suspended solids. Owing to the lack of established guidelines of sewage generation rate for construction sites, the recommended design rate for offices, specified in the Guidelines for the Design of Small Sewage Treatment Plants, EPD Solids Waste Control Group, March 1990 has been used for this assessment. A volume of approximately 9.4 m3 per day will be generated by 170 staff working at the Depot. It is also estimated that a maximum 22.23 L s-1 of sewage will be discharged from the stations(3). However, it is considered that significant water quality impact will happen only if the sewage is discharged directly into the receiving water body without any treatment.

Sewage from Tai Wai Depot

Liquid waste will be generated by the detergent wash plant used for the daily external washing of trains. Heavy cleaning using heavy duty floor scrubbers with water extraction will be undertaken on trains every two weeks. Further detergent water will be generated every day by hand cleaning of cab fronts and windscreens. Sewage effluents will also be generated by the on site work force. These effluents could result in physical, chemical and biological impacts within any receiving water bodies if appropriate waste water collection and treatment are not provided.

It is anticipated that facilities at the Tai Wai Depot will be provided for train interior heavy cleaning at 30 day intervals and for removal of stubborn stains on the car exterior. A water and detergent wash plant will be connected to the Depot reception tracks so that trains can be washed immediately upon return from service and then go straight into stabling or maintenance tracks. The plant will be able to operate in either direction if needed, to allow flexibility of train movements within the Depot.

Depending on the surface finish of the car body of the MOS Extension cars, an acid wash plant may be required for carrying out periodic cleaning of the car body exterior. The plant would be incorporated into the detergent wash plant, as acid washing will only be required infrequently (about one every 30 - 60 day cycle).

The routine operational activities of the Depot may release oil and grease residues. These oily and greasy residues can be dripped, washed or spilled onto the ground surface within a working area. In areas such as the maintenance facilities where runoff could be contaminated by oil and grease, oil interceptors are recommended for separating oil from

water prior to discharge. Dedicated areas will be provided for the temporary storage of all wastes produced by activities in the Depot.

It is estimated that a maximum 4.22 L s^{-1} of sewage will be generated from the maintenance activities and workers at the Tai Wai Depot[1]. Wastewater generated by train washing, heavy cleaning and maintenance facilities should be treated on-site prior to discharge. On-site wastewater treatment facilities should be provided to treat wastewater discharges collected from these facilities and any leachate from the solid water storage and handling area. Recycled wastewater should have on-site treatment to remove grit and oil. Waste water from the car wash plant, heavy cleaning tracks, workshops and similar facilities will be collected and treated according to TM standards before it is discharged to the Depot drainage system.

The waste water generated by the Depot should be collected and transferred to a dedicated on-site treatment plant which will adjust the pH of the effluent in order to meet the criteria specified in the TM, prior to discharge to the sewer. The daily volume of treated effluent and detergent water will be approximately 120 000 L. If acid cleaning is needed, which is relatively infrequent, there will be an additional daily volume of some 3000 L. The minor amount of detergent water generated from heavy cleaning and hand cleaning works will only be about 20 L and 100 L each day, respectively.

Operational Drainage

As reported in the Final Technical Report[2], the impacts of the MOS Extension upon the existing drainage system would be minor, as the rail link would be mainly above ground and routed through developed areas. The main impacts are mainly from the locations of the columns and foundations that conflict with the existing drainage system and from the Tai Wai Depot and Sha Tin Tau Station development that require the diversion of existing culverts crossing the sites. In addition, the rail bridge crossings of the Siu Lek Yuen and Tai Shui Hang Nullahs will require columns to be located within the channel. These columns will be positioned in line with the existing and future bridge crossings to minimise the impact upon the channel flow.

Based on the findings of the *Draft Drainage Impact Assessment, Tai Wai to Ma On Shan, Report MD2, Highways Department, 1996* (Report MD2), there were flooding records at the southeast side of the junction between Sha Tin Wai Road and Sha Kok Street. However, the MOS Extension will be elevated as it crosses Sha Tin Wai Road, and thus no flooding hazard is expected.

The proposed MOS Extension at Sai Sha Road will be on viaduct along the central reserve of this road such that the small natural channels in this area are unlikely to be

[1] *Kowloon Canton Railway Corporation* - Ma On Shan to Tai Wai Expansion, Final Technical Report, August 1998, Maunsell Consultants Asia Ltd.

[2] *Kowloon Canton Railway Corporation* - Ma On Shan to Tai Wai Expansion, Final Technical Report, August 1998, Maunsell Consultants Asia Ltd.

impacted if the storm water best management practices to control runoff from the works are implemented effectively during the construction.

5.7.3 Mitigation Measures

Cooling Water Discharge

It is currently envisaged that the Environmental Control Systems at the stations will comprise either natural and/or mechanical ventilation, and that air cooled chillers will be used at the depot. Consequently, it is unlikely that there will be any significant cooling water discharges.

If water-cooled air conditioning system are adopted, they would most probably result in the discharge of cooling water into the Tolo Harbour, potentially introducing local thermal impact to the marine water. It is therefore recommended that the current proposals for natural and/or mechanical ventilation and air cooled chillers are adopted rather than using a water cooled system which has the potential to cause water quality impact.

Runoff from Rail Tracks

The following measures should be adopted, where appropriate, for the operation of the MOS Extension:

(i) A surface water drainage system should be provided to collect track runoff. Where oils and lubricating fluids could be spilt, the track drainage channels discharge should pass through oil interceptors and sediment traps to remove oil, grease and sediment before being diverted to the public storm water system;

(ii) Silt traps, sediment basins and oil interceptors should be regularly cleaned and maintained in a good working order. The efficiency of these installations is dependent on regular cleaning and maintenance. Their designs should take into account the guidelines published in *Drainage Plans subject to Comment by the EPD, Professional Persons Environmental Consultative Committee, Practice Note for Professional Persons* (ProPECC PN 5/93);

(iii) On-site drainage must focus on the areas where contaminated effluent may be generated and provide a clear segregation of clean and contaminated effluents; and

(iv) Oily contents of oil interceptors should be collected for recycling, or transferred to an appropriate disposal facility.

Sewage Effluent from Work Force

Water quality impacts caused by sewage effluent generated by the work force at the Depot and stations should be effectively controlled through connection to the sewerage system or on-site waste water treatment facilities prior to discharge. Unacceptable water quality impact is therefore not anticipated.

Sewage from Tai Wai Depot

Hard standing surfaces should be provided for areas which may potentially give rise to contamination of storm water by oil and grease. Runoff and spillage prevention measures should conform with relevant engineering and design standards.

The acid washing facilities should be designed to achieve effective neutralisation of acids to TM requirements prior to discharge (for example, via neutralisation tanks). Prudent management practices should be adopted to minimise the amount of acid used.

Acidic waste water generated from acid cleaning activities at the Depot should be neutralised to within pH 6 - 10 before discharging to foul sewer. The efficacy of the Depot treatment facilities should be investigated in the detailed assessment phase to ensure the adequacy of the treatment facility with regard to all relevant parameters including surfactants (detergents), suspended solids, pH, oil and grease and ensure that all treated effluent will meet the TM criteria before discharge to sewer.

Any opportunities for the recycling of water within the automatic washing facilities should be sought to minimise discharge requirements. Bio-degradable detergents should be selected to minimise the impact on water quality and associated ecosystems of the receiving water bodies.

All plant maintenance areas should be bunded and constructed on a hard standing, and provided with sediment traps and petrol interceptors. Traps and interceptors should be regularly cleaned and maintained, especially after any accidental spillages. Each petrol interceptor should have a bypass to prevent flushing during periods of heavy rains. Layers of sawdust, sand or equivalent material should be laid underneath and around any plant and equipment that may possibly leak oil.

An emergency spillage action plan should be developed for the Depot to ensure that any accidental spillage event is treated immediately and does not impact on any water bodies.

All fuel tanks and storage areas within the Depot should be provided with locks and be located on sealed areas, within bunds of a capacity equal to 110% of the storage capacity of the largest tank, to prevent the escape of spilled fuel oils.

The disposal of waste oil and other chemicals is controlled by the Waste Disposal (Chemical Waste) (General) Regulation (Cap 354). Waste oil and other chemicals must be disposed of at the Government Chemical Waste Treatment Facility at Tsing Yi.

Appropriate drainage and effluent collection and treatment systems should be specified to meet the discharge limits as stipulated in the TM at the detailed design stage.

Operational Drainage

The Final Technical Report[1] has reported the required drainage mitigation measures in detail. These include:

- locating the columns of bridge crossings of the Siu Lek Yuen and Tai Shui Hang Nullahs in line with the existing columns of the bridge crossings at Ma On Shan Road for the Tai Shui Hang Nullah and Road D9 Extension for the Siu Lek Yuan nullah; and
- storm water drainage, sewer and U-channel diversions to allow for the proposed columns supporting the elevated track, at grade section of track, depot and station development.

Along the elevated sections of track, the foundations and columns will be strategically located to avoid disturbance to the existing main drainage pipes, culverts and nullahs. A minimum 3 m reserve area to either side of the drains should be provided to comply with the Drainage Services Department's drainage reserve requirement. If disturbance is unavoidable, any diversion or relocation of local drainage or existing sewer, such as the sewer passing through the Tai Wai Station and Depot site, should comply with both engineering and environmental requirements.

5.7.4 Residual Impact

MOS Extension

With the adoption and incorporation of the recommended mitigation measures and appropriate drainage and effluent collection systems specified in the SDIA of the Final Technical Report, no residual operational impacts are expected.

Tai Wai Depot

The design of the Tai Wai Depot should locate major activities using oils and similar materials within areas where exposure to rain is unlikely. Oil / grease interceptors should be provided within the drainage system. Assuming the adoption of these measures and the other mitigation measures described above, all Tai Wai Depot discharges should comply with the TM, and no residual impacts are predicted.

5.8 Environmental Monitoring and Audit

In order to monitor the efficacy of the proposed mitigation measures, it is recommended that water quality impact monitoring is undertaken during the course of the riverine works. The outline water quality impact monitoring are defined *in Section 12.6.*

[1] *Kowloon Canton Railway Corporation* - Ma On Shan to Tai Wai Expansion. Final Technical Report. August 1998. Maunsell Consultants Asia Ltd.

In addition to the physical monitoring, it is also recommended that regular site inspections and audits are undertaken to ensure that the recommended mitigation measures are strictly implemented.

5.9 Conclusions

5.9.1 Construction Phase

No insurmountable residual (that is, after adoption of the proposed mitigation measures) construction stage water quality impacts are predicted from the construction of the MOS Extension Project. With the proper implementation of the mitigation measures, all construction site discharges should comply with the TM standards of the WPCO and no residual water quality impact will result from the construction phase of the proposed development.

Although the riverine dredging works associated with the construction of the MOS Extension could lead to water quality impacts, detailed mitigation measures have been suggested, and appropriate water quality monitoring will be undertaken in order to ensure compliance with the WPCO criteria.

Marine disposal of any dredged riverine deposits from the Shing Mun River, Siu Lek Yuen Nullah and Tai Shui Hang Nullah should follow the procedures of Works Branch Technical Circular No. 22/92 for dumping permit application.

The drainage impact associated with the construction of the MOS Extension is considered to be minimal, provided the recommended mitigation measures are properly implemented.

Overall, no residual water quality impact will result from the construction phase of the proposed development.

5.9.2 Operational Phase

It is considered that, with the adoption of the proposed mitigation measures, no insurmountable water quality impacts will result from the operational phase of the MOS Extension Project.

Appropriate drainage collection facilities should be incorporated into the detailed design of the MOS Extension and the Tai Wai Depot as the storm water runoff may contain contaminants such as oil and grease, which could impact upon water quality in receiving water bodies. Mitigation in terms of sewage treatment at Tai Wai Depot, to achieve WPCO TM discharge standards, will prevent associated residual water quality impacts.

The drainage impact associated with the operation of the MOS Extension is considered to be minimal, provided the mitigation measures recommended in the Final Technical Report[1] are properly implemented.

[1] *Kowloon Canton Railway Corporation* - Ma On Shan to Tai Wai Expansion, Final Technical Report, August 1998. Maunsell Consultants Asia Ltd.