# 10 Water Quality Impact

## 10.1 Introduction

This chapter presents the assessment of potential water quality impacts, which may arise during the construction and operation of the SCL - Tai Wai to Hung Hom Section. Construction runoff, sediment dredging, sewage from site workforce, drainage diversion are potential water pollution sources during the construction phase. Operational water quality impact includes track run-off and tunnel seepage.

Mitigation measures have been proposed to alleviate the potential water quality impact. Adverse residual impacts during the construction and operational phases are not anticipated.

## 10.2 Legislation, Standards and Guidelines

The relevant legislation and associated guidance applicable to the present study for the assessment of water quality impacts include:

- Water Pollution Control Ordinance (WPCO) CAP 358, Water Quality Objectives (WQOs) for the Tolo Harbour and Channel Water Control Zone (THCWCZ) and Victoria Harbour Water Control Zone (VHWCZ);
- Technical Memorandum for Effluents Discharged into Drainage and Sewerage Systems Inland and Coastal Waters (TM-Water), Effluents discharge limits for the Tolo Harbour Water Control Zone and Victoria Harbour Water Control Zone;
- Environmental Impact Assessment Ordinance (EIAO) (Cap. 499), Technical Memorandum on Environmental Impact Assessment Process (TM-EIAO);
- ProPECC PN 5/93 "Drainage Plan subject to Comment by the Environmental Protection Department";
- ProPECC PN 1/94 "Construction Site Drainage";
- Guidance Notes of Contaminated Land Assessment and Remediation;
- "Recommended Pollution Control Clauses for Construction Contracts" issued by EPD;
- "Water Quality Standards for Seawater Flushing Points" issued by the Water Supply Department; and
- Recommended Sedimentation Rate for Coral Sites, Pastorok & Bilyard (1985) [10-2]

## 10.3 Baseline Conditions

### 10.3.1 Marine Water Quality Monitoring Stations Near to Project Site

The representative marine water quality monitoring stations in the vicinity of the project site are TM2 and TM4 at Tolo Harbour; VM2, VM4, VM5 and VM6 at the Victoria Harbour and EM2 at Eastern Buffer respectively. Locations of monitoring stations are shown in **Figure 10.1**. Water quality parameters monitored at these stations are given in EPD's Marine Water Quality Year 2009, and the key parameters are summarised in **Tables 10.1a** to **10.1c**.

**Table 10.1a**: Marine Water Quality of Tolo Harbour in Year 2009

| Parameter | WQO | Monitoring Station | |
|---|---|---|---|
| | | Tolo Harbour | |
| | | TM2 | TM4 |
| Temperature (°C) | Change due to waste discharge not to exceed 1°C.<br>The rate of temperature change | 24.5<br>(16.6 – 30.7) | 24.2<br>(16.2 – 30.5) |

| Parameter | WQO | Monitoring Station | |
|---|---|---|---|
| | | Tolo Harbour | |
| | | TM2 | TM4 |
| | shall not exceed 0.5°C per hour at any location, unless due to natural phenomena. | | |
| Salinity (ppt) | Change due to waste discharge not to be greater than ±3 ppt | 30.9<br>(28.3 – 32.6) | 31.4<br>(29.0 – 32.6) |
| Dissolved Oxygen (mg/L) | Surface to 2m above bottom:<br>Not less than 4 mg/L | 6.1<br>(4.6 – 9.0) | 6.2<br>(4.4 – 8.0) |
| Dissolved Oxygen, Bottom (mg/L) | Bottom<br>Not less than 2 mg/L | 6.0<br>(3.6 – 8.9) | 5.5<br>(2.2 – 8.4) |
| SS (mg/L) | N/A | 2.0<br>(1.4 – 3.5) | 1.9<br>(0.5 – 4.7) |
| $BOD_5$ (mg/L) | N/A | 1.2<br>(0.5 – 1.9) | 1.1<br>(0.5 – 1.8) |
| $NH_3$-N (mg/L) | N/A | 0.047<br>(0.015 – 0.11) | 0.037<br>(0.006 – 0.073) |
| Unionised Ammonia (mg/L) | N/A | 0.003<br>(<0.001-0.012) | 0.002<br>(<0.001 – 0.007) |
| TIN (mg/L) | N/A | 0.07<br>(0.02 – 0.15) | 0.06<br>(0.01 – 0.15) |
| Chlorophyll-a (µg/L) | Not to exceed 20 µg/L calculated as running arithmetic mean of 5 daily measurements for any location and depth | 5.6<br>(1.6 – 9.6) | 5.1<br>(1.5 – 14.2) |
| *E. coli* (cfu 100mL) | Annual geometric mean not to exceed 610 cfu/100 ml for secondary contact recreation subzones and fish culture subzones | 7<br>(1 – 200) | 4<br>(1 – 18) |

Notes:
[1] Data presented are depth averaged, except as specified.
[2] Data presented are annual arithmetic mean except for *E. coli*, which are geometric mean values
[3] Data enclosed in brackets indicate the ranges
[4] Bolded cells indicate non-compliance with the WQOs for a parameter

**Table 10.1b:** Marine Water Quality of Victoria Harbour in Year 2009

| Parameter | WQO | Monitoring Station | | | |
|---|---|---|---|---|---|
| | | Victoria Harbour | | | |
| | | VM2 | VM4 | VM5 | VM6 |
| Temperature (°C) | Change due to waste discharge not to exceed 2°C | 23.8<br>(18.7 – 28.5) | 23.8<br>(18.6 – 28.6) | 24<br>(18.7 – 28.6) | 24<br>(18.7 – 28.6) |
| Salinity (ppt) | Change due to waste discharge not exceed 10% of natural ambient level | 31.7<br>(22.5 – 33.5) | 31.8<br>(24.9 – 33.6) | 31.2<br>(21.4 – 33.4) | 31.4<br>(23.6 – 33.3) |
| Dissolved Oxygen (mg/L) | Depth average:<br>≥ 4 mg/L for 90% of | 5.6<br>(4.1 – 7.0) | 5.3<br>(4.1 – 6.7) | 5.2<br>(4.5 – 6.8) | 5.1<br>(4.5 – 6.3) |

| Parameter | WQO | Monitoring Station | | | |
|---|---|---|---|---|---|
| | | Victoria Harbour | | | |
| | | VM2 | VM4 | VM5 | VM6 |
| | samples | | | | |
| Dissolved Oxygen, Bottom (mg/L) | Bottom:<br>≥ 2 mg/L for 90% of samples | 5.5<br>(4.2 – 7.0) | 5.1<br>(2.6 – 6.8) | 5.2<br>(4.4 – 6.8) | 5.0<br>(3.4 – 6.6) |
| SS (mg/L) | Waste discharge not to raise the natural ambient level by 30% nor cause the accumulation of suspended solids which may adversely affect aquatic communities | 5.2<br>(2.7 – 8.3) | 5.8<br>(3.5 – 7.5) | 5.7<br>(3.3 – 9.1) | 6<br>(3.2 – 10.7) |
| $BOD_5$ (mg/L) | N/A | 0.7<br>(<0.1 – 1.2) | 0.7<br>(0.2 – 1.2) | 0.8<br>(0.3 – 1.5) | 0.8<br>(0.1 – 1.7) |
| $NH_3$-N (mg/L) | N/A | 0.08<br>(0.041 – 0.200) | 0.1<br>(0.049 – 0.203) | 0.12<br>(0.062 – 0.203) | 0.14<br>(0.069 – 0.227) |
| Unionised Ammonia (mg/L) | Annual mean not to exceed 0.021 mg/L | 0.003<br>(0.002 – 0.006) | 0.004<br>(0.001 – 0.007) | 0.005<br>(0.002 – 0.011) | 0.005<br>(0.001 – 0.009) |
| TIN (mg/L) | Annual mean depth-averaged TIN not to exceed 0.4 mg/L | 0.21<br>(0.07 – 0.60) | 0.24<br>(0.08 – 0.57) | 0.29<br>(0.12 – 0.63) | 0.32<br>(0.15 – 0.6) |
| Chlorophyll-a (µg/L) | N/A | 3.1<br>(0.7 – 9.1) | 3.3<br>(0.7 – 8.3) | 3.9<br>(0.7 – 10.1) | 3.7<br>(0.8 – 11.4) |
| *E. coli* (cfu 100mL) | N/A | 710<br>(100 –9400) | 2000<br>(510 – 8700) | 3900<br>(160 – 19000) | 2500<br>(200 – 11000) |

Notes:
[1] Data presented are depth averaged, except as specified.
[2] Data presented are annual arithmetic mean except for *E. coli*, which are geometric mean values
[3] Data enclosed in brackets indicate the ranges
[4] Bolded cells indicate non-compliance with the WQOs for a parameter

**Table 10.1c:** Marine Water Quality of Eastern Buffer in Year 2009

| Parameter | WQO | Monitoring Station |
|---|---|---|
| | | Eastern Buffer |
| | | EM2 |
| Temperature (°C) | Change due to waste discharge not to exceed 2°C | 23.4<br>(17.5 – 28.5) |
| Salinity (ppt) | Change due to waste discharge not exceed 10% of natural ambient level | 32.2<br>(25.7 – 33.9) |
| Dissolved Oxygen (mg/L) | Depth average:<br>≥ 4 mg/L for 90% of samples | 5.8<br>(4.5 – 7.3) |
| Dissolved Oxygen, Bottom (mg/L) | Bottom:<br>≥ 2 mg/L for 90% of samples | 5.4<br>(3.1 – 7.2) |

| Parameter | WQO | Monitoring Station |
|---|---|---|
| | | Eastern Buffer |
| | | EM2 |
| SS (mg/L) | Waste discharge not to raise the natural ambient level by 30% nor cause the accumulation of suspended solids which may adversely affect aquatic communities | 4.0 (2.8 – 6.6) |
| $BOD_5$ (mg/L) | N/A | 0.6 (<0.1 – 1.6) |
| $NH_3$-N (mg/L) | N/A | 0.029 (0.008 – 0.055) |
| Unionised Ammonia (mg/L) | Annual mean not to exceed 0.021 mg/L | 0.001 (<0.001 – 0.003) |
| TIN (mg/L) | Annual mean depth-averaged TIN not to exceed 0.4 mg/L | 0.1 (0.02 – 0.34) |
| Chlorophyll-a (μg/L) | N/A | 3.4 (0.6 – 10.7) |
| *E. coli* (cfu 100mL) | Annual geometric mean not to exceed 610 cfu/100 ml for fish culture subzones | 19 (3 – 240) |

Notes:
[1] Data presented are depth averaged, except as specified.
[2] Data presented are annual arithmetic mean except for *E. coli*, which are geometric mean values
[3] Data enclosed in brackets indicate the ranges
[4] Bolded cells indicate non-compliance with the WQOs for a parameter

According to Marine Water Quality Report 2009 which is the best available information, compliance of water quality at Tolo Harbour has is 71%, compared with 64% in 2008. The improvement was due to the higher compliance with DO objective (43% in 2009 as compared with 29% in 2008). As a landlocked harbour, its bottom water often recorded relatively low DO compliance rate compared with other WCZs (60% – 100%) particularly in summer months.

Victoria Harbour is a major tidal channel with considerable assimilative capacity. With the implementation of the Harbour Area Treatment Scheme (HATS) Stage 1, the improvement of water quality in the eastern side of Victoria Harbour has been sustained. Compliance rate of 97% of the WQOs has been achieved in the Eastern Buffer WCZ in 2009.

### 10.3.2 River Water Quality Monitoring Stations Near to Project Site

The representative river water quality monitoring stations in the vicinity of the project site are TR19, TR19C, TR20B, TR23A and TR23L at Shing Mun River; KN1, KN2, KN3, KN4, KN5 and KN7 at Kai Tak Nullah (see **Figure 10.2** for their locations). Water quality parameters monitored at these stations are given in EPD's River Water Quality Year 2009, which is the best available information, and the major parameters are summarized in **Tables 10.2** and **10.3** below.

**Table 10.2**: River Water Quality of Shing Mun River in Year 2009

| Parameter | WQO | Monitoring Station | | | | |
|---|---|---|---|---|---|---|
| | | Tai Wai Nullah | | Tin Sam Nullah | Siu Lek Yuen Nullah | |
| | | TR19C | TR19 | TR20B | TR23L | TR23A |
| Dissolved | ≥ 4 | 9.0 | 9.4 | 8.2 | 8.6 | 6.1 |

| Parameter | WQO | Monitoring Station | | | | |
|---|---|---|---|---|---|---|
| | | Tai Wai Nullah | | Tin Sam Nullah | Siu Lek Yuen Nullah | |
| | | TR19C | TR19 | TR20B | TR23L | TR23A |
| Oxygen (mg/L) | | (7.9-9.9) | (8.1 – 12.6) | (7.4 – 9.8) | (7.5 – 11.5) | (3.1 – 8.9) |
| pH | 6.5-8.5 | 7.8 (7.3 – 8.3) | 7.6 (7.3 – 8.8) | 8 (7.8 – 8.2) | 8.8 (8.1 – 9.3) | 7.8 (7.4 – 8.0) |
| SS (mg/L) | < 20 | 5 (3 – 37) | 5 (4 – 55) | 2 (<1 – 8) | 4 (1 – 100) | 4 (2 – 19) |
| $BOD_5$ (mg/L) | < 3 (Siu Lek Yuen) < 5 (Others) | 1 (<1 – 10) | 2 (<1 – 15) | <1 (<1 – <1) | 1 (<1 – 3) | 2 (<1 – 4) |
| COD (mg/L) | < 15 (Siu Lek Yuen) < 30 (Others) | 6 (3 – 12) | 7 (2 – 11) | 2 (<2 – 4) | 3 (2 – 7) | 7 (3 – 9) |
| *E. coli* (cfu 100m/L) | ≤ 1000 | 6300 (1500 – 28000) | 7300 (1200 – 91000) | <1 (<1 – 1) | 1100 (150 – 8000) | 2600 (400 – 42000) |
| $NH_4$-N (mg/L) | ≤ 0.5 | 0.09 (0.02 – 0.24) | 0.05 (0.02 – 0.33) | 0.02 (<0.01 – 0.12) | 0.01 (<0.01 – 0.08) | 0.32 (0.11 – 0.74) |

Notes:
[1] Data presented are annual median except for *E. coli*, which are annual geometric mean values.
[2] Data enclosed in brackets indicate the ranges.

**Table 10.3**: River Water Quality of Kai Tak Nullah in Year 2009

| Parameter | WQO | Kai Tak Nullah | | | | | |
|---|---|---|---|---|---|---|---|
| | | Monitoring Station | | | | | |
| | | KN1 | KN2 | KN3 | KN4 | KN5 | KN7 |
| Dissolved Oxygen (mg/L) | ≥ 4 mg/L | 6.6 (5.1 – 7.5) | 7.0 (6.3 – 7.7) | 7.2 (7.1 – 8) | 7.9 (6.8 – 8.5) | 7.9 (7.1 – 8.7) | 7.4 (7.0 – 8.4) |
| pH | Not to exceed the range of 6.0-9.0 units | 7.1 (6.9 – 7.6) | 7.3 (7.0 – 7.6) | 7.3 (7.1 – 7.7) | 7.3 (7.0 – 7.6) | 7.3 (6.9 – 7.5) | 7.2 (6.9 – 7.4) |
| SS (mg/L) | Annual median not to exceed 25 mg/L | 4 (3 – 32) | 8 (3 – 24) | 6 (4 – 19) | 11 (3 – 38) | 5 (3 – 12) | 5 (2 – 11) |
| $BOD_5$ (mg/L) | ≤ 5 mg/L | 4 (<1 – 6) | 3 (2 – 6) | 4 (2 – 8) | 6 (2 – 31) | 3 (1 – 8) | 3 (1 – 10) |
| COD (mg/L) | ≤ 30 mg/L | 26 (18 – 40) | 28 (23 – 34) | 29 (23 – 39) | 32 (19 – 50) | 27 (19 – 34) | 31 (19 – 33) |
| *E. coli* (cfu / 100m/L) | ≤ 1000 cfu/100mL, geometric mean of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days | 85000 (8000 – 880000) | 35000 (6000 – 120000) | 56000 (11000 – 240000) | 87000 (7800 – 1300000) | 21000 (8500 – 52000) | 23000 (8000 – 40000) |
| $NH_4$-N (mg/L) | N/A | 0.74 (0.33 – 2.80) | 0.49 (0.1 – 1.6) | 0.48 (0.13 – 1.5) | 0.57 (0.09 – 2.20) | 0.27 (0.08 – 1.70) | 0.26 (0.08 – 1.5) |

Notes:
[1] Data presented are annual median except for *E. coli*, which are annual geometric mean values.
[2] Data enclosed in brackets indicate the ranges

Kai Tak Nullah's catchment includes some of the most densely populated areas of Kowloon. According to EPD's River Water Quality Report 2009, the water quality of Kai Tak Nullah in 2009 was better when compared with 2008, with three of the six monitoring stations achieving an 'Excellent' WQI grading, and the remaining three graded 'Good', as compared with the five 'Good' and one 'Fair' grading in 2008. Levels of DO, pH and SS of these monitoring stations in Kai Tak Nullah generally complied with the respective WQOs while exceedances were found in levels of $BOD_5$, COD and *E. coli*. However, the water quality in the nullah has seen marked improvement with noticeable decrease in *E. coli* and $BOD_5$ levels as compared with previous years due to the Tolo Harbour Effluent Export Scheme.

According to River Water Quality 2009, Shing Mun River has shown a marked improvement in WQO compliance rate from 78% in 1997 to 95% in 2009.

## 10.4 Water Sensitive Receivers

### 10.4.1 SCL – Tai Wai to Hung Hom Section

There are only a few water receiving bodies in the vicinity of the project site, and they are mainly located in Tai Wai and former Tai Hom Village at Diamond Hill.

Shing Mun River Channel, which is located at a distance of about 400m away from the Tai Wai Depot, is one of the river monitoring stations for the Tolo Harbour water control zone.

Although the nullah next to Shatin Water Treatment Works is not connected to any major river, it is regarded as a WSR for the construction of SCL (TAW-HUH), as it is just about 50m away. The natural stream at Tei Lung Hau is also as part of a WSR.

The upper end of Kai Tak nullah at former Tai Hom Village is the only WSR on Kowloon side. Although the nullah is no longer in use after demolition of former Tai Hom Village, it still acts as a channel connecting to Victoria Harbour.

There is no marine biological sensitive receiver such as fish culture zone, shellfish culture zone, marine park/reserve and commercial fishing ground in the vicinity of SCL (TAW-HUH).

### 10.4.2 Off-Site Works Areas

There are a number of sensitive receivers in the vicinity of the off-site works areas and they are discussed below:

- Barging points including Kai Tak Runway and Freight Pier at Hung Hom (shared with Kwun Tong Line Extension).The proposed barging works at Kai Tak Runway are located within the Victoria Harbour Control Zone, with To Kwa Wan water and sediment monitoring stations (VT11 and VS20) nearby.
- The TKO Area 137 works area is located in vicinity of Tung Lung Chau Fish Cultural Zone.

Dredging works will only be carried out at Kai Tak Runway Barging Facility. No dredging work will be conducted at Freight Pier Barging Facility at Hung Hom (see **Figure 1.2**). Hence water quality assessment will only cover the dredging work at Kai Tak (see **Section 10.5.1.7**). The representative Water Sensitive Receivers (WSRs) in the vicinity of the project site are summarized in **Table 10.4** and shown in **Figure 10.3**.

**Table 10.4**: Water sensitive receivers

| WSR No. | WSRs Description | Works Area |
|---|---|---|
| WSR 1 | Shing Mun Main Channel, Tolo Harbour, Tai Wai Nullah, Tin Sam Nullah | SCL - Hin Keng to Tai Wai |
| WSR 2 | Freshwater Stream at Tei Lung Hau | SCL - Hin Keng to Tai Wai |
| WSR 3 | Nullah next to Shatin Water Treatment Works | SCL - Hin Keng to Tai Wai |
| WSR 4 | Kai Tak Nullah | SCL - Tai Wai to Hung Hom |

| WSR No. | WSRs Description | Works Area |
|---|---|---|
| WSR 5 | Victoria Harbour WCZ | Dredging at Kai Tak Runway Barging Facility |
| WSR 6 | Eastern Buffer WCZ, | TKO Area 137 |
| WSR 7 | Tung Lung Chau Fish Cultural Zone | TKO Area 137 |
| WSR 8 | Seawater intakes for flushing at Tai Wan | Dredging at Kai Tak Runway Barging Facility |
| WSR 9 | Seawater intakes for flushing at North Point | Dredging at Kai Tak Runway Barging Facility |
| WSR 10 | Seawater intakes for flushing at Quarry Bay | Dredging at Kai Tak Runway Barging Facility |
| WSR 11 | Cooling water intakes for Dairy Farm Ice Plant | Dredging at Kai Tak Runway Barging Facility |
| WSR 12 | Coral sites at Chiu Keng Wan | TKO Area 137 |
| WSR 13 | To Kwa Wan Typhoon Shelter | Dredging at Kai Tak Runway Barging Facility |

Although there are hard corals *Oulastrea crispata* located at Kai Tak Seawalls near the dredging location at Kai Tak Runway Barging Facility, these corals are isolated and only common species. According to the approved EIA for the Cruise Terminal, these corals are not considered as WSRs.

According to WSD's information, there are water gathering grounds located at Beacon Hill and Lower Shing Mun (**Figure 10.3A**). However, these water gathering grounds are located at least 300m away from the site of HIK. Although a rail tunnel will pass through Beacon Hill, it will be located in the granite layer without disturbing the aquifers. Therefore, these water gathering grounds would not be affected during both construction and operational phase.

## 10.5 Construction Water Quality Impact

The site will be maintained by good site practices and there will be no direct discharge of wastewater into Tolo Harbour and Victoria Harbour during the construction phase. Water quality issues relevant to the construction phase are described in the following sections.

### 10.5.1 Pollution Sources from Construction Activities

Potential water pollution sources during construction phase will include sources mainly from land-based activities as follows:

- Construction runoff;
- Runoff from tunnelling activities and underground works;
- Sewage effluent due to workforce on site;
- Drainage diversion;
- Groundwater seepage;
- Discharge of groundwater pumped out from potential contaminated area;
- Dredging works for Kai Tak Runway Barging Facility (N.B. Dredging is not required for other barging facility); and
- Accidental Spillage.

#### 10.5.1.1 Construction Runoff

Construction site runoff comprises:

- Runoff and erosion from site surfaces, drainage channels, earth working areas and stockpiles;
- Runoff from the proposed barging facility;
- Wash water from dust suppression sprays and wheel washing facilities; and
- Fuel, oil, solvents and lubricants from maintenance of construction machinery and equipment.

Construction runoff may cause physical, biological and chemical effects. The physical effects include potential blockage of drainage channels and increase of Suspended Solid (SS) levels in THCWCZ and VHWCZ.

Local flooding may also occur in heavy rainfall situations. The chemical and biological effects caused by the construction runoff are highly dependent upon its chemical and nutrient content.

Runoff containing significant amounts of concrete and cement-derived material may cause primary chemical effects such as increasing turbidity and discoloration, elevation in pH, and accretion of solids. A number of secondary effects may also result in toxic effects to water biota due to elevated pH values, and reduced decay rates of faecal micro-organisms and photosynthetic rate due to the decreased light penetration.

#### 10.5.1.2 Tunnelling and Underground Works

During tunnelling work, rainfall, surface runoff and groundwater seepage pumped out from the tunnel would have high SS content. The situation would be worse during wet seasons.

Surface runoff may also be contaminated by bentonite and grouting chemicals that would be required for the construction of bored tunnels (for tunnel boring and ground treatment) and diaphragm walls for cut-&-cover tunnel sections. In addition, wastewater from tunnelling works will also contain a high concentration of SS.

#### 10.5.1.3 Sewage Effluent

Sewage effluents will arise from the amenity facilities used by the construction workforce and site office’s sanitary facilities. The characteristics of sewage would include high levels of $BOD_5$, Ammonia and *E. coli* counts.

Overnight sewage from chemical toilets will also be generated. The sludge needs to be properly managed to minimize odour and potential health risks to the workforce by attracting pests and other disease vectors.

The number of construction workers to be employed on site is not available at this stage, but is anticipated to be over 1,000 staff in the peak period. As the workers will be scattered within the construction site, the most effective solution will be to provide adequate number of portable toilets within the site to ensure that sewage from site staff is properly collected. Depending on site conditions, land availability and site activities, the locations and number of portable toilets will be determined in the Environmental Management Plan (EMP) to be submitted by the Contractor. No adverse waste impact is envisaged provided that maintenance by licensed contractors is conducted regularly.

#### 10.5.1.4 Drainage Diversion

Drainage infrastructure is available along the proposed alignment from Tai Wai to Hung Hom. A separate Drainage Impact Assessment will be prepared and submitted by the Project Proponent. The assessment will identify the diversion or upgrading of the existing drainage infrastructure. The potential water quality impact associated with the drainage diversion or upgrading will be from the run-off and erosion from site surfaces and earth working areas. Small amount of wastewater may be released during the disconnection of various drainage systems.

#### 10.5.1.5 Groundwater Seepage

The stations and some of the tunnel sections will be constructed by cut-&-cover and method. Construction methodology using diaphragm wall techniques can minimise the intrusion of groundwater during excavation. It involves excavation of a narrow trench that is kept full of slurry, which exerts hydraulic pressure against the trench walls and acts as a shoring to prevent collapse. Slurry trench excavations can be performed in all types of soil, even below the ground water table.

The construction usually begins with the excavation of discontinuous primary panels of typically up to 6m long and down to the rockhead. In order to provide an effective cut-off to ground water flow, the walls will need to be toe grouted. Once the excavation of a panel is completed, a steel reinforcement cage will be placed in the centre of the panel. Concrete is then poured in one continuous operation. Once the primary panels are set, secondary panels will be constructed between the primary panels and the process then repeats to create a continuous wall. It should be noted that this slurry trench method will reduce the gap between the panels to the practicable minimum. After this, soil excavation will be commenced. The intrusion of groundwater through D-wall panels during soil excavation is therefore considered insignificant.

For those sections that may require bored tunnelling and / or drill-&-blast, some ground treatment (e.g. grouting) will be carried out prior to bored tunnelling. The intrusion of groundwater during bored tunnelling would therefore be insignificant.

#### 10.5.1.6 Groundwater from Contaminated Area

Site investigation (SI) works were commenced in February 2009 and carried out by the GI Contractor. The SI program includes 5 trial trenches and 24 drillholes at 10 identified potentially contaminated sites (i.e. refer to **Section 12** for details). According to **Section 12** for Land Contamination Impact Assessment, groundwater was encountered at 22 sampling locations and none of the groundwater samples exceed the RBRGs levels for industrial purpose. However, as soil contamination issues were identified at Site L4 - former Tai Hom Village (see **Figure 12.1**), discharge/ recharge of groundwater generated from this area may affect the groundwater quality, if uncontrolled.

#### 10.5.1.7 Dredging Works

No dredging work will be conducted at Freight Pier Barging Facility at Hung Hom.

For Kai Tak Runway Barging Facility, sediment removal is required in order to maintain the seabed level and provide adequate draft for barging. The location plan of Kai Tak Runway Barging Facility and the indicative dredging location is shown in **Figure 10.4**.

Since the total dredging volume will be only 56,000m$^3$, which is a relatively small amount compared to other dredging works (such as those in Kowloon Bay, refer to **Table 10.8**), change of hydrodynamic regime due to sediment removal is not anticipated. Furthermore, the removed sediment is not located in major waterways and is likely to be re-formed by natural sedimentation after the barging operation.

The closest WSR to the dredging area at Kai Tak is the To Kwa Wan Typhoon Shelter and WSD flushing water intake at Tai Wan, which is about 280m and 1.2 km away. There are also seawater intakes at North Point, Quarry Bay and Yau Tong, however, these WSRs are considered far away (> 2 km) from the dredging area and the expected water quality impact would be negligible.

The key water quality concerns during the dredging works include the following:

- Dredging works will disturb the marine bottom sediment, causing an increase in SS levels in the water column forming sediment plumes. The increase in SS levels may lead to reduction of DO levels and increase of nutrient levels.

- On the other hand, organic and inorganic contamination such as heavy metals, etc., bounded in the sediment, would be released into the water columns via suspension and dredging works. During dredging and transport of dredged materials, inappropriate handling and overflow from barges would also lead to leakage and spillage of sediment.

The quantities of fine sediment lost to suspension during dredging will primarily depend on dredging rate and methods. Impact from suspended solids may be caused by sediment plumes being transported to sensitive areas.

*Sediment Loss Rates*

The dredging works will be conducted at a production rate of 500 $m^3$/day and by using closed grab dredgers for 12 hours per day. Thus, the hourly production rate would be about 41.7 $m^3$/hour.

According to the Contaminated Spoil Management Study, the sediment loss rate for closed grab dredgers were about 11 to 20 kg/$m^3$ of dredged materials. As a conservative approach, the upper range of 20 kg/$m^3$ was adopted in this study. Therefore, the total sediment loss rate would then be 0.23 kg/s.

*Assessment Criteria*

The allowable elevation in SS concentration as defined by the WQO corresponds to the 30% tolerance level. The calculated maximum SS concentrations from the dredging have been compared with the 30% tolerance values to determine the acceptability of the impacts. The relevant EPD data and allowable elevations in suspended sediment concentration are 2.5 mg/l and 2.3 mg/l for dry and wet seasons respectively and summarised in **Table 10.6**. Apart from the WQO, WSD also specifies the SS criteria for the flushing water intakes and the criterion value is 10 mg/l.

**Table 10.6**: Ambient and Tolerance Values for Suspended Solids Concentrations in the Vicinity of Sensitive Receivers

| Sensitive Receiver (Relevant EPD Monitoring Station) | Dry Season | | Wet Season | | All Season |
|---|---|---|---|---|---|
| | $90^{th}$ Percentile | 30 % Tolerance | $90^{th}$ Percentile | 30 % Tolerance | Absolute Value |
| WSD flushing water intakes at Tai Wan (VM2 and VM4, 2009 data), about 1.2 km away from the dredging area | 8.3 mg/l | 2.5 mg/l | 7.5 mg/l | 2.3 mg/l | 10 mg/l |
| To Kwa Wan Typhoon Shelter (VM2 and VM4, 2009 data), about 280 m away from the dredging area | 8.3 mg/l | 2.5 mg/l | 7.5 mg/l | 2.3 mg/l | - |

*Impact Assessment*

A two dimensional steady-state Gaussian Dispersion Model[10-3][10-4][10-5][10-8] has been applied to the near field water quality impact prediction. The application of this near field model was also adopted in the Approved EIA report of Relocation Yiu Lian Floating Dock No. 3[10-5] and Peng Chau Helipad[10-7]. The line source solution of advection and diffusion equation is as follows:-

$$\mathbf{C(x,y) = M/[uH(4\pi Dx/u)^{0.5}] \exp(-y^2u/4Dx)}$$

where, C = SS concentration (kg/$m^3$)

x = distance in the direct flow direction (m)

y = distance in the lateral flow direction (m)

M = sediment loss rate (= 0.23 kg/s)

H = water depth (= 7m)

u = flow velocity (= 0.24 to 0.28m/s, take 0.24 m/s in this study)[10-10])

D = dispersion coefficient (= $1m^2/s$[10-5][10-7][10-9])

The water depth is about 7m to 11m in the area. In a conservative design, 7m water depth is assumed.

The details of the water quality modeling results for proposed dredging works are provided in **Appendix 10.1** and the calculation results of elevated suspended sediment concentrations are given in **Table 10.7a**.

**Table 10.7a**: Calculated Suspended Sediment Concentrations Elevation for Dredging of Sediment (Unmitigated)

| Centreline Distance from Source (m), Lateral distance (y) = 0m | Elevated Suspended Sediment Concentration (mg/l) |
|---|---|
| 100 | 1.9 |
| 200 | 1.3 |
| 300 | 1.1 |
| 400 | 1.0 |
| 500 | 0.9 |
| 600 | 0.8 |
| 700 | 0.7 |
| 800 | 0.7 |
| 900 | 0.6 |
| 1000 | 0.6 |
| 280 (at WSR 13 - To Kwa Wan Typhoon Shelter) | 1.1 |
| 1200 (at WSR 8 - Tai Wan Flushing Water Intake) | 0.5 |

Note

[1] WSR13 & WSR8 are closest to the proposed dredging works. Other WSR listed in Table 10.4 are considered not affected by dredging activities.

The modelling results in the above table show that without any mitigation measures at more than 200m from the dredging operation, the suspended sediment concentrations would be below 1.3 mg/l. Since the nearest sensitive receiver is about 280m away from the dredging location, it is concluded that sediment plumes generated from the dredging works are expected to be localized and acceptable.

*Mitigation Measures*

To minimise the potential impact due to SS, deployment of silt curtains around the closed grab dredgers is recommended for the dredging works to minimize any significant cumulative water quality impact with other possible concurrent marine works in the Victoria Harbour.

The implementation of silt curtain around the closed grab dredgers will reduce the dispersion of SS by 75% and the sediment loss rate within the dredging area would be about 0.06 kg/s after deploying the silt curtain around the works area. Thus, the predicted SS elevation at To Kwa Wan Typhoon Shelter and Tai Wan Flushing Water Intakes would be 0.3 mg/l and 0.1 mg/l respectively, which is negligible to the background variations and well within the criteria as stipulated in **Table 10.6**. The calculation results of elevated suspended sediment concentrations are given in **Table 10.7b**. Details of mitigation measures during dredging operations are presented in **Section 10.7.1.5**.

**Table 10.7b**: Calculated Suspended Sediment Concentrations Elevation for Dredging of Sediment (Mitigated)

| Centreline Distance from Source (m), Lateral distance (y) = 0m | Elevated Suspended Sediment Concentration (mg/l) |
|---|---|
| 100 | 0.5 |
| 200 | 0.3 |
| 300 | 0.3 |
| 400 | 0.2 |
| 500 | 0.2 |
| 600 | 0.2 |
| 700 | 0.2 |
| 800 | 0.2 |
| 900 | 0.2 |
| 1000 | 0.2 |
| 280 (at WSR 13 - To Kwa Wan Typhoon Shelter) | 0.3 |
| 1200 (at WSR 8 - Tai Wan Flushing Water Intake) | 0.1 |

Note
[1] WSR13 & WSR8 are closest to the proposed dredging works. Other WSR listed in Table 10.4 are considered not affected by dredging activities.

*Cumulative Impacts for Concurrent Dredging*

The dredging activities at Kai Tak Runway Barging Facility will be carried out in Jul 2012 and the duration will be six months. The possible concurrent dredging projects are listed below:-

- SCL – Hung Hom to Admiralty Section (SCL(HUH-ADM))
- Submarine Gas Pipelines (SGP)
- Cruise Terminal (CT)
- Central Kowloon Route (CKR)

There are also marine works for Wan Chai Development II, Central-Wan Chai Bypass and Trunk Road T2. However, these projects are considered far away from the SCL (TAW-HUH) (more than 2 km away) and cumulative impact is not anticipated.

Dredging activities will be carried out at SCL(HUH-ADM), which would be commenced in 2013. Therefore, cumulative impact is not expected. Dredging is not required for SCL(MKK-HUH).

According to the approved EIA Report for the Installation of Submarine Gas Pipelines and Associated Facilities from To Kwa Wan to North Point (EIA-SGP) (ref EIA-182/2010), the dredging rate and sediment loss rate for the installation of submarine gas pipeline will be 4,000 $m^3$/day and 1.39 kg/s respectively, compared with 500 $m^3$/day and 0.06 kg/s for that in SCL(TAW-HUH). Furthermore, the dredging works of gas pipeline will be commenced in April 2012 for completion in December 2012, and hence cumulative impact is expected.

According to the approved EIA Report for the Dredging Works for Proposed Cruise Terminal at Kai Tak (EIA-CT) (ref : EIA-138/2007), there are 2 stages of dredging. The first stage of dredging would involve a total dredging volume of about 1,022,300$m^3$. The second stage of dredging would involve a lesser amount of about 680,000$m^3$. Further liaison has been made with CEDD and the website of Tourism Commission has been reviewed. According to the information available, the dredging works for the cruise terminal has been commenced in

June 2010 and is anticipated to complete in 2015. Maintenance dredging will be carried out regularly during the operational period.

According to the latest design for SCL(TAW-HUH), some dredging is required for the Kai Tak Barging Facility which is anticipated to commence in mid 2012 (see **Section 3** for more details). The first stage of dredging for the Cruise Terminal, Submarine, Gas Pipelines and Associated Facilities may therefore overlap with the dredging work for the barging facility for Kai Tak. Cumulative construction phase water quality impacts are therefore anticipated.

The EIA-CT has assessed the cumulative water quality impact due to the superposition effect from the proposed dredging activities for Cruise Terminal (CT), Central Kowloon Route (CKR) and Truck Road T2. It should be noted that the dredging works for CKR project will be conducted from 2015 to 2020. Cumulative impact with CKR is not expected. Therefore, adopting the prediction results in EIA-CT would be in a conservative side.

Apart from the EIA-CT, the EIA Report of EIA-SGP which was approved on August 2010, has also assessed the cumulative water quality impact including SGP, CT and SCL (TAW-HUH). The assumed dredging rates for Kai Tak Runway Barging Facility and CT are 500 $m^3$/day and 4000 $m^3$/day respectively, which are in light of the latest programmes. Thus, the prediction results in EIA-SGP would be still valid.

A common WSR, i.e. Tai Wan Flushing Water Intake, was identified between the concurrent dredging works of Kai Tak Runway Barging Facility and that of CT and SGP. Comparing the assessment scenarios of EIA-CT and EIA-SGP to the proposed dredging works at Kai Tak Runway Barging Facility for SCL, the dredging volume for Kai Tak Runway Barging Facility is small (500 $m^3$/day) and the distance between dredging location and the common WSR is rather far away. Therefore, the water quality impact due to Kai Tak Runway Barging Facility should be less than that of EIA-CT and EIA-SGP. Since the EIA-CT and EIA-SGP have concluded an acceptable water quality impact, SCL should have insignificant SS elevations due to the much smaller scale dredging. A comparison between the assessment scenario of EIA-CT and EIA-SGP and the proposed dredging works at Kai Tak Runway Barging Facility for SCL is summarised in **Table 10.8** and the results of cumulative impacts with CT and SGP is presented in **Table 10.8a**.

**Table 10.8**: Comparison of Dredging Scenario for EIA-CT, EIA-SGP and SCL(TAW-HUH)

| Dredging Scenario Assumptions | EIA-CT | EIA-SGP | SCL (TAW-HUH) |
|---|---|---|---|
| Dredging Rate | 4,000 $m^3$/day [1] | 4,000 $m^3$/day [2] | 500 $m^3$/day |
| Dredging Volume | 1,380,000 $m^3$ | 260,665 $m^3$ | Around 56,000 $m^3$ |
| Dredging Period | P1: 2011 to 2012<br>(1 years, 12 hours per day)<br>P2: 2013 to 2014<br>(1 years, 12 hours per day) | Apr 2012 to Dec 2012<br>(8 months, 16 hours per day) | Jul 2012 to Dec 2012<br>(6 months, 12 hours per day) |
| Dredging Location | CT, CKR [3] | CT, SGP | Kai Tak Runway Barging Facility |
| Distance from dredging area to WSR | To Kwa Wan Typhoon Shelter<br>CT: ~1 km<br>Tai Wan Flushing Water Intake<br>CT: ~1 km | To Kwa Wan Typhoon Shelter<br>SGP: ~0.48 km<br>Tai Wan Flushing Water Intake<br>SGP: ~0.45 km | To Kwa Wan Typhoon Shelter<br>~0.28 km<br>Tai Wan Flushing Water Intake<br>~1.2 km |
| Mitigation Measures | Closed Grab Dredgers with Silt Curtain | | |

Note

[1] In Scenario 2b of EIA-CT, the assumed total dredging volumes are 4000, 2000 and 8000 $m^3$/day for CT, CKR and T2 respectively. Since T2 is rather far away from site, it was not considered in the comparison.

[2] In Scenario 2a of EIA-SGP, the assumed total dredging volumes are 4000, 4000 and 6000 m3/day for CT, SGP and T2 respectively. Since T2 is rather far away from site, it was not considered in the comparison.

[3] It should be noted that the CKR project will be conducted on 2015 to 2020 and cumulative impact with CKR is not expected. Therefore, adopting the prediction results in EIA-CT would be in a conservative side.

**Table 10.8a**: Impact Comparison on SS Results of CT, SGP, SCL(TAW-HUH) and the Cumulative Impacts

| | **SCL (TAW-HUH)** | **CT and SGP** | **Cumulative** |
|---|---|---|---|
| *WSR 8 - Tai Wan Flushing Water Intakes* | | | |
| Background [1] | SS (Absolute)<br>5.7 mg/l (Dry Season)<br>5.4 mg/l (Wet Season) | SS (Absolute)<br>5.7 mg/l (Dry Season)<br>5.4 mg/l (Wet Season) | SS (Absolute)<br>5.7 mg/l (Dry Season)<br>5.4 mg/l (Wet Season) |
| Project Contribution (Mitigated) | SS (Elevation) [2]<br>0.1 mg/l (All Season)- | SS (Absolute) [3]<br>7.5 mg/l (Dry Season)<br>6.9 mg/l (Wet Season) | SS (Absolute) [4]<br>7.6 mg/l (Dry Season)<br>7.0 mg/l (Wet Season)<br>SS (Elevation) [5]<br>1.9 mg/l (Dry Season)<br>1.6 mg/l (Wet Season) |
| Criteria | - | - | SS (Absolute)<br>10 mg/l<br>SS (Elevation)<br>2.5 mg/l (Dry Season)<br>2.3 mg/l (Wet Season) |
| *WSR 13 - To Kwa Wan Typhoon Shelter* | | | |
| Background [1] | 5.7 mg/l (Dry Season)<br>5.4 mg/l (Wet Season) | 5.7 mg/l (Dry Season)<br>5.4 mg/l (Wet Season) | 5.7 mg/l (Dry Season)<br>5.4 mg/l (Wet Season) |
| Project Contribution (Mitigated) | SS (Elevation) [2]<br>0.3 mg/l (All Season)- | SS (Absolute) [6]<br>7.5 mg/l (Dry Season)<br>6.9 mg/l (Wet Season) | SS (Absolute) [4]<br>7.8 mg/l (Dry Season)<br>7.2 mg/l (Wet Season)<br>SS (Elevation) [5]<br>2.1 mg/l (Dry Season)<br>1.8 mg/l (Wet Season) |
| Criteria | - | - | SS (Absolute)<br>-<br>SS (Elevation)<br>2.5 mg/l (Dry Season)<br>2.3 mg/l (Wet Season) |

Note

[1] Background conditions are adopted from the average SS level of Station VM2 and VM4 for Year 2009

[2] Refers to Table 10.7b

[3] Adopted from EIA-SGP, which includes the cumulative SS modeling results of from CT and SGP. No SS elevation is presented for the WSR - Tai Wan Flushing Water Intakes.

[4] The absolute values for SCL(TAW-HUH) are calculated from the summation of model result of CT and SGP and the modeling result in Table 10.7b.

[5] The cumulative SS elevations are backward calculated from absolute SS minus the "With Project" Scenario.

[6] SS levels on WSR 8 is not presented in both EIA-CT and/or EIA-SGP. However, it is anticipated the SS level due to CT and SGP in this WSR is less than or comparable to that on WSR13. As a conservative approach, it is assumed the SS levels due to CT and SGP on WSR13 is also applicable to that of WSR 8.

The cumulative impacts for dredging works at Kai Tak Runway Barging Facility are 7.0 to 7.8 mg/l and the SS levels would be well within the ambient variations and well below the WQO and/or WSD's requirements.

*Release of contaminants*

In the Kowloon Bay and To Kwa Wan area, there are several existing elutriate test carried out in other previously approved EIA studies such as South East Kowloon Development (SEKD) [10-10] and EIA-CT. The location plan of existing elutriate test point are extracted from these approved EIA studies and presented in **Appendix 10.2**.

The elutriate results in EIA-CT showed the concentrations of cadmium, copper, nickel, arsenic and mercury exceeded the assessment criteria. The maximum concentrations of these parameters are 3.6 μg/L, 29 μg/L, 75 μg/L, 52 μg/L and 0.5 μg/L respectively. Although exceedances were recorded in the elutriate results in EIA-CT, it should be noted that all these results in EIA-CT were located at the south end of runway (**Appendix 10.2**), in which the proposed dredging area for Kai Tak Runway Barging Facility is located in the mid-way side (recall **Figure 10.4**). Therefore, the elutriate results in EIA-CT are not applicable to this study.

By overlaying the locations of elutriate sampling points in EIA-SEKD and our dredging area, it is noted that Sampling Point KB7 in EIA-SEKD is located within the proposed dredging area [10-10]. Therefore, the elutriate results at this sampling point is considered appropriate to represent the proposed dredging activities in this study. The same approach is also adopted in the EIA Study of Kai Tak Development (KTD) [10-11]. **Table 10.9** present the elutriate test results and the comparison with the international standards.

**Table 10.9**: Elutriate Test Result as Adopted in the EIA Study of SEKD

| Station KB7, located at dredging area of Kai Tak Runway Barging Facility | Elutriate Test Result | Relevant International Standard / Background Concentration |
|---|---|---|
| Cadmium | < 0.2 μg/l | 2.5 μg/l [1] |
| Chromium | < 10 μg/l | 15 μg/l [1] |
| Copper | < 2 μg/l | 5 μg/l [1] |
| Mercury | 0.025 μg/l | 0.3 μg/l [1] |
| Nickel | 2 μg/l | 30 μg/l [1] |
| Lead | < 1 μg/l | 25 μg/l [1] |
| Zinc | < 10 μg/l | 40 μg/l [1] |
| Silver | < 1 μg/l | 2.3 μg/l [3] |
| Arsenic | 10 μg/l | 25 μg/l [1] |
| TBT | < 0.015 μg/l | 0.1 μg/l [2] |
| Nitrate Nitrogen | 0.23 mg/l | - |
| Nitrite Nitrogen | < 0.01 mg/l | - |
| Ammonia Nitrogen | 7.15 mg/l | - |
| Unionized Ammonia (UIA) | 0.4 mg/l [4] | 0.021 mg/l |
| Total Inorganic Nitrogen (TIN) | 7.39 mg/l [5] | 0.4 mg/l |

Note:

[1] UK Water Quality for Coastal Surface Water

[2] Michael H. Salazar and Sandra M Salaar (1996) Mussels as Bioindicators: Effects of TBT on Survival, Bioaccumulation, and Growth under Natural Conditions in Organotic, edited by M A Champ and P F Seligman. Chapman & Hall London

[3] USEPA Standards

[4] [UIA] = 5.62 x $10^{-10}$ x [$NH_4$-N] / $10^{-pH}$, taking pH of 8.0 according to the average pH value of EPD's monitoring station VM2 in Year 2009 (http://www.epd.gov.hk/epd/tc_chi/environmentinhk/water/marine_quality/files/Marinereport2009Chiv1.pdf)

[5] [TIN] = [$NO_3$-N] + [$NO_2$-N] + [$NH_4$-N]

According to the impact evaluation of EIA-KTD, the heavy metals levels in the elutriate samples would comply with the relevant international standards. In addition, the heavy metal levels at the WSR would be further diluted after the contaminants are released into the water column. Thus, the residue impacts of heavy metals at the WSRs would be insignificant.

According to the EIA-KTD, the levels of TBT, PCBs and PAHs in the elutriate samples at the dredging location were all below the detection limits. Therefore, the adverse water quality impact due to release of organic compounds would be insignificant.

The nutrient levels (UIA and TIN) at the dredging point exceeded the WQO. A dilution calculation was conducted by using the following equation [10-6]:

$$C(X) = q/DX\omega\pi^{0.5}$$

where:

C(x) = concentration at distance x from the source

q = sediment loss rate (assume 1 kg/s to calculate dilution factor)

D = water depth (= 7m)

X = distance from source

ω = diffusion velocity (= 0.01 m/s)

The radius of initial release was assumed to be 10m and the dilution factor is presented in Table 10.9a.

**Table 10.9a**: Dilution Factor for Nutrients

| Centreline Distance from Source (m), Lateral distance (y) = 0m | Dilution Factor |
|---|---|
| 100 | 10 |
| 200 | 20 |
| 300 | 30 |
| 400 | 40 |
| 500 | 50 |
| 600 | 60 |
| 700 | 70 |
| 800 | 80 |
| 900 | 90 |
| 1000 | 100 |
| 280 (at To Kwa Wan Typhoon Shelter) | 28 |
| 1200 (at Tai Wan Flushing Water Intake) | 120 |

By applying the dilution factors in **Table 10.9a**, the annual means of UIA and TIN concentrations are presented in **Table 10.9b**.

**Table 10.9b**: Impact Evaluations on Calculated Annual Mean of UIA and TIN Concentrations

| Centreline Distance from Source (m) | UIA (mg/l) [1] | | TIN (mg/l) [2] | |
|---|---|---|---|---|
| | During Dredging Period | Annual Mean | During Dredging Period | Annual Mean |
| 100 | 0.043 | 0.023 | 0.949 | 0.580 |
| 200 | 0.023 | 0.013 | 0.580 | 0.395 |
| 300 | 0.016 | 0.010 | 0.456 | 0.333 |
| 400 | 0.013 | 0.008 | 0.395 | 0.302 |
| 500 | 0.011 | 0.007 | 0.358 | 0.284 |
| 600 | 0.010 | 0.006 | 0.333 | 0.272 |
| 700 | 0.009 | 0.006 | 0.316 | 0.263 |
| 800 | 0.008 | 0.006 | 0.302 | 0.256 |
| 900 | 0.007 | 0.005 | 0.292 | 0.251 |
| 1000 | 0.007 | 0.005 | 0.284 | 0.247 |
| 280 (at WSR 13 - To Kwa Wan Typhoon Shelter) | 0.017 | 0.010 | 0.474 | 0.342 |
| 1200 (at WSR 8 - Tai Wan Flushing Water Intake) | 0.006 | 0.005 | 0.272 | 0.241 |
| Background | - | 0.003 | - | 0.210 |

Note:

[1] Background = 0.003 mg/l according to Station VM2 in Table 10.1b, Total dredging period = 50% of whole year (6 months dredging period).

[2] Background = 0.21 mg/l according to Station VM2 in Table 10.1b, Total dredging period = 50% of whole year. (6 months dredging period)

According to Table 10.9b, the predicted annual mean of UIA and TIN were well below the WQO at all WSRs. A mixing zone of exceedance for the predicted annual mean of UIA and TIN will be less than 200m and there is no sensitive receiver within the mixing zone.

According to the EIA-SGP[10-12], a negligible impact of UIA and TIN was predicted due to concurrent dredging activities of CT and SGP. Therefore, there will be no additional elevations of UIA and TIN at the WSR. Thus, adverse cumulative water quality impact due to release of nutrient is not anticipated.

_DO Depletion_

The degree of oxygen depletion exerted by a sediment plume is a function of the sediment oxygen demand of the sediment, its concentration in the water column and the rate of oxygen replenishment. For the purposes of this assessment, the impact of the sediment oxygen demand on dissolved oxygen concentrations has been calculated based on the following equation:

$DO_{Dep} = C * SOD * K * 0.001$

where:

$DO_{Dep}$ = Dissolved Oxygen depletion (mg/L)

C = Suspended Solids concentration (kg/m3)

SOD = Sediment Oxygen Demand

K = Daily oxygen uptake factor (set at 1.0/day for worse case estimate)

A Chemical Oxygen Demand (COD) of 22,000 mg/kg (in the range of 16000 mg/kg to 26000 mg/kg) has been taken with reference to EPD Marine Monitoring data (VS3, i.e. VM2 for water quality sampling point) in Year 2005 to 2009[10-13] as a suitably representative value for sediment oxygen demand[10-6] in Kowloon Bay and To Kwa Wan area.

The analysis using the above equation does not allow for re-aeration which would tend to reduce any impact of the suspended sediment on the water column DO concentrations. The analysis, therefore, errs on the conservative side so as not to underestimate the extent of DO depletion. Further, it should be noted that, for sediment in suspension to exert any oxygen demand on the water column will take time and, in that time, the sediment will be transported and mixed/dispersed with oxygenated water. As a result, the oxygen demand and the impact on dissolved oxygen concentrations will diminish as the suspended sediment concentrations decrease.

The calculation of predicted DO depletion is presented in Table 10.9c.

**Table 10.9c**: Calculated DO Depletion

| Centreline Distance from Source (m) | SS elevation[1] (mg/l) | DO Depletion (mg/l) |
|---|---|---|
| 100 | 1.9 | 0.04 |
| 200 | 1.3 | 0.03 |
| 300 | 1.1 | 0.02 |
| 400 | 1.0 | 0.02 |
| 500 | 0.9 | 0.02 |
| 600 | 0.8 | 0.02 |
| 700 | 0.7 | 0.02 |
| 800 | 0.7 | 0.02 |
| 900 | 0.6 | 0.01 |
| 1000 | 0.6 | 0.01 |
| 280 (at WSR 13 - To Kwa Wan Typhoon Shelter) | 1.1 | 0.02 |
| 1200 (at WSR 8 - Tai Wan Flushing Water Intake) | 0.5 | 0.01 |

Note:
[1] Refer to Table 10.7a, unmitigated SS elevation

According to Table 10.9c, while the unmitigated DO depletion is less than 0.04 mg/l. According to EPD Marine Water Quality Report 2009[10-13], the reporting limit of DO is 0.1 mg/l, which is greater than the predicted unmitigated DO depletion. The predicted DO depletion for mitigated scenario will be even lesser. The DO depletion due to the dredging works, in both unmitigated and mitigated scenarios, will have a negligible effect to the background values (see **Table 10.9d**). The absolute DO levels at WSR 8 and 13 from background, SCL(TAW-HUH), concurrent projects as well as the cumulative impact are presented in **Table 10.9e**.

**Table 10.9d**: 10 Percentile of DO Concentrations in the Vicinity of Sensitive Receivers

| Sensitive Receiver (Relevant EPD Monitoring Station) | Depth Average | Bottom |
|---|---|---|
| WSD flushing water intakes at Tai Wan (VM2 and VM4, 2009 data), about 1.2 km away from the dredging area | 5.3 mg/l (Dry Season)<br>4.0 mg/l (Wet Season) | 5.6 mg/l (Dry Season)<br>3.7 mg/l (Wet Season) |

| Sensitive Receiver (Relevant EPD Monitoring Station) | Depth Average | Bottom |
|---|---|---|
| To Kwa Wan Typhoon Shelter (VM2 and VM4, 2009 data), about 280 m away from the dredging area | 5.3 mg/l (Dry Season)<br>4.0 mg/l (Wet Season) | 5.6 mg/l (Dry Season)<br>3.7 mg/l (Wet Season) |

**Table 10.9e**: Impact Comparison on Calculated DO Concentrations of CT, SGP, SCL(TAW-HUH) and the Cumulative Impacts

| | SCL (TAW-HUH) | CT and SGP | Cumulative |
|---|---|---|---|
| *WSR 8 - Tai Wan Flushing Water Intakes* | | | |
| Background [1] | Minimum DO level<br>*10%ile Depth Averaged*<br>5.3 mg/l (Dry Season)<br>4.0 mg/l (Wet Season)<br>*10%ile Bottom*<br>5.6 mg/l (Dry Season)<br>3.7 mg/l (Wet Season) | Minimum DO level<br>*10%ile Depth Averaged*<br>5.3 mg/l (Dry Season)<br>4.0 mg/l (Wet Season)<br>*10%ile Bottom*<br>5.6 mg/l (Dry Season)<br>3.7 mg/l (Wet Season) | Minimum DO level<br>*10%ile Depth Averaged*<br>5.3 mg/l (Dry Season)<br>4.0 mg/l (Wet Season)<br>*10%ile Bottom*<br>5.6 mg/l (Dry Season)<br>3.7 mg/l (Wet Season) |
| Project Contribution (Mitigated) | DO depletion [2]<br>0.01 mg/l (All Season) | DO depletion [3]<br>*Depth Averaged*<br>0.1 mg/l (Dry Season)<br>0.0 mg/l (Wet Season)<br>*Bottom*<br>0.1 mg/l (Dry Season)<br>0.1 mg/l (Wet Season) | DO depletion<br>*Depth Averaged*<br>0.11 mg/l (Dry Season)<br>0.01 mg/l (Wet Season)<br>*Bottom*<br>0.11 mg/l (Dry Season)<br>0.11 mg/l (Wet Season) |
| | Minimum DO level<br>*10%ile Depth Averaged*<br>5.3 mg/l (Dry Season)<br>4.0 mg/l (Wet Season)<br>*10%ile Bottom*<br>5.6 mg/l (Dry Season)<br>3.7 mg/l (Wet Season) | Minimum DO level<br>*10%ile Depth Averaged*<br>5.2 mg/l (Dry Season)<br>4.0 mg/l (Wet Season)<br>*10%ile Bottom*<br>5.5 mg/l (Dry Season)<br>3.6 mg/l (Wet Season) | Minimum DO level<br>*10%ile Depth Averaged*<br>5.2 mg/l (Dry Season)<br>4.0 mg/l (Wet Season)<br>*10%ile Bottom*<br>5.5 mg/l (Dry Season)<br>3.6 mg/l (Wet Season) |
| Criteria | DO level<br>*10%ile Depth Averaged*<br>4 mg/l<br>*10%ile Bottom*<br>2 mg/l | DO level<br>*10%ile Depth Averaged*<br>4 mg/l<br>*10%ile Bottom*<br>2 mg/l | DO level<br>*10%ile Depth Averaged*<br>4 mg/l<br>*10%ile Bottom*<br>2 mg/l |
| *WSR 13 - To Kwa Wan Typhoon Shelter* | | | |
| Background [1] | Minimum DO level<br>*10%ile Depth Averaged*<br>5.3 mg/l (Dry Season)<br>4.0 mg/l (Wet Season)<br>*10%ile Bottom*<br>5.6 mg/l (Dry Season)<br>3.7 mg/l (Wet Season) | Minimum DO level<br>*10%ile Depth Averaged*<br>5.3 mg/l (Dry Season)<br>4.0 mg/l (Wet Season)<br>*10%ile Bottom*<br>5.6 mg/l (Dry Season)<br>3.7 mg/l (Wet Season) | Minimum DO level<br>*10%ile Depth Averaged*<br>5.3 mg/l (Dry Season)<br>4.0 mg/l (Wet Season)<br>*10%ile Bottom*<br>5.6 mg/l (Dry Season)<br>3.7 mg/l (Wet Season) |

| | SCL (TAW-HUH) | CT and SGP | Cumulative |
|---|---|---|---|
| Project Contribution (Mitigated) | DO depletion [2]<br>0.02 mg/l (All Season) | DO depletion [4]<br>*Depth Averaged*<br>0.1 mg/l (Dry Season)<br>0.0 mg/l (Wet Season)<br>*Bottom*<br>0.1 mg/l (Dry Season)<br>0.1 mg/l (Wet Season) | DO depletion<br>*Depth Averaged*<br>0.12 mg/l (Dry Season)<br>0.02 mg/l (Wet Season)<br>*Bottom*<br>0.12 mg/l (Dry Season)<br>0.12 mg/l (Wet Season) |
| | Minimum DO level<br>*10%ile Depth Averaged*<br>5.3 mg/l (Dry Season)<br>4.0 mg/l (Wet Season)<br>*10%ile Bottom*<br>5.6 mg/l (Dry Season)<br>3.7 mg/l (Wet Season) | Minimum DO level<br>*10%ile Depth Averaged*<br>5.2 mg/l (Dry Season)<br>4.0 mg/l (Wet Season)<br>*10%ile Bottom*<br>5.5 mg/l (Dry Season)<br>3.6 mg/l (Wet Season) | Minimum DO level<br>*10%ile Depth Averaged*<br>5.2 mg/l (Dry Season)<br>4.0 mg/l (Wet Season)<br>*10%ile Bottom*<br>5.5 mg/l (Dry Season)<br>3.6 mg/l (Wet Season) |
| Criteria | DO level<br>*10%ile Depth Averaged*<br>4 mg/l<br>*10%ile Bottom*<br>2 mg/l | DO level<br>*10%ile Depth Averaged*<br>4 mg/l<br>*10%ile Bottom*<br>2 mg/l | DO level<br>*10%ile Depth Averaged*<br>4 mg/l<br>*10%ile Bottom*<br>2 mg/l |

Note:

[1] Refer to Table 10.9d

[2] Refer to Table 10.9c

[3] Adopted from EIA-SGP, which includes the cumulative DO depletion results of from CT and SGP.

[4] DO depletion on WSR8 is not presented in both EIA-CT and/or EIA-SGP. However, it is anticipated the DO depletion due to CT and SGP in this WSR is less than or comparable to that on WSR13. As a conservative approach, it is assumed the DO depletion due to CT and SGP on WSR13 is also applicable to that of WSR8.

According to **Table 10.9d**, the 10 percentile DO concentration will comply with the WQO and adverse water quality impact due to DO depletion is not anticipated for the Project.

#### 10.5.1.8 Operation of Barging Facilities

The construction materials would be loaded or unloaded onto barges at the barging points. In order to avoid disturbance to marine water during transportation and loading/unloading operation, good site practices and mitigation measures have been recommended in **Section 10.7.1.6**. With the implementation of these recommended mitigation measures, adverse water quality impact due to operation of barging points are not expected.

#### 10.5.1.9 Accidental Spillage

The site coverage would be rather large during the construction phase. The soil of site area may be potentially contaminated by accidental spillage of grouting materials, surplus adhesives, lubrication oil, grease, acidic/alkaline solutions, petroleum products, chemical solvents, etc. Site runoff may wash the contaminated soil into stormwater drains or watercourses and cause water quality impact.

## 10.6 Operational Water Quality Impact

There will be no direct discharge of wastewater into the Tolo Harbour and Victoria Harbour during the operational stage. Hence, quantitative water quality dispersion modelling is considered not necessary. Other water quality issues relevant to the operational phase are described in the following sections.

### 10.6.1 Pollution Sources & Prediction of Impacts

Potential water pollution sources during the operational phase are summarised below:

- Runoff from rail track and operational tunnel drainage;
- Station runoff; and
- Sewage from station operation.

#### 10.6.1.1 Run off from Rail Track

Since all tracks are contained in concrete tunnel box, there will be no rainwater runoff. The tunnel wall will be equipped with water-tight liner and design for no seepage. The amount of groundwater seepage into the tunnel will be insignificant. Any tunnel run-off could be contaminated with limited amount of grease from passing trains or from maintenance activities. Standard designed silt trap and oil interceptor will be provided to remove the oil, lubricants, grease, silt, grit and debris from the wastewater before discharging into foul drainage. The waste will then be disposed of as general refuse and industrial wastes as described in **Section 11** of the EIA Report. No adverse impact on marine environment is anticipated.

#### 10.6.1.2 Station Runoff

Rainwater runoff from station structure (e.g. ventilation building, entrance etc) is not contaminated and hence has no adverse water quality impact.

#### 10.6.1.3 Discharge from Fresh Water Cooling Facility

Individual seawater cooling system would not be adopted and hence there would be no associated impacts.

#### 10.6.1.4 Sewage from Station

A separate consultant will be appointed by the Project Proponent to conduct the detailed design of sewer for station and he will be responsible for carrying out the Sewerage Impact Assessment and submit to the relevant government departments for approval. The typical Average Dry Weather Flow (ADWF) for a train station (without top-side properties) would be about 0.8l/s, which would be equivalent to about 55m$^3$/day, assuming 19 hours of operation. It is therefore anticipated that the ADWF for each station would be of similar order and probably in the order of 50-100m$^3$ /day. Given the small quantity of the ADWF for each station, the capacity of the foul sewer is adequate for the proposed sewage discharge. Hence, no water quality impact is anticipated.

## 10.7 Mitigation Measures

### 10.7.1 Construction Phase

In accordance with the Practice Note for Professional Persons on Construction Site Drainage, Environmental Protection Department, 1994 (ProPECC PN 1/94), construction phase mitigation measures shall include the following:

#### 10.7.1.1 Construction Runoff and Site Drainage

- At the start of site establishment, perimeter cut-off drains to direct off-site water around the site should be constructed with internal drainage works and erosion and sedimentation control facilities implemented. Channels (both temporary and permanent drainage pipes and culverts), earth bunds or sand bag barriers should be provided on site to direct stormwater to silt removal facilities. The design of the temporary on-site drainage system will be undertaken by the contractor prior to the commencement of construction.
- The dikes or embankments for flood protection should be implemented around the boundaries of earthwork areas. Temporary ditches should be provided to facilitate the runoff discharge into an appropriate watercourse, through a site/sediment trap. The sediment/silt traps should be incorporated in the permanent drainage channels to enhance deposition rates.

- The design of efficient silt removal facilities should be based on the guidelines in Appendix A1 of ProPECC PN 1/94, which states that the retention time for silt/sand traps should be 5 minutes under maximum flow conditions. Sizes may vary depending upon the flow rate, but for a flow rate of 0.1 $m^3/s$ a sedimentation basin of $30m^3$ would be required and for a flow rate of 0.5 $m^3/s$ the basin would be 150 $m^3$. The detailed design of the sand/silt traps shall be undertaken by the contractor prior to the commencement of construction.

- All exposed earth areas should be completed and vegetated as soon as possible after earthworks have been completed, or alternatively, within 14 days of the cessation of earthworks where practicable. 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 traffic 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.

- 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 $50m^3$ 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 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 storm 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 facilities should be provided at every construction site exit where practicable. 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 of soil and silty water to public roads and drains.

- Oil interceptors should be provided in the drainage system downstream of any oil/fuel pollution sources. The oil interceptors should be emptied and cleaned regularly to prevent the release of oil and grease into the storm water drainage system after accidental spillage. A bypass should be provided for the oil interceptors to prevent flushing during heavy rain.

- Construction solid waste, debris and rubbish on site should be collected, handled and disposed of properly to avoid water quality impacts. Requirements for solid waste management are detailed in **Section 11** of this EIA Report.
- All fuel tanks and storage areas should be provided with locks and sited on sealed areas, within bunds of a capacity equal to 110% of the storage capacity of the largest tank to prevent spilled fuel oils from reaching water sensitive receivers nearby.
- By adopting the above mitigation measures with Best Management Practices (BMPs) it is anticipated that the impacts of construction site runoff from the construction site will be reduced to an acceptable level before discharges.
- All the earth works involving should be conducted sequentially to limit the amount of construction runoff generated from exposed areas during the wet season (April to September) as far as practicable.

#### 10.7.1.2 Tunnelling Works

- Cut-&-cover/ open cut tunnelling work should be conducted sequentially to limit the amount of construction runoff generated from exposed areas during the wet season (April to September) as far as practicable.
- Uncontaminated discharge should pass through sedimentation tanks prior to off-site discharge
- The wastewater with a high concentration of SS should be treated (e.g. by sedimentation tanks with sufficient retention time) before discharge. Oil interceptors would also be required to remove the oil, lubricants and grease from the wastewater.
- Direct discharge of the bentonite slurry (as a result of D-wall and bored tunnelling construction) is not allowed. It should be reconditioned and reused wherever practicable. Temporary storage locations (typically a properly closed warehouse) should be provided on site for any unused bentonite that needs to be transported away after all the related construction activities are completed. The requirements in ProPECC PN 1/94 should be adhered to in the handling and disposal of bentonite slurries.

#### 10.7.1.3 Sewage Effluent

Adequate numbers of portable toilets should be provided for handling the construction sewage generated by the workforce. The portable toilets should be maintained in a reasonable state, which will not deter the workers from utilizing these portable toilets. Overnight sewerage should be collected by licensed collectors regularly.

#### 10.7.1.4 Groundwater from Contaminated Areas

No direct discharge of groundwater from contaminated areas should be adopted. Prior to the excavation works within these potentially contaminated areas, the groundwater quality should be reviewed with reference to the site investigation data in this EIA report for compliance to the Technical Memorandum on Standards for Effluents Discharged into Drainage on Sewerage Systems, Inland and Coastal Waters (TM-Water) and the existence of prohibited substance should be confirmed. The review results should be submitted to EPD for examination If the review results indicated that the groundwater to be generated from the excavation works would be contaminated, the contaminated groundwater should be either properly treated in compliance with the requirements of the TM-Water or properly recharged into the ground.

If wastewater treatment is deployed, the wastewater treatment unit shall deploy suitable treatment process (e.g. oil interceptor / activated carbon) to reduce the pollution level to an acceptable standard and remove any prohibited substances (e.g. TPH) to undetectable range. All treated effluent from wastewater treatment plant shall meet the requirements as stated in TM-Water and should be discharged into the foul sewers.

If groundwater recharging wells are deployed, recharging wells should be installed as appropriate for recharging the contaminated groundwater back into the ground. The recharging wells should be selected at places where the groundwater quality will not be affected by the recharge operation as indicated in the Section 2.3 of TM-Water. The baseline groundwater quality shall be determined prior to the selection of the recharge wells, and submit a working plan (including the laboratory analytical results showing the quality of groundwater at the proposed recharge location(s) as well as the pollutant levels of groundwater to be recharged) to EPD for agreement. Pollution levels of groundwater to be recharged shall not be higher than pollutant levels of ambient groundwater at the recharge well. Prior to recharge, any prohibited substances such as TPH products should be removed as necessary by installing the petrol interceptor. The Contractor should apply for a discharge licence under the WPCO through the Regional Office of EPD for groundwater recharge operation or discharge of treated groundwater.

#### 10.7.1.5 Dredging Works

The following good practice shall apply for the dredging works:

- Install efficient silt curtains, i.e. at least 75% SS reduction, at the point of seawall dredging to control the dispersion of SS;
- Water quality monitoring should be implemented to ensure effective control of water pollution and recommend additional mitigation measures required;
- The decent speed of grabs should be controlled to minimize the seabed impact and to reduce the volume of over-dredging; and
- All vessels should be sized so that adequate clearance is maintained between vessels and the seabed in all tide conditions, to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash.

#### 10.7.1.6 Operation of Barging Facilities

The following good practice shall apply for the barging facilities operations:

- All barges should be fitted with tight bottom seals to prevent leakage of materials during transport;
- Barges or hoppers should not be filled to a level that will cause overflow of materials or polluted water during loading or transportation;
- All vessels should be sized so that adequate clearance is maintained between vessels and the seabed in all tide conditions, to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash; and
- Loading of barges and hoppers should be controlled to prevent splashing of material into the surrounding water.
- Mitigation measures as outlined in **Section 10.7.1.1** should be applied to minimise water quality impacts from site runoff and open stockpile spoils at the proposed barging facilities where appropriate.

#### 10.7.1.7 Accidental Spillage

In order to prevent accidental spillage of chemicals, proper storage and handling facilities should be provided. All the tanks, containers, storage area should be bunded and the locations should be locked as far as possible from the sensitive watercourse and stormwater drains. The Contractor should register as a chemical waste producer if chemical wastes would be generated. Storage of chemical waste arising from the construction activities should be stored with suitable labels and warnings. Disposal of chemical wastes should be conducted in compliance with the requirements as stated in the Waste disposal (Chemical Waste) (General) Regulation.

### 10.7.2 Operational Phase

Mitigation measures are only required to mitigate runoff from track during the operational phase. The following mitigation measures during operational phase are recommended:

- Track drainage channels discharge should pass through oil/grit interceptors/chambers to remove oil, grease and sediment before discharging into public storm drainage/ foul sewerage system;
- The silt traps and oil interceptors should be cleaned and maintained regularly; and
- Oily contents of the oil interceptors should be transferred to an appropriate disposal facility, or to be collected for reuse, if possible.

## 10.8 Residual Impacts

Adverse residual impacts during the construction and operational phases are not anticipated provided that the above mitigation measures are implemented.

## 10.9 Conclusion

### 10.9.1 Construction Phase

Potential water pollution sources have been identified as construction runoff, sewage from site workforce, drainage diversion and groundwater contamination. Mitigation measures including covering excavated materials and providing sedimentation tanks on-site etc are recommended to mitigate any adverse water quality impacts.

To minimise the potential impact due to SS, deployment of silt curtains around the closed grab dredgers is recommended for the dredging works at Kai Tak Runway to minimize any significant water quality impact in the Victoria Harbour.

According to the quantitative assessment for dredging activities, the cumulative water quality impact due to concurrent dredging activities from CT were well within the acceptable level.

### 10.9.2 Operational Phase

The operational water quality impact for track run-off and tunnel seepage will have no adverse water quality impact provided that mitigation measures are incorporated in the design.

All proposed mitigation measures are clearly defined in the Environmental Mitigation Implementation Schedule.

## 10.10 References

[10-1] Agreement No. CE35/2006 (CE) Dredging Works for Proposed Cruise Terminal at Kai Tak, EIA Report (EIA138/2007), Civil Engineering & Development Department (2007)

[10-2] Pastorok, R. A. and Bilyard, G.R. (1985) *Effects of sewage pollution on coral-reef communities*. Marine Ecology Progress Series 21: 175-189

[10-3] CIRIA (2000). Scoping the Assessment of Sediment Plumes from Dredging, CIRIA Publication C547

[10-4] Fischer, Hugo B. (1979) Mixing in inland and coastal waters

[10-5] Yiu Lian Dockyard (2006) Environmental Impact Assessment Report Relocation of Yiu Lian Floating Dock No. 3

[10-6] Ove Arup & Partners (2009) Environmental Impact Assessment Report Hong Kong Boundary Crossing Facilities

[10-7] CEDD (2005) EIA Study Peng Chau Helipad

[10-8] USEPA (2005) Performance Standard for Dredging Re-suspension

[10-9] EPD (1999) Update on Cumulative Water Quality and Hydrological Effect of Coastal Developments and Upgrading of Assessment Tool, Report on Calibration and Verification of the Hydrodynamic Model

[10-10] TDD (2001) EIA Study Comprehensive Feasibility Study for the Revised Scheme of South East Kowloon Development

[10-11] CEDD (2008) EIA Study Kai Tak Development Engineering Study cum Design and Construction of Advance Works – Investigation, Design and Construction

[10-12] Mott (2009) EIA Study Installation of Submarine Gas Pipelines and Associated Facilities from To Kwa Wan to North Point for Former Kai Tak Airport Development

[10-13] EPD (2009) Marine Water Quality 2009