6 WATER QUALITY

6.1 Legislation and Standards

6.1.1 The entire Hong Kong waters are divided into ten Water Control Zones (WCZs) and four supplementary WCZs under the Water Pollution Control Ordinance (WPCO) (CAP 358). Each WCZ has a designated set of statutory Water Quality Objectives (WQOs) designed to protect the inland and/or marine environment and its users. The Study Area is close to Victoria Harbour and Junk Bay WCZs. **Tables 6.1a** and **6.1b** summarise the corresponding WQOs.

Table 6.1a: Water Quality Objectives for Victoria Harbour Water Control Zone

Parameters	Water Quality Objective	WCZ
Aesthetic Appearance	No objectionable odour or discolouration of the water; No visible rubbish; No mineral oil; No lasting foam.	Whole zone
Bacteria	The level of *Escherichia coli* should not exceed 1000 per 100 mL, calculated as the geometric mean of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Inland waters
Colour	Human activity should not cause the colour of water to exceed 50 Hazen Units.	Inland waters
Dissolved Oxygen (DO)	Within 2 m of bottom: not less than 2 mg/L for 90% samples; Depth average: not less than 4 mg/L for 90% samples	Marine waters
	Rest of water column: not less than 4 mg/L	Inland waters
pH	Between 6.5 - 8.5; change due to waste discharge not to exceed 0.2	Marine waters
Temperature	Change due to waste discharge not to exceed 2.0 °C	Whole zone
Salinity	No more than 10% by change due to waste discharge	Whole zone
Suspended Solids (SS)	Change due to waste discharge not to exceed 30%; No cause the accumulation of suspended solids which may adversely affect aquatic community	Marine waters
Ammonia	Annual mean for un-ionized ammoniacal nitrogen level not to exceed 0.021 mg/l	Whole zone
Nutrients	Annual mean for inorganic nitrogen level not to exceed 0.4 mg/l	Marine waters
5-day Biochemical Oxygen Demand (BOD_5)	Not to exceed 5 mg/l	Inland waters
Chemical Oxygen Demand (COD)	Not to exceed 30 mg/l	Inland waters
Toxicants	Not to be present at levels producing significant toxic effect	Whole zone

Table 6.1b: Water Quality Objectives for Junk Bay Water Control Zone

Parameters	Water Quality Objective	WCZ
Offensive Odour, Tints	Not to be present	Whole zone
Visible foam, oil scum, litter	Not to be present	Whole zone
Dissolved Oxygen (DO) within 2 m of the seabed	Not less than 2.0 mg/L for 90% of samples	Marine waters
Depth-averaged DO	Not less than 4.0 mg/L for 90% of samples	Marine waters excepting fish culture subzones
	Not less than 5.0 mg/L for 90% of samples	Fish culture subzones
	Not less than 4.0 mg/L	Inland waters
5-Bay Biochemical Oxygen Demand (BOD_5)	Change due to waste discharges not to exceed 5 mg/L	Inland waters
Chemical Oxygen Demand (COD)	Change due to waste discharges not to exceed 30 mg/L	Inland waters
pH	To be in the range of 6.5 - 8.5, change due to waste discharges not to exceed 0.2	Marine waters
	To be in the range of 6.0 - 9.0	Inland waters
Salinity	Change due to waste discharges not to exceed 10% of ambient	Whole zone
Temperature	Change due to waste discharges not to exceed 2 ^{o}C	Whole zone
Suspended solids (SS)	Not to raise the ambient level by 30% caused by waste discharges and shall not affect aquatic communities	Marine waters
	Change due to waste discharges not to exceed 25 mg/L of annual median	Inland waters
Unionised Ammonia (UIA)	Annual mean not to exceed 0.021 mg/L as unionised form	Whole zone
Nutrients	Shall not cause excessive algal growth	Marine waters
Total Inorganic Nitrogen (TIN)	Annual mean depth-averaged inorganic nitrogen not to exceed 0.3 mg/L	Marine waters
Dangerous substances	Should not attain such levels as to produce significant toxic effects in humans, fish or any other aquatic organisms	Whole zone
	Waste discharges should not cause a risk to any beneficial use of the aquatic environment	Whole zone
Bacteria	Not exceed 610 per 100ml, calculated as the geometric mean of all samples collected in one calendar year	Secondary contact recreation subzones and fish culture subzones
	Not exceed 1000 per 100ml, calculated as the geometric mean of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days	Inland waters
Colour	Change due to waste discharges not to exceed 50 Hazen units	Inland waters

Technical Memorandum for Effluents Discharge into Drainage and Sewerage Systems, Inland & Coastal Waters (TM-DSS)

6.1.2 Apart from the WQOs, Section 21 of the WPCO also specifies the limits to control the physical, chemical and microbial parameters for effluent discharges into drainage and sewerage system at both inland and coastal waters under the Technical Memorandum for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters (TM-DSS). The discharge limits vary with the effluent flow rates. Sewerage from the proposed development should comply with the standards for effluent discharged into drainage and sewerage systems. **Table 6.2a** and **6.2b** summarise the standards for effluent discharged into marine waters of Victoria Harbour WCZ and Junk Bay WCZ respectively.

Table 6.2a: Standards for effluents discharged into the marine waters of Victoria Harbour Water Control Zone

Flow Rate (m^3/day)	**≤10**	**>10 and ≤200**	**>200 and ≤400**	**>400 and ≤600**	**>600 and ≤800**	**>800 and ≤1000**	**>1000 and ≤1500**	**>1500 and ≤2000**	**>2000 and ≤3000**	**>3000 and ≤4000**	**>4000 and ≤5000**	**>5000 and ≤6000**
pH (pH units)	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10
Temperature (°C)	45	45	45	45	45	45	45	45	45	45	45	45
Colour (lovibond units) (25mm cell length)	4	1	1	1	1	1	1	1	1	1	1	1
Suspended Solids	700	600	600	500	375	300	200	150	100	75	60	40
BOD_5	700	600	600	500	375	300	200	150	100	75	60	40
COD	1500	1200	1200	1000	700	600	400	300	200	100	100	85
Oil & Grease	50	50	50	30	25	20	20	20	20	20	20	20
Iron	20	15	13	10	7.5	6	4	3	2	1.5	1.2	1
Boron	6	5	4	3.5	2.5	2	1.5	1	0.7	0.5	0.4	0.3
Barium	6	5	4	3.5	2.5	2	1.5	1	0.7	0.5	0.4	0.3
Mercury	0.1	0.1	0.05	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Cadmium	0.1	0.1	0.05	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Other toxic metals individually	2	1.5	1	0.8	0.6	0.5	0.32	0.24	0.16	0.12	0.1	0.1
Total toxic metals	4	3	2	1.6	1.2	1	0.64	0.48	0.32	0.24	0.2	0.14
Cyanide	1	0.5	0.5	0.5	0.4	0.3	0.2	0.1	0.1	0.08	0.06	0.04
Phenols	0.5	0.5	0.5	0.3	0.3	0.2	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
Total residual chlorine	1	1	1	1	1	1	1	1	1	1	1	1
Total nitrogen	100	100	100	100	100	100	100	100	100	100	100	50
Total phosphorus	10	10	10	10	10	10	10	10	10	10	10	5
Surfactants (total)	30	20	20	20	15	15	15	15	15	15	15	15
E. coli (counts/100 ml)	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000

Notes:

[1] Extracted from Table 10b of "Technical Memorandum for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters".

[2] All units in mg/L unless otherwise stated; All figures are upper limits unless otherwise indicated.

Table 6.2b: Standards for effluents discharged into the marine waters of Junk Bay Water Control Zone

Flow Rate (m^3/day)	**≤10**	**>10 and ≤200**	**>200 and ≤400**	**>400 and ≤600**	**>600 and ≤800**	**>800 and ≤1000**	**>1000 and ≤1500**	**>1500 and ≤2000**	**>2000 and ≤3000**	**>3000 and ≤4000**	**>4000 and ≤5000**	**>5000 and ≤6000**
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)	40	40	40	40	40	40	40	40	40	40	40	40
Colour (lovibond units) (25mm cell length)	1	1	1	1	1	1	1	1	1	1	1	1
Suspended Solids	50	30	30	30	30	30	30	30	30	30	30	30
BOD_5	50	20	20	20	20	20	20	20	20	20	20	20
COD	100	80	80	80	80	80	80	80	80	80	80	80
Oil & Grease	30	20	20	20	20	20	20	20	20	20	20	10
Iron	15	10	10	7	5	4	3	2	1	1	0.8	0.6
Boron	5	4	3	2	2	1.5	1.1	0.8	0.5	0.4	0.3	0.2
Barium	5	4	3	2	2	1.5	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	0.7	0.5	0.4	0.3	0.2	0.15	0.1	0.1	0.1
Total toxic metals	2	2	1.6	1.4	1	0.8	0.6	0.4	0.3	0.2	0.1	0.1
Cyanide	0.2	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	0.3	0.25	0.2	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
Total residual chlorine	1	1	1	1	1	1	1	1	1	1	1	1
Total nitrogen	100	100	80	80	80	50	50	50	50	50	50	50
Total phosphorus	10	10	8	8	8	8	5	5	5	5	5	5
Surfactants (total)	20	15	15	15	15	15	10	10	10	10	10	10
E. coli (counts/100 ml)	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000

Environmental Impact Assessment Ordinance (EIAO) (Cap. 499), Technical Memorandum on Environmental Impact Assessment Process (TM-EIAO)

6.1.3 The general criteria and guidelines for evaluating and assessing water quality impacts are listed in Annexes 6 and 14 of the TM-EIAO.

Hong Kong Planning Standards and Guidelines

6.1.4 Chapter 9 of the Hong Kong Planning Standards and Guidelines (HKPSG) outlines environmental requirements that need to be considered in land use planning. The recommended guidelines, standards and guidance cover the selection of suitable locations for the developments and sensitive uses, provision of environmental facilities, and design, layout, phasing and operational controls to minimise adverse environmental impacts. It also lists out environmental factors influencing land use planning and recommend buffer distances for land uses.

ProPECC PN 1/94 "Construction Site Drainage"

6.1.5 The Practice Note for Professional Persons (ProPECC Note PN1/94) on Construction Site Drainage provides guidelines for the handling and disposal of construction discharges. It is applicable to this study for control of site runoff and wastewater generated during the construction phase. The types of discharges from construction sites outlined in the ProPECC Note PN1/94 include:

(1) Surface runoff;

(2) Groundwater;

(3) Boring and drilling water;

(4) Wastewater from concrete batching;

(5) Wheel washing water;

(6) Bentonite slurries;

(7) Water for testing and sterilization of water retaining structures and water pipes;

(8) Wastewater from building construction and site facilities; and

(9) Acid cleaning, etching and pickling wastewater.

6.2 Description of Existing Environment

6.2.1 The Study Area is located on the south-western slopes of the Tai Sheung Tok Hill and its nearest river is Tseng Lan Shue Stream. Its existing water quality can be referred to EPD's routine water quality monitoring data from three monitoring stations JR3, JR6 and JR11. The locations of these three monitoring stations are shown in **Figure 227724/E/3001**. In general, the compliance rate for Tseng Lan Shue Stream improved from 79% in 1997 to 87% in 2011. The water quality at JR11 and JR6 were graded as "Excellent" and "Good" and the water quality at downstream improved to "Fair" category due to the continued enforcement of the pollution control legislation, the implementation of Sewerage Master Plans and the extended village sewerage in the catchments. **Table 6.3** presents the EPD's monitoring data.

Table 6.3: Summary of water quality monitoring data for Tseng Lan Shue Stream in 2011

Parameter	Unit	Tseng Lan Shue Stream		
		JR3	JR6	JR11
Dissolved Oxygen (DO)	mg/L	6.5 (4.9-7.5)	7.6 (6.3-8.3)	8.9 (7.9-10.5)
pH	-	7.3 (6.9-7.6)	7.6 (7.3-8.0)	8.0 (7.8-8.1)

Parameter	Unit	Tseng Lan Shue Stream		
		JR3	JR6	JR11
Suspended Solids (SS)	mg/L	8 (<1 - 22)	6 (2 - 35)	2 (1 - 6)
5-day Biochemical Oxygen Demand (BOD_5)	mg/L	8 (4 - 43)	7 (3 - 23)	<1 (<1 - 4)
Chemical Oxygen Demand (COD)	mg/L	17 (10 - 46)	14 (9 - 35)	8 (5 - 13)
Oil & grease	mg/L	0.9 (<0.5 - 3.3)	0.7 (<0.5 - 1.6)	<0.5 (<0.5 - 1.7)
Faecal coliforms	cfu/ 100ml	23,000 (50 - 160,000)	170,000 (21,000 - 500,000)	1,600 (200 - 7,600)
E. coli	cfu/ 100ml	10,000 (7 - 100,000)	56,000 (8,000 - 140,000)	240 (90 - 800)
Ammonia-nitrogen	mg/L	4.35 (0.85 - 12.00)	0.64 (0.34 - 2.60)	0.04 (0.02 - 0.17)
Nitrate-nitrogen	mg/L	1.20 (0.59 - 2.00)	3.50 (1.70 - 4.40)	3.65 (2.30 - 6.90)
Total Kjeldahl nitrogen	mg/L	5.45 (1.60 - 14.00)	2.15 (1.10 - 4.30)	0.47 (0.24 - 0.78)
Ortho-phosphate	mg/L	0.61 (0.21 - 0.96)	0.90 (0.40 - 1.30)	0.55 (0.31 - 1.00)
Total phosphorus, SP	mg/L	0.70 (0.36 - 1.20)	1.10 (0.54 - 1.50)	0.58 (0.34 - 1.00)
Total sulphide	mg/L	<0.02 (<0.02 - 0.04)	<0.02 (<0.02 - 0.04)	<0.02 (<0.02 - <0.02)
Aluminium	µg/L	150 (70 - 230)	120 (60 - 150)	65 (<50 - 80)
Cadmium	µg/L	<0.1 (<0.1- 0.2)	<0.1 (<0.1- <0.1)	<0.1 (<0.1- <0.1)
Chromium	µg/L	<1 (<1- 1)	<1 (<1 - <1)	<1 (<1 - <1)
Copper	µg/L	4 (<1 - 6)	4 (2 - 6)	2 (<1 - 3)
Lead	µg/L	2 (<1 - 7)	1 (<1 - 4)	<1 (<1 - 2)
Zinc	µg/L	30 (20 - 80)	40 (40 - 70)	25 (10 - 60)
Flow	L/s	NM	NM	66 (16 - 360)

Notes:

[1] NM indicates no measurement taken.

[2] Figures in brackets are annual ranges.

6.2.2 There is no existing monitoring data at the streams southeast to the project site (hereinafter named Ma Yau Tong Stream). Thus, additional monitoring in terms of Suspended Solid, Dissolved Oxygen, Temperature, pH, flow rate, nutrients (ammonia and unionized ammonia), BOD_5 and COD, Salinity and *E.coli*. has been conducted at 4 monitoring locations as shown in **Figure 227724/E/3002**. The measurement was carried out three times a week within two consecutive weeks for both dry season (i.e. March 2013) and wet season (i.e. June 2013). The monitoring results are presented in **Table 6.4a** and **6.4b**.

Table 6.4a: Summary of water quality monitoring data for Ma Yau Tong Stream (dry season)

Parameter	Unit	Monitoring Data During Dry Season			
		Location A	Location B	Location C	Location D
Suspended Solids (SS)	mg/L	6.6 (1.2-11.0)	96.1 (0.7-358.5)	1.9 (0.6-3.8)	2.6 (0.8-6.3)
Ammonia as N	mg/L	0.02 (0.01-0.02)	0.73 (<0.01-1.67)	8.53 (5.95-10.45)	8.57 (5.45-13.35)
Unionized Ammonia (as N)	mg/L	<0.01 (<0.01-<0.01)	0.1 (<0.01-0.2)	0.3 (0.2-0.4)	0.2 (0.1-0.4)
Chemical Oxygen Demand	mg/L	6.5 (3.0-11.5)	24.4 (3.0-89.5)	15.8 (14.0-19.5)	16.6 (11.0-23.5)
Biochemical Oxygen Demand	mg/L	1.5 (<1-1.5)	15.1 (<1-52.5)	5.7 (5.0-6.5)	5.4 (4.0-9.0)
pH Value	-	7.8 (7.2-8.3)	8.2 (7.4-8.7)	7.9 (7.8-8.0)	7.8 (7.7-8.0)
Temperature	°C	20.3 (19.3-21.8)	20.8 (19.2-23.6)	21.4 (19.4-23.5)	21.4 (19.1-23.8)
Salinity	g/L	0.1 (<0.1-0.1)	<0.1 (<0.1-0.2)	0.2 (0.1-0.2)	0.2 (<0.1-0.2)
Turbidity	NTU	9.3 (3.0-19.0)	220.3 (3.5-758.0)	4.4 (3.0-7.0)	4.4 (2.5-7.0)
Water Flow	L/s	3 (2-4)	<1 (<1-<1)	16 (12-25)	15 (12-20)
Dissolved Oxygen	mg/L	7.6 (5.0-9.7)	8.3 (5.8-10.0)	7.7 (6.5-9.3)	7.6 (6.9-8.6)
Dissolved Oxygen - % Saturation	%	84.2 (54.9-106.0)	83.2 (68.1-95.4)	83.6 (73.5-92.9)	85.6 (79.5-96.4)
E. coli	cfu/ 100ml	450 (40-2,700)	1,200 (N.D.-20,000)	31,000 (11,000-110,000)	23,000 (6,000-72,000)

Notes:

[1] N.D. indicates not detected.

Table 6.4b: Summary of water quality monitoring data for Ma Yau Tong Stream (wet season)

Parameter	Unit	Monitoring Data During Wet Season			
		Location A	Location B	Location C	Location D
Suspended Solids (SS)	mg/L	15.5 (2.8-37.5)	227.7 (18.6-492.0)	39.6 (2.5-143.5)	104.4 (4.8-201.5)
Ammonia as N	mg/L	0.01 (<0.01-0.02)	0.03 (<0.01-0.07)	0.86 (0.01-2.18)	0.69 (0.03-1.26)
Unionized Ammonia (as N)	mg/L	<0.01 (<0.01-<0.01)	<0.01 (<0.01-<0.01)	0.03 (<0.01-0.1)	<0.01 (<0.01-0.1)

Parameter	Unit	Monitoring Data During Wet Season			
		Location A	Location B	Location C	Location D
Chemical Oxygen Demand	mg/L	6.4 (<2-8.5)	8.0 (3.0-18.5)	7.9 (2.0-14.0)	10.1 (4.0-15.5)
Biochemical Oxygen Demand	mg/L	1.0 (<1-1.0)	1.5 (<1-2.0)	3.5 (<1-5.0)	2.2 (1.0-4.0)
pH Value	-	7.4 (6.7-7.8)	8.1 (8.0-8.6)	7.8 (7.7-7.9)	7.9 (7.8-8.0)
Temperature	°C	23.6 (23.1-24.4)	24.6 (24.0-26.0)	24.9 (23.5-27.3)	24.7 (23.5-27.0)
Salinity	g/L	<0.1 (<0.1-<0.1)	<0.1 (<0.1-<0.1)	<0.1 (<0.1-<0.1)	<0.1 (<0.1-<0.1)
Turbidity	NTU	20.9 (4.5-57.5)	308.6 (32.0-576.5)	48.1 (5.0-168.0)	129.4 (6.0-255.5)
Water Flow	L/s	88 (55-225)	15 (5-30)	38 (20-90)	102 (48-195)
Dissolved Oxygen	mg/L	8.3 (6.9-8.8)	8.1 (8.0-8.3)	7.9 (6.7-8.4)	8.0 (7.6-8.6)
Dissolved Oxygen - % Saturation	%	96.3 (81.5-101.0)	97.7 (94.5-99.0)	94.6 (84.0-99.0)	96.8 (93.0-101.5)
E. coli	cfu/ 100ml	900 (60-22,000)	1,600 (30-24,000)	6,000 (600-33,000)	9,000 (1,000-39,000)

6.2.3 Monitoring data shown in above tables indicate that levels of nutrients at all monitoring locations are low. All monitoring locations have relatively high concentrations of DO. The comparatively higher concentrations of BOD_5 and COD during dry season might be due to the low runoff volume and minor wastewater discharges from nearby villages. Generally, the water quality conditions at Ma Yau Tong Stream are satisfactory except relatively high levels of suspended solids at Location B that discharges construction effluents occasionally from the nearby sites.

6.3 Water Quality Sensitive Receivers & Pollution Sources

Water Quality Sensitive Receivers

6.3.1 Potential water sensitive receivers (WSRs) include Tseng Lan Shue Stream (WSR1) and Ma Yau Tong Stream (WSR2), which are shown in **Figure 227724/E/3001**.

6.3.2 Tseng Lan Shue Stream is a natural stream within 500m boundary of the Study Area and finally discharges the water into Junk Bay. Ma Yau Tong Stream is also a natural stream collecting water from the south-eastern part of the Study Area and Ma Yau Tong Village and finally discharges the water into Victoria Harbour. The section of the Ma Yau Tong Stream tributary between Anderson Road and Po Lam Road is being transformed into drainage pipes under Contract No. CV/2007/03 – Development at Anderson Road – Site Formation and Associated Infrastructure Works (DAR) and likely results in the relatively high level of suspended solids. Such construction works are expected to be completed before the commencement of this Project. Hence, the future water quality of WSR2 would not be affected by current activities by the time of this Project starts.

Pollutions Sources

6.3.3 The Project Site at current stage is vacant and there is no pollution source identified within the Site. However, during construction phase, there would be construction site runoff generated during construction activities and sewage from site workforce that might cause adverse impact to nearby WSRs without proper control. Meanwhile, additional water pollution might be induced by the accidental spillage of chemicals entering into the WSRs in the vicinity, if any. Subject to the findings of land contamination assessment, if groundwater was contaminated, careful handling would be required during construction phase.

6.3.4 During operational phase, there would be surface runoff carrying pollutants, like vehicle dust, tyre scraps and oils and sewage generated from the domestic activities within the development site that would affect nearby WSRs.

6.3.5 Details of the pollution sources are summarized and evaluated in later section.

6.4 Potential Concurrent Projects

6.4.1 No concurrent project related to water quality impact is identified. Thus, cumulative water quality impacts from other projects are not anticipated.

6.5 Assessment Methodology

6.5.1 In accordance with the Study Brief, the area for water quality impact assessment included all areas within a distance of 500m from the Project. The assessment would be extended to include other areas such as stream courses and associated water systems in the vicinity being impacted by the Project if found justifiable.

6.5.2 The major area of concern during construction and operation of the Project are construction site runoff, sewage from workforce and non-point sources discharge such as additional surface runoff due to change of hydrology regime.

6.5.3 Construction methods and configurations, and operation of the Project are also reviewed to identify and predict the likely water quality impacts.

6.5.4 There will be no dredging and reclamation works such that in general the works will have no direct contact with water bodies. Thus, quantification of impacts arising from these works is not required.

6.5.5 The assessment approach is referred to Annex 6 – Criteria for Evaluating Water Pollution and Annex 14 – Guidelines for Assessment of Water Pollution under the TM-EIAO.

6.6 Construction Phase Assessment

General Site Operation

6.6.1 During rainstorm events, construction site runoff would come from the works site (~0.044 km^2 of 10% active areas, which are separated into 2 phases and the maximum phase II construction area has been adopted for conservative assessment) during construction period of around 6 years. According to DSD Stormwater Drainage Manual, the total peak runoff is about 354 m^3/hr under 10-year-return-period rainstorm. The surface runoff might be polluted by:

(1) Runoff and erosion from site surfaces, earth working areas and stockpiles;

(2) Wash water from dust suppression sprays and wheel washing facilities; and

(3) Fuel, oil, solvents and lubricants from maintenance of construction machinery and equipment.

6.6.2 Construction runoff may cause physical, biological and chemical effects. The physical effects include potential blockage of drainage channels and increase of suspended solid levels. 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.

6.6.3 According to the above, mitigation measures should be provided in accordance with the Practice Note for Professional Persons on Construction Site Drainage, Environmental Protection Department, 1994 (ProPECC PN 1/94) and these best management practices should be implemented as far as practicable as below:

(1) 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. 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.

(2) Diversion of natural stormwater should be provided as far as possible. The design of temporary on-site drainage should prevent runoff going through site surface, construction machinery and equipment in order to avoid or minimize polluted runoff. Sedimentation tanks with sufficient capacity, constructed from pre-formed individual cells of approximately 6 to 8 m^3 capacities, are recommended as a general mitigation measure which can be used for settling surface runoff prior to disposal. The system capacity shall be flexible and able to handle multiple inputs from a variety of sources and suited to applications where the influent is pumped.

(3) 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 silt/sediment trap. The silt/sediment traps should be incorporated in the permanent drainage channels to enhance deposition rates.

(4) The design of efficient silt removal facilities should be based on the guidelines in Appendix A1 of ProPECC PN 1/94. The detailed design of the sand/silt traps should be undertaken by the contractor prior to the commencement of construction.

(5) Construction works should be programmed to minimize surface excavation works during the rainy seasons (April to September). All exposed earth areas should be completed and vegetated as soon as possible after earthworks have been completed. 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.

(6) 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.

(7) All open stockpiles of construction materials (for example, aggregates, sand and fill material) of 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.

(8) 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.

(9) 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 summarized in Appendix A2 of ProPECC PN 1/94. Particular attention should be paid to the control of silty surface runoff during storm events.

(10) 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.

(11) 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.

(12) Construction solid waste, debris and rubbish on site should be collected, handled and disposed of properly to avoid water quality impacts.

(13) 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.

(14) Regular environmental audit on the construction site should be carried out in order to prevent any malpractices. Notices should be posted at conspicuous locations to remind the workers not to discharge any sewage or wastewater into the rivers.

6.6.4 By adopting the best management practices, it is anticipated that the impacts of general site construction runoff will be reduced to satisfactory levels before discharges. The details of best management practices will be highly dependent on the actual site condition. Contractor shall apply for a discharge license under WPCO before the commencement of construction.

Sewage from Workforce

6.6.5 Sewage effluents will arise from the sanitary facilities provided for the on-site construction workforce. According to Table T-2 of Guidelines for Estimating Sewage

Flows for Sewage Infrastructure Planning, the unit flow is 0.15 m^3/day/employed populations. With reference to **Chapter 8**, the maximum number of construction workforce is estimated to be around 250 on site. It is therefore anticipated that the total sewage generated per day would be 37.5 m^3 during construction phase. The characteristics of sewage would include high levels of BOD_5, Ammonia and *E. coli* counts.

6.6.6 Portable chemical toilets should be provided for handling the construction sewage generated by the workforce. Assume that the capacity of the chemical toilets would be 0.4m^3 and suck up twice a day under normal practices, around 45 chemical toilets would be required for the whole site at peak hour. And it should be noted that under normal construction periods, less chemical toilets would be needed. In addition, the total number of the chemical toilets would be subject to later detailed design, the capacity of the chemical toilets, and contractor's site practices. Nevertheless, a licensed contractor should be employed to provide appropriate and adequate portable toilets to cater around 37.5 m^3/day sewage and be responsible for appropriate disposal and maintenance. Since portable chemical toilets will be provided, no adverse water quality impact from the workforce sewage is anticipated.

6.6.7 Notices should be posted at conspicuous locations to remind the workers not to discharge any sewage or wastewater into the nearby environment during the construction phase of the Project. Regular environmental audit on the construction site should be conducted in order to provide an effective control of any malpractices and achieve continual improvement of environmental performance on site. It is anticipated that sewage generation during the construction phase of the Project would not cause water quality impact after undertaking all required measures.

Accidental Spillages

6.6.8 A variety of chemicals may be used during construction activities. These chemicals may include petroleum products, adhesives, lubrication oil, grease, acid and alkaline solutions/solvents and other chemicals. Accidental spillage of chemicals in the works areas may contaminate the surface soils. When the contaminated soil was washed away by construction site runoff, entering the water bodies nearby or the spillage of chemicals entered the water bodies nearby directly, these would cause water pollutions.

6.6.9 To prevent accidental spillage of chemicals, proper storage and handling facilities should be provided. All the tanks, containers and storage area should be bunded and the locations should be locked as far as possible from the sensitive watercourse and storm drains. The Contractor is required to register as a chemical waste producer if chemical wastes would be generated from the construction activities. The storage of chemical waste arising from the construction activities should be well managed with suitable labels and warnings while the disposal of those chemical wastes should comply with the requirement states in Waste Disposal Ordinance (Cap 354) as well as Waste Disposal (Chemical Waste) (General) Regulations.

Stream Alternation

6.6.10 During construction phase, there would be no stream alternation due to the development of Project. Hence, adverse water quality impact is not anticipated during construction phase.

Groundwater from Contaminated Area

6.6.11 Site investigation (SI) works has been recommended to investigate the potential land contamination prior to construction (See **Chapter 9**) after the land was resumed. If contaminated site found, discharge/ recharge of groundwater generated from the contaminated area may affect the groundwater quality, if uncontrolled.

6.6.12 The Contractor should apply for a discharge licence under the WPCO through the Regional Office of EPD for groundwater discharge. Prior to the excavation works within these potentially contaminated areas, the groundwater quality should be reviewed during the process of discharge license application. The compliancy to the TM-DSS and the existence of prohibited substance should be confirmed after further SI. 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 TM-DSS or properly recharged into the ground.

6.6.13 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 to undetectable range. All treated effluent from wastewater treatment plant shall meet the requirements as stated in TM-DSS and should be discharged into the foul sewers.

6.6.14 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-DSS. 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 should be removed as necessary by installing the petrol interceptor.

6.7 Operational Phase Assessment

Hydrological Change and Surface Runoff

6.7.1 Under existing scenario, the area is mainly unpaved area. The only change in hydrology regime due to the project involves the additional paved area of about 40ha, which will affect the infiltration rate in the catchment. Increasing flood risk as a result of extra stormwater runoff may occur and this would be assessed in the Drainage Impact Assessment Report under this study. In terms of water quality impact, additional loading would be due to addition runoff (known as non-point source pollution) from the reduction of infiltration rate from the development. Worst scenario will be due to first flush under heavy rainstorm events. On the other hand, vehicle dust, tyre scraps and oils might be washed away from the road surface / open areas to the nearby water courses by surface runoff or road surface cleaning.

6.7.2 According to “Stormwater Drainage Manual”, annual rainfall in Hong Kong is around 2200mm. However, EPD’s report on "Update on Cumulative Water Quality and Hydrological Effect of Coastal Developments and Upgrading of Assessment Tool-Pollution Loading Inventory Report" (Pollution Loading Report) indicates only rainfall events of sufficient intensity and volume would give rise to runoff and that runoff percentage for the wet season is about 82% while dry season is only 44%. Therefore, only 1386mm of 2200mm annual rainfall would be effective rainfall to generate additional runoff (i.e. 1386mm=2200mm×(82%+44%)/2). Non-point source pollution would be generated from the paved road, of which total surface area is around $0.13km^2$. Therefore, assume 0.6 as the additional runoff coefficient (0.9 of runoff coefficient is adopted for paved areas while 0.3 runoff coefficient for unpaved/undeveloped area. Hence, the additional runoff coefficient due to the development is 0.6=0.9-0.3), the total additional average daily runoff will be about $0.6 \times 1386mm/year \times 0.13km^2 = 296\ m^3/day$. According to Pollution Loading Report, the typical concentration of BOD_5, total nitrogen and total phosphate in Hong Kong stormwater are 22.5 mg/L, 2.0 mg/L and 0.2 mg/L respectively. By adopting 20% removal efficiency with the implementation of silt traps, the induced loading due to the Project from the paved road surface on BOD_5, total nitrogen and total phosphate will then be 5.3 kg/day, 0.5 kg/day and 0.05 kg/day respectively. **Table 6.5** summarizes the net increase of loading from the paved road surface runoff due to the change of hydrological regime.

Table 6.5 Induced loading from paved road surface runoff

Parameters	Concentraiton (mg/L)	Induced Loading (kg/day)
BOD_5	22.5	5.3
Total nitrogen	2.0	0.5
Total phosphate	0.2	0.05

Note:

[1] 1386mm rainfall is assumed to generate the additional runoff.

[2] In accordance with the "Stormwater Drainage Manual", the runoff coefficient for paved area is around 0.9 while for the unpaved area is around 0.3. 0.6 as the additional runoff coefficient is assumed

[3] Typical concentrations of BOD_5, total nitrogen and total phosphate are 22.5 mg/L, 2.0 mg/L and 0.2 mg/L.

[4] 20% removal efficiency of the silt traps is adopted.

6.7.3 To minimize the potential impact from the non-point source pollution, the capacities of road drainage system shall be adequate to the target drainage performance, subject to detailed design and requirement of relevant government departments. Proper drainage systems with silt traps should be installed. The design of road gullies with silt traps should be incorporated in later detailed design.

6.7.4 The surface runoff could be controlled by best management practice. It could be intercepted by properly designed and managed silt traps at appropriate spacings so that common roadside debris, refuse and fallen leaves etc. can be captured before allowing the runoff to drain into Ma Yau Tong Stream. The operator should undertake the cleaning at a frequent interval and the frequency should be increased to suit actual site conditions. Moreover, it is recommended each of the cleaning events should be carried out during low traffic flow period. After removal of the pollutants, the pollution levels from stormwater would be much reduced.

6.7.5 Given the stochastic nature of non-point source pollution and adopting flexible management and cleaning frequency to suit site conditions, the impact to the receiving water body is insignificant.

Sewage and Sewerage System

6.7.6 During operational phase, sewage discharge will be the major water pollution source. It is not required to construct any new sewage treatment facilities, provided that the total population is less than 25,000. There will be adequate capacity for existing sewage system and all the sewage will be diverted to the existing sewage system. No sewage overflow and emergency discharge is anticipated and no additional mitigation measure is required. Details of sewage and sewerage implication are presented in **Chapter 7**.

6.8 Residual Impacts

6.8.1 No adverse residual impact is anticipated during the construction and operation of the Project with the implementation of mitigation measures.

6.9 Environmental Acceptability of Schedule 2 Designated Projects

6.9.1 The engineering feasibility study of the proposed ARQ development is a Schedule 3 Designed Project (DP) under the EIAO, whilst there will be two Schedule 2 DPs; i.e. road improvement works and rock cavern developments under the ARQ project. Details of these two Schedule 2 DPs are provided in **Section 1.4** and shown in **Figure 227724/E/0002**.

Road Improvement Works

6.9.2 Three road improvement works were proposed at junction of (J/O) Lin Tak Road and Sau Mau Ping Road, at J/O Clear Water Bay Road and Road L1 of Development of Anderson Road (DAR), as well as at the new merging lane at New Clear Water Bay Road near Shun Lee Tsuen Road. In view of the land based road project nature, adverse water quality impact is considered to be minimal and surface runoff will be the only key issue. During construction phase, site runoff could be mitigated by applying the generic site practices as described in ProPECC PN 1/94.

6.9.3 During operational phase, non-point source pollution due to road runoff would be the key issues. The capacities of road drainage system shall be adequate to the target drainage performance, subject to detailed design and requirement of relevant government departments. Proper drainage systems with silt traps should be installed. The design of road gullies with silt traps should be incorporated in later detailed design. The surface runoff could be controlled by best management practice. It could be intercepted by properly designed and managed silt traps at appropriate spacing so that common roadside debris, refuse and fallen leaves etc. can be captured before allowing the runoff to drain into main drainage culverts. The operator should undertake the cleaning at a frequent interval and the frequency should be increased to suit actual site conditions. Moreover, it is recommended each of the cleaning events should be carried out during low traffic flow period. After removal of the pollutants, the pollution levels from stormwater would be much reduced. Given the stochastic nature of non-point source pollution and adopting flexible management and cleaning frequency to suit site conditions, the impact to the receiving water body is insignificant.

6.9.4 Nevertheless, the detailed water quality impact of this Schedule 2 DP will be further investigated in a separate EIA under the EIAO.

Rock Cavern Developments

6.9.5 The proposed cavern development is located on the hillside of the proposed ARQ Development. Groundwater discharge with high level of suspended solids during cavern excavations will be the key water quality impact during construction phase. In general, the contractor should apply for a discharge licence under the WPCO prior to the excavation works. On-site treatment prior to discharge will be required such that to comply the TM-DSS. Further assessment on such contaminated groundwater discharge and surface run-off with high level of suspended solids will be conducted in a separated EIA in next stage of study.

6.9.6 According to the best available information at this stage, the caverns are proposed for commercial use (e.g. food and beverage) as well as museum. In view of its operational nature, adverse water quality impact is not anticipated. Nevertheless, the detailed water quality impact of this Schedule 2 DP will be further investigated in a separate EIA under the EIAO.

6.10 Conclusion

6.10.1 With full implementation of the mitigation measures, no adverse impact is anticipated. No adverse residual impact and cumulative impact is anticipated during both construction and operational phases of the Project. In order to ensure the effectiveness of the implemented mitigation measures, regular site audit should be undertaken routinely to inspect the construction activities and works areas during construction phase.