Highways Department

Route 11 (Section between Yuen Long and North Lantau)

Environmental Impact Assessment Report

Final | September 2023

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 284104

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5.1 Legislations, Standards, Guidelines and Criteria

5.1.1 General

5.1.1.1 The relevant legislations, standards, guidelines and criteria applicable to this Study for the assessment of water quality impacts include:

- Environmental Impact Assessment Ordinance (EIAO) (Cap. 499);
- Water Pollution Control Ordinance (WPCO) (Cap. 358);
- Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters (TM-DSS);
- Hong Kong Planning Standards and Guidelines (HKPSG);
- ProPECC PN 1/94 “Construction Site Drainage”;
- ProPECC PN 5/93 “Drainage Plans Subject to Comment by the Environmental Protection Department”;
- Environment, Transport and Works Bureau (ETWB) Technical Circular (Works) No. 5/2005: Protection of Natural Streams/Rivers from Adverse Impacts Arising from Construction Works;
- Water Supplies Department’s (WSD) Target Values of Sea Water Quality for Flushing Supply at Intake Point of Salt Water Pumping Station; and
- Assessment Criteria for Heavy Metals and Trace Organics.

5.1.2 Environmental Impact Assessment Ordinance (EIAO) (Cap. 499)

5.1.2.1 EIAO (Cap. 499) provides the major statutory framework for the Environmental Impact Assessment (EIA) in Hong Kong. Under Section 16 of the EIAO, EPD issued the Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM) which specifies the assessment methods and criteria for EIA process. Annexes 6 and 14 of the EIAO-TM stipulate the “Criteria for Evaluating Water Pollution” and “Guidelines for Assessment of Water Pollution” respectively.

5.1.3 Water Pollution Control Ordinance (WPCO) (Cap. 358)

5.1.3.1 WPCO (Cap. 358) provides the major statutory framework for the protection and control of water quality in Hong Kong. According to the Ordinance and its subsidiary legislation, the entire Hong Kong waters are divided into ten Water Control Zones (WCZs) and four supplementary WCZs. Each WCZ has a designated set of statutory Water Quality Objectives (WQOs). The WQOs set limits for different parameters that should be achieved in order to protect specific beneficial uses and conservation goals of each of the zones.

5.1.3.2 The Project is situated within North Western, Western Buffer, and Deep Bay WCZs, the water quality objectives for both WCZs are summarized in **Table 5.1**.

Table 5.1 WQOs for North Western, Western Buffer and Deep Bay WCZs

Water Quality Objectives (WQO)	North Western WCZ	Western Buffer WCZ	Deep Bay WCZ
Aesthetic Appearance			
• Tarry residues, floating wood, articles made of glass, plastic, rubber or any other substances should be absent. • Mineral oil should not be visible on the surface. Surfactants should not give rise to a lasting foam. • There should be no recognisable sewage-derived debris. • Floating, submerged and semi-submerged objects of a size likely to interfere with the free movement of vessels, or cause damage to vessels, should be absent.	Whole Zone	Whole Zone	Whole Zone
• Waste discharges shall cause no objectionable odours or discolouration of the water. • Waste discharges shall not cause the water to contain substances which settle to form objectionable deposits.	Whole Zone	N/A	Whole Zone
• There should be no objectionable odours or discoloration of the water. • The water should not contain substances which settle to form objectionable deposits.	N/A	Whole Zone	N/A
Bacteria			
• The level of *Escherichia coli* should not exceed 610 per 100mL, calculated as the geometric mean of all samples collected in a calendar year.	Secondary Contact Recreation Subzones	Secondary Contact Recreation Subzone & Fish Culture Zones	Secondary Contact Recreation Subzone and Mariculture Subzone (L.N. 455 of 1991)
• The level of *Escherichia coli* should not exceed 180 per 100 mL, calculated as the geometric mean of all samples collected from March to October inclusive. Samples should be taken at least 3 times in one calendar month at intervals of between 3 and 14 days.	Bathing Beach Subzones	Recreation Subzone	Yung Long Bathing beach Subzone (L.N. 455 of 1991)
• The level of *Escherichia coli* should be less than 1 per 100 mL, calculated as the geometric mean of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	N/A	Water Gathering Ground Subzones	N/A

Water Quality Objectives (WQO)	North Western WCZ	Western Buffer WCZ	Deep Bay WCZ
• The level of *Escherichia coli* should be less than 1 per 100 mL, calculated as the running median of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Tuen Mun (A) and Tuen Mun (B) Subzones and Water Gathering Ground Subzones	N/A	N/A
• The level of *Escherichia coli* should not exceed 1,000 per 100 mL, calculated as the running median of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Tuen Mun (C) Subzone and other inland waters	Other Inland Waters	Yuen Long & Kam Tin (Lower) Subzone and other inland waters
• The level of *Escherichia coli* should be zero per 100 mL, calculated as the running median of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	N/A	N/A	Yuen Long & Kam Tin (Upper) Subzone, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Subzones
Colour			
• Waste discharges shall not cause the colour of water to exceed 30 Hazen units.	Tuen Mun (A) and Tuen Mun (B) Subzones and Water Gathering Ground Subzones	N/A	Yuen Long & Kam Tin (Upper) Subzone, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground
• Waste discharges shall not cause the colour of water to exceed 50 Hazen units.	Tuen Mun (C) Subzone and other inland waters	N/A	Yuen Long & Kam Tin (Lower) Subzone and other inland waters
• Human activity should not cause the colour of water to exceed 30 Hazen units.	N/A	Water Gathering Ground Subzones	N/A
• Human activity should not cause the colour of water to exceed 50 Hazen units.	N/A	Other Inland Waters	N/A

Water Quality Objectives (WQO)	North Western WCZ	Western Buffer WCZ	Deep Bay WCZ
Dissolved Oxygen			
• Waste discharges shall not cause the level of dissolved oxygen to fall below 4 mg/L for 90% of the sampling occasions during the year; values should be calculated as the water column average (arithmetic mean of at least 3 measurements at 1 metre below surface, mid-depth, and 1 metre above seabed). In addition, the concentration of dissolved oxygen should not be less than 2 mg/L within 2 metres of the seabed for 90% of the sampling occasions during the year.	Marine Waters	N/A	N/A
• Waste discharges shall not cause the level of dissolved oxygen to fall below 4 mg/L for 90% of the sampling occasions during the year; values should be calculated as the water column average (arithmetic mean of at least 2 measurements at 1 metre below surface and 1 metre above seabed). In addition, the concentration of dissolved oxygen should not be less than 2 milligrams per litre within 2 metres of the seabed for 90% of the sampling occasions during the year.	N/A	N/A	Outer Marine Subzone excepting Mariculture Subzone
• Waste discharges shall not cause the level of dissolved oxygen to be less than 4 mg/L.	Tuen Mun (A), Tuen Mun (B) and Tuen Mun (C) Subzones, Water Gathering Ground Subzones and other inland waters	N/A	Yuen Long & Kam Tin (Upper and Lower) Subzones, Beas Subzone, Indus Subzone, Ganges Subzone, Water Gathering Ground Subzones and other inland waters of the Zone

Water Quality Objectives (WQO)	North Western WCZ	Western Buffer WCZ	Deep Bay WCZ
• The dissolved oxygen level should not be less than 5 mg/L for 90% of the sampling occasions during the year; values should be calculated as water column average (arithmetic mean of at least 3 measurements at 1 metre below surface, mid-depth and 1 metre above seabed). In addition, the concentration of dissolved oxygen should not be less than 2 mg/L within 2 metres of the seabed for 90% of the sampling occasions during the year.	N/A	Fish Culture Subzones	N/A
• The level of dissolved oxygen should not fall below 4 mg/L for 90% of the sampling occasions during the whole year; values should be calculated as the annual water column average (arithmetic mean of at least 3 measurements at 1 metre below surface, mid-depth and 1 metre above seaed). In addition, the concentration of dissolved oxygen should not be less than 2 mg/L within 2 metres of the seabed for 90% of the sampling occasions during the whole year.	N/A	Marine Waters Except Fish Culture Subzones	N/A
• The level of dissolved oxygen should not be less than 4 mg/L.	N/A	Water Gathering Ground Subzones and Other Inland Waters	N/A
• Waste discharges shall not cause the level of dissolved oxygen to fall below 4 mg/L for 90% of the sampling occasions during the year; values should be taken at 1 metre below surface.	N/A	N/A	Inner Marine Subzone excepting Mariculture Subzone
• The dissolved oxygen level should not be less than 5 mg/L for 90% of the sampling occasions during the year; values should be taken at 1 metre below surface.	N/A	N/A	Mariculture Subzone
pH			
• The pH of the water should be within the range of 6.5-8.5 units. In addition, waste discharges shall not cause the natural pH range to be extended by more than 0.2 units.	Marine Waters excepting Bathing Beach Subzones	N/A	Marine waters excepting Yung Long Bathing Beach Subzone

Water Quality Objectives (WQO)	North Western WCZ	Western Buffer WCZ	Deep Bay WCZ
• The pH of the water should be within the range of 6.0-9.0 units.	Other Inland Waters	N/A	Other Inland Waters
• The pH of the water should be within the range of 6.0-9.0 units for 95% of samples. In addition, waste discharges shall not cause the natural pH range to be extended by more than 0.5 units.	Bathing Beach Subzones	N/A	Yung Long Bathing Beach Subzone
• Waste discharges shall not cause the pH of the water to exceed the range of 6.5–8.5 units.	Tuen Mun (A), Tuen Mun (B) and Tuen Mun (C) Subzones and Water Gathering Ground Subzones	N/A	Yuen Long & Kam Tin (Upper and Lower) Subzones, Beas Subzone, Indus Subzone, Ganges Subzone, Water Gathering Ground Subzones
• The pH of the water should be within the range of 6.5-8.5 units. In addition, human activity should not cause the natural pH range to be extended by more than 0.2 unit.	N/A	Marine Waters	N/A
• Human activity should not cause the pH of the water to exceed the range of 6.0-9.0 units.	N/A	Other inland waters	N/A
• Human activity should not cause the pH of the water to exceed the range of 6.5-8.5 units.	N/A	Water Gathering Ground Subzones	N/A
Temperatures			
• Waste discharges shall not cause the natural daily temperature range to change by more than 2.0°C.	Whole Zone	N/A	Whole Zone
• Human activity should not cause the natural daily temperature range to change by more than 2.0ºC.	N/A	Whole Zone	N/A
Salinity			
• Waste Discharges shall not cause the natural ambient salinity level to change by more than 10%.	Whole Zone	N/A	Whole Zone
• Human activity shall not cause the natural ambient salinity level to change by more than 10%.	N/A	Whole Zone	N/A
Suspended Solids			
• Waste discharges shall neither cause the natural ambient level to be raised by 30% nor give rise to accumulation of suspended solids which may adversely affect aquatic communities.	Marine Waters	N/A	Marine Waters

Water Quality Objectives (WQO)	North Western WCZ	Western Buffer WCZ	Deep Bay WCZ
• Waste discharges shall not cause the annual median of suspended solids to exceed 20 mg/L.	Tuen Mun (A), Tuen Mun (B) and Tuen Mun (C) Subzones and Water Gathering Ground Subzones	N/A	Yuen Long & Kam Tin (Upper and Lower) Subzones, Beas Subzone, Indus Subzone, Ganges Subzone, Water Gathering Ground Subzones and other inland waters
• Waste discharges shall not cause the annual median of suspended solids to exceed 25 mg/L.	Other Inland Waters	N/A	N/A
• Human activity should neither cause the natural ambient level to be raised by more than 30% nor give rise to accumulation of suspended solids which may adversely affect aquatic communities.	N/A	Marine Waters	N/A
• Human activity should not cause the annual median of suspended solids to exceed 20 mg/L.	N/A	Water Gathering Ground Subzones	N/A
• Human activity should not cause the annual median of suspended solids to exceed 25 mg/L.	N/A	Other Inland Waters	N/A
Ammonia			
• The un-ionised ammoniacal nitrogen level should not be more than 0.021 mg/L calculated as the annual average (arithmetic mean).	Whole Zone	Whole Zone	Whole Zone
Nutrients			
• Nutrients shall not be present in quantities sufficient to cause excessive or nuisance growth of algae or other aquatic plants.	Marine Waters	Marine Waters	Inner and Outer marine Subzones
• Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.3 mg/L, expressed as annual water column average (arithmetic mean of at least 3 measurements at 1 metre below surface, mid-depth and 1 metre above seabed).	Castle Peak Bay Subzone	N/A	N/A

Water Quality Objectives (WQO)	North Western WCZ	Western Buffer WCZ	Deep Bay WCZ
• Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.5 mg/L, expressed as annual water column average (arithmetic mean of at least 3 measurements at 1 metre below surface, mid-depth and 1 metre above seabed).	Marine Waters excepting Castle Peak Bay Subzone	N/A	N/A
• Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.5 mg/L, expressed as annual water column average (arithmetic mean of at least 2 measurements at 1 metre below surface and 1 metre above seabed).	N/A	N/A	Outer Marine Subzone
• Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.4 mg/L, expressed as annual water column average (arithmetic mean of at least 3 measurements at 1 metre below surface, mid-depth and 1 metre above seabed).	N/A	Marine Waters	N/A
• Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.7 mg/L, expressed as annual mean.	N/A	N/A	Inner Marine Subzone
5-Day Biochemical Oxygen Demand			
• Waste discharges shall not cause the 5-day biochemical oxygen demand to exceed 3 mg/L.	Tuen Mun (A), Tuen Mun (B) and Tuen Mun (C) Subzones and Water Gathering Ground Subzones	N/A	Yuen Long & Kam Tin (Upper) Subzone, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground
• Waste discharges shall not cause the 5-day biochemical oxygen demand to exceed 5 mg/L.	Other Inland Waters	N/A	Yuen Long & Kam Tin (Lower) Subzone and other inland waters
• The 5-day biochemical oxygen demand should not exceed 3 mg/L.	N/A	Water Gathering Ground Subzones	N/A
• The 5-day biochemical oxygen demand should not exceed 5 mg/L.	N/A	Other Inland Waters	N/A

Water Quality Objectives (WQO)	North Western WCZ	Western Buffer WCZ	Deep Bay WCZ
Chemical Oxygen Demand			
• Waste discharges shall not cause the chemical oxygen demand to exceed 15 mg/L.	Tuen Mun (A), Tuen Mun (B) and Tuen Mun (C) Subzones and Water Gathering Ground Subzones	N/A	Yuen Long & Kam Tin (Upper) Subzone, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Subzones
• Waste discharges shall not cause the chemical oxygen demand to exceed 30 mg/L.	Other Inland Waters	N/A	Yuen Long & Kam Tin (Lower) Subzone and other inland waters
• The chemical oxygen demand should not exceed 15 mg/L.	N/A	Water Gathering Ground Subzones	N/A
• The chemical oxygen demand should not exceed 30 mg/L.	N/A	Other Inland Waters	N/A
Toxins			
• Waste discharges shall not cause the toxins in water to attain such levels as to produce significant toxic carcinogenic, mutagenic or teratogenic effects in humans, fish or any other aquatic organisms, with due regard to biologically cumulative effects in food chains and to toxicant interactions with each other. • Waste discharges shall not cause a risk to any beneficial use of the aquatic environment.	Whole Zone	N/A	Whole Zone
• Toxic substances in the water should not attain such levels as to produce significant toxic, carcinogenic, mutagenic or teratogenic effects in humans, fish or any other aquatic organisms, with due regard to biologically cumulative effects in food chains and to interactions of toxic substances with each other. • Human activity should not cause a risk to any beneficial use of the aquatic environment.	N/A	Whole Zone	N/A
Phenol			
• Phenols shall not be present in such quantities as to produce a specific odour, or in concentration greater than 0.05 mg/L as C_6H_5OH.	Bathing Beach Subzones	N/A	Yung Long Bathing Beach Subzone

Water Quality Objectives (WQO)	North Western WCZ	Western Buffer WCZ	Deep Bay WCZ
Turbidity / Light Penetration			
• Waste discharges shall not reduce light transmission substantially from the normal level.	Bathing Beach Subzones	Bathing Beach Subzones	Yung Long Bathing Beach Subzone

5.1.4 Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters (TM-DSS)

5.1.4.1 Under Section 21 of the WPCO (Cap. 358), TM-DSS was issued to control the physical, chemical, and microbial quality of effluent discharges into foul sewers, stormwater drains, inland and coastal waters. Specific limits apply for different areas and are different between surface waters and sewers, and the limits vary with the rate of effluent flow. Under the TM-DSS, any effluents discharged from the Project must comply with pollutant concentration standards defined by EPD and are specified in license conditions for any new discharge.

5.1.5 Hong Kong Planning Standards and Guidelines (HKPSG)

5.1.5.1 Chapter 9 of HKPSG outlines the 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 provision of environmental facilities, design, layout, phasing, and operational controls to minimise adverse environmental impact. It lists out environmental factors influencing land use planning and recommends buffer distances for land uses.

5.1.5.2 Section 5 under Chapter 9 of HKPSG provides broad guidelines on water quality which includes the principal framework for planning against water pollution. The overall objectives for planning against water pollution are:

- Achieving and maintaining the quality of inland waters, coastal waters, marine waters and groundwaters so that they can be used for their legitimate purposes;
- Providing adequate public sewerage, wastewater treatment and disposal facilities for all wastewaters; and
- Putting in place and enforce water pollution control legislation aimed at safeguarding the health and welfare of the community.

5.1.5.3 With reference to the aforementioned part of HKPSG, a list of potentially polluting and sensitive uses is summarized below in **Table 5.2**.

Table 5.2 Potential Polluting Sources and Water Sensitive Uses

Potential Polluting Sources	Water Sensitive Uses
• Industry and agriculture (including livestock keeping and slaughterhouses); • Sewage disposal (including sewage from private residential developments); • Civil engineering works (including all building works, well boring, ground investigation, dredging, reclamation, excavation of fill, man-made lagoons etc.); and	• Bathing beaches; • Aquaculture and fisheries; • Agriculture; • Residential and recreational development; • Typhoon shelters, marinas and boat parks; • Water gathering grounds; • Nature reserves; • Sites of Special scientific Interest; • Marine parks/marine reserves; • Coastal protection areas;

Potential Polluting Sources	Water Sensitive Uses
• Transport facilities.	• Conservation areas; and • Fish spawning grounds.

5.1.6 ProPECC PN 1/94: "Construction Site Drainage"

5.1.6.1 Professional Persons Environmental Consultative Committee Practice Note (ProPECC PN) 1/94 on construction site drainage provides guidelines for the handling and disposal of construction discharges. This note is applicable for the control of site run-off and wastewater generated during the construction phase of the Project.

5.1.6.2 The types of discharges from construction sites outlined in the ProPECC PN 1/94 include:

- Surface run-off;
- Groundwater;
- Boring and drilling water;
- Wastewater from concrete batching and precast concrete casting;
- Wheel washing water;
- Water for testing and sterilisation of water retaining structures and water pipes;
- Wastewater from building construction;
- Acid cleaning, etching, and pickling wastewater; and
- Wastewater from site facilities.

5.1.7 ProPECC PN 5/93: "Drainage Plans subject to Comment by the Environmental Protection Department"

5.1.7.1 ProPECC PN 5/93 issued by EPD provides guidelines on the environmental design and pollution control in drainage plans submitted under Building (standards of Sanitary Fitments, Plumbing, Drainage Work and Latrines) Regulations 40(1), 40(2), 41(1), and 90. Any submitted drainage plans submitted shall be referred to EPD for comment on whether there may be concerns regarding pollution control.

5.1.8 Environment, Transp ort and Works Bureau (ETWB) Technical Circular (Works) No. 5/2005: "Protection of Natural Streams/Rivers from Adverse Impacts Arising from Construction Works"

5.1.8.1 The ETWB TC (W) No. 5/2005 provides a framework to better protect all natural streams/rivers from the adverse impacts of construction works. The procedures promulgated under the Circular aims to clarify and strengthen existing measures for protection of natural streams/rivers from both government and private projects/developments. The guidelines and precautionary mitigation measures given in the Circular should be followed to the best of abilities to protect inland watercourses at or near the Project area during the construction phase.

5.1.9 Water Supplies Department's (WSD) Target Values of Sea Water Quality for Flushing Supply at Intake Point of Salt Water Pumping Station

5.1.9.1 The criteria for assessing the water quality impact on the WSD's seawater intakes are based on the Target Values of Sea Water Quality for Flushing Supply at Intake Point of Salt Water Pumping Station (at intake point) issued by the WSD and are summarized under **Table 5.3**.

Table 5.3 WSD's Target values of Sea Water Quality at Intake Point of Salt Water Pumping Stations

Parameter	Target Value
Colour	< 20 Hazen Unit
Turbidity	< 10 Nephelometric Turbidity unit (N.T.U.)
Threshold Odour No.	< 100 odour unit
Ammoniacal Nitrogen	< 1 mg/l
Suspended Solids	< 10 mg/l
Dissolved Oxygen	> 2 mg/l
Biochemical Oxygen Demand	< 10 mg/l
Synthetic Detergents	< 5 mg/l
E. coli	< 20,000 cfu/100 ml

5.1.10 Assessment Criteria for Heavy Metals and Trace Organics

5.1.10.1 There are no existing legislations or guidelines for heavy metals, metalloids, trace organics (i.e. polycyclic aromatic hydrocarbons (PAH) and polychlorinated biphenyls (PCB)), and organotin (i.e. tributyltin (TBT) at water sensitive receivers (WSRs) in Hong Kong waters. According to the common practices in previous EIA studies, conservative criteria were set out by comparing different countries standards such as USA, Australia, and New Zealand. The lowest values from various international standards have been adopted as the assessment criteria. The adopted criteria for heavy metals and trace organics are presented in **Table 5.4**.

Table 5.4 Proposed Assessment Criteria for Heavy Metal and Trace Organics at WSRs

Heavy Metal/Metalloids/Trace Organics	Proposed Criteria (μg/L)	Reference
Arsenic	13	1
Cadmium	5.5	1
Chromium	4.4	1
Copper	1.3	1
Lead	4.4	1
Mercury	0.4	1
Nickel	70	1
Silver	1.4	1
Zinc	8	1
Total PAHs	0.2	2
PCBs	0.03	2
TBT	0.006	2

References:

[1] Australian Department of Agriculture, Water and the Environment, Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2019). For chromium, the more stringent standard (i.e. chromium(VI)) was adopted. For arsenic, since there was no standard for marine water, the more stringent standard for freshwater (i.e. arsenic(V)) was adopted.

[2] U.S. Environmental Protection Agency, National Recommended Water Quality Criteria (2009). The Criteria Continuous Concentration (CCC) is an estimate of the highest concentration of a material in surface marine water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect, and was hence adopted as the criteria.

5.2 Baseline Conditions

5.2.1 Marine Water

5.2.1.1 The marine water within the assessment area (see **Section 5.3**) of the Project includes North Western and Western Buffer WCZs. The marine water of Deep Bay WCZ is not at the vicinity of the Project's alignment and work sites.

5.2.1.2 North Western WCZ is located at the western side of Hong Kong and covers the waters around the North and Western side of Lantau Island, Tuen Mun, Sha Chau, and Lung Kwu Chau. According to EPD's Marine Water Quality of Hong Kong 2021 report, the overall WQO compliance rate of the North Western WCZ was 89% in year 2021. The Dissolved Oxygen (DO) and ammonia-nitrogen (NH_3-N) WQOs were fully met. However, for Total Inorganic Nitrogen (TIN), the WQO was 67% under the influence of high background levels in the Pearl River Estuary. For the past 5 years, the WQO compliance rate has fluctuated, and there was an increase from 72% in Years 2017, to 89% in Years 2018 and 2019, before declining to 67% in 2020, and eventually rising back to 89% in 2021.

5.2.1.3 Western Buffer WCZ is located at the central areas of Hong Kong, and covers the waters around Tsing Lung Tau (TLT), Tsing Yi towards the north, and Ap Lei Chau towards the south. The Western Buffer WCZ fully achieved the WQOs in 2021, since the commissioning of the Harbour Area Treatment Scheme Advance Disinfection Facilities (HATS ADF) in 2021, the *E. coli* levels in the WCZ decreased substantially by about 90%.

5.2.1.4 The water quality monitoring data from monitoring stations NM1, NM2 of North Western WCZ, and WM4 of Western Buffer WCZ in 2021 is presented in **Table 5.5** below.

Table 5.5 Summary of EPD's Routine Marine Water Quality Data for North Western and Western Buffer WCZs in 2021

Parameters		North Western WCZ[1,2,3,4,5,6]		Western Buffer WCZ[1,2,3,4,5,6]
		NM1	NM2	WM4
Temperature (°C)		24.5 (19.3 - 26.8)	24.8 (19.5 - 27.9)	24.4 (19.8 - 28.4)
Salinity (ppt)		30.6 (27.1 - 33.5)	29.3 (22.9 - 33.5)	31.5 (29.1 - 33.5)
Dissolved Oxygen (mg/L)	Depth Averaged	4.8 (3.5 - 6.3)	4.9 (4.1 - 5.7)	4.6 (3.6 - 5.6)
	Bottom	4.2 (2.2 - 6.3)	4.9 (3.3 - 6.7)	4.2 (2.4 - 6.0)
Dissolved Oxygen (% Saturation)	Depth Averaged	67 (51 - 83)	70 (59 - 82)	65 (52 - 81)
	Bottom	59 (31 - 85)	69 (47 - 90)	60 (35 - 84)
pH		7.5 (7.2 - 7.9)	7.5 (7.2 - 7.9)	7.5 (7.2 - 7.9)
Secchi Disc Depth (m)		2.8 (1.5 - 5.2)	2.3 (1.7 - 3.5)	2.5 (1.6 - 4.4)
Turbidity (NTU)		6.5 (3.0 - 11.5)	6.0 (2.9 - 11.5)	6.5 (3.7 - 11.3)

Parameters	North Western WCZ[1,2,3,4,5,6]		Western Buffer WCZ[1,2,3,4,5,6]
	NM1	NM2	WM4
Suspended Solids (mg/L)	6.1	4.9	6.5
	(1.6 - 12.8)	(1.6 - 9.4)	(1.9 - 11.4)
5-day Biochemical Oxygen Demand (mg/L)	1	1.3	0.8
	(0.2 - 2.8)	(0.2 - 4.9)	(0.3 - 1.5)
Ammonia Nitrogen (mg/L)	0.100	0.090	0.122
	(0.041 - 0.173)	(0.038 - 0.167)	(0.056 - 0.210)
Unionised Ammonia (mg/L)	0.001	0.001	0.002
	(<0.001 - 0.003)	(<0.001 - 0.003)	(<0.001 - 0.007)
Nitrite Nitrogen (mg/L)	0.053	0.063	0.043
	(0.003 - 0.108)	(0.004 - 0.117)	(0.006 - 0.084)
Nitrate Nitrogen (mg/L)	0.216	0.280	0.177
	(0.051 - 0.477)	(0.047 - 0.617)	(0.073 - 0.393)
Total Inorganic Nitrogen (mg/L)	0.37	0.43	0.34
	(0.20 - 0.64)	(0.21 - 0.76)	(0.23 - 0.53)
Total Kjeldahl Nitrogen (mg/L)	0.69	0.61	0.60
	(0.43 - 0.96)	(0.35 - 0.95)	(0.34 - 0.89)
Total Nitrogen (mg/L)	0.83	0.78	0.75
	(0.63 - 1.09)	(0.59 - 1.11)	(0.46 - 1.16)
Orthophosphate Phosphorous (mg/L)	0.014	0.014	0.016
	(0.007 - 0.026)	(0.003 - 0.027)	(0.003 - 0.027)
Total Phosphorous (mg/L)	0.05	0.06	0.09
	(0.04 - 0.08)	(0.04 - 0.09)	(0.05 - 0.14)
Silica (as SiO_2) (mg/L)	1.07	1.29	1.05
	(0.34 - 1.80)	(0.34 - 2.10)	(0.40 - 2.13)
Chlorophyll-*a* (µg/L)	4.2	4.8	3.9
	(0.4 - 12.5)	(0.8 - 15.5)	(0.8 - 13.3)
E. coli (count/100mL)	95	31	230
	(8 - 590)	(6 - 350)	(16 – 7,800)
Faecal Coliforms (count/100mL)	170	59	450
	(18 - 910)	(14 - 610)	(31 – 17,000)

Notes:
[1] Data presented are annual arithmetic means of the depth-averaged results except for E. coli and faecal coliforms which are annual geometric means.
[2] Data in brackets indicate the ranges.
[3] NM indicates no measurement taken.
[4] Values at or below laboratory reporting limits are presented as laboratory reporting limits.
[5] Equal values for annual medians (or geometric means) and range indicates that all data are the same as or below laboratory reporting limits.
[6] Unless specified otherwise, data presented are depth-averaged value which are calculated by taking the means of three depths (i.e. surface, mid-depth, and bottom).

5.2.2 Typhoon Shelter

5.2.2.1 Tuen Mun Typhoon Shelter is located at Tuen Mun South and at the mouth of Tuen Mun River, which is at the vicinity of the Project's assessment area. There are no bacteriological WQOs for typhoon shelters as their beneficial use are primarily for vessel mooring, hence the concerned parameters for typhoon shelter water quality are mainly DO and NH_3-N. All 2 parameters have met the WQO in 2021, in general the long-term trend shows an improvement of water quality in Tun Mun Typhoon Shelter.

5.2.2.2 The water quality monitoring data from monitoring stations NT1 of Tuen Mun Typhoon Shelter is presented in **Table 5.6** below.

Table 5.6 Summary of EPD's Routine Marine Water Quality data for Tuen Mun Typhoon Shelter in 2021

Parameters		**Tuen Mun Typhoon Shelter[1,2,3]**
		NT1
Temperature (°C)		26.2
		(20.6 - 29.1)
Salinity (ppt)		26.1
		(20.4 - 31.8)
Dissolved Oxygen (mg/L)	Depth Averaged	4.8
		(4.2 – 5.8)
	Bottom Layer	4.7
		(4.0 - 5.2)
Dissolved Oxygen (% Saturation)	Depth Averaged	69
		(58 - 83)
	Bottom Layer	67
		(56 - 75)
pH		7.5
		(7.1 - 7.6)
Secchi Disc Depth (m)		1.7
		(1.4 - 2.4)
Turbidity (NTU)		6.9
		(4.9 - 12.2)
Suspended Solids (mg/L)		7.1
		(3.2 - 10.1)
5-day Biochemical Oxygen Demand (mg/L)		0.9
		(0.5 - 1.3)
Ammonia Nitrogen (mg/L)		0.098
		(0.036 - 0.200)
Unionised Ammonia (mg/L)		0.001
		(<0.001 - 0.003)
Nitrite Nitrogen (mg/L)		0.053
		(0.019 - 0.073)
Nitrate Nitrogen (mg/L)		0.330
		(0.143 - 0.635)
Total Inorganic Nitrogen (mg/L)		0.48
		(0.25 - 0.74)
Total Kjeldahl Nitrogen (mg/L)		0.63
		(0.58 - 0.68)
Total Nitrogen (mg/L)		0.83
		(0.81 - 0.84)
Orthophosphate Phosphorous (mg/L)		0.011
		(0.005 - 0.021)
Total Phosphorous (mg/L)		0.08
		(0.06 - 0.09)
Silica (as SiO_2) (mg/L)		1.25
		(0.63 - 1.95)
Chlorophyll-*a* (µg/L)		7.0
		(0.8 - 19.5)
E. coli (count/100mL)		33
		(8 - 220)

Parameters	Tuen Mun Typhoon Shelter[1,2,3]
	NT1
Faecal Coliforms (count/100mL)	210 (42 - 990)

Notes:
[1] Data presented are annual arithmetic means of the depth-averaged results except for E. coli and faecal coliforms which are annual geometric means.
[2] Data in brackets indicate the ranges.
[3] Unless specified otherwise, data presented are depth-averaged value which are calculated by taking the means of three depths (i.e. surface, mid-depth, and bottom).

5.2.3 Marine Sediment

EPD Sediment Monitoring Stations

5.2.3.1 As discussed in **Section 2**, dredging/filling works associated with the reclamation would be required. The disturbed sediment during dredging / filling may release pollutants that may cause water quality impacts at WSRs. Hence, baseline sediment quality information was collated from EPD's latest marine water quality report published in 2021, and additional pore water and elutriate tests were conducted on sediment samples collected near the reclamation area.

5.2.3.2 The sediment quality at the nearest EPD sediment quality monitoring station (i.e. Pearl Island (NS2) of North Western WCZ at 2021 is presented in **Table 5.7**. The sediment quality at NS2 is good as concentrations of all parameters did not exceed the Lower Chemical Exceedance Level (LCEL) presented under Appendix A of the Management Framework for Disposal of Dredged/Excavated Sediment (PNAP 252 ADV-21) published by Buildings Department.

Table 5.7 Summary of EPD's Routine Marine Sediment Quality Data for Pearl Island in 2021

Parameters	North Western WCZ[1,2,3,4,5,6]
	NS2
Particle Size Fractionation <63µm (%w/w)	65 (20 – 97)
Electrochemical Potential (mV)	-125 (-170 - -59)
Total Solids (%w/w)	51 (39 – 63)
Total Volatile Solids (%TS)	6.5 (4.8 – 7.8)
Chemical Oxygen Demand (mg/kg)	11,520 (9,200 – 13,000)
Total Carbon (%w/w)	0.6 (0.5 – 1.0)
Ammonical Nitrogen (mg/kg)	5.27 (0.23 – 11.00)
Total Kjeldahl Nitrogen (mg/kg)	440 (280 – 540)
Total Phosphorous (mg/kg)	220 (170 – 280)
Total Sulphide (mg/kg)	32.4 (2.5 – 77.0)

Parameters	North Western WCZ[1,2,3,4,5,6]
	NS2
Total Cyanide (mg/kg)	0.1 (<0.1 – 0.2)
Arsenic (mg/kg)	12.0 (7.7 – 23.0)
Cadmium (mg/kg)	0.1 (<0.1 – 0.1)
Chromium (mg/kg)	34 (21 – 53)
Copper (mg/kg)	33 (17 – 48)
Lead (mg/kg)	46 (29 – 90)
Mercury (mg/kg)	0.10 (0.06 – 0.14)
Nickel (mg/kg)	20 (13 - 31)
Silver (mg/kg)	0.2 (<0.2 – 0.3)
Zinc (mg/kg)	150 (79 – 220)
Total Polychlorinated Biphenyls (PCBs) (μg/kg)	18 (18 – 18)
Low Molecular Weight Polycyclic Aromatic Hydrocarbons (PAHs) (μg/kg)	110 (90 – 150)
High Molecular Weight Polycyclic Aromatic Hydrocarbons (PAHs) (μg/kg)	69 (40 – 110)

Notes:

[1] Data presented are arithmetic means; data in brackets indicate ranges.

[2] All data are based on the analyses of bulk (unsieved sediment and are reported on a dry weight basis unless stated otherwise.

[3] Total PCBs results are derived from the summation of 18 congeners. If the concentration of a congener is below report limit (RL), the result will be taken as 0.5xRL in the calculation.

[4] Low molecular weight polyaromatic hydrocarbons (PAHs) include 6 congeners of molecular weight below 200, namely: Acenaphthene, Acenaphthylene, Anthracene, Flourene, Naphthalene and Phenanthrene.

[5] High molecular weight polyaromatic hydrocarbons (PAHs) include 10 congeners of molecular weight above 200, namely: Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Dibenzo(a,h)anthracene, Benzo(g,h,i)perylene and Indeno(1,2,3-cd)pyrene.

[6] Low and high molecular weight PAHs results are derived from the summation of the corresponding congeners. If the concentration of a congener is below RL, the result will be taken as 0.5xRL in the calculation.

Pore Water and Elutriate Test Results

5.2.3.3 Sediment samples were collected at 2 sampling locations at the proposed reclamation site at TLT on 26th and 27th September 2022. Pore water and elutriate tests were conducted for the following parameters:

- Heavy metals and metalloids including cadmium, chromium, copper, mercury, nickel, lead, zinc, silver, and arsenic;
- Organic micropollutants including PAHs and PCBs; and
- Inorganic non-metallic pollutants including nitrogen and phosphorous.

5.2.3.4 The maximum value of pore water and elutriate test results of each sampling location are summarised in **Table 5.8** and **Table 5.9** respectively, with detailed results and sampling locations presented in **Appendix 5.1**.

Table 5.8 Pore Water Test Results

Parameter	Proposed Criteria	Units	Sample ID[3]		Criteria Compliance
			TLB/VB1	TLB/VB3	
Heavy Metals/Metalloids					
Arsenic	13	µg/L	6	7	✓
Cadmium	5.5	µg/L	<0.2	<0.2	✓
Chromium	4.4	µg/L	<1.0	<1.0	✓
Copper	1.3	µg/L	1.1	2.1	✓
Lead	4.4	µg/L	<1.0	<1.0	✓
Mercury	0.4	µg/L	<0.05	<0.05	✓
Nickel	70	µg/L	2	3	✓
Silver	1.4	µg/L	<1.0	<1.0	✓
Zinc	8	µg/L	1	2	✓
Inorganic Non-Metallic Pollutants					
TKN	-	mg/L	15	14	✓
NH_3-N	-	mg/L	13	10	✓
NO_2-N	-	mg/L	<0.01	<0.01	✓
NO_3-N	-	mg/L	0.2	0.1	✓
TIN[1]	0.4 or 0.5	mg/L	**12.7**	**9.7**	To be further assessed[4]
UIA[2]	0.021	mg/L	**0.555**	**0.427**	To be further assessed[4]
Reactive-P	-	mg/L	<0.01	<0.01	✓
Ortho-P	-	mg/L	0.3	0.4	✓
Total-P	-	mg/L	0.3	0.4	✓
PCBs/PAHs/TBT					
Total PAHs	0.2	µg/L	**<9.0**	**<9.0**	To be further assessed[4]
PCBs	0.03	µg/L	**<0.18**	**<0.18**	To be further assessed[4]
TBT	0.006	µg/L	**<0.015**	**<0.015**	To be further assessed[4]

Notes:

[1] TIN is calculated by summation of NO_2-N, NO_3-N and NH_3-N. The proposed criteria for TIN is dependent on the location of the WSR (i.e. 0.4mg/L for Western Buffer WCZ and 0.5mg/L for North Western WCZ.)

[2] UIA is estimated by multiplying a conversion factor of 4.44% to NH_3-N. This factor is dependent on water temperature and pH (i.e. 25.4°C and 7.9) at the nearest EPD water quality monitoring station (i.e. NM1), the conversion factor referenced "Aqueous Ammonia Equilibrium- Tabulation of Percent Unionized Ammonia" (Thurston, 1979).

[3] Sampled values that are below the lowest detection limit are presented as the lowest detection limit, bold values indicate an exceedance of the criteria.

[4] For pore water test results that exceeded the criteria, the parameter will be further assessed using quantitative water quality modelling to determine the criteria compliances at the WSRs.

Table 5.9 Elutriate Test Results

Parameter	Proposed Criteria [3]	Units	Sample ID[4]		Criteria Compliance
			TLB/VB1	TLB/VB3	
Heavy Metals/Metalloids					
Arsenic	13	µg/L	**15**	6	To be further assessed[5]
Cadmium	5.5	µg/L	<0.2	<0.2	✓
Chromium	4.4	µg/L	<1.0	<1.0	✓
Copper	1.3	µg/L	<1.0	1.1	✓
Lead	4.4	µg/L	1.0	<1.0	✓

Parameter	Proposed Criteria [3]	Units	Sample ID[4]		Criteria Compliance
			TLB/VB1	TLB/VB3	
Mercury	0.4	μg/L	<0.05	<0.05	✓
Nickel	70	μg/L	1.3	1.7	✓
Silver	1.4	μg/L	<1.0	<1.0	✓
Zinc	8	μg/L	**131**	1	To be further assessed[5]
Inorganic Non-Metallic Pollutants					
TKN	-	mg/L	2.3	14.9	✓
NH_3-N	-	mg/L	1.39	12.5	✓
NO_2-N	-	mg/L	0.04	<0.01	✓
NO_3-N	-	mg/L	0.18	0.19	✓
TIN[1]	0.4 or 0.5	mg/L	1.6	**12.7**	To be further assessed[5]
UIA[2]	0.021	mg/L	**0.062**	**0.555**	To be further assessed[5]
Reactive-P	-	mg/L	0.04	<0.01	✓
Ortho-P	-	mg/L	0.09	0.33	✓
Total-P	-	mg/L	0.13	0.34	✓
PCBs/PAHs/TBT					
Total PAHs	0.2	μg/L	**<9.0**	**<9.0**	To be further assessed[5]
PCBs	0.03	μg/L	**<0.18**	**<0.18**	To be further assessed[5]
TBT	0.006	μg/L	**<0.015**	**<0.015**	To be further assessed[5]

Notes:

[1] TIN is calculated by summation of NO_2-N, NO_3-N and NH_3-N. The proposed criteria for TIN is dependent on the location of the WSR (i.e. 0.4mg/L for Western Buffer WCZ and 0.5mg/L for North Western WCZ.)

[2] UIA is estimated by multiplying a conversion factor of 4.44% to NH_3-N. This factor is dependent on water temperature and pH (i.e. 25.4°C and 7.9) at the nearest EPD water quality monitoring station (i.e. NM1), the conversion factor referenced "Aqueous Ammonia Equilibrium- Tabulation of Percent Unionized Ammonia" (Thurston, 1979).

[3] Reference for proposed criteria can be referred to the footnotes of **Table 5.4.**

[4] Sampled values that are below the lowest detection limit are presented as the lowest detection limit, bold values indicate an exceedance of the criteria.

[5] For elutriate test results that exceeded the criteria, the parameter will be further assessed using quantitative water quality modelling to determine the criteria compliances at the WSRs.

5.2.3.5 As seen from the tables above, the results indicated that for most parameters, the criteria were met. However, for parameters that exceeded the criteria (i.e. arsenic, zinc, TIN, UIA, Total PAHs, PCBs, and TBT), further calculations will be conducted to assess whether their respective concentrations would comply with the criteria at WSRs after dispersion (see **Section 5.6.4** for more discussion).

5.2.4 Inland Water

<u>EPD River Monitoring Stations</u>

5.2.4.1 Tuen Mun River is a major river located in the western New Territories, which passes through Lam Tei, San Hing Tsuen and Fu Tei in its upstream section, then through the densely populated Tuen Mun Town in its mid-stream before draining into the Tuen Mun Typhoon Shelter at its mouth. This river has experienced improvement in its water quality over the last three decades, with its WQO compliance rate has risen significantly from from 42% in 1991 to 85% in 2021. Four of the six monitoring stations (i.e. TN3 to TN6) are situated at the middle to lower sections of the river, and maintained a "Good" water quality index (WQI) grading. In 2021, the upstream monitoring station (i.e. TN2) received a "Fair" WQI grading, while another upstream monitoring station (TN1) was graded "Bad", mainly due to discharges from unsewered rural areas.

5.2.4.2 Pai Min Kok Stream is located in western New Territories near Sham Tseng, and ultimately discharges into Anglers' Beach. The stream achieved an overall WQO compliance rate of 98% in 2021, and both EPD monitoring stations (i.e. AN1 and AN2) of the stream maintained an "Excellent" water quality index (WQI) grading.

5.2.4.3 While a portion of the 500m assessment area is within the Deep Bay WCZ near Lam Tei, there are neither major rivers nor inland waterbodies within the assessment area.

5.2.4.4 The water quality monitoring data from monitoring stations TN1 and TN2 of Tuen Mun River, and AN1 and AN2 of Pai Min Kok Stream in 2021 is presented in **Table 5.10** below.

Table 5.10 Summary of EPD's Routine River Water Quality Data for Tuen Mun River and Pai Min Kok Stream in 2021

Parameters	Tuen Mun River[1,2,3,4,5]		Pai Min Kok Stream[1,2,3,4,5]	
	TN1	TN2	AN1	AN2
Dissolved Oxygen (mg/L)	4.4 (2.0 - 5.9)	8.0 (4.3 - 12.9)	8.2 (7.6 - 9.4)	8.6 (7.7 - 9.9)
pH	7.6 (7.4 - 8.2)	7.9 (7.2 - 9.2)	8.1 (7.8 - 8.6)	8.5 (7.7 - 9.6)
Suspended Solids (mg/L)	11.0 (3.0 - 16.0)	7.6 (3.3 – 6,600.0)	2.4 (0.9 - 26.0)	5.8 (1.2 - 83.0)
5-Day Biochemical Oxygen Demand (mg/L)	24.0 (11.0 - 47.0)	3.9 (2.4 - 66.0)	1.4 (0.4 - 2.3)	0.6 (0.2 - 2.2)
Chemical Oxygen Demand (mg/L)	32 (20 - 54)	15 (6 - 100)	10 (4 - 20)	8 (4 - 19)
Oil & Grease (mg/L)	0.6 (<0.5 - 1.4)	<0.5 (<0.5 - 2.0)	<0.5 (<0.5 - <0.5)	<0.5 (<0.5 - <0.5)
E. coli (counts/100mL)	100,000 (44,000 – 230,000)	190,000 (49,000 – 1,400,00)	4,800 (1,200 – 34,000)	14,000 (430 – 85,000)
Faecal Coliforms (counts/100mL)	340,000 (130,000 – 990,000)	290,000 (75,000 – 2,000,000)	29,000 (13,000 – 120,000)	25,000 (6,300 – 89,000)
Ammonia Nitrogen (mg/L)	6.900 (5.400 - 9.700)	2.100 (1.200 - 7.800)	0.057 (0.024 - 0.250)	0.026 (0.015 - 0.062)
Nitrate Nitrogen (mg/L)	0.280 (<0.002 - 0.710)	1.100 (0.011 - 7.000)	0.825 (0.320 - 1.500)	0.150 (0.008 - 0.390)
Total Kjeldahl Nitrogen (mg/L)	11.50 (8.60 - 13.00)	9.00 (3.50 - 11.00)	0.76 (0.65 - 0.88)	0.46 (0.34 - 0.78)
Orthophosphate Phosphorous (mg/L)	0.520 (0.400 - 0.600)	0.260 (0.140 - 0.780)	0.043 (0.012 - 0.055)	0.029 (0.015 - 0.290)
Total Phosphorous (mg/L)	0.94 (0.69 - 1.00)	0.86 (0.39 - 0.96)	0.08 (0.06 - 0.12)	0.08 (0.03 - 0.12)
Sulphide (mg/L)	0.03 (<0.02 - 0.05)	<0.02 (<0.02 - 0.03)	<0.02 (<0.02 - 0.02)	<0.02 (<0.02 - <0.02)
Aluminium (µg/L)	<50 (<50 - 442)	<50 (<50 - 140)	<50 (<50 - 155)	54 (<50 - 158)
Cadmium (µg/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)
Chromium (µg/L)	<1 (<1 - 1)	<1 (<1 - 3)	<1 (<1 - <1)	<1 (<1 - <1)

Parameters	Tuen Mun River[1,2,3,4,5]		Pai Min Kok Stream[1,2,3,4,5]	
	TN1	TN2	AN1	AN2
Copper (µg/L)	1 (<1 - 2)	2 (<1 - 7)	3 (<1 - 5)	2 (<1 - 4)
Lead (µg/L)	<1 (<1 - <1)	<1 (<1 - 2)	<1 (<1 - <1)	<1 (<1 - 2)
Zinc (µg/L)	<10 (<10 - 36)	<10 (<10 - 46)	<10 (<10 - 19)	<10 (<10 - 14)
Flow (m³/s)	0.138 (0.072 - 0.328)	0.017 (0.006 - 0.059)	NM[3]	0.003 (0.000 - 0.023)

Notes:
[1] Data presented are annual arithmetic means of the depth-averaged results except for *E. coli* and faecal coliforms which are annual geometric means.
[2] Data in brackets indicate the ranges.
[3] NM indicates no measurement taken.
[4] Values at or below laboratory reporting limits are presented as laboratory reporting limits.
[5] Equal values for annual medians (or geometric means) and range indicates that all data are the same as or below laboratory reporting limits.

<u>Additional Inland Water Quality Sampling at So Kwun Wat, Siu Lam and Tai Lam Chung</u>

5.2.4.5 There are no EPD inland water quality monitoring stations at the vicinity of So Kwun Wat, Siu Lam, and Tai Lam Chung areas to establish the baseline conditions of the inland waters of these areas. Hence, additional water quality samplings were conducted under this EIA to supplement the inland water quality information for both wet season (i.e. between April 2022 and October 2022) and dry season (i.e. between November 2022 and March 2023). Samplings were conducted at a frequency of 3 sampling days per week over a 2 week period (i.e. 6 sampling days in total), at the locations as indicated in **<u>Appendix 5.2</u>**.

5.2.4.6 The water quality parameters that were measured and sampled were the same as those used by EPD's river monitoring stations. In addition, other relevant data (i.e. monitoring location, time, weather conditions, river conditions, etc.) were also recorded. The samples were then analysed at a Hong Kong Laboratory Accreditation Scheme (HOKLAS) accredited laboratory. The water quality sampling results for wet season and dry season at Stream at So Kwun Wat Village, Stream at Siu Lam, and Tai Lam Chung River are summarised in **Table 5.11** and **Table 5.12** respectively. In-situ monitoring records and laboratory analysis results are also presented in **<u>Appendix 5.2</u>**.

Table 5.11 Wet Season Water Quality Sampling Results for Stream at So Kwun Wat Village, Streat at Siu Lam and Tai Lam Chung River

Parameters	Wet Season[1,2,3,4,5]		
	Stream at So Kwun Wat Village (R1)	Stream at Siu Lam (R2)	Tai Lam Chung River (R3)
Dissolved Oxygen (mg/L)	6.9 (5.6 - 7.5)	7.5 (7.3 - 7.7)	5.0 (4.8 - 5.6)
pH	9.2 (8.1 – 10.0)	9.4 (7.9 - 10.4)	8.3 (6.0 – 9.0)
Suspended Solids (mg/L)	18.7 (2.0 - 48.5)	1.9 (0.6 - 5.1)	5.2 (1.8 – 9.0)

Parameters	Wet Season[1,2,3,4,5]		
	Stream at So Kwun Wat Village (R1)	Stream at Siu Lam (R2)	Tai Lam Chung River (R3)
5-Day Biochemical Oxygen Demand (mg/L)	1.5 (<0.1 - 4.5)	0.6 (<0.1 - 1.1)	0.6 (<0.1 - 1.1)
Chemical Oxygen Demand (mg/L)	10 (6 - 14)	6 (<2 - 8)	25 (20 - 40)
Oil & Grease (mg/L)	0.5 (<0.5 - 0.6)	0.5 (<0.5 - 0.6)	0.5 (<0.5 - 0.6)
E. coli (counts/100mL)	120,561 (330 – 510,000)	396 (80 - 890)	421 (80 – 1,000)
Faecal Coliforms (counts/100mL)	274,875 (1,100 – 1,200,000)	873 (190 – 1,300)	720 (200 – 1,800)
Ammonia Nitrogen (mg/L)	0.660 (<0.005 - 2.580)	0.010 (<0.005 - 0.016)	0.150 (0.128 - 0.188)
Nitrate Nitrogen (mg/L)	0.137 (0.035 - 0.375)	0.175 (0.074 - 0.231)	0.356 (0.238 - 0.475)
Total Kjeldahl Nitrogen (mg/L)	0.84 (0.10 - 3.06)	0.10 (0.08 - 0.15)	0.37 (0.31 - 0.49)
Orthophosphate Phosphorous (mg/L)	0.024 (<0.001 - 0.044)	0.013 (<0.001 - 0.021)	0.066 (0.047 - 0.083)
Total Phosphorous (mg/L)	0.09 (0.04 - 0.28)	0.03 (0.02 - 0.04)	0.09 (0.06 - 0.11)
Sulphide (mg/L)	<0.05 (<0.05 - <0.05)	<0.05 (<0.05 - <0.05)	<0.05 (<0.05 - <0.05)
Aluminium (µg/L)	280 (75 - 656)	93 (63 - 152)	69 (23 - 165)
Cadmium (µg/L)	<0.1 (<0.1 - 0.1)	<0.1 (<0.1 - 0.1)	<0.1 (<0.1 -<0.1)
Chromium (µg/L)	<1.0 (<1.0 - <1.0)	<1.0 (<1.0 - <1.0)	<1.0 (<1.0 - <1.0)
Copper (µg/L)	1.3 (<1.0 - 2.3)	1.7 (<1.0 - 5.9)	2.0 (<1.0 – 6.0)
Lead (µg/L)	2.3 (<1.0 - 4.5)	<1.0 (<1.0 - <1.0)	<1.0 (<1.0 - <1.0)
Zinc (µg/L)	40 (13 - 150)	12 (<10 - 15)	31 (<10 - 119)
Flow (m^3/s)	0.1 (0.1 - 0.1)	0.2 (0.1 - 0.2)	0.2 (0.1 - 0.3)

Notes
[1] Data source: Inland water sampling conducted in October 2022 for wet season.
[2] Data presented are annual arithmetic means of the depth-averaged results except for E. coli and faecal coliforms which are annual geometric means.
[3] Data in brackets indicate the ranges.
[4] Values at or below laboratory reporting limits are presented as laboratory reporting limits.
[5] The sampling period was conducted over 2 weeks, with 3 sampling days for each week, hence, there are a total of 6 sampling days for each season.

Table 5.12 Dry Season Water Quality Sampling Results for Stream at So Kwun Wat Village, Stream at Siu Lam and Tai Lam Chung River

Parameters	Dry Season[1,2,3,4,5]		
	Stream at So Kwun Wat Village (R1)	Stream at Siu Lam (R2)	Tai Lam Chung River (R3)
Dissolved Oxygen (mg/L)	7.8 (7.38 – 8.3)	8.5 (8.0 – 9.2)	6.7 (5.3 - 8.0)

Parameters	Dry Season[1,2,3,4,5]		
	Stream at So Kwun Wat Village (R1)	Stream at Siu Lam (R2)	Tai Lam Chung River (R3)
pH	8.0 (7.38 - 8.42)	8.5 (7.6 - 9.1)	7.8 (7.4 - 8.3)
Suspended Solids (mg/L)	74.1 (33 - 126)	20.7 (4.1 - 41.4)	5.7 (4.5 - 8.0)
5-Day Biochemical Oxygen Demand (mg/L)	1.8 (1.5 - 2.4)	1.0 (0.7 - 1.3)	1.3 (0.7 - 3.5)
Chemical Oxygen Demand (mg/L)	27 (20 - 38)	10 (9 - 14)	20 (13 - 26)
Oil & Grease (mg/L)	0.5 (<0.5 - 0.6)	0.6 (<0.5 - 0.8)	0.5 (<0.5 - 0.7)
E. coli (counts/100mL)	1100 (0 - 4100)	127 (8 - 590)	267 (34 - 1600)
Faecal Coliforms (counts/100mL)	1357 (0 - 4100)	142 (14 - 590)	700 (52 - 4600)
Ammonia Nitrogen (mg/L)	0.13 (0.01 - 0.24)	0.05 (0.03 - 0.10)	0.18 (0.14 - 0.34)
Nitrate Nitrogen (mg/L)	0.178 (0.128 - 0.264)	0.252 (0.157 - 0.556)	0.35 (0.20 - 0.47)
Total Kjeldahl Nitrogen (mg/L)	0.56 (0.17 - 0.85)	0.28 (0.07 - 0.53)	0.49 (0.38 - 0.80)
Orthophosphate Phosphorous (mg/L)	0.023 (0.016 - 0.030)	0.019 (0.013 - 0.030)	0.06 (0.036 - 0.118)
Total Phosphorous (mg/L)	0.26 (0.03 - 0.43)	0.07 (0.02 - 0.13)	0.10 (0.06 - 0.14)
Sulphide (mg/L)	<0.05 (<0.05 - <0.05)	<0.05 (<0.05 - <0.05)	<0.05 (<0.05 - <0.05)
Aluminium (µg/L)	1063 (595 - 1630)	446 (103 - 1040)	74 (40 - 102)
Cadmium (µg/L)	0.1 (<0.1 - 0.2)	0.1 (<0.1 - 0.4)	<0.1 (<0.1 -<0.1)
Chromium (µg/L)	1.0 (<1.0 - 1.1)	1.0 (<1.0 - 1.3)	1.1 (<1.0 - 2.0)
Copper (µg/L)	2.6 (1.8 - 4.4)	3.2 (<1.0 - 4.2)	1.5 (1.0 – 3.0)
Lead (µg/L)	8.3 (4.2 - 12.5)	2.3 (1.4 - 6)	<1.0 (<1.0 - <1.0)
Zinc (µg/L)	57 (23 - 128)	40 (18 - 89)	104 (<10 - 273)
Flow (m^3/s)	0.1 (0.1 - 0.1)	0.1 (0.1 - 0.2)	0.2 (0.1 - 0.3)

Notes
[1] Data source: Inland water sampling conducted in January 2023 for dry season.
[2] Data presented are annual arithmetic means of the depth-averaged results except for E. coli and faecal coliforms which are annual geometric means.
[3] Data in brackets indicate the ranges.
[4] Values at or below laboratory reporting limits are presented as laboratory reporting limits.
[5] The sampling period was conducted over 2 weeks, with 3 sampling days for each week, hence, there are a total of 6 sampling days for each season.

5.2.4.7 To summarise, with reference to the WQOs of North Western and Western Buffer WCZs stated in **Section 5.1.3**, the Stream at So Kwun Wat Village (R1) attained a WQO compliance rate of 57%, with parameters pH, *E. coli*, and NH_3-N exceeded the WQOs. Whereas Stream at Siu Lam (R2) and Tai Lam Chung River (R3) both attained a WQO compliance rate of 86%, with pH levels and NH_3-N exceeded the WQOs for R2 and R3 respectively. The exceedances of E. coli and NH_3-N could be an indication of biomass growth due to high organic loading of the inland waters, which may be attributed to nearby unsewered village houses.

5.2.5 Beaches

5.2.5.1 Beaches in both Tuen Mun and Tusen Wan Districts are at the vicinity of the assessment area. Summaries of EPD's routine beach water quality monitoring data for the past decade (i.e. Years 2012 to 2022) are presented in **Table 5.13** and **Table 5.14**.

5.2.5.2 As for the beach water quality monitored in Year 2022, for Tuen Mun District, 2 beaches (i.e. Golden Beach and Cafeteria New Beach) ranked "Good" and 4 beaches (i.e. Cafeteria Old Beach, Kadoorie Beach, Castle Peak Beach and Butterfly Beach) ranked "Fair". As for Tsuen Wan District, all 8 beaches attained a "Fair" ranking. The water quality monitored at these beaches has seen a gradual improvement over the last decade, currently stable water quality suitable for bathing is observed at these beaches. This can be attributed to the completion of sewerage works in the beach hinterland, and the commissioning of the disinfection facilities of the Harbour Area Treatment Scheme.

Table 5.13 Annual geometric mean *E. coli* levels for Beaches of Tuen Mun District (Years 2012 to 2022)

Beach	*E. coli* counts per 100mL										
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Butterfly	42	71	38	98	131	81	39	91	129	57	50
Cafeteria New	47	50	31	30	38	31	18	40	37	17	20
Cafeteria Old	48	39	45	41	70	50	30	64	53	23	34
Castle Peak	48	78	91	71	106	65	70	128	112	103	162
Golden	62	45	39	31	45	37	22	41	45	19	24
Kadoorie	40	52	37	29	48	31	28	52	55	19	31

Table 5.14 Annual geometric mean *E. coli* levels for Beaches of Tsuen Wan District (Years 2012 to 2022)

Beach	*E. coli* counts per 100mL										
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Anglers'	69*	133	130	77	76	45	143	88	105	135	142
Approach	83	106	121	143	78	114	92	97	133	71	84
Casam	50	71	63	52	42	43	94	79	84	74	109
Gemini	40*	135*	110*	56*	40*	39*	120*	79*	101*	127*	139*
Hoi Mei Wan	51	86	58	90	65	63	92	112	84	76	75
Lido	32	53	57	52	39	34	76	65	66	98	111
Ma Wan Tung Wan	24	41	31	20	32	29	74	46	84	93	54
Ting Kau	88*	107*	89	151	140	75	101	102	93	85	96

Note
[1] "*" denotes Beach not open for swimming that year

5.3 Representative Water Sensitive Receivers

5.3.1.1 The assessment area for the water quality impact assessment shall include areas within 500m from the Project boundary, and shall cover the North Western WCZ and other affected WCZs as stipulated in Clause 3.4.6.2 of EIA Study Brief (ESB-352/2022). The assessment area was extended beyond the 500m assessment area to cover other locations including beaches, water pumping stations, and cooling water intakes, etc., to identify other WSRs that may also be affected by the Project and may have a bearing on the environmental acceptability of the Project. The WSRs are listed in **Table 5.15** and shown in **Figure 5.1**, with the major WSR groupings summarised below:

- Gazetted beaches;
- Corals;
- Horseshoe crabs;
- Mangroves;
- Seagrass beds;
- Cooling water intakes;
- WSD flushing water intakes;
- Typhoon shelters / marinas;
- Marine Park;
- Country Parks;
- Rivers;
- Fish Culture Zone and Fisheries Habitat; and
- Water gathering ground and reservoirs.

Table 5.15 Summary of Identified Representative WSRs

ID	WSR
	Beaches
B1	Castle Peak Beach
B2	Kadoorie Beach
B3	Cafeteria Old Beach
B4	Cafeteria New Beach
B5	Golden Beach
B6	Anglers' Beach
B7	Gemini Beaches
B8	Hoi Mei Wan Beach
B9	Casam Beach
B10	Lido Beach
B11	Ting Kau Beach
B12	Approach Beach
B13	Ma Wan Tung Wan Beach
	Corals
CR1	Corals at To Kau Wan
CR2	Corals at Sunny Bay

ID	WSR
Horseshoe Crabs	
H1	Horseshoe Crabs Area at Yam O
Mangroves	
MG1	Mangrove near Ma Wan
MG2	Mangrove near Yam O
Seagrass Beds	
SG2	Seagrass Beds near Yam O
Water Pumping Stations/Cooling Water Intakes	
C1	Seawater Intake for Future Sunny Bay Development
C2	ASD Tuen Mun Hospital
C3	EMSD Sam Shing Estate
WSD1	Tuen Mun Salt Water Pumping Station
WSD2	Salt Water Pumping Station near Hong Kong Garden
WSD3	Sunny Bay Salt Water Pumping Station
WSD4	Salt Water Pumping Station near Lok On Pai
Typhoon Shelters/Sheltered Anchorages/Marinas	
SA1	Ting Kau Sheltered Anchorages
TS1	Tuen Mun Typhoon Shelter
M1	Gold Coast Marina and Country Club
Marine Park	
MP1	The Brothers Marine Park Indicator Point 1
MP2	The Brothers Marine Park Indicator Point 2
MP3	The Brothers Marine Park Indicator Point 3
MP4	The Brothers Marine Park Indicator Point 4
Country Park	
CP1	Tai Lam Country Park
Rivers	
RIV1	Tuen Mun River
RIV2	Tai Lam Chung River
Fish Culture Zone and Fisheries Habitat	
F1	Ma Wan Fish Culture Zone
F2	Spawning ground of commercial fisheries resources in North Lantau Water
Water Gathering Ground and Reservoirs	
RSV1	Lam Tei Irrigation Reservoir
RSV2	Hung Shui Hang Irrigation Reservoir
RSV3	Tai Lam Chung Reservoir
WG1	Water Gathering Ground

5.4 Approaches to Avoid and Minimise Hydrodynamic and Water Quality Impacts

5.4.1 General

5.4.1.1 As discussed in **Section 2**, the Project has been proactively designed, and duly examined to reduce both the hydrodynamic and water quality impacts induced by the marine and land based works associated with the Project. A summary of the approaches adopted to avoid and minimise water quality impacts are summarised below.

5.4.2 Avoidance of Aboveground Works within Tai Lam Country Park and Water Gathering Ground

5.4.2.1 As the Project alignment would inevitably go through Tai Lam Country Park (the Country Park), to minimise disturbances towards the Country Park, the latest design proposes to adopt tunnel design at the section of Project alignment crossing the Country Park, which would be constructed using drill-and-blast and drill-and-break methods (D&B). Hence, there would be no aboveground works within the Country Park. By adopting this tunnel design and suitable engineering design during tunnel construction, it would avoid any adverse impacts on the water gathering ground inside and in the vicinity of the Country Park, in addition to minimizing impacts caused to the Country Park.

5.4.3 Avoidance of High Ecological Value Natural Watercourses

5.4.3.1 While the alignment sections within the Country Park would take a tunnel form, there would be at-grade roads and viaducts to connect the tunnel sections that daylight outside the Country Park. The ecological impact assessment conducted has identified few natural watercourses with higher ecological value. These watercourses include those near the Tai Lam Chung Reservoir, it should however be noted that works on natural watercourses within the Country Park would be totally avoided. According to the current design, the alignment sections across these watercourses would be in a viaduct form above or in tunnel from underneath. To avoid any direct impacts on these watercourses, the design of these viaduct sections would ensure that the supports and the associated works areas would totally avoid these watercourses. Nevertheless, suitable mitigation measures would also be provided to ensure that indirect impacts such as surface runoff during construction period would not adversely affect these watercourses.

5.4.4 Avoidance of Reclamation near To Kau Wan at North Lantau

5.4.4.1 The latest alignment of the Project has been designed to reduce both hydrodynamic and water quality impacts by completely avoiding reclamation works at To Kau Wan, North Lantau. When comparing with the preliminary alignment presented in the Project Profile, the latest design adjusted the design of Tsing Lung Bridge so that the southern bridge tower can be setback from offshore to the land, thereby eliminating the need for reclamation works at North Lantau. This decision will further improve the hydrodynamic and water quality conditions of the area. However, reclamation works for the northern anchor at TLT would be inevitable due to site constraints (i.e. Tuen Mun Road and existing buildings, etc.).

5.4.5 Conduct Filling Works Within the Seawall

5.4.5.1 As reclamation is unavoidable at TLT, non-dredged reclamation methods such as deep cement mixing (DCM) has been explored to minimise water quality impacts. However, upon considering all aspects including engineering feasibilities, geological conditions, environmental implications, etc., the presence of a thin marine sediment layer at the reclamation area may inevitably require to be dredged. Besides, according to the current design, filling works will only commence upon the full completion of the perimeter seawall and will only be conducted within the seawall to prevent any fill materials and fine suspended solids from being discharged to the open sea. Nonetheless, the dredging works would inevitably generate suspended solids from the disturbed sediment. Hence, quantitative water quality modelling would be conducted to assess the associated impacts.

5.4.6 Minimisation of Reclamation Area in Tsing Lung Tau

5.4.6.1 In addition to considering different reclamation methods, the design of the northern anchor has also been meticulously considered. The preliminary design presented in the Project Profile stated that the reclamation area above sea level would be approximately 2.7ha. However after scrutinising multiple aspects including engineering and environmental technicalities, the latest proposed design has reduced the reclamation extent by approximately 0.5ha (i.e. from 2.7ha to 2.2ha). This reduction has reduced the total amount of dredged sediments, hence reducing the associated water quality impacts during the construction phase. This would also reduce the extent of narrowing the Ha Pang Fairway, thereby reducing the change in hydrodynamic regime during the operational phase.

5.5 Identification and Evaluation of Water Quality Impacts for Construction Phase – Land Based Works

5.5.1 Assessment Methodology

5.5.1.1 The assessment for evaluating the water quality impacts induced by land-based construction works were conducted according to the assessment methodologies specified in Annexes 6 and 14 of EIAO-TM, and Appendix D of the EIA Study Brief, which includes:

- Identification of impact causing factors; and
- Recommendation of mitigation measures (see **Section 5.11**).

5.5.2 Summary of Key Construction Activities

5.5.2.1 A review has been conducted on the construction methodologies given in **Section 2**. A summary of the construction methodologies for various alignment sections are given under **Table 5.16** and **Table 5.17** below. According to the latest design, D&B tunnelling would be adopted for all tunnel sections.

Table 5.16 Summary of Construction Methods for Different Alignment Sections

Alignment Section	Construction Method
• Lam Tei Quarry Interchange • So Kwun Wat Interchange • North Lantau Interchange • Tsing Lung Tau Interchange • So Kwun Wat – Siu Lam Open Road Section	• At-grade works
• Tai Lam Chung River Viaduct	• At-grade works without viaduct piers at the river
• Lam Tei Tunnel • So Kwun Wat Link Road • Tai Lam Chung Tunnel (North Section) • Tai Lam Chung Tunnel (South Section)	• Drill-and-blast tunnelling • Drill-and-break tunnelling
• Tsing Lung Bridge	• Cross-channel suspension bridge with one anchor each on the northern and southern shore

5.5.2.2 Other than construction methods, other construction elements are also associated with the construction phase of the Project:

Table 5.17 Construction Elements Required for Construction Works

Construction Elements	Location
Magazine sites for the storage of explosives (for shared use with the Tuen Mun Bypass (TMB) project)	1 no. at Lam Tei 1 no. at Siu Lam 1 no. at Pillar Point
Barging point	1 no. at TLT 2 nos. at North Lantau
Temporary works areas	5 nos. at So Kwun Wat 1 no. at Tai Lam Chung 1 no. at TLT 2 nos. at North Lantau

5.5.2.3 The potential water pollution sources associated with the construction of the Project are identified and summarised below:

- Construction run-off and general construction activities;
- Tunnelling and underground works;
- Construction for ventilation buildings and administration buildings;
- Sewage due to construction workforce;
- Construction works in close proximity of inland water;
- Diversion of watercourses;
- Groundwater from contaminated areas and contaminated site run-off;
- Operation of barging point; and
- Accidental spillage of chemicals.

5.5.3 Construction Run-off and General Construction Activities

5.5.3.1 Construction site run-off will be generated from construction activities conducted at work sites and has the potential to cause adverse water quality impacts. The potential water pollution sources from construction site run-offs and construction activities may include:

- Run-off and erosion from site surfaces, earth working areas and stockpiles;
- Accidental release of any concrete washing and other grouting materials associated with construction run-off, stormwater or groundwater dewatering process;
- Wash water from concrete washing, dust suppression sprays, equipment and wheel washing facilities;
- General site cleaning and polishing; and
- Chemical spillage such as fuel, oil, solvents and lubricants from the maintenance of construction machinery and equipment.

5.5.3.2 In addition, during rainstorm events, site run-off would wash away soil particles on unpaved lands and areas with exposed topsoil. Which generally contains high concentrations of SS, meaning the discharge of uncontrolled site run-off would increase the SS levels and turbidity at the nearby water bodies. Uncontrolled site run-off may also contain concrete and cement-derived materials which may increase the turbidity, discoloration and pH levels of nearby waterbodies. The increased turbidity of water bodies decreases the amount of sunlight penetration, hence reducing the rate of faecal bacteria decay and the rate of photosynthesis. However, the adverse impacts could be minimised with the implementation of good construction site practices as described in **Section 5.11**.

5.5.4 Tunnelling and Underground Works

5.5.4.1 As discussed in **Section 5.5.1**, the tunnel sections of the Project would be constructed by D&B methods. **Section 2** has stated that the majority of the tunnel section would go underneath Tai Lam Country Park, where the underground stratum comprised mainly of granite. The depth of this tunnel section would vary between 43 to 465m below local ground. After considering the latest geological information, D&B tunnelling is considered the most suitable construction methodology for the tunnel sections underneath Tai Lam Country Park.

5.5.4.2 The proposed D&B tunnelling works may result in groundwater infiltration which may increase construction site run-off and lead to potential groundwater table drawdown. Any potential drawdown could result in different degrees of ground settlement and dewatering of surface waterbodies (i.e. Lam Tei Irrigation Reservoir, Hung Shui Hang Irrigation Reservoir, Tai Lam Chung Reservoir and nearby streams), and hence groundwater in the vicinity may also be depleted. SS would also be a key concern as infiltrated water could increase the amount of construction site run-off from the site to nearby drainage systems.

5.5.4.3 However, as the D&B tunnel section would be in the granite stratum and with sufficient depth below ground, together with the good practices and mitigation measures as described in **Section 5.11**, adverse impacts from the change in groundwater level and SS would be insignificant.

5.5.5 Ventilation Buildings and Administration Buildings

5.5.5.1 As discussed in **Section 2**, there would be a total of 7 ventilation buildings (1 no. at Lam Tei, 2 nos at Pak Shek Hang, 1 no. at So Kwun Wat, 1 no. at Siu Lam, 1 no. at Tai Lam Chung and 1 no. at TLT) and 2 administration buildings (at Lam Tei and North Lantau) along the entire tunnel section, which are also shown in **Figure 5.1**. The construction of these ventilation buildings and administration buildings would adopt an open cut excavation method and followed by construction of superstructure and utilities.

5.5.5.2 These buildings are located at the vicinity of waterbodies including Lam Tei Irrigation Reservoir, Tai Lam Chung Reservoir, marine waters, and existing drainage systems outside Tai Lam Country Park, etc. Potential impacts may occur during rainfall events whilst the excavation works are ongoing, as silt and sandy materials carried by run-off from the excavation may enter nearby watercourses, increasing their SS content and turbidity. Other pollutants, such as oil and grease, chemicals, and grouting materials, may also be present in the run-off should it flow over storage or maintenance areas, where it may increase discoloration, turbidity, chemical and pH levels of the nearby water bodies. Additionally, the erosion of soil enriched in organic matter may release excess nutrients into adjacent water bodies, potentially leading to eutrophication.

5.5.5.3 These impacts would require the good practices and mitigation measures as described in **Section 5.11** to ensure that any residual impacts would be insignificant.

5.5.6 Sewage due to Construction Workforce

5.5.6.1 Sewage will be generated by sanitary facilities (i.e. chemical toilets) provided for the on-site construction workforce. Sewage is characterized by high levels of BOD_5, ammonia and *E. coli* counts. According to Table T-2 of Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning (GESF) published by EPD, the unit flow factor (UFF) is 0.23 m^3/day/employee (0.08 m^3/day/employee for commercial employee and 0.15 m^3/day/employee for employees of construction activities).

5.5.6.2 According to the current design, during the peak time of construction works, it is anticipated that there will be a workforce of approximately 4,000 people working on site. Hence, it is estimated that during the peak times, a total sewage load of approximately 920 m^3/day will be generated.

5.5.6.3 With these mitigation measures in such as providing adequate chemical toilets as described in **Section 5.11** in place, no adverse water quality impacts are anticipated.

5.5.7 Construction Works in Close Proximity of Inland Water

5.5.7.1 Construction activities may pollute nearby inland waterbodies near Lam Tei, Siu Lam, Tai Lam Chung, and TLT (i.e. Tai Lam Chung River, Lam Tei Irrigation Reservoir, Hung Shui Hang Irrigation Reservoir, Tai Lam Chung Reservoir, other streams and water gathering ground) through the potential release of construction wastes, which are generally characterised by high concentration of SS and elevated pH. With the implementation of adequate construction site drainage as specified in the ProPECC PN 1/94 , as well as relevant guideline promulgated by WSD for works within water gathering ground stated in **Section 5.11**, no adverse water quality impacts are anticipated.

5.5.8 Removal or Diversion of Watercourses

5.5.8.1 Due to engineering constraints and geological conditions, it is unavoidable that the Project alignment would encroach, or pass over natural streams at locations including Lam Tei, So Kwun Wat, Siu Lam, Tsing Lung Tau, and North Lantau. The removal or diversion of watercourses would involve excavation and construction works. If not properly controlled, pollutants including excavated materials, chemicals, wastewater or construction materials may be flushed downstream via the watercourse, inducing adverse water quality impacts, in addition flooding may occur in the downstream areas of the diverted or removed watercourses. It should be noted that natural watercourses within the Tai Lam Country Park would be totally avoided. With the implementation of proper mitigation measures stated in **Section 5.11**, insignificant water quality impacts are anticipated.

5.5.9 Groundwater from Potential Contaminated Areas and Contaminated Site Run-off

5.5.9.1 As discussed in **Section 2**, the majority of the Project alignment would go underneath Tai Lam Country Park which would have no potential for land contamination.

5.5.9.2 **Section 7** has conducted a comprehensive land contamination study for the entire Project. According to the current findings, potential contaminated areas were identified at Lam Tei, Tai Lam Chung, Tsing Lung Tau, and To Kau Wan areas. Proper land contamination remediation and mitigation measures proposed in **Section 7** should be followed. If the groundwater that is pumped out or discharged from the dewatering process during excavation works are located within potential contaminated areas, the discharge water could also be contaminated. Any potential contaminated materials which may be disturbed, or any foreign materials which contacts such contaminated material, could be washed by site run-off into the drainage system, thereby discharging contaminated water into the drainage system. Any potential contaminated groundwater or site run-off should be properly treated and disposed in compliance with the requirements of TM-DSS, and mitigation measures described in **Section 5.11** should be followed, hence no adverse water quality impacts are anticipated.

5.5.10 Operation of Barging Points

5.5.10.1 As discussed in **Section 2**, the barging points are located at TLT and North Lantau, which are shown in **Figure 2.6**. The latest design of the barging point at TLT would be in the form of a temporary barging point located at the proposed reclamation area. Piling at only Tsing Lung Tau would be required for the construction of the barging point, and the barging point will be removed after the construction phase. Construction of the piles will generally involve the use of in-situ bored piles foundations founded on bedrock or seabed. All piling equipment would be set up on a barge, then the pile constructed would be through placing steel pile casing at the pier site in which the seawater trapped would be inside the casing. A funnel would be placed at the top of pile casing during excavation. This construction method of creating a confined environment for excavation could minimize the release of contaminant into the water column and hence reduce the risk of disturbance to the seabed and adjacent marine environment. No open sea dredging of seabed will be involved for the piling works.

5.5.10.2 Considering the relatively small scale of the barging point, the construction of the barging point would have insignificant impacts on water quality, and considering the east-west flow of Urmston Road’s current, it would also have insignificant impacts on the adjacent hydrodynamics. Additionally, given the sufficient water depth, dredging would not be required, this would have avoided any disturbance to the seabed and hence the associated water quality impacts.

5.5.10.3 However, activities conducted at the barging point still have the potential to cause adverse water quality impacts. Uncontrolled surface run-off generated at the barging point may contain high concentrations of SS, oil, grease, and chemicals. Additionally, materials may also be splashed into the surrounding water during the transportation of spoil using the barging point. These activities may increase the turbidity, discoloration, pH level of the nearby marine waters. Barges may also increase the turbidity and SS content of the nearby waters as marine deposits on the seabed may be disturbed through vessel movements and propeller wash.

5.5.10.4 With the implementation of the good practices and mitigation measures recommended in **Section 5.11**. any residual water quality impacts would be insignificant.

5.5.11 Accidental Spillage of Chemicals

5.5.11.1 The use of chemicals such as engine oil and lubricants, and their storage as waste materials has the potential to cause adverse water quality impacts if spillage occurs and enters the adjacent water bodies. Waste oil may infiltrate the surface soil layer, or discharged into the nearby water environment, increasing hydrocarbon levels. However, adverse impacts can be mitigated by implementing practical mitigation measures and good site practices as described in **Section 5.11**.

5.6 Identification and Evaluation of Water Quality Impacts for Construction Phase – Marine Based Works

5.6.1 Assessment Methodology

5.6.1.1 According to the latest design, dredging would be required for the reclamation works at TLT. The proposed construction sequence is shown in **Appendix 5.3**. It can be seen that all the filling works would be constructed within the seawall (i.e. when the seawall reaches above the sea level) and hence there would be no SS released to the marine water. Nonetheless, as the dredging works would be constructed prior to the seawall construction, it would inevitably generate SS when the seabed sediments are disturbed. Hence, a quantitative water quality model was conducted to assess the water quality impacts induced by the reclamation works.

5.6.1.2 Besides reclamation, other potential sources of water quality impacts are identified for the construction phase (marine based works) of the Project:

- Construction of mud pit; and
- Marine works.

5.6.2 Reclamation Works

Model Parameters

5.6.2.1 The hydrodynamic model for this Project has adopted and refined that of the previously approved Tung Chung New Town Area (TCNTE) EIA (AEIAR-196/2016). The hydrodynamic grids were refined near the reclamation area to simulate the hydrodynamic and water quality impacts for both construction and operational phases of the Project.

5.6.2.2 Delft3D-FLOW module was used for hydrodynamic simulations with the grid layout shown in **Appendix 5.5**. The model has also been verified against the approved TCNTE EIA model to ensure the grid refinement did not adversely affect the model's performance. Validation methodologies and results are shown in **Appendix 5.5**. Detailed information regarding hydrodynamic modelling methodology and parameters can also be referred to **Appendix 5.4**.

5.6.2.3 The Delft3D-WAQ module was adopted for construction phase water quality modelling. Outputs from the hydrodynamic model conducted using the Delft3D-FLOW module were coupled into the water quality model for water quality simulation, including parameters such as averaged fresh water flow, wind, initial conditions and boundary conditions, etc. Methodology and modelling parameters for the water quality models are presented in **Appendix 5.6**.

Consideration of Concurrent Projects

5.6.2.4 Based on the latest information, as part of the construction of Road P1 (Tai Ho - Sunny Bay Section), dredging may be required at Sham Shui Kok, which may overlap with the construction programme of Route 11, hence the dredging works for Road P1 is also included in the construction phase water quality model of this Project to simulate the cumulative impacts of both construction works. Details can also be referred to in **Appendix 5.6**.

Modelled Scenarios

5.6.2.5 As discussed in **Section 2**, dredging would be required due to the thin layer of marine sediments at the reclamation area, and filling will only be conducted within the completed seawall (i.e. when the seawall reaches above the sea level). Therefore, only water modelling scenarios associated with the dredging works were conducted, as no adverse water quality impacts are anticipated from filling works.

5.6.2.6 A total of 4 scenarios were modelled to simulate the water quality impacts induced from the reclamation works, including:

- WQ01a “Base Case 1”: Reclamation works next to shoreline without silt curtain;
- WQ01b “Base Case 2”: Reclamation works away from shoreline without silt curtain;
- WQ02a “Enhanced Case 1”: Reclamation works next to shoreline with silt curtain deployed; and
- WQ02b “Enhanced Case 2”: Reclamation works away from shoreline with silt curtain deployed.

5.6.2.7 For all modelling scenarios, a conservative assumption of a total dredged sediment volume of 30,000m^3 over 10 working days were adopted. Dredging for Road P1 (Tai Ho - Sunny Bay Section) at Sham Shui Kok is included for all 4 scenarios.

Water Quality Model Observation Points

5.6.2.8 Observation points were selected from the list of Representative WSRs presented under **Section 5.3**, and included in the water quality model outputs to evaluate the construction phase water quality impacts. The selected observation points are listed below in **Table 5.18** and shown in **Figure 5.1**.

Table 5.18 Water Quality Model Observation Points

ID	Observation Points	Geodesic Distance from Reclamation Area (km)
B6	Anglers' Beach	1.8
B13	Ma Wan Tung Wan Beach	2.4
C1	Seawater Intake for Future Sunny Bay Development	2.2
WSD2	Salt Water Pumping Station near Hong Kong Garden	0.7
WSD4	Salt Water Pumping Station near Lok On Pai	4.3
CR1	Corals at To Kau Wan	1.1
CR2	Corals at Sunny Bay	2.3
F1	Ma Wan Fish Culture Zone	1.6
MG1	Mangrove near Ma Wan	2.0
MP1	The Brothers Marine Park Indicator Point 1	6.1
MP2	The Brothers Marine Park Indicator Point 2	4.6

5.6.3 Criteria for Construction Phase Water Quality Modelling

Criteria for Suspended Solids

5.6.3.1 According to the WQOs for marine water, the SS criterion states that "Waste discharges / human activities shall not cause the natural ambient level to be to be raised by 30% nor give rise to accumulation of suspended solids which may adversely affect aquatic communities". Hence for the water quality model, the SS criteria is defined as 30% of the 90th percentile of the SS data measured at the monitoring stations. The ambient SS concentrations (i.e. 90th percentile value) of the closest EPD monitoring stations NM1, NM2, and WM4 in North Western and Western Buffer WCZs were analysed.

5.6.3.2 The 90th percentile of marine suspended solid concentrations measured at surface, middle, and bottom layers are presented in **Table 5.19**. Monthly sampling data from years 1986 to 2021 were taken from April to September and October to March for wet season and dry season respectively.

Table 5.19 Ambient SS levels from EPD Monitoring Station (1986-2021)

Station	90th Percentile Suspended Solids Concentrations (mg/L)								
	Surface		Middle		Bottom		Depth Averaged		
	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	Annual
NM1	14.7	9.7	20.0	15.0	23.7	26.4	17.8	16.3	17.3
NM2	13.0	9.6	15.0	11.1	23.3	17.6	15.4	11.6	12.6
WM4	13.0	9.1	20.2	13.0	25.2	20.1	20.9	16.7	13.2

5.6.3.3 The SS criteria (i.e. the allowed elevation of SS), is then derived from the 90th percentile SS concentration measurements of EPD's monitoring stations, and the observation points adopted the criteria are summarised under **Table 5.20**.

Table 5.20 Observation Points and Adopted Suspended Solids Criteria

Station/ Observation Points	Suspended Solids Criteria (mg/L)								
	Surface		Middle		Bottom		Depth Averaged		
	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	Annual
NM1	4.4	2.9	6.0	4.5	7.1	7.9	5.3	4.9	5.2

Station/ Observation Points	Suspended Solids Criteria (mg/L)								
	Surface		Middle		Bottom		Depth Averaged		
	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	Annual
NM2	3.9	2.9	4.5	3.3	7.0	5.3	4.6	3.5	3.8
WM4	3.9	2.7	6.1	3.9	7.6	6.0	6.3	5.0	4.0

Criterion for Sedimentation Rate

5.6.3.4 Corals were discovered in the vicinity of the reclamation area, the dredging/filling activities may adversely impact the coral communities if there are any significant amount of sediment deposition. Hence, sedimentation rate of SS is also considered in the water quality model. Studies conducted by Hawker & Connell (1992) and Pastorok & Bilyard (1985) suggested that a sedimentation rate higher than 100 $g/m^2/day$ would introduce moderate to severe impact upon corals. This value is therefore adopted as the criterion for sedimentation rate assessment.

Criteria for Dissolved Oxygen Depletion

5.6.3.5 Dissolved oxygen (DO) depletion induced by dredging/filling associated with the construction phase of the Project was assessed based on the requirements of the WQO, and hence were adopted as the assessment criterion for DO depletion.

5.6.3.6 DO data from EPD's routine water quality monitoring programme from years 1986 to 2021 were analysed to determine the allowable change in DO levels from each EPD monitoring station. The allowable change is calculated as the ambient DO level minus the DO requirements of the WQO (i.e. 4mg/L for depth averaged, surface and middle layers, 2mg/L for bottom layer, and 5mg/L for FCZs), whereas the WSD DO criterion (i.e. > 2 mg/L) was adopted for WSD salt water pumping stations. The ambient level is calculated as the 10^{th} percentile value of the DO data measured by EPD monitoring stations.

5.6.3.7 The ambient levels of the concerned EPD monitoring stations, and the DO Depletion criteria are summarised in **Table 5.21** and **Table 5.22** respectively.

Table 5.21 Ambient DO Levels from EPD Monitoring Stations (1986-2021)

Station	Ambient DO (mg/L)							
	Surface		Middle		Bottom		Depth Averaged	
	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season
NM1	5.3	4.5	5.7	3.3	5.6	2.7	5.6	3.8
NM2	5.6	4.6	5.8	4.2	5.8	3.6	5.7	4.6
WM4	5.1	4.4	5.6	3.4	5.6	4.4	5.5	3.9

Table 5.22 Criteria for DO Depletion

Location	DO Depletion Criteria (mg/L)							
	Surface		Middle		Bottom		Depth Averaged	
	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season
NM1	1.3	0.5	1.7	0.0	3.6	0.7	1.6	0.0

Location	DO Depletion Criteria (mg/L)							
	Surface		Middle		Bottom		Depth Averaged	
	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season
NM2	1.6	0.6	1.8	0.2	3.8	1.6	1.7	0.6
WM4	1.1	0.4	1.6	0.0	3.6	2.4	1.5	0.0
FCZs	0.1	0.0	0.6	0.0	0.6	0.0	0.5	0.0

5.6.4 Water Quality Modelling Results for Construction Phase

5.6.4.1 As discussed in **Section 5.6.2**, modelling scenarios (i.e. WQ01a and b and WQ02a and b) were conducted to simulate the water quality impacts induced upon nearby observation points during the construction phase. The modelling results for the key water quality parameters are summarised below with detailed results given in **Appendix 5.7**.

Suspended Solids

5.6.4.2 The modelled maximum SS concentrations at all the observation points are summarised in **Table 5.24** to **Table 5.27**, with the SS criteria presented in which is presented in **Table 5.23**. According to the modelling results, the predicted SS elevations due to construction under Base Cases (WQ01a and b) at all observation points are well within their respective criteria. The Enhanced Cases (WQ02a and b) showed the further improvement in water quality after the implementation of a silt curtain, and the SS criteria are compiled for all observation points. Hence, adverse water quality impact due to the release of SS is not anticipated even before the implementation of silt curtain. Nonetheless as a water quality enhancement measure, the deployment of silt curtain is still recommended. It should be noted that for both WQ01a-b and WQ02a-b, the observation points nearest to the dredging site of the Project (i.e. Tsing Lung Tau) including B6, WSD2, CR1, and F1 have all complied with their respective SS criteria. This indicates that the overall water quality impact of the Project's construction phase is insignificant.

Table 5.23 SS Criteria for Observation Points

Obs Pts[2]	SS Criteria (mg/L)[1]							
	Dry Season				Wet Season			
	S	M	B	DA	S	M	B	DA
B6	3.9	2.8	6.2	3.9	7.7	6.2	6.3	4.0
B13	3.9	2.8	6.2	3.9	7.7	6.2	6.3	4.0
C1	4.5	2.9	6.0	4.6	7.2	8.2	5.4	5.0
WSD2	3.9	2.8	6.2	3.9	7.7	6.2	6.3	4.0
WSD4	3.9	2.9	4.5	3.3	7.1	5.6	4.5	3.5
CR1	4.5	2.9	6.0	4.6	7.2	8.2	5.4	5.0
CR2	4.5	2.9	6.0	4.6	7.2	8.2	5.4	5.0
F1	3.9	2.8	6.2	3.9	7.7	6.2	6.3	4.0
MG1	3.9	2.8	6.2	3.9	7.7	6.2	6.3	4.0
MP1	4.5	2.9	6.0	4.6	7.2	8.2	5.4	5.0
MP2	4.5	2.9	6.0	4.6	7.2	8.2	5.4	5.0

Notes:
[1] S = surface layer, M = middle layer, B = bottom layer, and DA = depth averaged.

[2] Obs Pts = observation points.

Table 5.24 Maximum SS Elevation for Scenario WQ01a

Obs Pts[2]	Modelled SS Elevation (mg/L)[1]								Compliance of Criteria
	Dry Season				Wet Season				
	S	M	B	DA	S	M	B	DA	
B6	0.9	1.0	1.2	1.0	0.8	0.8	0.8	0.8	✓
B13	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.0	✓
C1	0.2	0.2	0.3	0.2	0.1	0.2	0.3	0.1	✓
WSD2	1.3	1.8	2.1	1.7	1.6	2.0	2.6	2.0	✓
WSD4	0.4	0.5	0.6	0.5	0.2	0.3	0.5	0.4	✓
CR1	0.1	0.1	0.2	0.1	0.1	0.1	0.2	0.1	✓
CR2	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	✓
F1	0.2	0.2	0.2	0.2	0.1	0.1	0.2	0.1	✓
MG1	0.2	0.2	0.2	0.2	0.1	0.1	0.2	0.1	✓
MP1	0.2	0.3	0.5	0.3	0.2	0.3	0.4	0.3	✓
MP2	0.4	0.5	0.6	0.5	0.4	0.5	0.4	0.4	✓

Notes:
[1] S = surface layer, M = middle layer, B = bottom layer, and DA = depth averaged.
[2] Obs Pts = observation points.

Table 5.25 Maximum SS Elevation for Scenario WQ01b

Obs Pts[2]	Modelled SS Elevation (mg/L)[1]								Compliance of Criteria
	Dry Season				Wet Season				
	S	M	B	DA	S	M	B	DA	
B6	0.6	0.7	0.9	0.7	0.6	0.6	0.5	0.6	✓
B13	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1	✓
C1	0.2	0.2	0.3	0.2	0.1	0.2	0.3	0.2	✓
WSD2	0.6	0.9	1.0	0.9	0.8	0.9	1.2	1.0	✓
WSD4	0.3	0.4	0.5	0.4	0.2	0.3	0.4	0.3	✓
CR1	0.1	0.1	0.2	0.1	0.1	0.2	0.2	0.2	✓
CR2	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	✓
F1	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.1	✓
MG1	0.1	0.1	0.2	0.2	0.1	0.1	0.2	0.1	✓
MP1	0.2	0.3	0.5	0.3	0.2	0.3	0.5	0.3	✓
MP2	0.4	0.5	0.6	0.5	0.4	0.5	0.4	0.4	✓

Notes:
[1] S = surface layer, M = middle layer, B = bottom layer, and DA = depth averaged.
[2] Obs Pts = observation points.

Table 5.26 Maximum SS Elevation for Scenario WQ02a

Obs Pts[2]	Modelled SS Elevation (mg/L)[1]								Compliance of Criteria
	Dry Season				Wet Season				
	S	M	B	DA	S	M	B	DA	
B6	0.5	0.5	0.7	0.6	0.5	0.4	0.4	0.4	✓
B13	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	✓
C1	0.1	0.1	0.2	0.1	0.1	0.1	0.2	0.1	✓
WSD2	0.7	1.0	1.2	0.9	0.9	1.1	1.4	1.1	✓

Obs Pts[2]	Modelled SS Elevation (mg/L)[1]								Compliance of Criteria
	Dry Season				Wet Season				
	S	M	B	DA	S	M	B	DA	
WSD4	0.2	0.3	0.3	0.3	0.1	0.2	0.3	0.2	✓
CR1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	✓
CR2	0.1	0.1	0.2	0.1	0.0	0.1	0.1	0.1	✓
F1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	✓
MG1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	✓
MP1	0.1	0.2	0.4	0.2	0.1	0.2	0.3	0.2	✓
MP2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	✓

Notes:
[1] S = surface layer, M = middle layer, B = bottom layer, and DA = depth averaged.
[2] Obs Pts = observation points.

Table 5.27 Maximum SS Elevation for Scenario WQ02b

Obs Pts[2]	Modelled SS Elevation (mg/L)[1]								Compliance of Criteria
	Dry Season				Wet Season				
	S	M	B	DA	S	M	B	DA	
B6	0.3	0.4	0.5	0.4	0.3	0.3	0.3	0.3	✓
B13	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	✓
C1	0.1	0.1	0.2	0.1	0.1	0.1	0.2	0.1	✓
WSD2	0.3	0.5	0.6	0.5	0.5	0.5	0.7	0.5	✓
WSD4	0.2	0.2	0.3	0.2	0.1	0.2	0.2	0.2	✓
CR1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	✓
CR2	0.1	0.1	0.2	0.1	0.1	0.1	0.2	0.1	✓
F1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	✓
MG1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	✓
MP1	0.1	0.2	0.4	0.2	0.1	0.2	0.3	0.2	✓
MP2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	✓

Notes:
[1] S = surface layer, M = middle layer, B = bottom layer, and DA = depth averaged.
[2] Obs Pts = observation points.

Sedimentation Rate

5.6.4.3 The modelled maximum daily sedimentation rates at coral habitats are summarised in **Table 5.28**. According to the modelling results, the predicted daily sedimentation rates due to construction under Base Cases (WQ01a and b), at coral habitats are well within the criterion of 100 g/m^2/day, with Enhanced Cases (WQ02a and b) demonstrating further optimisation of water quality with the deployment of a silt curtain. Hence, adverse water quality impact due to sedimentation is not anticipated.

Table 5.28 Sedimentation Rate at Coral Habitats (g/m^2/day)

Obs Pts[2]	Modelled Sedimentation Rate								Criteria	Compliance of Criteria
	Dry Season				Wet Season					
	WQ 01A	WQ 01B	WQ 02A	WQ 02B	WQ 01A	WQ 01B	WQ 02A	WQ 02B		
CR1	4.5	4.4	2.6	2.8	5.7	6.5	3.3	3.7	100	✓
CR2	9.1	9.2	6.6	6.7	4.0	4.5	2.5	2.9	100	✓

Dissolved Oxygen Depletion

5.6.4.4 The DO depletion calculated from the maximum SS elevation is presented from **Table 5.29** to **Table 5.32**. The calculation methodology is presented in **Appendix 5.6**. Modelling results revealed that the oxygen depletion at all observation points for the Base Cases (WQ01a and b) will be less than the detection limit of 0.1mg/L even without the deployment of silt curtains. Hence, it is anticipated that the DO depletion arising from the reclamation works will be insignificant. The results from Enhanced Cases (WQ02a and b) demonstrated that the deployment of silt curtains will further reduce the water quality impacts. However, it is still advisable to deploy silt curtain as a good practice which would further reduce the water quality impacts.

Table 5.29 Maximum DO Depletion for Scenario WQ01a

Obs Pts[2]	Maximum DO Depletion (mg/L)[1]							
	Dry Season				Wet Season			
	S	M	B	DA	S	M	B	DA
B6	1.2E-02	1.3E-02	1.6E-02	1.4E-02	1.1E-02	1.0E-02	1.1E-02	1.1E-02
B13	1.1E-03	1.2E-03	1.4E-03	1.2E-03	5.4E-04	6.2E-04	7.1E-04	6.3E-04
C1	2.1E-03	2.6E-03	3.8E-03	3.0E-03	1.6E-03	2.1E-03	3.3E-03	1.9E-03
WSD2	1.6E-02	2.3E-02	2.8E-02	2.2E-02	2.0E-02	2.7E-02	3.4E-02	2.6E-02
WSD4	5.4E-03	6.7E-03	8.1E-03	6.7E-03	3.2E-03	4.5E-03	6.1E-03	4.6E-03
CR1	1.7E-03	1.9E-03	2.7E-03	1.9E-03	1.3E-03	1.9E-03	2.9E-03	1.9E-03
CR2	1.3E-03	1.7E-03	2.8E-03	1.7E-03	7.5E-04	1.0E-03	1.6E-03	1.1E-03
F1	2.1E-03	2.4E-03	2.9E-03	2.3E-03	1.8E-03	1.9E-03	2.3E-03	1.8E-03
MG1	2.0E-03	2.1E-03	2.3E-03	2.1E-03	1.4E-03	1.7E-03	2.1E-03	1.7E-03
MP1	2.6E-03	3.8E-03	7.0E-03	4.0E-03	2.2E-03	3.8E-03	5.8E-03	3.3E-03
MP2	4.8E-03	6.0E-03	7.3E-03	6.1E-03	5.4E-03	6.2E-03	5.6E-03	5.6E-03

Notes:
[1] S = surface layer, M = middle layer, B = bottom layer, and DA = depth averaged.
[2] Obs Pts = observation points.

Table 5.30 Maximum DO Depletion for Scenario WQ01b

Obs Pts[2]	Maximum DO Depletion (mg/L)[1]							
	Dry Season				Wet Season			
	S	M	B	DA	S	M	B	DA
B6	7.3E-03	8.8E-03	1.2E-02	9.5E-03	8.0E-03	7.8E-03	6.7E-03	7.4E-03
B13	1.1E-03	1.2E-03	1.4E-03	1.2E-03	5.7E-04	6.5E-04	7.5E-04	6.6E-04
C1	2.1E-03	2.8E-03	3.9E-03	3.0E-03	1.7E-03	2.3E-03	3.6E-03	2.1E-03
WSD2	8.2E-03	1.2E-02	1.3E-02	1.1E-02	1.1E-02	1.2E-02	1.6E-02	1.3E-02
WSD4	4.1E-03	5.5E-03	6.7E-03	5.5E-03	2.9E-03	4.2E-03	5.5E-03	4.3E-03
CR1	1.5E-03	1.8E-03	2.7E-03	1.8E-03	1.2E-03	2.1E-03	3.1E-03	2.1E-03
CR2	1.3E-03	1.7E-03	2.8E-03	1.7E-03	8.4E-04	1.2E-03	1.8E-03	1.2E-03
F1	2.0E-03	2.4E-03	2.7E-03	2.1E-03	1.6E-03	2.0E-03	2.5E-03	1.9E-03
MG1	1.8E-03	1.9E-03	2.1E-03	2.0E-03	1.5E-03	1.7E-03	2.2E-03	1.7E-03
MP1	2.6E-03	3.9E-03	7.1E-03	4.1E-03	2.3E-03	3.9E-03	5.9E-03	3.5E-03
MP2	4.9E-03	5.9E-03	7.4E-03	6.1E-03	5.3E-03	6.3E-03	5.7E-03	5.5E-03

Notes:
[1] S = surface layer, M = middle layer, B = bottom layer, and DA = depth averaged.

[2] Obs Pts = observation points.

Table 5.31 Maximum DO Depletion for Scenario WQ02a

Obs Pts[2]	Maximum DO Depletion (mg/L)[1]							
	Dry Season				Wet Season			
	S	M	B	DA	S	M	B	DA
B6	6.6E-03	7.1E-03	8.9E-03	7.5E-03	5.9E-03	5.7E-03	5.8E-03	5.8E-03
B13	6.1E-04	7.0E-04	8.2E-04	7.2E-04	3.5E-04	4.0E-04	4.6E-04	4.0E-04
C1	1.2E-03	1.5E-03	2.4E-03	1.7E-03	9.3E-04	1.3E-03	2.1E-03	1.2E-03
WSD2	9.0E-03	1.3E-02	1.5E-02	1.2E-02	1.1E-02	1.5E-02	1.9E-02	1.4E-02
WSD4	3.0E-03	3.7E-03	4.5E-03	3.7E-03	1.8E-03	2.5E-03	3.4E-03	2.6E-03
CR1	9.9E-04	1.1E-03	1.7E-03	1.1E-03	7.4E-04	1.2E-03	1.9E-03	1.2E-03
CR2	8.4E-04	1.0E-03	2.0E-03	1.1E-03	4.5E-04	6.6E-04	1.0E-03	6.9E-04
F1	1.2E-03	1.4E-03	1.7E-03	1.3E-03	1.0E-03	1.2E-03	1.5E-03	1.1E-03
MG1	1.1E-03	1.2E-03	1.3E-03	1.2E-03	8.7E-04	1.1E-03	1.4E-03	1.1E-03
MP1	1.4E-03	2.3E-03	4.6E-03	2.5E-03	1.4E-03	2.5E-03	4.0E-03	2.2E-03
MP2	2.8E-03	3.5E-03	4.4E-03	3.7E-03	3.3E-03	4.0E-03	3.7E-03	3.5E-03

Notes:
[1] S = surface layer, M = middle layer, B = bottom layer, and DA = depth averaged.
[2] Obs Pts = observation points.

Table 5.32 Maximum DO Depletion for Scenario WQ02b

Obs Pts[2]	Maximum DO Depletion (mg/L)[1]							
	Dry Season				Wet Season			
	S	M	B	DA	S	M	B	DA
B6	4.0E-03	4.8E-03	6.5E-03	5.2E-03	4.4E-03	4.3E-03	3.7E-03	4.1E-03
B13	6.0E-04	6.9E-04	8.1E-04	7.1E-04	3.7E-04	4.3E-04	4.9E-04	4.3E-04
C1	1.2E-03	1.6E-03	2.5E-03	1.7E-03	1.0E-03	1.5E-03	2.3E-03	1.3E-03
WSD2	4.5E-03	6.3E-03	7.4E-03	6.2E-03	5.9E-03	6.8E-03	8.6E-03	6.9E-03
WSD4	2.3E-03	3.0E-03	3.7E-03	3.0E-03	1.6E-03	2.4E-03	3.2E-03	2.5E-03
CR1	9.0E-04	1.0E-03	1.7E-03	1.1E-03	7.7E-04	1.3E-03	2.0E-03	1.4E-03
CR2	8.4E-04	1.0E-03	2.0E-03	1.1E-03	7.7E-04	1.3E-03	2.0E-03	1.4E-03
F1	1.1E-03	1.3E-03	1.6E-03	1.2E-03	9.9E-04	1.3E-03	1.6E-03	1.2E-03
MG1	1.1E-03	1.1E-03	1.3E-03	1.1E-03	9.0E-04	1.2E-03	1.5E-03	1.1E-03
MP1	1.5E-03	2.4E-03	4.6E-03	2.6E-03	1.5E-03	2.6E-03	4.1E-03	2.3E-03
MP2	2.9E-03	3.6E-03	4.4E-03	3.7E-03	3.4E-03	4.2E-03	3.7E-03	3.5E-03

Notes:
[1] S = surface layer, M = middle layer, B = bottom layer, and DA = depth averaged.
[2] Obs Pts = observation points.

<u>Contaminant Release from Disturbed Sediment</u>

5.6.4.5 Contaminant releases from disturbed sediment is anticipated during dredging works. The pore water and elutriate test results in **Table 5.8** indicated that parameters including arsenic, zinc, TIN, UIA, total PAHs, PCBs, and TBT would require further assessment to determine whether the criteria would be complied with at the key observation points (see detailed calculations and methods shown in **<u>Appendix 5.6</u>**). The calculations presented in **Table 5.33** and **Table 5.34** for concentrations derived from elutriate tests, and **Table 5.35** and **Table 5.36** for concentrations derived from pore water tests. It can be seen that there are full compliances of criteria at ecological and recreational observation points for both elutriate and pore water tests calculations. Hence, adverse water quality impact from contaminants released from disturbed sediments are not anticipated.

Table 5.33 Estimated Contaminant Concentration at Observation Points in Western Buffer WCZ from Elutriate Tests

Parameter		As	Zn	TIN[1]	UIA[1]	PAHs	PCBs	TBT
Criteria		**13**	**8**	**0.40**	**0.021**	**0.2**	**0.03**	**0.006**
Baseline Conditions		**-**	**-**	**0.35**	**0.004**	**-**	**-**	**-**
Obs Pts	**Dilution Factor**	**(μg/L)**	**(μg/L)**	**(mg/L)**	**(mg/L)**	**(μg/L)**	**(μg/L)**	**(μg/L)**
B6	176	8.5E-02	7.4E-01	3.6E-01	4.4E-03	5.1E-02	1.0E-03	8.5E-05
B13	240	6.3E-02	5.5E-01	3.6E-01	4.3E-03	3.8E-02	7.5E-04	6.3E-05
F1	157	9.6E-02	8.3E-01	3.6E-01	4.4E-03	5.7E-02	1.1E-03	9.6E-05
MG1	200	7.5E-02	6.6E-01	3.6E-01	4.3E-03	4.5E-02	9.0E-04	7.5E-05
Compliance		✓	✓	✓	✓	✓	✓	✓

Note:
[1] A factor (i.e. 10/365) is applied converting the assumed working days to the WQO annual criteria.

Table 5.34 Estimated Contaminant Concentration at Observation Points in North Western WCZ from Elutriate Tests

Parameter		As	Zn	TIN[1]	UIA[1]	PAHs	PCBs	TBT
Criteria		**13**	**8**	**0.5**	**0.021**	**0.2**	**0.03**	**0.006**
Baseline Conditions		**-**	**-**	**0.5**	**0.003**	**-**	**-**	**-**
Obs Pts	**Dilution Factor**	**(μg/L)**	**(μg/L)**	**(mg/L)**	**(mg/L)**	**(μg/L)**	**(μg/L)**	**(μg/L)**
CR1	113	1.3E-01	1.2E+00	5.0E-01	3.6E-03	8.0E-02	1.6E-03	1.3E-04
CR2	229	6.6E-02	5.7E-01	5.0E-01	3.3E-03	3.9E-02	7.9E-04	6.6E-05
Compliance		✓	✓	✓	✓	✓	✓	✓

Note:
[1] A factor (i.e. 10/365) is applied converting the assumed working days to the WQO annual criteria.

Table 5.35 Estimated Contaminant Concentration at Observation Points in Western Buffer WCZ from Pore Water Tests

Parameter		TIN[1]	UIA[1]	PAHs	PCBs	TBT
Criteria		**0.40**	**0.021**	**0.2**	**0.03**	**0.006**
Baseline Conditions		**0.35**	**0.004**	**-**	**-**	**-**
Obs Pts	**Dilution Factor**	**(mg/L)**	**(mg/L)**	**(μg/L)**	**(μg/L)**	**(μg/L)**
B6	176	3.5E-01	7.2E-03	5.1E-02	1.0E-03	8.5E-05
B13	240	3.5E-01	6.3E-03	3.8E-02	7.5E-04	6.3E-05
F1	157	3.5E-01	7.5E-03	5.7E-02	1.1E-03	9.6E-05
MG1	200	3.5E-01	6.8E-03	4.5E-02	9.0E-04	7.5E-05
Compliance		✓	✓	✓	✓	✓

Note:
[1] A factor (i.e. 10/365) is applied converting the assumed working days to the WQO annual criteria.

Table 5.36 Estimated Contaminant Concentration at Observation Points in North Western WCZ from Pore Water Tests

Parameter		TIN[1]	UIA[1]	PAHs	PCBs	TBT
Criteria		**0.50**	**0.021**	**0.2**	**0.03**	**0.006**
Baseline Conditions		**0.50**	**0.003**	**-**	**-**	**-**
Obs Pts	**Dilution Factor**	**(mg/L)**	**(mg/L)**	**(μg/L)**	**(μg/L)**	**(μg/L)**
CR1	113	5.0E-01	7.9E-03	8.0E-02	1.6E-03	1.3E-04
CR2	229	5.0E-01	5.4E-03	3.9E-02	7.9E-04	6.6E-05
Compliance		✓	✓	✓	✓	✓

Note:
[1] A factor (i.e. 10/365) is applied converting the assumed working days to the WQO annual criteria.

5.6.4.6 As seen through the water quality modelling results, the water quality at the key observation points have achieved full compliance of the criteria. Nonetheless, "Enhanced Case" (i.e. simulation with one silt curtain deployed) was also simulated to determine the effectiveness of the enhancement measures. Results indicate that the water quality would experience further improvements. Hence, it is recommended as a good practice to deploy a silt curtain during dredging works to further optimise the water quality.

5.6.5 Construction of Mud Pit

5.6.5.1 As mentioned in **Section 2.9**, marine deposit will be dredged during the construction of seawall. The dredged marine deposit will be backfilled to a mud pit formed within the reclamation area. The mud pit will be formed by sheet piling with the silt curtain in place. The mud pit will be completely sealed, such that the backfilled marine deposit will not leak to surrounding waterbodies. Given the nature of sheet piling works, minimal amount of suspended solids will be generated. With deployment of silt curtain, adverse water quality impact is not anticipated.

5.6.6 Marine Works

5.6.6.1 During construction phase, marine traffic for the transportation of construction materials for reclamation is anticipated to increase. The induced number of marine vessels during construction phase may impact the marine water quality. The potential water quality impacts include sewage generated by the construction workforce and accidental spillage of chemicals / chemicals waste into the marine environment. The potential impact associated with sewage generated by the workforce can be readily controlled by the provision of adequate sanitary facilities such as portable chemical toilets on the marine vessels. The storage and disposal of chemical waste should follow the guidelines stipulated in the Waste Disposal (Chemical Waste) (General) Regulations. Water quality impacts due to the increase in marine traffic is not anticipated. Besides, overflow of filling materials in the barges or hoppers can cause water pollution during loading or transportation. Good management practice such as limiting the capacity of a barge to avoid overflow of filling material can minimise the potential water quality impact.

5.7 Identification and Evaluation of Water Quality Impacts for Operational Phase

5.7.1 Assessment Methodology

5.7.1.1 According to the latest design, the reclaimed northern anchor at TLT may affect the hydrodynamic regime of the area through narrowing the Ha Pang Fairway between TLT and To Kau Wan. Hence, a quantitative hydrodynamic assessment was conducted to assess the overall hydrodynamic impacts.

5.7.1.2 Other potential sources of water quality impacts are identified for the operational phase of the Project:

- Road run-off discharged from paved roads and developments proposed under the Project;
- Tunnel run-off and drainage;
- Sewage generated by ventilation buildings and administration buildings; and
- Wastewater generated from washing and maintenance operations.

5.7.2 Reclaimed Northern Anchor

Modelling Parameters

5.7.2.1 Hydrodynamic modelling using the Delf3D-FLOW module was used to simulate the hydrodynamic regime change due to the reclaimed northern anchor. The details of hydrodynamic modelling methodology and parameters are presented in **Appendix 5.4**.

Modelled Scenarios

5.7.2.2 To simulate the hydrodynamic changes induced by the reclaimed northern anchor at TLT, the modelling scenarios summarised below were conducted, details on the scenarios can be referred to in **Appendix 5.4**:

- Scenario H01 “Base Case”; and
- Scenario H02 “Operational Case”.

5.7.3 Hydrodynamic Modelling Results

5.7.3.1 Hydrodynamic modelling was conducted to simulate that hydrodynamic regime changes as a result of the narrowed Ha Pang Fairway between TLT and To Kau Wan due to the northern anchor reclamation.

5.7.3.2 The instantaneous discharge, cumulative discharge, and depth averaged velocity at five major channels around the study site, i.e. 1) Siu Lam, 2) Kap Shui Mun, 3) Ma Wan Channel, 4) Rambler Channel, and 5) Victoria harbour for both Scenarios H01 and H02 are summarised under **Table 5.37** to **Table 5.40** respectively, with detailed results shown in **Appendix 5.8**.

5.7.3.3 As shown in **Table 5.37**, the changes in instantaneous discharge for Scenario H02 are insignificant for both dry and wet seasons for all 5 channels. The comparison of ebb/flood tidal flow volume for the 5 channels are shown in **Table 5.38**. For the cross section at Siu Lam and Vitoria Harbour, which are further away from the proposed reclamation, the changes in ebb/flood tidal flow volume are insignificant (<1%) for both wet and dry seasons. For cross sections that are closer to the proposed reclamation, it is observed that there was a slight increase in tidal flow volume at Kap Shui Mun, and a slight decrease in tidal flow volume at Ma Wan Channel during both dry and wet seasons. The highest percentage change was observed at Kap Shui Mun during flood tide of the wet season, at approximately 3.7%. The cumulative flux (i.e. the residual of the combined flow volume from ebb tide flow volume and flood tide flow volume change for a typical wet/dry season) is compared in **Table 5.39**, which indicates that the net change in cumulative flow is much less than the daily tidal flow volume. Hence the overall hydrodynamic impacts are considered insignificant.

5.7.3.4 The changes in depth averaged velocities for Scenario H02 are also insignificant as shown in **Table 5.40**, overall the changes of depth averaged velocities are between 0.0m/s to 0.2m/s. During the dry season, it was observed that the percentage changes are from -1.2% to 2.8% and for wet season, the percentage changes are from -0.9% to 1.9%.

Table 5.37 Comparison of Instantaneous Discharge Results at Concerned Channels

Channels	Seasons	Instantaneous Discharge (m^3/s)[1]	
		Scenario H01	Scenario H02
Siu Lam	Dry	-5.4E+04 - 6.3E+04	-5.4E+04 - 6.2E+04
	Wet	-5.1E+04 - 6.4E+04	-5.1E+04 - 6.4E+04
Kap Shui Mun	Dry	-1.8E+04 - 1.6E+04	-1.7E+04 - 1.6E+04
	Wet	-1.8E+04 - 1.4E+04	-1.8E+04 - 1.4E+04
Ma Wan Channel	Dry	-4.5E+04 - 3.8E+04	-4.5E+04 - 3.8E+04
	Wet	-4.4E+04 - 3.8E+04	-4.4E+04 - 3.7E+04
Rambler Channel	Dry	-2.4E+03 - 4.6E+03	-2.5E+03 - 4.6E+03
	Wet	-1.9E+03 - 5.1E+03	-2.0E+03 - 5.2E+03
Victoria Harbour	Dry	-1.1E+04 - 1.1E+04	-1.1E+04 - 1.1E+04
	Wet	-1.4E+04 - 8.5E+03	-1.4E+04 - 8.3E+03

Note:
[1] Please refer to **Appendix 5.8** for the current flow direction of different cross sections.

Table 5.38 Comparison of Ebb/Flood Tidal Flow Volume at Concerned Channels

Channels	Ebb Tidal Flow (m^3)				Flood Tidal Flow (m^3)			
	Scenario H01	Scenario H02	Difference		Scenario H01	Scenario H02	Difference	
Dry Season								
Siu Lam	1.5E+10	1.5E+10	-8.1E+07	-0.5%	-1.8E+10	-1.8E+10	6.9E+07	-0.4%
Kap Shui Mun	4.3E+09	4.3E+09	4.1E+07	1.0%	-5.1E+09	-5.2E+09	-8.7E+07	1.7%
Ma Wan	1.0E+10	1.0E+10	-1.0E+08	-1.0%	-1.3E+10	-1.3E+10	1.5E+08	-1.2%
Rambler	1.3E+09	1.3E+09	-1.7E+07	-1.3%	-6.1E+08	-6.0E+08	1.6E+06	-0.3%
Victoria	2.3E+09	2.3E+09	-7.8E+06	-0.3%	-4.0E+09	-3.9E+09	7.3E+06	-0.2%
Wet Season								
Siu Lam	1.5E+10	1.5E+10	-1.2E+08	-0.8%	-1.6E+10	-1.6E+10	-6.2E+07	0.4%
Kap Shui Mun	4.6E+09	4.7E+09	3.5E+07	0.7%	-3.6E+09	-3.8E+09	-1.4E+08	3.8%
Ma Wan	9.7E+09	9.6E+09	-1.4E+08	-1.5%	-1.3E+10	-1.2E+10	9.3E+07	-0.7%
Rambler	1.5E+09	1.5E+09	-1.6E+07	-1.1%	-2.8E+08	-2.9E+08	-1.0E+07	3.7%
Victoria	3.8E+09	3.8E+09	-1.1E+07	-0.3%	-2.4E+09	-2.4E+09	-6.0E+06	0.3%

Note:
[1] Please refer to **Appendix 5.8** for the current flow direction of different cross sections.

[2] The presented values are the cumulative tidal flow volume within a 15-day spring-neap cycle.

Table 5.39 Comparison of Cumulative Discharge Results at Concerned Channels

Channels	Scenario H01 (m^3)	Scenario H02 (m^3)	Cumulative Change (m^3)		Daily Maximum Tidal Flow of Scenario H01 (m^3)	Change to Tidal Flow (%)
			15days	Daily Averaged		
	A	B	C	D	E	F
Dry Season						
Siu Lam	-2.9E+09	-2.9E+09	-1.2E+07	-8.1E+05	1.40E+09	-0.1
Kap Shui Mun	-8.5E+08	-9.0E+08	-4.6E+07	-3.0E+06	4.10E+08	-0.7
Ma Wan	-2.8E+09	-2.7E+09	4.9E+07	3.3E+06	1.01E+09	0.3
Rambler	7.0E+08	6.8E+08	-1.5E+07	-1.0E+06	1.18E+08	-0.9
Victoria	-1.6E+09	-1.6E+09	-4.6E+05	-3.0E+04	2.99E+08	0.0
Wet Season						
Siu Lam	-6.2E+08	-8.0E+08	-1.8E+08	-1.2E+07	1.40E+09	-0.8
Kap Shui Mun	1.0E+09	9.1E+08	-1.0E+08	-6.9E+06	4.24E+08	-1.6
Ma Wan	-2.9E+09	-2.9E+09	-4.8E+07	-3.2E+06	9.85E+08	-0.3
Rambler	1.2E+09	1.2E+09	-2.7E+07	-1.8E+06	1.33E+08	-1.3
Victoria	1.4E+09	1.4E+09	-1.7E+07	-1.1E+06	3.09E+08	-0.4

Notes:
[1] A 15-day spring-neap cycle in a typical wet/dry season is considered. The daily average cumulative change (D) = C/ 15days.
[2] The daily tidal flow range is the highest ebb/flood tide volume within the typical season.
[3] F = D / E
[4] Please refer to **Appendix 5.8** for the current flow direction of different cross sections.

Table 5.40 Comparison of Depth Averaged Velocity at Concerned Channels

Channels	Seasons	Seasonal Average of Depth Averaged Velocities (m/s)		Difference (m/s)	Difference (%)
		Scenario H01	Scenario H02		
Siu Lam	Dry	0.46	0.47	0.01	2.8
	Wet	0.40	0.41	0.01	1.9
Kap Shui Mun	Dry	0.99	1.00	0.01	1.1
	Wet	0.89	0.90	0.02	1.8
Ma Wan Channel	Dry	0.53	0.52	-0.01	-1.2
	Wet	0.55	0.54	-0.01	-0.9
Rambler Channel	Dry	0.27	0.27	0.00	-0.9
	Wet	0.25	0.25	0.00	0.0
Victoria Harbour	Dry	0.30	0.30	0.00	-0.3
	Wet	0.30	0.30	0.00	-0.1

Potential Water Quality Impacts

5.7.3.5 Considering that the overall hydrodynamic impacts on the marine waters due to the reclamation is insignificant and considering that there are no additional pollution sources induced by the project, the predicted water quality impact on marine waters due to the operational phase of the Project is minimal.

5.7.4 Surface Run-off from Paved Areas of the Project

5.7.4.1 Surface run-offs would typically contain pollutants that are deposited onto paved surfaces including roads, bridges, administration buildings and ventilation buildings which are then discharged to existing waterways during rainfall and storms via drainage systems, and are considered as a non-point source. The key pollutants in concern include sediments, oil and grease, heavy metals, debris, rubber, and fertilizers.

5.7.4.2 Pollutants such as rubber, debris, oil and grease and sediments are mostly generated by road users (i.e. vehicles), and are accumulated on the roads during dry periods, most of the accumulation is found in slightly depressed and at-grade road sections where sediment and silt will be carried and deposited. Pollutants deposited on the road surface will be washed away from the roads by run-off generated during rainfall and storms events, where a large proportion of the rainfall landing on road hard surfaces will reach the surface water drainage systems.

5.7.4.3 Factors including climatic conditions and intensity of precipitation, topography, and the degree of urbanisation has a significant influence on the characteristics of road run off. Following high intensity precipitation, the road surface may be scoured, resulting in an initial run-off that is referred to as the “first-flush”, which typically contains a high amount of pollutants, and may include significant water quality impacts on the water bodies. Subsequent run-offs may contain lower levels of pollutants. Overall, with the application of adequate mitigation measures such as providing adequate silt traps and oil interceptors as necessary at road drainages described in **Section 5.11**, any water quality impacts can be reduced to an acceptable level.

5.7.5 Drainage of Road Surface and Tunnel Runoff

5.7.5.1 During or after rainstorm events, rainwater fell on the at-grade roads and viaducts may flow into the drainage system, and seepage of groundwater into the tunnel may generate tunnel run-off. In addition, the regular cleansing of the tunnel will also generate tunnel run-off. These run-off may contain limited amount of SS, oil and grease. Directly discharge of tunnel run-off into nearby waterbodies may induce adverse water quality impact and should be avoided. No adverse water quality impacts are anticipated with the proper implementation of recommended mitigation measures such as the installation of silt traps and oil/grit interceptors as necessary as described in **Section 5.12**.

5.7.6 Sewage Effluent from the Proposed Buildings

5.7.6.1 During the operational phase, the sewage generated at administration buildings proposed at Lam Tei and Ng Kwu Leng would be a pollution source. Staff and workers stationed at the administration buildings will generate sewage through toilet and sanitary facilities. To avoid adverse water quality impacts, the sewage should not be discharged to waterbodies, and instead discharged through sewers that are connected to public sewerage systems which are located at the vicinity of the buildings.

5.7.6.2 No toiletry facilities are proposed for all ventilation buildings. It is therefore considered that no sewage will be generated at the ventilation buildings. Adverse impacts are therefore not anticipated.

5.7.7 Wastewater Generated from Washing and Maintenance Operations

5.7.7.1 Wastewater will be generated from washing and maintenance operations associated with work vehicles and the maintenance activities for the tunnel ventilation system. Direct discharge of the generated wastewater to the nearby drainage system and waterbodies will induce adverse water quality impacts and should be avoided, the wastewater should instead be discharged to the sewerage system.

5.7.7.2 The estimated amount of wastewater generated by washing and maintenance operations associated with the tunnel system would be approximately 300 m^3/day, which includes water used for general cleansing (using water and vacuuming cleaning only) of the tunnel surface and the ventilation system. The wastewater generated from general cleansing of ventilation system may include dusts and undissolved oils.

5.7.7.3 The estimated amount of wastewater generated by washing and maintenance activities of work vehicles is approximately 3.0 m^3/day. Wastewater from washing and maintenance operations associated work vehicles usually contains hydrocarbon pollutants such as petroleum and diesel.

5.7.7.4 No adverse water quality impact is anticipated with the proper implementation of recommended mitigation measures such as discharging wastewater to the public sewerage system properly, as described in **Section 5.12**.

5.8 Cumulative Impacts from Concurrent Projects

5.8.1.1 The construction of the Project may potentially overlap with the construction phase of Road P1 (Tai Ho - Sunny Bay Section), based on the latest information. Hence, the proposed dredging at Sham Shui Kok is included within the construction phase water quality model. No unacceptable cumulative water quality impacts have been anticipated given that proper mitigation measures (i.e. deployment of silt curtains) are implemented.

5.8.1.2 The construction of the Project may potentially overlap with the construction periods of other nearby concurrent projects as identified in **Section 2**. The identified concurrent projects within the 500m Assessment Area of the Project may induce cumulative water quality impacts, which are evaluated and discussed in **Appendix 5.9**. No cumulative water quality impacts have been anticipated for concurrent projects.

5.8.1.3 **Appendix 5.9** also tabulates and evaluates those concurrent projects that are beyond the 500m Assessment Area of the Project. Given the large separation distances, the cumulative impacts from these concurrent projects beyond 500m would not be significant.

5.9 Recommended Mitigation Measures – Construction Phase (Marine Based Works)

5.9.1 Marine Works

5.9.1.1 The potential impact associated with sewage generated by the workforce shall be controlled by the provision of adequate sanitary facilities such as portable chemical toilets on the marine vessels. The storage and disposal of chemical waste shall follow the guidelines stipulated in the Waste Disposal (Chemical Waste) (General) Regulations. Besides, overflow of filling materials in the barges or hoppers can cause water pollution during loading or transportation. Good management practice such as limiting the capacity of a barge to avoid overflow of filling material can minimise the potential water quality impact.

5.10 Recommended Enhancement Measures – Construction Phase (Marine Works)

5.10.1 Dredging Works

5.10.1.1 The deployment of a silt curtain can reduce the sediment dispersing away from the reclamation site, with the aim of localising the sediment plume because of the dredging activities. The feasibility of deploying a double silt curtain (adopted in the approved EIA Report of Hong Kong International Airport 3rd Runway System (AEIAR-185/2014)) has been carefully considered to further enhance the water quality. However, considering that the current flow velocity at the vicinity of TLT exceeds 1.0m/s, the effectiveness of a double layer silt curtain would be significantly reduced. Hence, the deployment of a single layer silt curtain is recommended as a water quality enhancement measure throughout the reclamation works at TLT.

5.10.1.2 The quantitative water quality modelling results (i.e. Scenario WQ01a and b) have shown that dredging even without the use of any enhancement measures (i.e. deployment of silt curtain), full compliance of the assessment criteria have been met at the concerned key observation points. Nonetheless, scenarios with the implementation of the enhancement measure (i.e. Scenario WQ02a and b) have shown that the deployment of a silt-curtain would further reduce water quality impacts due to dredging works, whilst continuing to ensure the full compliance of assessment criteria at all key observation points.

5.10.2 Construction of Mud Pit

5.10.2.1 The deployment of silt curtain is also recommended as a water quality enhancement measure during the formation of mud pit. The mud pit should be completely sealed to prevent any leakage of backfilled sediments to the surrounding marine waters.

5.11 Recommended Mitigation Measures – Construction Phase (Land Based Works)

5.11.1 Construction Run-off and General Construction Activities

5.11.1.1 Best Management Practices (BMPs) of mitigation measures in controlling water pollution and good site management, as specified in ProPECC PN 1/94, should be followed as applicable to prevent run-off with a high level of SS from entering the surrounding waters. Additionally, all effluent discharged from the construction site should comply with the standards stipulated in the TM-DSS. The following mitigation measures are recommended to protect the water quality of the nearby waterbodies, and should provide sufficient and adequate control to site discharges to minimise adverse water quality impacts when properly implemented.

5.11.1.2 All effluent discharged from the construction site should comply with the standards stipulated in the TM-DSS. The following measures are recommended to protect the water quality of the nearby water, and when properly implemented should be sufficient to adequately control site discharges to avoid water quality impacts:

- 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. Drains (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 run-off activities 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;
- 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;
- All areas with exposed earth should be 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. All drainage facilities, and erosion and sediment control structures should be regularly inspected and maintained to ensure proper and efficient operation at all times, particularly following rainstorms. Deposited silt and grit should be removed regularly and disposed of by spreading evenly over stable, vegetated areas. Considering the scale of the proposed excavation works, it is not practicable to avoid works during the rainy season as this would significantly affect the overall construction programme. However, for works area that is close to watercourses, excavation works shall avoid the rainy season whenever possible. Excavation works shall be proceeded section by section to reduce the amount of works are with exposed earth;
- Measures should be taken to minimise the ingress of site drainage into excavations. If the excavation of trenches in rainy seasons are necessary, it should be excavated and backfilled in short sections wherever practicable. Water pumped from trenches or foundation excavations should be discharged into storm drains installed with silt removal facilities;
- All open stockpiles of construction materials (i.e. aggregates, sand and fill material, etc.) 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 to prevent silt, construction materials or debris from being washed into the drainage system and storm run-off being directed into foul sewers;
- Precautions should be taken during rainy seasons, and actions as summarised in Appendix A2 of ProPECC PN 1/94 should be taken when a rainstorm is

forecasted or imminent. Particular attention should be paid to the control of silty surface run-off during storm events;

- All vehicles and plants should be cleaned before leaving construction sites to minimise the deposition of earth, mud, debris and other potentially polluting particles 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 back fall towards the wheel-wash bay to prevent vehicles from 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 stormwater 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 minimise adverse water quality impacts;
- Water used for tests to check for leakages in structures and pipes should be reused for other purposes as far as practicable. Surplus unpolluted water could be discharged into stormwater drainage;
- Earthworks final surfaces should be compacted, and the subsequent permanent work or surface protection should be carried out immediately after the final surfaces are formed to prevent erosion of earth caused by rainstorms. Appropriate drainage with intercepting channels should be provided where necessary;
- Extracted groundwater from activities such as water pumped from basement or foundation construction, and groundwater seepage pumped from tunnel or cavern constructions should be discharged into stormwater drainage after the removal of silt through silt removal facilities; and
- Water used in ground boring and drilling for site investigation or rock/soil anchoring should as far as practicable be recirculated after sedimentation. When there is a need for final disposal, the wastewater should be discharged into stormwater drainage through silt removal facilities.

5.11.1.3 As recommended in DSD Technical Circular No. 1/2017 "Temporary Flow Diversions and Temporary Works Affecting Capacity in Stormwater Drainage System" and DSD's Practice Notes No. 1/2017 "Design rainfall and profile for temporary works within the Dry Season", the temporary drainage system during the construction phase should cope with a design return period of 1 in 10 years rainfall for dry season. For the design of temporary works and temporary flow diversion in the wet season, the design rainfall depths and profiles as stated in DSD Stormwater Drainage Manual (SDM) should be adopted. This is because rainfall intensity in the dry season is usually less than that encountered in the wet season.

5.11.1.4 Good site practices should be adopted to remove rubbish and litter from construction sites so as to prevent the rubbish and litter from spreading from thes site area. It is recommended to clean the construction sites on a regular basis.

5.11.1.5 Requirements to be incorporated in the contract document of the Project should be established based on the water quality mitigation measures as mentioned above.

5.11.2 Tunnelling and Underground Works

5.11.2.1 Whilst conducting tunnelling works, the Contractor should adopt suitable water control strategies as far as practicable, including:

- Probing ahead: The Contractor should undertake rigorous probing of the ground ahead of tunnel excavation works to identify zones of potential significant water inflow. The probe drilling results should be evaluated to determine where grouting is required in line with the tunnel ahead. In zones where significant water inflow could occur due to discrete, permeable features, grouting should be applied to reduce overall inflow of gsroundwater;
- Pre-grouting: Where water inflow quantities are excessive, pre-grouting will be required to reduce the water inflow into the tunnel, which will be achieved via a systematic and carefully specified protocol; and
- In principle, the grout pre-treatment would be designed based on probe hole drilling ahead of the tunnel face.

5.11.2.2 In the event of where there is still excessive drawdown of the groundwater table, even after the implementation of water control strategies, post-grouting should be applied as far as practicable, which is described below:

- Post-grouting: Groundwater drawdown will most likely be caused by inflows of water into the tunnel that have not been sufficiently controlled by pre-grouting measures. Should there be groundwater drawdown, post-grouting should be undertaken before the lining is cast. Whilst post-grouting is unlikely required, it should still be considered as a contingency measure to further reduce the permeability of the tunnel to limit groundwater inflow to acceptable levels.

5.11.3 Ventilation Buildings and Administration Buildings

5.11.3.1 For underground excavations for the proposed ventilation buildings and administration buildings which will require temporary dewatering during their construction, the following mitigation measures are recommended to minimise the potential adverse effects to the groundwater table during the works:

- Toe grouting should be applied beneath the toe level of the temporary/permanent cofferdam walls as necessary to lengthen the effective flow path of groundwater from outside and thus control the amount of water inflow to the excavation; and
- Recharge wells should be installed as necessary outside the excavation areas. Water pumped from the excavation areas should be recharge back onto the ground.

5.11.4 Sewage due to Construction Workforce

5.11.4.1 No sewage discharge to the drainage system, watercourses, and marine water will be allowed. Adequate and sufficient portable chemical toilets should be provided in the works areas to handle sewage generated by the construction workforce. Should there be any on-site kitchens or canteens, a temporary storage tank should be provided to collect wastewater. A registered collector should be employed to clean and maintain the chemical toilets on a regular basis.

5.11.4.2 Notices should be posted at conspicuous locations to remind the construction workforce not to discharge any sewage or wastewater into the surrounding environment. Regular environmental audit of the construction site should be conducted to provide an effective control of any malpractices and to achieve continual improvement of environmental performances on site.

5.11.5 Construction Works in Close Proximity of Inland Water

5.11.5.1 The practices outlined in ETWB TC (Works) No. 5/2005 "Protection of natural streams/rivers from adverse impacts arising from construction works" should also be adopted where applicable to minimise the water quality impacts. Relevant mitigation measures from the ETWB TC (Works) No. 5/2005 are listed below:

- Construction works close to the inland waters should be carried out in dry season as far as practicable where the flow in the surface channel or stream is low;
- Trenches should be dug and backfilled in short sections. Measures should be taken to minimize the ingress of rainwater into trenches;
- The use of less or smaller construction plants may be specified in areas close to the water courses to reduce the disturbance to the surface water;
- Temporary storage of materials (e.g. equipment, chemicals and fuel) and temporary stockpile of construction materials should be located well away from any watercourses during carrying out of the construction works;
- Stockpiling of construction materials and dusty materials should be covered and located away from any watercourses. Construction debris and spoil should be covered up and / or disposed of as soon as possible to avoid being washed into the nearby water receivers; and
- Proper shoring may need to be erected in order to prevent soil or mud from slipping into the watercourses.

5.11.5.2 In addition, WSD's Conditions for Working within Water Gathering Grounds shall also be complied with. The conditions are provided in **Appendix 5.10**.

5.11.6 Removal or Diversion of Watercourses

5.11.6.1 During removal or diversion of watercourses, precaution measures should be implemented to prevent adverse water quality impact to the surrounding environment and downstream areas. Removal or diversion of natural watercourses within the Tai Lam Country Park would be totally avoided. Good site practices as described in ETWB TC(Works) No. 5/2005 *"Protection of natural streams/rivers from adverse impacts arising from construction works"* and ProPECC PN1/94 *"Construction Site Drainage"* should be implemented. The following major measures include:

- Cofferdams or impermeable structures should be installed as appropriate to isolate the water flow from the construction works area;
- Dewatering or flow diversion shall be conducted prior to the construction works to prevent water overflow to the surrounding area;
- Watercourse removal and flow diversion should be conducted in dry season as far as practicable when the water flow is low;
- Water drained from the watercourse shall be diverted to new/temporary drainage for watercourse diversion; and

- Any excavated land-based sediment from the diversion of watercourse shall be properly stored at bunded areas away from any watercourses and covered with tarpaulin before transporting out of the site.

5.11.7 Groundwater from Contaminated Areas and Contaminated Site Run-off

5.11.7.1 The remediation of contaminated land should be properly conducted following the recommendations proposed under **Section 7**.

5.11.7.2 Any excavated contaminated material and exposed contaminated surface should be properly housed and covered to avoid generation of contaminated run-off, the open stockpiling of contaminated materials should not be allowed. Any contaminated run-off generated under the construction process should be properly collected and treated as necessary before disposal.

5.11.7.3 The direct discharge of groundwater from contaminated areas is not allowed. Prior to any excavation works within potentially contaminated areas, the baseline groundwater quality in these areas should be reviewed based on the past relevant site investigation data and any additional groundwater quality measurements to be performed with reference to Guidance Note for Contaminated Land Assessment and Remediation, the review results should be submitted to EPD for approval. If the review results indicated that the groundwater generated from the excavation works would be contaminated, the contaminated groundwater should be either properly treated or properly recharged into the ground in compliance with the requirements of the TM-DSS.

5.11.7.4 If a water treatment facility is deployed on-site to treat the contaminated groundwater, it should be equipped with suitable instruments (e.g. oil interceptor, activated carbon, etc.) to reduce the pollution level to an acceptable standard and remove to any prohibited substances (such as total petroleum hydrocarbon) to an undetectable range. All treated effluent from the wastewater treatment plant shall meet the requirements as stipulated in the TM-DSS and should be either discharged into the foul sewers or tankered away for proper disposal.

5.11.7.5 If the deployment of a treatment facility to treat the contaminated groundwater is not feasible, groundwater recharging wells should be installed as appropriate to recharge the contaminated groundwater back onto the ground. The recharging wells should be selected at places where the groundwater quality will not be affected by the recharge operation as stipulated in TM-DSS. The baseline groundwater quality should be determined before selecting the recharge wells and a working plan should be submitted to EPD for agreement. Pollution levels of the recharged groundwater shall not be higher than pollutant levels of ambient groundwater at the recharge well. Groundwater monitoring wells should be installed near the recharge points to monitor the effectiveness of the recharge wells, and to ensure that no there is no increase of groundwater level and the transfer of pollutants beyond the site boundary. Prior to the recharge, oil and grease, if any, should be removed as necessary by installing an oil interceptor. The Contractor should apply for a discharge licence under the WPCO through the Regional Office of EPD for groundwater recharge operation or the discharge of treated groundwater.

5.11.7.6 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. 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. For works area that is close to watercourses, excavation works shall avoid the rainy season as far as possible, and excavation works shall be proceeded section by section.

5.11.8 Operation of Barging Points

5.11.8.1 To minimise the adverse water quality impacts of the surface run-off generated by the operation of the barging point, the mitigation measures recommended under **Section 5.11.1** should be followed. To minimise the potential adverse water quality impact due to the transportation of spoil using the barging point, the following good site practices should be strictly followed:

- Loading of barges and hoppers should be controlled to prevent the splashing of material into the surrounding water. Barges or hoppers should not be filled to a level that will cause the overflow of materials or polluted water during loading or transportation; and
- All vessels should be sized so that adequate clearance is maintained between vessels and the seabed in all tide conditions, to minimise that undue turbidity is not generated by turbulence from vessel movement or propeller wash.

5.11.9 Accidental Spillage of Chemicals

5.11.9.1 The Contractor must be registered as a chemical waste producer if chemical wastes are produced from the construction activities. The Waste Disposal Ordinance (Cap. 354) and its subsidiary regulations, in particular the Waste Disposal (Chemical Waste) (General) Regulation (Cap. 354C), should be observed and complied with for the control of chemical wastes. The Contractor is also recommended to develop management procedures for the chemicals used and prepare an emergency spillage handling procedure to deal with chemical spillage in case of an accident occurs, a contingency plan for any accidental spillage and heavy rainfall event should also be devised.

5.11.9.2 Any services and maintenance facilities should be located on hard standings within a bunded area, sumps and oil interceptors should be provided. Activities with the potential for accidental leakage and spillage of chemicals, including the maintenance of vehicles and equipment should only be undertaken within areas that are appropriately equipped to control the discharges from these potential accidents. The service and maintenance, and any chemical storage areas should not be positioned near watercourses as a safeguard measure.

5.11.9.3 Disposal of chemical wastes should be carried out in compliance with the Waste Disposal Ordinance. The Code of Practice on the Packaging, Labelling, and Storage of Chemical Wastes published under the Waste Disposal Ordinance details the requirements to deal with chemical wastes. General requirements are given as follows:

- Suitable containers should be used to hold the chemical wastes to avoid leakage or spillage during storage, handling, and transport;
- Chemical waste containers should be suitably labelled, to notify and warn the personnel who are handling the wastes, to avoid accidents; and

- Storage area should be selected at a safe location on-site and adequate space should be allocated to the storage area.

5.11.10 Adoption of Marine Based Construction Method

5.11.10.1 To minimise the water quality impacts induced by the reclamation works, all filling works should be conducted within the completed leading seawall, so that reclamation filling materials would not be discharged into the open sea.

5.12 Recommended Mitigation Measures – Operational Phase

5.12.1 Reclaimed Northern Anchor

5.12.1.1 As discussed in **Section 5.7**, the hydrodynamic modelling results have indicated that the overall change in hydrodynamic regime due to the reclaimed northern anchor at Tsing Lung Tau are insignificant. Hence it is also expected that the operational phase water quality impacts would be minimal. Hence no mitigation measures are considered necessary.

5.12.2 Surface Run-off from Paved Areas of the Project

5.12.2.1 Surface run-off is identified as a source of water pollution. The paved and developed areas, especially the new roads and tunnels will increase the quantity of surface run-off. The presence of oil, grease and grit on the paved surfaces could be washed into the nearby drainage systems, or nearby watercourses during rainfall.

5.12.2.2 To minimise the adverse water quality impacts, the road drainages should be equipped with adequate silt traps and oil interceptors as necessary. Regular washing of the roads and paved areas are also recommended to prevent the accumulation of pollutants. To maintain the equipment's efficiency, contents collected in silt traps and oil interceptors should be cleared regularly, and transferred to an appropriate disposal facility, or to be collected for reuse if possible. Considering the recommended mitigation measure, the adverse water quality impact generated by surface run-off is kept to a minimum.

5.12.3 Drainage of Road Surface and Tunnel Runoff

5.12.3.1 Tunnel run-off is also identified as a non-point water pollution sources. To minimise the adverse water quality impacts, the discharge of road drainage channels should pass through treatment facilities (i.e. silt traps and oil/grit interceptors) as necessary to remove oil, grease and sediment content before the run-off is discharged to the public stormwater drainage system. The treatment facilities including silt traps and oil interceptors should be cleaned and maintained regularly to ensure their continued effectiveness. Oily contents of the oil interceptors should be transferred to an appropriate facility, or where possible, reused. With the proper implementation of the recommended mitigation measures, no adverse water quality impacts are anticipated.

5.12.4 Sewage Effluent from the Proposed Buildings

5.12.4.1 Sewage effluent generated should be discharged to the existing sewerage networks identified at the vicinity of the proposed administration buildings, the sewerage system at these buildings should be connected properly whilst ensuring that the public networks have a sufficient capacity to handle the sewage load generated. Toilets and other sanitary facilities should be cleaned and maintained on a regular basis.

5.12.5 Wastewater Generated from Washing and Maintenance Operation

5.12.5.1 Wastewater generated by washing and maintenance activities of ventilation systems should be collected and treated via an active carbon filter before being discharged to public stormwater drainage system, whereas wastewater generated by washing and maintenance activities associate with work vehicles should be collected and treated by petrol interceptors before being discharged. A Licensed Chemical Contractor should be employed to collect and dispose of spent lubrication oil generated from vehicle maintenance activities in compliance with the Waste Disposal Ordinance. No direct discharge of these wastewaters into the inland water will be allowed, and instead should be discharged to the public sewerage system properly.

5.13 Residual Impacts

5.13.1.1 With the full implementation of the recommended mitigation measures for the construction phase of the proposed Project, no unacceptable residual impacts on water quality are anticipated. It is recommended that regular audit of the implementation of the recommended mitigation measures be carried out during the construction phase.

5.13.1.2 With the full implementation of the recommended mitigation measures for the operational phase of the proposed Project, no unacceptable residual impacts on water quality are anticipated.

5.14 Environmental Monitoring and Audit (EM&A)

5.14.1.1 With the proper implementation of the recommended mitigation measures, no unacceptable water quality impacts are expected during the construction phase of the Project. Nevertheless, inland water quality monitoring is still recommended. Details of the monitoring and auditing requirements are provided in the stand-alone EM&A Manual for the Project.

5.14.1.2 Marine water quality monitoring is recommended during dredging/filling associated with the reclamation works at TLT, the sampling locations are recommended at the key concerned WSRs. Details of the monitoring and auditing requirements are provided in the stand-alone EM&A Manual for the Project.

5.14.1.3 As no adverse water quality impact is anticipated for the operational phase of the Project, no EM&A activities are required.

5.15 Conclusion

5.15.1.1 The key water quality impact associated with the Project which could impact the nearby waterbodies and water sensitive receivers are mainly associated with the construction phase of the Project, which includes general construction activities, construction site run-off, tunnelling and underground works, sewage due to construction workforce, construction works in close proximity of inland water, groundwater from contaminated areas and contaminated site run-off, the accidental spillage of chemicals, and dredging and filling works for the reclamation. With the proper implementation of recommended mitigation measures, no adverse water quality impacts would be anticipated during the construction phase of the Project.

5.15.1.2 During the operational phase of the Project, the major sources of potential adverse water quality impact include road run-off discharged from paved roads and developments proposed under the Project, the sewage generated by the proposed ventilation and administration buildings, and the change in hydrodynamic regime due to the reclamation. However, with proper implementation of the recommended mitigation measures, no adverse water quality impacts would be anticipated during the operational phase of the Project.